Environment and Social Impact Assessment (ESIA) Study for the Proposed 1,050MW Coal Fired Power Plant Project, Kenya

Report Prepared for

Amu Power Company Limited

Report No. KT/4085/ESIA/V1/R1

July 16

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1 Project details

Title of Project	**:**	**1,050MW Coal Fired Power Plant, Lamu County, Kenya**	
NEMA Reference Number	**:**	NEMA/PR/5/2/14779	
Owner's Engineer (Up to Financial Close)	**:**	Sargent and Lundy, Chicago, USA	
NEMA licensed Firm of Experts	**:**	Kurrent Technologies Ltd. (Kenya)	
NEMA License Number	**:**	0191	
Specialists	**Study name**		**Specialist**
	Marine Thermal Discharge Study	:	Ward Karlson Consulting
	Air Quality Study	:	Ward Karlson Consulting
	Nosie Quality Study	:	Ward Karlson Consulting
	Ecological Impact Assessment Study	:	Geoffrey Mwangi, Dr. George G. Ndiritu, Dr. Peter Njoroge, Mr. Vincent Muchai, Mr. Laban Njoroge, Mr. Kennedy Wambua
	Geology and Soils Study	:	Mr. Bernard Muhangu – Reg. Geologist
	Hydrology study	:	Mr. Bernard Muhangu – Reg. Geologist
	Hydrogeology study	:	Mr. Bernard Muhangu – Reg. Geologist
	Social Impact Assessment study	:	Ms. Belinda Muya and Mr. Gideon Owaga
	Cultural Heritage Assessment study	:	Dr. Freda Nkirote and Ms. Angela Kabiru
	Visual Impact Assessment Study	:	Aurecon South Africa

Disclaimer

Please see disclaimer below regarding this ESIA Study.

2 Acronyms and abbreviations

Acronym	Definition
AfDB	African Development Bank
ALARP	As Low As Reasonably Practical
APCL	Amu Power Company Limited
API	American Petroleum Institute
asl	Above Sea Level
BAT	Best Available Technologies
BMP	Best Management Practices
BSI	British Standards Institute
CDL	Chart Datum Level
CLO	Community Liaison Officer
DB	Distribution Board
DOSHS	Directorate of Occupational Safety and Health Services
DWT	Dead weight tons
EDL	Effluent Discharge License
EMCA	Environment Management and Coordination Act, 1999
EPR	Environment Project Report
ERC	Energy Regulatory Commission
ESIA	Environment And Social Impact Assessment
ESMP	Environment And Social Management Plan
ESP	Electro-Static Precipitator
ETP	Effluent treatment plant
FGD	Flue Gas Desulfurization
FY	Fiscal Year
H&S	Health and Safety

Acronym	Definition
Ha	Hectare
HIA	Heritage Impact Assessment
HSD	High Speed Diesel
I&APs	Interested and Affected Parties
IFC	International Finance Corporation
IPP	Independent Power Producer
JSA	Job Safety Analysis
KenGen	Kenya Electricity Generating Company Ltd.
KETRACO	Kenya Electricity Transmission Company
Km^2	Square Kilometers
KP	Kenya Power
KPA	Kenya Ports Authority
KTL	Kurrent Technologies Ltd.
kV	Kilovolt
kWH	Kilowatt Hour
L.N.	Legal Notice
LAPSSET	Lamu Port South Sudan Ethiopia Transport Corridor Project
m^2	Square meters
m^3/day	Cubic meters per day
m^3/hour	Cubic meters per hour
masl	Meters Above Sea Level
MCA	Member of the County Assembly
MCE	Member of the County Executive
mg/l	Milligrams per liter
MJ/kg	Mega joules per kilogram
MoEP	Ministry of Energy and Petroleum

Acronym	Definition
MP	Member of Parliament
MPA	Mega Pascal
MSD	Medium Speed Diesel
Mt	Million tons
MW	Megawatt
NEMA	National Environment Management Authority
NFPA	National Fire Protection Association
NLC	National Land Commission
NMK	National Museums of Kenya
NO_x	Oxides of nitrogen
OEM	Original Equipment Manufacturer
OGV	Ocean going vessel
OSHA	Occupational Safety and Health Act, 2007
OUV	Outstanding universal value
OWS	Oil Water Separator
PM_{10}	Particulates with a diameter of 10μm or more
$PM_{2.5}$	Particulates with a diameter of 2.5μm or more
PPE	Personal Protective Equipment
ppm	Parts per million
ppm	Parts Per Million
PPP	Public Private Partnership
ppt	Parts per thousand
S&L	Sargent & Lundy
SCR	Selective Catalytic Reduction
SEDC	Sichuan Electric Power Design & Consulting Co. Ltd.
SIA	Social Impact Assessment

Acronym	Definition
SO_2	Sulfur dioxide
SO_x	Oxides of sulfur
STI	Sexually Transmitted Infection
ToR	Terms of Reference
UKC	Under Keel Clearance
UNFCCC	United Nations Framework Convention on Climate Change
VIA	Visual Impact Assessment
WHC	World Heritage Council
WHO	World Health Organization
WHS	World heritage site
WWTP	Waste Water Treatment Plant

3 Terminology and Definitions

Terminology	Definition
Alien species	Animals and plants invading and becoming established in areas where they do not normally occur
Alternatives	Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the "do-nothing" alternative.
Ambient	Refers to the surrounding environment and/or conditions
Ambient sound level or ambient noise	The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources, both near and far. Note that ambient noise includes the noise from the noise source under investigation. The use of the word ambient should however always be clearly defined (compare with residual noise).
Aquifer	A bounded underground accumulation of water in certain types of geological formations
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals, and micro-organisms, the genes they contain, the evolutionary history and potential they encompass, and the ecosystems, ecological processes, and landscapes of which they are integral parts.
Compaction	Compression of the soil such that it is difficult to plough, and water cannot drain through it effectively or an increase in the density of something.
Cultural resources	A broad term covering any physical, natural and spiritual properties and features that are adapted, used and created by humans, in the past and the present. Cultural resources include traditional systems of cultural practice, belief or social interaction.
Cumulative impacts	Impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (e.g. discharges of nutrients or heated water to a river that combine to cause algal bloom and subsequent loss of dissolved oxygen that is greater than the additive impacts of each pollutant). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
Direct impacts	Impacts that are caused directly by an activity and generally occur at the same time and at the place of the activity. These impacts are generally associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
Domestic Waste	Solid waste, composed of garbage and rubbish, which normally originates from residential, private households, or apartment buildings. Domestic waste may contain a significant amount of toxic or hazardous waste from improperly discarded pesticides, paints, batteries, and cleaners.

Terminology	Definition
Do-nothing alternative	The "do-nothing" alternative is the option of not undertaking the proposed activity or any of its alternatives. The "do-nothing" alternative also provides the baseline against which the impacts of other alternatives should be compared.
Economic growth	Percentage change in GDP, generally measured in terms of a calendar year.
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.
Effluent	That water which flows out of a man-made system into a river, usually wastewater.
Emissions	Referring to pollutants released into the atmosphere.
Employment	Number of people employed in jobs in the formal sector of the economy.
Endangered species	Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating. Included here are taxa whose numbers of individuals have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.
Endemic	An "endemic" species is a species that grows in a particular area (is endemic to that area) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.
Environment	The surroundings within which humans exist and that are made up of: i). The land, water and atmosphere of the earth; ii). Micro-organisms, plant and animal life; iii). Any part or combination of (i) and (ii) and the inter-relationships among and between them; and iv). The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.
Environment Impact Assessment	Environment Impact Assessment (EIA) means the process of collecting, organizing, analyzing, interpreting and communicating information that is relevant to the consideration of the application.
Environmental impact	The degree of change in an environment resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts include both the direct or indirect consequences of an activity.
Environmental Impact Assessment Report	In-depth assessment of impacts associated with a proposed development. The second Phase of an Environmental Impact Assessment.
Environmental Management Plan	A legally binding working document, which stipulates environmental and socio-economic mitigation measures that must be implemented by several responsible parties throughout the duration of the proposed project.
Erosion	Wearing away or rock and soil by physical or chemical action, especially by wind or water, leading to removal of particles.
Fauna	The animal life of a region.

Terminology	Definition
Flora	The plant life of a region.
Groundwater	Subsurface water in the saturated zone below the water table.
Habitat	The normal abode or locality of a living organism defined by the set of physical, chemical and biological features. the natural home of species of plants or animals.
Hazardous	Processes or substances which have the potential to cause significant danger or harm to human health or the environment (e.g. hazardous waste).
Heritage	That which is inherited and forms part of the National Estate.
Hydrology	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Indigenous	Born, growing, or produced naturally (native) in an area, region, or country.
Indirect impacts	Indirect or induced changes that may occur as a result of the proposed activity (e.g. the reduction of water in a stream that supplies water to a reservoir that supplies water to the activity). These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
Industrial	Resource use patterns linked to or influenced by commercial / industrial benefits.
Land	Terrestrial bio-productive system that comprises soil, vegetation and other biota, as well as the ecological and hydrological processes that operate within the system.
Legal requirements	Identification and listing of the specific legislation and permit requirements which could potentially be infringed upon by the proposed project, if mitigation is necessary should the proposed development impact on a heritage resource.
Migration	The number of people entering and leaving the country. Internal migration refers to the relocation of people within the country.
Monitoring	In an environmental context, the repetitive and continued observation, measurement and evaluation of environmental data to follow changes over a period of time to assess the efficiency of control measures.
Negative impact	A resultant change due to an activity that reduces the quality of the environment (e.g. by reducing indigenous species diversity and the reproductive capacity of the ecosystem; by damaging health; property or by causing nuisance).
Noise	Any acoustic phenomenon producing any aural sensation perceived as disagreeable or disturbing by an individual or group. Noise may therefore be defined as any unwanted sound or sound that is loud, unpleasant or unexpected.
Perennial	Flow throughout the year.
Pollutant	A substance that contaminates.

Terminology	Definition
Pollution	Defilement or unfavorable alteration of the surroundings, normally as a result of human actions. In the water environment, any foreign substance that impairs the usefulness of water.
Pollution prevention	Complete prevention of releasing hazardous substances having polluting properties to any public stream or water body.
Positive impact	A resultant change due to an activity that improves the quality of the environment (e.g. restoring natural species diversity and ecosystem functioning, by removing nuisances or improving amenities).
Rare and endangered species	Species, which have naturally small populations, and species which have been reduced to small (often unstable) populations by man's activities.
Red data species	Species listed in terms of the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of threatened species.
Rehabilitation	The restoration of a disturbed area which has been degraded as a result of activities such as mining, road construction or waste disposal, to a land use in conformity with the original land use before the activity started.
Significant impact	An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.
Soil	A mixture of organic and inorganic substances, the composition and structure of the latter is derived from the parent rock material. Soil also contains bacteria, fungi, viruses and micro-arthropods, nematodes and worms.
Solid Waste	Any solid, semi-solid, liquid, or contained gaseous materials discarded from industrial, commercial, mining, or agricultural operations, and from community activities. Solid waste includes garbage, construction debris, commercial refuse, sludge from water supply or waste treatment plants, or air pollution control facilities, and other discarded materials.
Stakeholder	Individuals or groups concerned with or affected by an activity and its consequences. These include authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, seas, estuaries) and all springs, wells, or other collectors directly influenced by surface water.
Topography	Referring to natural features on the surface of the earth.
Topsoil	The top few centimeters of soil that contains most of the soil organic matter and nutrients.

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1 Executive Summary

1.1 Introduction

Amu Power Company Ltd. (APCL) proposes to develop a 1,050MW coal fired power plant using super-critical technology in the Kwasasi area of Hindi/Magogoni sub-county, Lamu County, Kenya. The power plant will be situated approximately 21km north of Lamu town as indicated in Figure 1-1. The project is part of the larger Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor project emanating in Lamu in which, a coal fired power plant was envisaged as part of the transport corridor project.

APCL is a project development company formed by two sponsors namely, Gulf Energy Limited (lead sponsor) and Centum Investment Company Ltd. (co-sponsor). Gulf Energy Limited is a leading oil marketing company in Kenya and also owns an 80MW medium speed diesel (MSD) power plant in Athi River, Kenya. Centum Investment Company Ltd. is a Nairobi Securities Exchange listed company whose investments span real estate, shopping malls, etc.

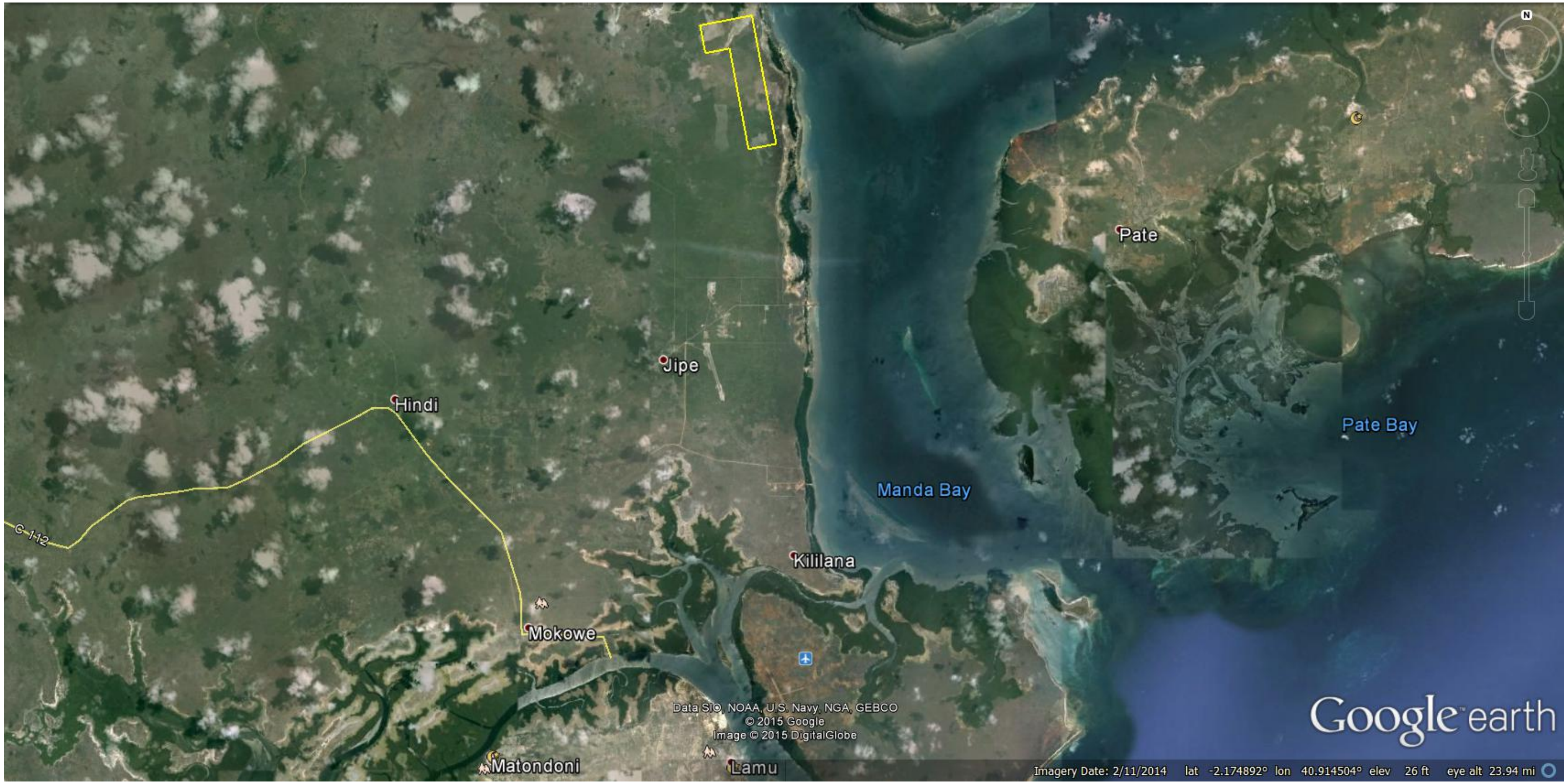
APCL has awarded an Engineering, Procurement and Construction (EPC) contract to design, build and operate the Lamu coal fired power plant to the Power Construction Corporation of China (POWERCHINA). The EPC contractor has vast experience in building and operating thermal power plants and has undertaken the installation of over 15,000 MW of turbine-generator units around the world.

Kurrent Technologies Ltd. was appointed by APCL to complete the Environment and Social Impact Assessment (ESIA) Study report for the necessary environmental authorization required in terms of Legal Notice 101 titled Environment (Impact Assessment and Audit) Regulations, 2003 (EIA/EA Regulations) promulgated under the Environment Management and Coordination Act, 1999 (EMCA). Kurrent Technologies Ltd. is a National Environment Management Authority (NEMA) registered Firm of Experts and is producing this report in accordance with Regulations 18 – 23 of the EIA/EA Regulations.

Additionally, the ESIA Study has been undertaken in accordance with the Integrated Safeguards System (ISS) of the African Development Bank and the 2012 Environmental and Social (E&S) standards of the International Finance Corporation (IFC).

This ESIA Study describes the detailed environmental assessment of the proposed project including an Environment and Social Management Plan (ESMP). NEMA is the lead agency in Kenya responsible for environmental authorization of the project.

Figure 1-1 Map showing location of proposed coal fired power plant in Lamu County



1.2 Purpose and need for the project

The purpose of the proposed 1,050MW coal fired power plant is to provide Kenyans with electricity at a cost effective price in order to grow the economy. The need for the project is based upon increased demand emanating from proposed industrial parks, LAPPSET projects, resort cities, iron and steel smelting industry and, the standard gauge railway.

According to the Draft National Energy and Petroleum Policy dated January 2015, peak demand increased from 899MW in FY 2004/05 to 1470MW in FY2013/14 reaching 1512MW by December, 2014. The number of electricity consumers more than trebled from 735,144 in FY 2004/05 to 2,757,983 by June 2014.

The energy mix in Kenya is diverse and comprises a combination of renewable and fossil fuel type sources of electricity. Currently, about 65% of the energy mix comes from renewable energy sources while 35% comes from fossil fuel sources. In order to meet the growing demand of electricity, Kenya will need to implement power projects using a variety of power generation technologies.

As at December 2014, the installed capacity of electrical power was 2173MW; this power is generated by KenGen and Independent Power Producers (IPPs). This capacity is insufficient for Kenya's socio-economic development.

Several sectors of the economy are projected to grow under the devolved system of government such as mining, crude oil pipelines, standard gauge railway, manufacturing, steel manufacturing from local iron ore deposits, etc. These sectors will require significant amounts of electricity to drive their businesses. Additionally, the residential demand for electricity is continuing to increase with connections. According to the Draft National Energy and Petroleum Policy, January 2015, there were over 730,000 consumers connected to electricity in June 2004 while ten years later in June 2014, the number had exponentially increased to over 2,700,000 consumers.

The proposed 1,050MW coal fired power plant is being developed in order to meet the growing demand of electricity in Kenya. According to the Draft National Energy and Petroleum Policy, January 2015, peak electricity demand is projected to grow from 1512MW in December 2014 to 3,400MW by 2016 and to 5,359MW by 2018.

Annual energy consumption is projected to increase from 8,841GWh in 2013/14 to 32,862GWh in 2016/17. It is projected that by 2030, peak demand will be 18,000MW against an installed capacity of 24,000MW (Draft National Energy and Petroleum Policy, January 2015).

According to the Draft National Energy and Petroleum Policy (January 19, 2015), it is proposed to increase power generation capacity by 5000MW from October 2013 to slightly over 6700MW by 2018. In order to meet the increased demand from commercial and residential consumers, Kenya must generate electricity from a variety of sources including renewable and fossil fuel power plants. The 5000MW power generation program envisages establishment of power generation projects from an energy mix comprising Geothermal (1,646MW), Natural Gas (1,050MW), Wind (630MW) and Coal (1,920MW) through Independent Power Producers (IPPs) under the Public Private Partnership (PPP) framework.

This will enable Kenyans to enjoy affordable and competitive electrical energy to transform Kenya's economy. Through this roadmap, the generation cost is projected to reduce from US¢11.30 to US¢7.41, while the indicative end-user tariffs are projected to reduce from US¢14.14 to US¢9.00 for commercial/industrial customers and from US¢19.78 to US¢10.45 for domestic customers.

According to the Draft National Energy and Petroleum Policy (January 19, 2015), coal is an affordable, competitive, reliable and easily accessible source of energy, especially for electricity generation. Indeed, with the current coal exploration going on in various parts of Kenya, it is anticipated that coal will provide about 2,000MW of electricity generation by 2017 and 4,500MW by 2030.

1.3 Description of the project

The proposed 1,050MW coal fired power plant will use super-critical technology which has the benefits of producing the same amount of electricity with lesser coal than sub-critical technology.

The proposed coal fired power plant will incorporate clean coal technologies in order to meet the guideline air emission limits set out in the World Bank Group's 2008 Environment, Health and Safety Guidelines for Thermal Power Plants. Such clean coal technologies include electrostatic precipitators (ESPs) for managing fly ash and Wet Flue Gas Desulfurization (FGD) for managing Sulphur oxide emissions.

The key components of the proposed coal fired power plant include:

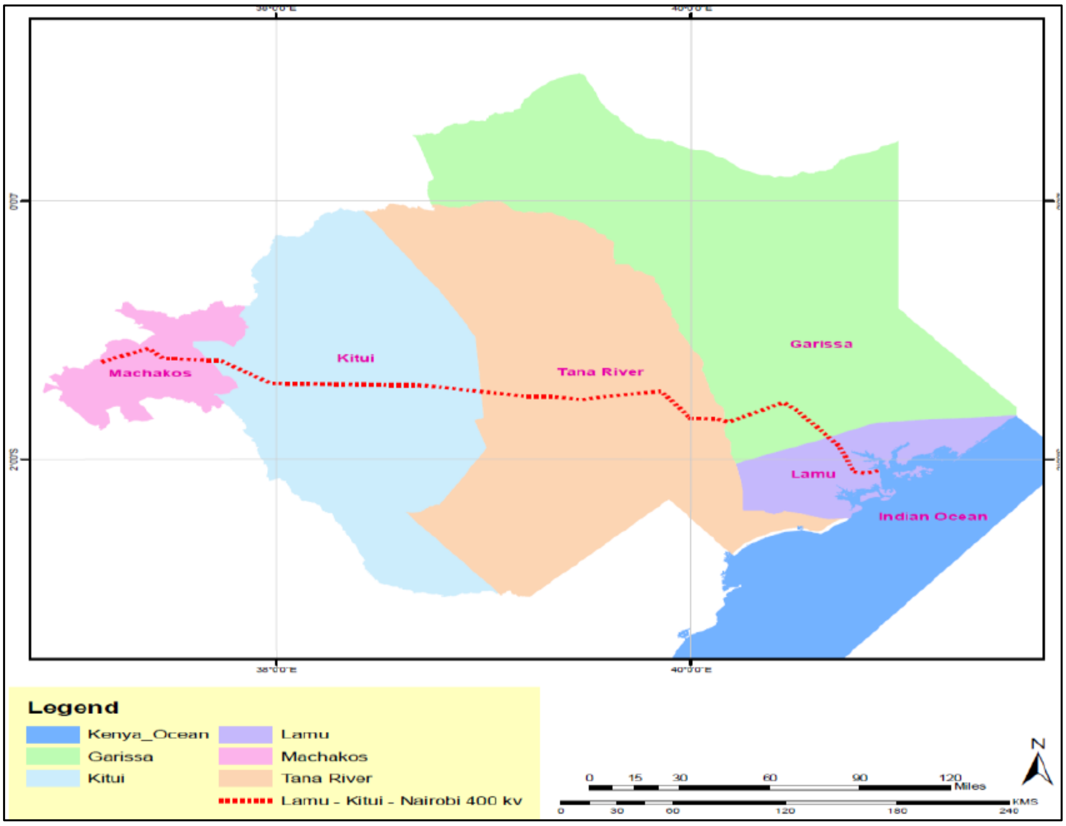
- 3×350MW high-pressure supercritical units with condensing steam turbines operating as base load capacity;
- Coal receiving berth at Kililana with coal off-loading and handling equipment;
- A coal conveyor system (~15km long) complete with transfer towers between the coal receiving berth at Kililana and the coal stock yard within the project site;
- Coal stock yard which will have 38 days' storage capacity, including 20 days of Security Stock;
- Ash yard designed to have a storage capacity of 15 years';
- Limestone receiving system and gypsum handling system;
- Once-through sea water cooling system;
- Flue gas air quality conditioning equipment including a 210m tall chimney. This includes a flue gas desulphurization system and electrostatic precipitators;
- Sea water desalination facilities to meet the demand for the power plant's process water, service/fire water as well as water for domestic use;
- Sub-station and switching facilities up to the 400 kV overhead line gantries for power evacuation into the KETRACO 400 kV system. The KETRACO 400 kV overhead transmission line is an associated facility to the proposed coal power plant and is being managed directly by KETRACO;
- Distributed control system (DCS) which will be used for monitoring and control of plant operation;
- Buildings, roads, and other structures for the Project;
- Auxiliary boiler and black-start diesel generator (DG); and
- A permanent workers' colony for the operational phase of the project having a capacity to accommodate 250 – 300 persons.

1.4 Associated facilities

The power generated by the 1,050MW Lamu coal fired power plant will be evacuated to Nairobi East via an overhead double circuit 400kV transmission line. This project is an associated facility to the coal power plant and will be developed by the Kenya Electricity Transmission Company (KETRACO).

The transmission line will be 520km long and will traverse the counties of Lamu, Garissa, Tana River, Kitui, Machakos and Nairobi. From Nairobi, the electricity will be distributed by Kenya Power across the country.

Figure 1-2: Proposed route of the Lamu-Kitui-Nairobi East transmission line



An independent ESIA Study for the above transmission line project has been undertaken by others for the transmission line project. A cumulative impact assessment have been addressed in Section 9 of this ESIA Study.

1.5 Alternatives considered

Alternative aspects of the development were considered which included location, technology and scheduling alternatives.

Location alternatives: The location of the proposed coal power plant is determined by the Government of Kenya. Under the Request for Proposal (RFP) for the coal fired power plant, it was stated that the site for building the project would be provided to the developer by the Ministry of Energy and Petroleum (MoEP).

The original LAPSSET Study done in 2011 recommended a coal fired power plant to be situated in Shindakazi Island (part of Pate Island) which is at the entrance to the Manda Bay. However the MoEP decided against this location and instead identified a location in Kwasasi in the Hindi/Magogoni sub-county.

In the Kwasasi area, there were three alternative site configurations that were studied having sizes varying from 500 acres, 880 acres and 975.4 acres. While all three options were acceptable, the MoEP has provided APCL with a parcel of land 975.4 acres in size for the proposed power plant site.

Based on site visits, technical, environmental and operational reasons, Amu Power selected the current location (refer to Figure 1-1) which is about 975.4 acres in size.

Technology alternatives: There are three technologies that are available for coal fired power plants namely, sub-critical, super-critical and ultra-super-critical. The Request for Proposal for the coal fired power plant stated that the MoEP required the successful bidder to install technology that is extensively available and proven around the world. There is a large inventory of coal fired power plants around the world that use super-critical technology which is superior to sub-critical technology. There is a small inventory of ultra-super-critical power plants around the world.

From a technology perspective, Amu Power selected supercritical technology over sub-critical technology. This technology will enable the power plant to burn less quantities of coal to produce the same amount of electricity and also reduce the air emissions associated with such a power plant.

Scheduling alternatives: The proposed coal fired power plant is part of the MoEP's 5000+MW power generation program in 40 months commencing September 2013. Subsequently, the coal fired power plant is needed in order to supply the most cost effective base load electricity to existing consumers and reasonably foreseeable projects such as the Standard Gauge Railway (SGR), Konza City Technopolis, LAPSSET projects in Lamu and the steel smelting and manufacturing sector. So far, geothermal energy which is required to contribute a significant amount of electricity has not materialized; neither has wind energy. The MoEP is therefore challenged to produce the ambitious 5000+MW from new generation capacity and consequently, the proposed coal fired power plant must start producing power by 2020.

Coal sourcing alternatives: The RFP for the project stated that the proposed coal fired power plant should be designed to burn both Kenyan and imported coal. Until the Kenyan coal resource is developed, the proposed coal fired power plant will utilize imported coal.

For imported coal, the price of this raw material will be determined between the Government of Kenya and the Government of the country where the coal is to be sourced from. A coal study undertaken for the project indicates that coal can be sourced from among other countries, South Africa, Mozambique, Indonesia and Australia. Coal for the power plant will be sourced from an imported country based on the specifications required in the RFP, quality and cost.

Coal transportation alternatives: The proposed coal fired power plant will utilize about 3,600,000 tons of coal per annum. It will have a 38 days storage capacity including a 20 day security stock. There are two alternatives to transport coal to the project site as outlined below.

Based on the selected site location (refer to Figure 1-1), imported coal can be received in large bulk ship carriers (e.g. Cape Max) which can anchor at the entrance of Manda Bay, off-load coal into smaller barges which then transport the coal to a coal receiving jetty near the project site. For this alternative, a new coal receiving jetty will need to be constructed near the power plant project site. In the second alternative, a large bulk ship carrier can dock at one of the three new berths under construction in Kililana and off-load coal onto a land based conveyor system connected to the project site.

If Kenyan coal is to be utilized, a rail line will need to be constructed by the Government of Kenya from Kitui to the project site, a distance of over 350km. This may or may not happen in the medium term (next 5 – 10 years).

1.6 Environmental and social impact assessment

Several potential impacts arising from the proposed development have been assessed by the specialists and KTL. The significance of potential impacts identified during the process was assessed according to an assessment criteria (extent, duration, magnitude and probability) to determine the significance of each environmental and social impact.

Using an established methodology (*See* Section 7 of this ESIA Report), impacts were assigned a significance rating on a scale from low to high and as positive and/or negative. Each potential impact was rated twice; prior to and after management measures had been implemented. Design and planning considerations informed impact management.

1.7 Key findings of the specialist studies

Specialist studies were undertaken on specific aspects of the environment, with the aim of ascertaining the potential project impacts and making recommendations for measures to avoid and/or mitigate/enhance these effects during the planning and design; preconstruction and construction; operation and closure phases. These recommendations informed the environmental assessment. As the proposed project is a coal power plant, most environmental impacts are envisaged to occur during the construction and operational phases respectively. No absolute no go areas were identified from the specialist studies undertaken, although areas of sensitivity were identified.

1.7.1 Thermal effluent

The proposed coal fired power plant will use a once-through cooling water system to cool and condense the steam for return to the boiler. According to the World Bank Group's EHS Guidelines for Thermal Power Plants 2008, the thermal discharge water temperature should not exceed ambient water quality standards by 3^0C at the edge of a scientifically established mixing zone.

Given that Manda Bay has mangrove trees, sea grass beds and coral beds, the location of the Circulating Water discharge was identified in order to reduce/minimize adverse environmental impacts associated with thermal effluent discharged from the coal fired power plant.

Subsequently, a thermal plume modeling study (Appendix 01) was undertaken for the project to determine the optimal location of the circulating water (CW) discharge point that complies with the World Bank Group's guideline mentioned above.

The EPC contractor had proposed a preliminary location for the CW discharge point which was modeled using a US Environmental Protection Agency (EPA) approved methodology known as CORMIX for the near-field mixing zone; based on the modeling study, this location did not meet the above criteria. Subsequently, screening was carried out in slightly deeper water near the original CW discharge point to determine a "near-field" mixing zone that meets the World Bank Group criteria.

Based on the results of the new screening, it was established that the 3^0C criteria can be met at an average seawater depth of ~5m using a discharge pipe about 600m long from the shore and having uni-directional perpendicular diffusers. For this location, advanced hydrodynamic modeling was carried out using the PLUME 3D modeling system to characterize the far-field behavior of the effluent plume. Based on the results of this study, it was established that the far-field thermal effluent criteria of the World Bank Group 2008 Environment Health and Safety Guidelines is met using the selected circulating water discharge location.

1.7.2 Air quality

The proposed coal fired power plant is expected to provide base load capacity with an availability of between 80% and 100% of the time.

Without adequate mitigation measures, the construction, commissioning and operation of the proposed coal power plant may have potential negative impacts on the ambient air quality in the fall-out areas. It must be noted that the prevailing wind directions within the general project area are from the south and easterly regions. Wind directions from the other sectors occur relatively infrequently.

During the construction phase, air quality impacts are anticipated to arise from the following activities:

- General dust and more specifically, the PM10 fraction within it from earth working and on- site vehicle movement activities;
- Exhaust emissions associated with vehicles transporting materials and personnel to and from the site, i.e. off-site emissions; and,
- Exhaust emissions associated with construction activities on-site (e.g. equipment, heavy machinery and vehicle idling).

Based on an air quality risk assessment done in accordance with the United Kingdom Institute of Air Quality Management, "Guidance on the Assessment of Dust from Demolition and Construction," IAQM, London, 2014, it was established that the significance of air quality impacts arising from the above activities is low prior to mitigation measures.

During the operational phase, an air dispersion modeling study was undertaken to determine the ground level concentration of priority pollutants namely sulfur oxides, nitrous oxides, particulate matter and selected metals such as mercury, arsenic, nickel, lead and cadmium. The air dispersion modeling study was conducted using the US EPA approved AERMOD and CALPUFF air quality models for a 50 x 50 km area and the results compared with Kenyan Air Quality Regulations (Legal Notice 34 titled Environment Management and Coordination (Air Quality) Regulations 2014) and the 2008 World Bank Group (WBG) and International Finance Corporation (IFC) EHS Guidelines for Thermal Power Plants (see Appendix-02).

It was discussed and agreed that the air dispersion modeling study be undertaken for the following main operational phase scenarios:

1. Normal Operations of the Lamu Power Station including the three main boilers operating at 100% load;
2. Fugitive dust from coal and ash handling and storage activities including dust mitigation controls (including emissions from three main boilers);
3. Total suspended particulates (TSP) fallout for selected metals as a result of fugitive dust from ash operations; and
4. Black Start of Power Station.

The results of the air dispersion modeling study concluded that none of the priority pollutants modeled would exceed the stipulated Kenyan air quality discharge limits or the World Bank Group 2008 emission limits. Additionally, it was confirmed through the modeling study that the fallout areas would be to the north of the project site where there are no sensitive receptors. Impacts on human health are expected to be low at all locations; the stack design height of 210m should be implemented to further reduce the risk of air quality impacts.

1.7.3 Noise quality

A noise quality impact assessment (Appendix 03) was undertaken for the construction and operational phases of the project. Construction phase noise assessment was undertaken in accordance with British Standards Institute (BSi), 2008, 'BS5228 – Noise and Vibration Control on Construction and Open Sites'. This standard provides a noise calculation method, practical information on noise reduction measures, and promotes 'Best Practice Means' approach to control noise emissions during construction.

For the operational phase, noise modeling was undertaken using SoundPLAN Version 7.3 software and the results compared with the environmental noise limits recommended in the World Bank Group's General EHS Guidelines.

Due to the temporary and transient nature of construction noise, a Project threshold value has been set at 10 dB(A) higher than the World Bank Group's General EHS Guidelines limit (i.e. 55 dB(A) + 10 dB(A) = 65 dB(A)). This margin has been applied on the basis of typical assessment criteria outlined in BS5228. The criteria indicates that a 10 dB(A) exceedance of statutory background noise limits as being the point at which the project is liable for costs of temporary relocation of inhabitants affected by the construction noise. Based on the results for the construction phase noise assessment, it is expected that the construction noise threshold of 65 dB(A) will be met within a radius of approximately 50m - 75m from the edge of the construction site.

Based on the model results for the operational phase of the project, the boundary noise levels are not envisaged to exceed the World Bank Group's General EHS Guidelines daytime and night-time noise limit. With the added mitigation created by trees, grasses and various other naturally occurring screening measures, it is expected that boundary noise levels will be lower than those predicted in this assessment.

1.7.4 Climate change and Greenhouse Gas impacts

A climate change and greenhouse gas impact assessment was undertaken for the project. According to the climate change specialist report, the envisaged risks of climate change on utility scale thermal power plants include high temperature (air or oceans), flooding, drought and sea level rise. These potential impacts were identified and addressed in the specialist study.

On Greenhouse Gas emissions (GHGs), the Scope 1 (*direct emissions* from sources owned or under the operational control of the company) GHGs that could potentially be generated by the proposed coal power plant are estimated to be ~9.0 million tonnes CO_2e per year when the plant is fully operational. Without mitigation, the proposed project will increase greenhouse gas emissions in Kenya by approximately 6% to 10% on 2010 figure of $73MtCO_2e$ (it must be noted that it is from a low base). However, these percentages could reduce with other projects around the country being operationalized.

1.7.5 Biodiversity impacts

Most of the biodiversity related impacts associated with the proposed coal power plant would potentially occur during the construction phase of the project. The success of the mitigation measures described in this ESIA Study will be determined by preventing impacts from spreading outside the footprint areas. It is imperative for the EPC contractor to develop and implement an alien invasive species (AIS) prevention plan for the construction phase of the project.

Other potential impacts to biodiversity resulting from the project include dust, effluent, contamination, hydrocarbon spills, and to a minor extent, human-animal conflict situations. These potential impacts will represent the ultimate challenge of implementing the environmental and social management plan (ESMP) as these aspects will cause the spread and exacerbation of impacts into the natural environment caused by the proposed project.

The expected loss of natural resources from the project footprint area and its immediate environs will result in low and localized impacts on the natural environment. The overall impact to pans/wetlands in the vicinity of the project area would be low as mitigation measures can be adopted to avoid impacts to such important biodiversity areas. Additionally, any animals that use the area around the project site for ranging could potentially be affected by fencing the project site, but the mobility of most species renders the probability of this impact to be unlikely.

1.7.6 Impacts on soils

The soils within the project site are predominantly covered by fine sandy soils, black cotton soil which is underlain by highly weathered coral limestone, clay, silt and shales. From an agricultural perspective, the crops grown here are *sim sim* seeds and maize; *sim sim* is grown as a cash crop while maize is grown for subsistence. The construction and operation of the proposed coal fired power plant will have low adverse impacts on agricultural resources and productivity as most farming is done on a small scale over relatively small acreages.

Erosion of soils during the construction phase could have negative impacts on surface water quality unless appropriate mitigation measures are implemented. Impacts from soil erosion are considered to be of low significance after implementation of the recommended mitigation measures.

1.7.7 Surface and groundwater impacts

The project site has a generally flat topography ranging from about 0.1% - 0.2%. Being a flat area, the project area has a high potential for flooding and water logging especially in times of intense storms; intense and heavy storms of over 200mm in a day are common in Lamu County during the wet season.

Impacts on water quality relate to sedimentation and contamination during the construction and operational phases of the project respectively. During the construction phase, contamination of surface water from the spillage/leakage of fuels from vehicles and fuel/chemical/waste storage areas could potentially occur. During the operational phase, contamination of the sub-surface could potentially occur from the ash yard, vehicle parking areas, improper sewage treatment and disposal, etc. without adequate designs. Impacts on water resources are expected to be medium to low significance. The Kwasasi area is a water scarce area with a sparse population. A desalination plant will be constructed for utilities and processes and the workers' temporary and permanent colony.

The brine from the desalination plant will be injected into the once through circulating water discharge pipe and ejected into the Manda Bay.

1.7.8 Waste management

Impacts associated with waste will generally emanate from effluent and management and burning of coal. Burning of coal produces coal combustion products (CCPs) which include fly ash, bottom ash and gypsum. There will be additional but minor amounts of process wastes which will be generated by the project during the construction and operational phases of the project.

In some countries that use coal fired power plants for power generation, CCPs are a by-product providing beneficial uses. For example, fly ash and bottom ash can be used in road building or concrete block manufacturing while gypsum is used in the cement manufacturing industry or manufacture of wall boards.

In the case of the proposed Lamu coal fired power plant, industries currently don't exist for the utilization of CCPs and consequently, these will be disposed as waste in the ash yard. Additionally, there are currently no sewage treatment facilities available in Hindi/Magogoni Sub-county or Lamu County as a whole so human activities will generate sewage as a waste.

Without adequate mitigation measures, potential impacts on surface and groundwater are anticipated to be contamination of the surface, sub-surface and groundwater. The coal stockyard and ash yard should be designed based on actual project site conditions (soil lithology and geology) and incorporate impermeable layers of protection such as compacted in-situ clay, impermeable membranes (e.g. geotextile membrane) leachate collection and treatment before receipt of ash from the process areas. Additionally, an on-going surface and groundwater monitoring program should be implemented for the operational phase of the project. A network of groundwater monitoring wells should be provided along the boundary of the project site based on the groundwater flow direction to monitor the quality of groundwater.

All sewage from human related activities should be treated in an adequately sized sewage treatment plant during the construction and operational phases of the project. An integrated water and waste management plan should be implemented for the project during the construction and operational phases of the project.

1.7.9 Visual impacts

Landscape and visual impacts close to the power plant site are expected to be medium significance to high significance within a 5km radius from the center of the project site. As the Kwasasi area is dark at night, an issue of potential concern relates to lighting of the power plant and the impact this will have on the rural nature of the area. The vegetation cover of the region is an important element of the construction and operation of the power plant and should be revered as a critical component in the mitigation and potential negation of the visual impacts. Towards this end, the developer should plant indigenous trees that grow tall around the perimeter of the plot to reduce the visual intrusion created by tall structures such as the boiler units and to a certain extent the 210m stack.

1.7.10 Cultural heritage impacts

The archaeological and cultural heritage impacts arising from the construction and operation of the proposed coal fired power plant are expected to be of low to medium significance without mitigation. Based on the field survey, it was established that the proposed coal power plant site does not have ritual sites, shrines, sacred graves, sacred stones or sacred trees, however based on archaeological artefacts collected near the project area, there may be archaeological finds below the surface. Mitigation measures for archeology will include a "Chance Finds Procedure" in which an archeologist from the National Museums of Kenya should be engaged to implement the Chance Finds Procedure especially during the construction phase of the project.

The project site is located about 26km by road and north of Lamu town where the old stone town area of 16 hectares was inscribed as a UNESCO World Heritage Site in 2001. It is further recognized that a Heritage Impact Assessment was undertaken for the first three berths currently under construction in the Kililana area of Manda Bay to evaluate the potential impacts of that project on the cultural heritage within Lamu County.

Most of the people that live on Lamu Island cross over to the mainland for their daily work and business related purposes and return back to their abodes in the evenings. Economic activities such as farming, livestock rearing, bee keeping and other economic activities are prevalent on the mainland in towns such as Hindi, Mpeketoni and Mokowe. The County Government offices are also in the process of moving out of Lamu Island and onto the mainland where connectivity to services will become better over time.

The proposed coal power plant will create a demand for housing and other amenities surrounding the project site and it is expected that there will be an influx of migrants from other parts of Lamu County and the country at large. It is expected that towns such as Hindi, Mpeketoni and Mokowe will benefit from such peripheral business and social related activities. Such developments are not expected to influence the change in cultural heritage of Lamu Island as cultural practices will continue in Lamu town.

There could be potential impacts on the hunter-gatherer communities that generally live in the Baragoni area north of the proposed project site. These communities still practice their traditional ways of life including bee keeping. The potential impacts to such communities without mitigation measures may include, (a) displacement of the community from their existing settlement areas for infrastructure development, and (b) reduction and abandonment of cultural heritage practices such as bee keeping and hunting/gathering resulting from getting jobs at the coal fired power plant project.

1.7.11 Socio-economic impacts

The proposed 1,050MW coal fired power plant is expected to have positive and adverse socio-economic impacts during the construction and operational phases of the project. During the construction and operational phase, positive effects are envisaged to include additional cost effective electricity supply to the country, employment creation in Lamu County, economic development of the County (currently there is not a single factory in Lamu County), increased household income, increased taxes to the County and Central governments and CSR activities and projects by the developer.

There may be some adverse impacts which are challenging to quantify and mitigate. These are associated with visual impacts and sense of place, land acquisition and involuntary resettlement, disruption and loss of livelihoods, in-migration of people, public health, occupational safety and health, increased traffic and related accidents, and potential security related incidents. It is important to recognize that these adverse impacts may be felt in and around the project area and Lamu County, while the positive impacts will accrue to the economies within the project area and its environs, Lamu County and nationally.

While the negative impacts cannot be eliminated, the trade-offs between negative and positive impacts suggests that from a socio-economic perspective, the project will have more positive than adverse impacts. It is imperative that the construction and operation of the power plant is conducted in the most sustainable manner with the primary objective of eliminating and if not possible, minimizing the potential for deterioration of livelihoods and culture.

1.7.12 In-migration of workers

The proposed coal fired power plant will require about 3,500 workers during the peak construction period; of this number, about 60% of the jobs will be taken up by Kenyans while approximately 40% will be taken up by foreigners mainly from China. Construction of the power plant is expected to take about 42 months (three and a half years) to commission with the first turbine commissioned 36 months from the Notice-To-Proceed (NTP) date, the second turbine 39 months from the NTP and the third turbine 42 months from the NTP. During the operational phase, the power plant will require about 500 full-time workers over the lifetime of the Power Purchase Agreement (25 years). Of this number, about 50% will be Kenyans while the other 50% will be foreigners mainly from China.

The influx of foreign workers could potentially have adverse impacts on the:

- **Environment** (e.g. exploitation and loss of biodiversity, land-use change, land degradation, depletion of natural resources such as fuelwood, water, aquatic resources, etc., and erosion and loss of soil productivity);
- **Public infrastructure, services and utilities** (e.g. increased use of existing roads and transportation systems, increased pressure on education and health services, increased pressure on waste management systems; increased demand for electricity, water supplies, and sanitation; unplanned and uncontrolled development of squatter settlements; increased demand on communications networks; increased demand for housing; increased use of/demand for community, religious, and recreational facilities);
- **Local and regional economy and livelihood strategies** (e.g. increased poverty, increased cost of living; competition for economic resources and employment, e.g., loss of productive land to urban settlement; reduced availability and increased cost of land, food, fuel and housing; reduced reliance on local subsistence production systems; increased dependence on broader cash-based economy to meet needs; increased economic vulnerability for marginal groups such as women, elderly, minorities, etc.; and "Boom /Bust" cycles associated with initial construction, eventual closure);
- **Public health** (e.g. increased incidence of accidents and fatalities associated with project traffic; increased pollution of air, water, dust, noise, traffic; proliferation of communicable diseases including sexually transmitted infections, respiratory infections, waterborne diseases; insufficient number of health centers, staff and medical supplies; inadequate public hygiene facilities; and changes in nutrition status; the social and cultural environment (e.g. impacts on traditional beliefs, damage to cultural heritage); loss of knowledge, skills, and experience related to traditional livelihood activities; upheaval in traditional leadership, behavior, customs, values, and norms; changes in

power relationships, including undermining and changing of leadership and traditional authority structures; welfare imbalances and differential wage incomes, wealth accumulation and opportunities; dilution of social cohesion and cultural disruption (separation of households and communities); changing relationships between groups (gender, age, socioeconomic status, ethnicity); possible marginalization of women, ethnic minorities, and other vulnerable groups; loss of local identity; creation of land markets leading to changes in traditional land tenure systems; increased tension, disputes, and conflicts between locals and migrants concerning natural resources, employment opportunities, and other project benefits; increased incidence of social ills, including alcoholism, drug abuse, prostitution, gambling; increase in domestic violence; increase in criminality; decrease in law and order; and increased ethnic tension and violence.

1.7.13 Land acquisition and involuntary resettlement

As stated previously, the Ministry of Energy and Petroleum (MoEP) is responsible for providing the land needed to develop the proposed 1,050MW coal fired power plant. The land tenure of the project site is defined as Community Land which constitutionally, is held in trust by the County Government of Lamu on behalf of the people of that County. At the time of undertaking the Social Impact Assessment (SIA) baseline studies for the proposed project, there were minimal people living within the project site. However, by mid-July 2015, the MoEP established that there were Project Affected Persons (PAPs) who were either residing or utilizing land earmarked for the proposed coal fired power plant for livelihood purposes. Subsequently, in August 2015, the MoEP initiated a Resettlement Action Plan (RAP) and engaged a RAP Consultant to carry out this study.

When the RAP was initiated, a multi-agency “RAP Steering Committee” and a “RAP Technical Committee” made up of various National and County Government institutions and, APCL was formed to steward the resettlement process for the project. The RAP Steering Committee was to provide the strategic direction and leadership while the RAP Technical Committee provided the technical details of developing and implementing the RAP.

The RAP Consultant was provided with a written Terms of Reference (TOR) by the MoEP which was aligned with the requirements of the African Development Bank’s Operational Safeguard 2 on Involuntary Resettlement and the International Finance Corporation’s Performance Standard 5 on Land Acquisition and Involuntary Resettlement.

At the time of submission of this ESIA Study, the RAP for the project was still on-going. The RAP Study will be released after it is finalized and approved by the County Government and Assembly of Lamu for subsequent implementation. There has been community involvement at the grassroots level through Community Committee(s) and independently formed by the PAPs; it is understood that the RAP process has been an inclusive one.

The potential adverse impacts associated with an improperly undertaken and executed RAP include loss of property and access to common land, community disintegration and, loss of income sources and livelihood. For example, during the public/stakeholder meetings undertaken as part of the ESIA Study, it was common to hear affected persons stating that they had stopped planting food and cash crops awaiting compensation.

The lack of a properly executed RAP Study can potentially lead to disenfranchisement of the PAPs which could potentially lead to negative sentiments against the proposed project. Further, it would become potentially challenging for APCL to acquire a social license to operate as a result of the community’s perceived disenfranchisement.

1.7.14 Occupational safety and health

Most coal fired power plants face a number of Safety and Health (S&H) during the construction phase of the project. The potential hazards for workers in construction include, fall (from height), trenches collapse, scaffold collapse, electric shock and arc flash/arc blast, failure to use proper personal protective equipment and repetitive motion injuries, working in confined spaces, electric shocks, being struck by falling or moving objects, vehicle related accidents, accidents associated with lifting equipment, etc.

During the peak construction period, the proposed coal fired power plant will have approximately 2,978 workers on site. Without adequate controls, there will be potential adverse impacts on workers arising from inconsistent management of occupational safety and health. Some conventional construction hazards include:

- Falls which includes, people falling or things falling on people;
- Electrical contact with energized sources of plant and equipment or cables;
- Working on or near live equipment – workers who are asked to work on or near energized equipment (regardless of the energy source) must comply with plant requirements to be applied in all work situations where systems are to be de-energized and locked out by devices such as switches or valves; and
- Rigging and hoisting hazards.

There may also be industrial hygiene hazards that workers could potentially be exposed to such as chemical handling without the use of proper personal protective equipment or studying the Safety Data Sheet (SDS) for the chemical on safe handling.

The above hazards and risks associated with the construction phase may arise from the lack of a comprehensive written S&H Plan drawn up by the EPC Contractor for the construction phase of the project.

Additionally, the S&H regulator – DOSHS, lacks sufficient resources to regulate workplaces in Lamu County and there is currently no DOSHS office in Lamu. This is a significant S&H related weakness for the proposed coal fired power plant and could potentially lead to the lack of compliance with S&H related laws and regulations by the EPC Contractor during the construction phase which in turn could lead to accidents and incidents that do not get reported.

1.8 Mitigation measures

Potential environmental and social impacts associated with the proposed project should to the extent possible, be avoided. Examples of avoidance measures include (i) site selection to identify and, where feasible, avoid potentially sensitive resources and locations (ii) design of a power plant to international standards, (iii) incorporation of clean coal technologies in the design, (iv) use of low sulfur coal, (v) early identification of potential environmental and social impacts, (vi) consideration of environmental effects in the analysis of project alternatives such as supercritical vs subcritical alternatives, (vii) incorporation of drainage, erosion, and sedimentation control measures to protect water resources, (viii) incorporation of sanitation, housing, vector-control, food and water supply, and workplace safety guidelines for the project, and (ix) Development and implementation of a consultation and participation process with stakeholders and the community that allow for the identification of issues significant to the affected population. With respect to site selection, the proposed coal fired power plant site has been provided to APCL by the

Ministry of Energy and Petroleum and therefore the location for the coal power plant is confirmed.

The proposed project will to the extent practical, endeavor to avoid environmental and social impacts associated with its construction and operation. For those potential impacts which cannot be avoided, the mitigation measures outlined below are proposed for the sustainable construction and operation of the coal power plant.

1.8.1 Location of the project

The location of the proposed coal fired power plant project is determined by the Ministry of Energy and Petroleum (MoEP). The MoEP identified an area within Kwasasi where the coal power plant should be located. APCL then undertook a geotechnical study to determine the sub-surface soil qualities for siting the power plant in order to confirm that the MoEP area was suitable geotechnically for the project. This was followed by various iterations of the site plan from a 500 acre rectangular site (2km x 1km) to an 870 acre inverted "L" site to an extended inverted "L" site measuring 975.4 acres.

1.8.2 Design of the project

The proposed Lamu coal fired power plant is designed to international standards. Specifically, the power plant will be designed to appropriate Chinese, Kenyan, American and British/European standards for thermal power plants. These standards are enumerated in the ESIA Study.

1.8.3 Thermal effluent

The coal fired power plant will utilize once-through-cooling water in the condenser to cool the steam from the boiler units and return it to the liquid phase; at the circulating water discharge point, the water temperature is envisaged to be about 9^0C higher than the ambient water. The World Bank Group's 2008 General EHS Guidelines states that the temperature of wastewater prior to discharge should not exceed 3^0C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

A thermal plume modeling study has been undertaken to determine the optimal location of the circulating water discharge outlet. This study was undertaken using the US EPA approved method known as CORMIX and PLUME 3D to determine the "near-field" and "far-field" characteristics respectively of the thermal effluent emanating from the once through cooling water system.

As part of the thermal plume modeling study, several diffuser designs were evaluated and an optimal design chosen. Based on the results of the study, it was established that the $\Delta T = 3^0$C can be achieved within 100m (referred to as the "far-field") of the discharge point. Subsequently, this study can confirm that based on the thermal plume modeling study, the following design of the circulating water discharge pipe and diffuser will be used for the project:

- 600m long steel pipe having a diameter of ~2.6m buried in the sea bed;

- The last 50m of the pipe will be a diffuser which will have 20 ports each having a diameter of 0.58m; and
- The height of each port will be 1m with the first 0.5m being vertical and the next 0.5m welded at an angle of 45^0.

1.8.4 Air quality

Air emissions from the project were identified as a key issue by regulatory agencies, the public, and stakeholders. The primary air emissions from the coal fired power plant during the construction and operational phases include oxides of sulfur (SO_x), oxides of nitrogen (NO_x) and particulate matter (PM_{10}).

The assessment of air contaminant emissions predicted that it was extremely unlikely for any of the priority pollutants to exceed the air emission limit guideline values recommended by the World Bank Group's 2008 EHS Guidelines for Thermal Power Plants. Additionally, the design of a 210m tall stack will further assist in reducing air quality impacts arising from the proposed power plant.

Consequently, from the outset, initiatives and technologies to mitigate these emissions have been incorporated into the project by the Design Team, including but not limited to: the use of dust suppressants, low NO_x burners to manage the NO_x emissions, Electrostatic Precipitators (ESPs) for managing the PM_{10} emissions, Wet Flue Gas Desulfurization (FGD) for managing SO_x emissions and, continuous emission monitoring system (CEMS).

1.8.5 Noise quality

During construction, unwanted sound or noise may be emitted during activities associated with site preparation, physical construction and equipment installation, and road transportation. Engines used to power the heavy equipment (e.g., cranes, lifts, front end loaders, dump trucks) are sources of substantive noise emissions during the site preparation activities. Diesel generators and welding sets may generate noise during the construction of process units and buildings at the site.

During the operational phase, substantive emissions of noise may be generated through operation and maintenance of coal fired power plant equipment and during road transportation. Large process units such as the boilers, conveyor system, pumps, fans, and vehicle traffic may contribute to noise emissions from the Project.

The mitigation measures for noise prevention and control include the following:

a) Mufflers be fitted on all engines and vehicles,
b) Where possible, noisy construction activities be restricted to the daytime period to reduce noise environmental effects,
c) Blasting and pile driving where required for the project infrastructure foundations, will only be conducted during the day time, Monday to Saturday, and not on statutory holidays,
d) Stockpiles of overburden may be used between the construction activities on-site and off-site receptors, where the opportunity exists to provide shielding,
e) If practical, fabricate process modules away from the project site, greatly reducing the machining, welding, and steam fitting tasks on-site that could generate noise,

f) The provision of buses during construction for construction workers, where desired, to minimize construction-related vehicle traffic to and from the site on a daily basis,

g) Use of mufflers on noisy process equipment, and enclosure of pump rooms, engine rooms, and compressors.

Based on the noise modeling study and mitigation measures, it was considered very unlikely for a project-related environmental noise emission to cause a guideline or standard to be exceeded, mainly because the distances between sources and noise sensitive receptors are relatively large. Project-related sound emissions during construction and operation were rated not significant in consideration of existing background levels, planned mitigation, and other future development in the area.

1.8.6 Coal stock yard and ash yard design

The coal stock yard and ash yard will be designed to Chinese Standard GB 18599-2001: Standards for pollution control on the storage and disposal site for general industrial solid wastes. GB 18599-2001 states that if the coefficient of permeability is greater than 1.0×10^{-7}cm/s, there should be natural or artificial material to build an impermeable layer the thickness of which should produce an anti-seepage capacity which is equal to that of the clay layer of 1.0×10^{-7}cm/s permeability coefficient and of 1.5m thickness.

The stability of the coal stock yard and ash yard must be incorporated into the design of these two infrastructure components in order to reduce to As Low As Reasonably Practical (ALARP) the potential for dike/berm failure which could lead to a massive coal or ash spill into the Manda Bay.

1.8.7 Climate change and greenhouse gases

Mitigation measures for climate change related impacts include (i) adaptation measures such as rollout of a community health program to reduce vector borne diseases, (ii) improving dust suppression mechanisms during high winds, (iii) rollout of community based program considering food security to take care of the vagaries of agriculture, (iv) implementing adequately designed flood control measures for the coal stock yard, ash yard, etc.

Mitigation measures for greenhouse gas emissions include (i) efficient sewage treatment plant with the organic rich waste filtered through man-made mangroves to clean the water naturally and to sequester carbon deep within the mangrove root systems (his has been applied successfully on a 300ha farm in Shenzhen, China), (ii) reducing fuel consumption by using energy efficient vehicles, (iii) designing the offices and workers colonies using appropriate "green buildings" methods, and (iv) progressive rehabilitation of unused land on site as well as a 'biodiversity offset' elsewhere in the region which will could act as a carbon sink.

1.8.8 Biodiversity

A Critical Habitat Assessment (CHA) was undertaken as part of the Ecological Impact Assessment (EcIA) to determine areas of high biodiversity value within the project site and its environs. Based on an evaluation of the CHA within and around the project site coupled with the project related activities, the potential environmental effects on terrestrial and marine populations of species at risk that are present will be mitigated with standard construction practices and scheduling of project components (e.g. clearing only those areas of the project footprint that are required for construction purposes). Additionally, an alien invasive species (AIS) management plan will be implemented by the EPC Contractor during the construction phase.

Mitigation measures for the seawater cooling intake will include barriers and fish screens to minimize impingement and entrainment of fish. Mangroves that will be cut to pave way for the coal off-loading jetty and will be offset and planted at a location to be shown by the mangrove cutters association.

1.8.9 Soils

Mitigation measures for potential soil erosion resulting from excavation and carting away of soils include silt control measures such as silt traps, silt fences, etc. Stockpiles of excavated materials should be stored in areas away from the Manda Bay or watercourse area to the north of the project site.

1.8.10 Surface and groundwater

Mitigation measures for prevention of sedimentation are similar to those for prevention of soil erosion. The Water Balance diagram shows that there will be minimal discharge of treated wastewater and effluent into the environment and aquatic environment as all treated wastewater will be used for dust suppression purposes. During the construction phase, the EPC Contractor will construct an effluent treatment plant for managing liquid wastes. For oily wastes, the EPC Contractor will construct an adequately sized Oil Water Separator (OWS).

In order to prevent groundwater contamination from the ash yard, it should be designed to incorporate a 1.5m thick in-situ compacted clay layer over which an impermeable liner should be laid and a 0.15m thick sand bed provided. The ash yard will contain several groundwater monitoring wells for sampling and analysis of groundwater internally as well as external NEMA accredited laboratories. The leachate will be treated in the industrial wastewater treatment plant to be installed for the project.

1.8.11 Waste management

Mitigation measures for management of wastes for the proposed coal power plant will include development of a waste management plan that will include issues such as waste minimization, generation, transport, disposal, and monitoring.

An inventory of all estimated waste quantities to be generated during the construction and operational phases of the proposed project has been generated by the EPC Contractor and the O&M Company. During the construction phase, the EPC Contractor will endeavor to prevent the generation of wastes or reduction of the wastes generated through careful planning. Where prevention is not possible, the EPC Contractor will endeavor to recycle and reuse any by-products of the construction activities. If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, the EPC Contractor will treat the waste generated prior to transport through a NEMA licensed transport company for final disposal. The EPC Contractor will take all measures to avoid potential impacts to human health and the environment.

Any hazardous wastes generated during the construction and operational phases will be properly stored to prevent and control accidental releases in bunded areas that have impermeable surfaces. Employees will be given specific training on the safe handling of hazardous wastes. On-site and Off-site transportation of waste will be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public. As for non-hazardous wastes, transportation of hazardous wastes will be done by a NEMA licensed transporter.

1.8.12 Landscape and visual

The mitigation measures proposed in the Landscape and Visual Impact Assessment specialists study are associated the construction phase. They include (i) reducing unnecessary disturbance of land needed for clearing, grubbing, excavation of the project area, borrow pits, access roads, etc. (ii) selection of colors for the infrastructure that blend in with the surrounding landscape; this will have the greatest impact on the visual success or failure of the project, (iii) restoring contrasts from earthworks by fitting the proposed project infrastructure to the existing landforms in a manner that minimizes the size of cuts and fills, (iv) restoring and rehabilitating to as near original as possible all disturbed areas of construction, and (v) incorporating effective light management into the design of the lighting to ensure that the visual influence is limited to the power station, without jeopardizing operational safety and security.

1.8.13 Cultural heritage

There were no surface archaeological artefacts found within the project site, subsequently, it is recommended that a watching brief be implemented over all excavated areas within the project footprint area during the construction phase. The watching brief should include an archaeologist from the National Museums of Kenya (NMK) to be present during at all times during excavation works. Additionally, the NMK "Chance Finds Procedure" should be implemented for the project.

From a cultural heritage perspective, some of the mitigation measures include (i) consideration given to Swahili architecture in the design and/or construction of the permanent workers' colony in order to maintain the cultural landscape, (ii) providing financial support to Swahili institutions within Lamu County that are involved with cultural preservation, (iii) provision of prayer room within the workers colony or the building of a mosque near the project footprint area for the Muslim workers, (iv) promoting and supporting annual cultural festivals such as the *Maulidi*, (v) induction of project related workers and visitors on the culture and traditions of the Lamu people, (vi) promoting local foods serving Swahili dishes within the project site, (vii) promotion of local dress code in the project area that is aligned with Swahili values, and (viii) implementing a peer educator program for HIV/AIDS for workers within the project area.

1.8.14 In-migration of workers

In order to manage in-migration of the large workforce, APCL will employ a number of strategies as discussed herein. The project site will be fenced with security provided on a 24/7 basis; the construction phase project camp site will be located within the fenced area and there will be only one access into and out of the project site. This physical barrier will create a buffer zone to manage incoming and outgoing goods, services and persons during the construction phase of the project.

APCL will work with the Lamu County Government and LAPSSET Corridor Development Authority (LCDA) to support the development of spatial planning and resource allocation for land use in the vicinity of the project site to avoid spontaneous and unplanned growth in housing.

APCL will develop and implement a workforce recruitment policy which will include workforce targets, prioritization, the location and use of local recruitment centers in the 10 wards of Lamu County, hiring policy and practice for day/casual laborers, medium-to-long-term localization plans and, worker mobilization and demobilization strategies. During the construction phase, the EPC Contractor will provide worker accommodation to those migrant workers who do not have an abode. The EPC Contractor's camp should be designed in accordance with the requirements contained in the IFC/EBRD (2009) publication titled *Workers' Accommodation: Processes and Standards.*

For supply of all locally sourced input materials, APCL will define the route, driver codes-of conduct, established trucking stops and tracking systems to monitor trucks. Other mitigation measures will be developed as the project definition with respect to the staff strength become more clear.

1.8.15 Socio-economic

Mitigation measures for the potential adverse socio-economic impacts include (i) development and implementation of a Resettlement Action Plan (RAP) that is compliant with the requirements of the African Development Bank Operational Safeguard 2 and International Finance Corporation Performance Standard 5 on Land Acquisition and Involuntary Resettlement, (ii) provision of job opportunities to the people of Lamu County during the construction and operational phase (there will be about 1791 direct job opportunities during the construction phase), (iii) EPC contractor to procure as much of the construction materials for the project from Lamu County and, (iv) development and implementation of project specific a health and safety (H&S) plan based on potential H&S risks envisaged for the project.

1.8.16 Occupational safety and health

In order to manage the potential Occupational Safety and Health (OSH) aspects and impacts during the construction phase, the EPC Contractor will develop and implement a comprehensive Safety and Health (S&H) Management Plan (MP). The S&H MP will be designed in accordance with the requirements of OHSAS 18001 and shall be a precondition prior to the commencement of any construction works on site.

The EPC Contractor shall be required to regularly update their documented S&H MS based on a thorough and comprehensive S&H risk management framework that must be deployed throughout the construction phase. As required under Section 6(3) of Kenya's Occupational Safety and Health Act, 2007 (OSHA), the EPC Contractor shall carry out a formal and appropriate S&H risk assessment of the construction phase of the project and submit a report to the nearest Directorate of Occupational Safety and Health Services (DOSHS) OSH Officer.

The EPC Contractor will provide continual formal task specific S&H training to all their staff based on a documented training needs analysis. It will be mandatory for the EPC Contractor to undertake daily Tool-Box-Talks (TBTs) and records of all formal and informal training shall be maintained on site for inspection.

All activities carried out on site shall be done based on documented S&H risk assessments, Examples of these include Job Safety Analysis (JSA), Permit-To-Work (PTW) System, Noise Level Survey, etc. From each risk assessment, the EPC Contractor shall develop and implement a documented Safety Method Statement (SMS) for safely carrying out any activity on site.

To manage community health and safety issues, the EPC Contractor shall develop and implement a written Emergency Response Plan (ERP) for all off-site emergencies. The ERP must be developed based on a formal emergency response risk assessment of emergency scenarios.

The EPC Contractor shall ensure that they comply with all statutory requirements of reporting stipulated in the latest version of the OSHA and its subsidiary legislation always. Examples of statutory requirements include undertaking (i) S&H risk assessments, (ii) S&H audits, (iii) plant safety inspections using DOSHS Approved Persons, etc.

The above mitigation measures are an example of the types of things that comprise an S&H MP that the EPC Contractor shall be required to implement during the construction phase of the project and should not be considered conclusive.

During the operational phase, the O&M Company shall develop and implement a formal S&H Management System in alignment with the requirements of ISO 31000 – Risk Management Standard, ISO 45000 – S&H Management Systems, ISO 14001 – Environmental Management System, ISO 9001 – Quality Management System and the International Finance Corporation (IFC) Environmental and Social Management System (ESMS).

1.8.17 Land acquisition and involuntary resettlement

As stated in the potential impacts section above, that the failure to develop and implement a thorough Resettlement Action Plan (RAP) could potentially lead to disenfranchising the Project Affected Persons (PAPs).

The Ministry of Energy and Petroleum (MoEP) initiated a RAP Study in August 2015 and engaged a Consultant to undertake the Study. The Consultant is in the process of undertaking the RAP Study which must be undertaken in accordance with:

(a) Applicable Kenyan land laws;

(b) The African Development Bank's (AfDB's) Integrated Safeguard System (ISS) and specifically Operational Safeguard 2 on Involuntary Resettlement; and

(c) The International Finance Corporation (IFC) Performance Standard 5 (PS5) on Land Acquisition and Involuntary Resettlement.

The RAP Study is being led by the MoEP and consequently, it is expected that as a minimum, the Study will comply with applicable laws and regulations in Kenya on compulsory acquisition of land.

1.9 Environment and Social Management Plan

The purpose of the Environmental and Social Management Plan (ESMP) is to ensure that social and environmental impacts, risks and liabilities identified during the ESIA process are effectively managed during the construction, operations and closure of the proposed Lamu coal power plant project. The ESMP specifies the mitigation and management measures to which APCL is committed, and shows how the Project will mobilize organizational capacity and resources to implement these measures. It also shows how management measures aimed at mitigation and enhancement will be scheduled.

Best practice principles require that every reasonable effort be made to reduce and preferably to prevent adverse impacts, while enhancing positive benefits, especially within the communities most directly affected by the proposed project. These principles have guided the ESIA process. For the proposed coal power plant, potential negative impacts will be avoided through a robust design and engineering process.

The ESMP is a key product of the ESIA process and is generated based on management and/or mitigation measures that will be taken into consideration to address impacts during the planning and design, pre-construction and construction activities, and operations, as necessary.

The ESMP is a living document that will be periodically reviewed and updated. It may be necessary to update the version presented in this ESIA Study (See Section 10) during the detailed design phase, prior to the commencement of construction.

During the construction phase, accountability for implementing the ESMP will reside with the Senior Most Person in the EPC Contractor's organization in Kenya and during the operational phase, accountability for implementing the ESMP will reside with the senior most person in the O&M Company.

Responsibility for the ESMP will reside in the Health, Safety and Environment (HSE) functional management of the EPC contractor for the construction phase while responsibility for the ESMP will reside in the HSE functional management within the O&M Company during the operational phase.

1.10 Public/stakeholder consultation

As part of the ESIA study, a public/stakeholder consultation program was undertaken in order to:

- Provide information about the proposed project
- Contribute to the design of the stakeholder engagement process
- Assist in identifying potential impacts and reasonable alternatives
- Ensure that their views and concerns are incorporated into project design and implementation with the objectives of reducing or offsetting negative impacts and enhancing benefits from the project
- Contribute relevant local information and traditional knowledge to the ESIA and ensure that community issues have been considered in the environmental and social specialist studies

The public consultation was focused on engaging community residents, businesses, local/public authorities, community leaders, County Government as well as other individuals or groups that expressed an interest in the project. APCL is committed to effective and open consultation to ensure that potentially affected members of the public are fully aware of the project and have the opportunity to make their views known.

The receipt of information on public and stakeholder comments and concerns will help ensure that all important issues are considered in the environmental assessment and effectively addressed.

Stakeholder consultation is an ongoing process and consultations will be undertaken as the project progresses. Minutes of meetings held and digital photographs taken during the meeting are appended in the Social Impact Assessment specialist Study (Appendix 8).

The publicity of the stakeholder meetings was done through APCL CLOs, local elders, public notice posters, and formal invitation letters. A combination of various information and consultation methods was used. These included key informant consultations, meetings with the public and media activities. The table below shows the meetings conducted during the scoping and detailed ESIA phase.

Date and Place	Stakeholder group and meeting purpose
9th January 2015 Subira Hotel, Hindi, Lamu mainland	Ward administrator, Hindi and Senior Chief, Village headmen, community leaders (from affected communities) and mangrove cutters representative. Project Introductory meetings
9th January 2015 Lamu Museum, Lamu Island	National Museum of Kenya representatives (Lamu museum) Project Introductory meetings
9th January 2015	Assistant County Commissioner, Lamu County

Date and Place	Stakeholder group and meeting purpose
Lamu Island	Project Introductory meeting
24th January 2015 Mwana Arafa Restaurant Gardens, Lamu Island	Save Lamu Representatives Workshop
24th January 2015 Mwana Arafa Restaurant Gardens, Lamu Island	Lamu Youth Alliance Representatives Workshop
25th January 2015 Mwana Arafa Restaurant Gardens, Lamu Island	Male Opinion leaders Representatives Workshop
25th January 2015 Mwana Arafa Restaurant Gardens, Lamu Island	Female opinion leaders Representatives
26th January 2015 Bargoni Primary School	Bargoni and Ngini Residents Dissemination and consultation public meeting
26th January 2015 Mokowe Primary School	Mokowe Residents Dissemination and consultation public meeting
27th January 2015 Ardhi House, Mokowe, Lamu	Lamu County Land Management Board Project Briefing Meeting
27th January 2015 Kwasasi (Proposed project site)	Kwasasi Residents Dissemination and consultation public meeting
27th January 2015 Hindi Digital Sports Centre and News Hindi, Lamu mainland	Hindi Residents Dissemination and consultation public meeting
28th January 2015 Changa Chini, Mtangawanda, Pate Island	Mtangawanda residents Dissemination and consultation public meeting
28th January 2015 Pate social hall, Pate Island	Pate residents Dissemination and consultation public meeting
2nd February – 3rd February 2015, Sarova Panafric hotel, Nairobi	Lamu County Government workshop
10th February 2015, Serena Hotel , Nairobi	Media editors Kick-off briefing
11th February 2015, Standard Media Group Offices Nairobi	Standard media group editors Kick-off briefing

Date and Place	Stakeholder group and meeting purpose
12th February – 13th February 2015, Tamani Jua Resort, Malindi	Lamu members of County Assembly workshop
24th February 2015 Crowne Plaza Hotel, Nairobi	Media houses press briefing
1st April 2015 Mwana Arafa Restaurant Gardens, Lamu Island	Lamu County Administration kick-off workshop
22nd June 2015 Lamu Island	Key Informant Interview Ministry of Gender, youth and social services Lamu County Government
23rd June 2015 Ardhi House, Mokowe	Key Informant Interview Ministry of Education Lamu County Government
23rd June 2015 Public health Office, Lamu Island	Key Informant Interview Ministry of Health and Environment Lamu County Government
24th June 2015 Ministry of Agriculture Office, Lamu Island	Key Informant Interview Ministry of Agriculture Lamu County Government
23rd June 2015 Chief's camp, Hindi	Focus Group Discussion with vulnerable stakeholder groups – Members of the Pastoralist communities
24th June 2015 Chief's camp, Hindi	Focus Group Discussion with vulnerable stakeholder groups – Women from communities proximate to the project site
24th June 2015 Chief's camp, Hindi	Focus Group Discussion with vulnerable stakeholder groups – Elders from indigenous minority communities
25t June 2015 Chiefs camp, Pate Island	Focus Group Discussion with vulnerable stakeholder groups – Farmers

The minutes and registration logs for the stakeholder disclosure and consultation meetings are included in Appendix 8A in Volume 2 of the ESIA Study.

1.11 Conclusion

This ESIA Study has been undertaken based on information provided by APCL, Sargent & Lundy (Owner's Engineer up to Financial Close), Sichuan Electric Power Design & Consulting Co. Ltd. – SEDC (Power Plant Design Company), appropriate field studies and past ESIA experience of the specialists appointed by Kurrent Technologies Ltd. (KTL).

The overall conclusion of the ESIA Study is that if the mitigation measures recommended in this report are implemented, the proposed 1,050MW coal fired power plant will have low impact significance on the biophysical and social environment. A number of impacts are short-term and of a temporary nature and can be readily addressed through the hierarchical principles namely (1) Elimination, (2) Substitution, (3) Engineering Controls, (4) Administrative Controls and, (5) Personal Protective Equipment.

Additionally, the implementation of the Environmental and Social Management Plan (ESMP), Stakeholder Engagement Plan (SEP) and Grievance Mechanism (GM) will support APCL's efforts in acquiring a social license to operate.

APCL has already commenced a program of corporate social responsibility (CSR) initiatives which were identified with community inputs. These initiatives should continue throughout the lifetime of the project to enable social benefits to accrue to the communities in Lamu County.

It has been established throughout the ESIA process that the project affected communities are supportive of the proposed power plant as they perceive it as a springboard to uplift the socio-economic status of the area which has lacked development since independence. The proposed project is the first industrial activity in Lamu County and therefore several socio-economic impacts are predicted.

While the proposed project will not have direct impacts to the cultural heritage of the stone town in Lamu (16ha) which is inscribed as a UNESCO World Heritage Site for its Outstanding Universal Value (OUV), there could potentially be indirect effects on the cultural heritage of the project affected communities associated with socio-economic development. Such changes include access to better schools, medical facilities in lieu of homeopathy, modern shopping centers and the amenities associated with them, etc. these types of developments may change the perceptions of those people that use such developments to the detriment of cultural values ascribed by the current generation of leaders and elders.

The Government of Kenya is responsible for undertaking the Resettlement Action Plan (RAP) for the project while the National Land Commission (NLC) is the implementing agency for the RAP. APCL is part of the steering committee set up for the development and implementation of the RAP and their role is to ensure that to the extent possible, the Government will develop and implement the RAP in accordance with the requirements of the African Development Bank's Operational Safeguard 2 on Involuntary Resettlement and the IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement.

The conclusions of this ESIA Study are the result of comprehensive studies and specialist assessments. These studies were based on issues identified through the ESIA scoping process and the parallel process of public participation. The public consultation process has been rigorous and extensive, and every effort has been made to include representatives of all stakeholders within the process.

The findings of the specialist studies undertaken within this ESIA provide an assessment of the potential positive and adverse impacts anticipated as a result of the proposed project. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented.

The ESIA process is iterative and as stated above, is valid based on the information and data available at the time of conducting the ESIA Study. KTL has used reasonable care, skill and judgement to undertake the ESIA Study using the information provided to it by the Proponent, Consultants directly appointed by the Proponent and other stakeholders engaged in the process of undertaking the study.

1.12 Structure of the ESIA Report

This report is Volume I of the ESIA Study undertaken for the proposed Lamu coal power plant project and represents the outcome of the ESIA phase of the process; it contains the following sections:

Section 1 is an Executive Summary of the environment and social impacts associated with the proposed project.

Section 2 provides an overview of the regulatory and legal context for power generation projects and the ESIA process.

Section 3 describes the need for the proposed project.

Section 4 provides Description of the Project.

Section 5 provides a description of the baseline environment and social setting of the project.

Section 6 contains an evaluation of the project alternatives including site, technology, energy type, etc.

Section 7 discusses the assessment methodology used in the ESIA Study

Section 8 analyzes the potential environmental and social impacts associated with the proposed project using the methodology described in section 7.

Section 9 presents an overview of the Stakeholder Engagement Plan (SEP), Grievance Mechanism (GM) and framework for the Resettlement Action Plan (RAP)

Section 10 evaluates the cumulative impacts associated with the proposed project in relation to associated facilities and in particular the proposed 520km long 400kV Overhead Transmission Line connected to the proposed project.

Section 11 presents the Environment and Social Management Plan (ESMP) for the proposed project.

Section 12 contains the conclusions about the potential environmental and social aspects and impacts of the proposed project.

Section 13 contains a list of Appendices associated with the ESIA Study.

In compiling this ESIA Study, a number of specialist studies were undertaken by the Firm of Experts. These studies are appended in Volume II of this ESIA Study and are listed in Table 1-1 below for ease of reference.

Table 1-1: Specialist studies undertaken as part of the ESIA Study for the Lamu coal power project

Appendix in Volume II of this ESIA Study	Specialist Study
Appendix 01	Marine thermal discharge Study
Appendix 02	Air Quality Study
Appendix 03	Nosie Quality Study
Appendix 04	Climate Change and GHG Impact Assessment Study
Appendix 05	Ecological Impact Assessment Study
Appendix 06	Geology and Soils Study
Appendix 07	Hydrology Study
Appendix 08	Hydrogeology Study
Appendix 09	Social Impact Assessment Study
Appendix 10	Stakeholder Engagement Plan
Appendix 11	Grievance Mechanism
Appendix 12	Cultural Heritage Impact Assessment study
Appendix 13	Visual Impact Assessment Study
Appendix 14	Baseline air, water, soil and sediment sampling and analysis reports and certificates

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2 Policy, Legal and Institutional Framework

This section of the ESIA Study provides an overview of the applicable environmental legislative and regulatory framework which the proposed project will be required to comply with during its lifetime.

In addition to the corporate environmental and social policies developed throughout the lifetime of the project, APCL will be required to comply with the following:

a. Environmental and social legislation in Kenya (existing and emerging);

b. African Development Bank policies on coal power plants and environmental and social safeguards;

c. Environmental and Social Performance Standards of the World Bank Group and specifically the International Finance Corporation (IFC); and

d. International conventions and treaties associated with the proposed coal power plant project.

The policy, legal and institutional framework under which the project will be undertaken is outlined below.

2.1 Corporate Environmental and Social Policies

Amu Power Company Ltd. (APCL) is a special purpose vehicle whose sponsors are Gulf Energy Ltd. (Lead Sponsor) and Centum Investments Ltd. (Co-Sponsor).

As a legal entity undertaking the project, APCL shall develop and implement environmental and social policies, plans and programs that are applicable to their project in Lamu. In order to demonstrate their compliance, APCL is in the process of developing a formal environmental and social management system (ESMS) based on the Deming Cycle requirements of Plan Do Check Adjust.

Once developed, the company will implement the system throughout the lifetime of the project. It is imperative that the ESMS is in place prior to the commencement of the construction phase of the project.

APCL will be required to comply with relevant existing and emerging environmental laws and regulations in Kenya throughout the lifetime of the project. The relevant environmental laws and regulations are discussed in the sub-sections below.

2.2 Policy and Legal Framework

2.2.1 Constitution of Kenya, 2010

Environment and social sustainability is covered explicitly in the Constitution of Kenya, 2010. Article 42 under the Bill of Rights provides *inter alia* that every person has a right to a clean and healthy environment. Article 43 states that every person in Kenya has economic and social rights.

Chapter 5 of the Constitution on "Land and the Environment" provides for the sustainable management of land and the environment in Kenya. One of the principles of land policy is articulated in Article 60(1)(e) which requires sound conservation and protection of ecologically sensitive areas such as mangroves. Articles 69 – 72 deal with environmental management in Kenya.

Article 69 places obligations on the state to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Article 69(1)(f) of the Constitution requires the State to develop systems for environmental impact assessment. The State already has a system for environmental impact assessment in the form of the Environment Management and Coordination Act, 1999 (EMCA) and its subsidiary legislation titled Legal Notice 101: Environment (Impact Assessment and Audit) Regulations, 2003 (L.N. 101).

The proposed coal power plant will be undertaken in compliance with the requirements of the environmental and social safeguards provided under the Constitution of Kenya 2010.

2.2.2 The Energy Policy 2004

Kenya's existing Sessional Paper Number 4 of 2004 is the country's energy policy. This Sessional Paper recognizes that the success of socio-economic and environmental transformation strategies pursued by the Government at present and in the future is to a large extent dependent on the performance of the energy sector as an enabler of development.

Among several policy recommendations, Sessional Paper Number 4 of 2004 proposed the enactment of the Energy Act 2006 which subsequently replaced the previous Electric Power Act and the Petroleum Act into one statute. The Sessional Paper further recommended the formation of a single energy sector regulator which is today known as the Energy Regulatory Commission.

The Energy Policy 2004 discusses the development of various types of energy polices including coal. Among other things, the Coal Exploration and Utilization Policy within the Energy Policy advocates for the use of clean and efficient coal technologies.

As part of its integrated energy planning in Kenya, the Energy Policy 2004 contains a 20-year horizon Least Cost Power Development Plan (LCPDP) Policy. The LCPDP Policy is operationalized through a Least Cost Power Development Plan with the most recent version of the LCPDP being 2013 – 2033.

In the LCPDP, three demand scenarios were developed based on assumptions which were defined to reflect both current and future economic and social outlook in the vision 2030. The low GDP forecast reflected a pessimistic case while the high scenario gives an optimistic case based on the vision 2030 aspiration while the reference scenario was the middle ground between the two scenarios.

Based on the current and future economic and social outlook, the load forecast indicates a peak demand of about 1370MW in 2012 increasing to 8631MW (low scenario), 14,446MW (reference scenario) and 19,940MW (high scenario) in the year 2030 respectively.

The energy mix within this LCPDP includes several non-renewable and renewable sources of energy. According the Energy Regulatory Commission, the total installed capacity of electricity in Kenya as at December 31, 2014 was 2173MW. Of this installed capacity 1477.5MW (68%) was generated by renewable sources while 695.3MW (32%) was generated by non-renewable sources.

In September 2013, the Ministry of Energy and Petroleum developed a power generation program of 5000+MW of additional electricity capacity in 40 months beginning October 2013 in order to have the total electricity generation capacity from 1664MW to 6762MW by 2017. This capacity will mainly be developed from an energy mix of Geothermal – 1,646MW, Natural Gas – 1,050MW, Wind – 630MW and Coal – 1,920MW through Independent Power Producers (IPPs) under the Public Private Partnership (PPP) framework.

Given below is the Energy Act Number 4 of 2006 which will be applicable to the proposed coal fired power plant.

2.2.3 The Energy Act, 2006

The proposed coal fired power plant project must be compliant with relevant clauses of the Energy Act, 2006. Specifically, a license or permit issued by the ERC is required for generation of electrical energy. Clause 27 states that a license issued by the ERC is required for the generation of electrical power in excess of 3000kW (3MW).

Clause 28 of the Energy Act specifies the process steps required for application of an electric generation license. The proposed project will have to comply with the requirements of these clauses.

The Energy Act, 2006 is presently the primary legislation that contains provisions for the management of the energy sector. The subsidiary legislation to operationalize the Act is yet to be developed but is expected to stipulate HSE licensing requirements for all types of energy related activities such as the proposed project.

The Act which was promulgated in 2006 with an effective date of July 1st 2007 contains several HSE provisions for the environmentally sound management of projects in the energy sector. For example, Clause 30(1)(b) requires that an applicant should comply with the requirements of the Environment Management and Coordination Act, 1999 (EMCA) in order to be granted an electric power generation license. The requirements of the EMCA and its subsidiary legislation as it applies to the proposed project is outlined below.

2.2.4 Environment Management and Coordination Act, 1999

The proposed project will be undertaken in accordance with relevant sections of the Environment Management and Coordination Act, 1999 (EMCA), specifically Clauses 58 – 63 on Environment Impact Assessment. These sections of the Act are operationalized by subsidiary legislation promulgated under the Act and specifically L.N. 101: Environment (Impact Assessment and Audit) Regulations, 2003.

The EMCA is a framework environmental law in Kenya. This Act was assented to on January 14, 2000 in order to provide a structured approach to environmental management in Kenya. With the coming into force of the EMCA, the environmental provisions within the sectoral laws were not superseded; instead the environmental provisions within those laws were reinforced to better manage Kenya's ailing environment.

2.2.4.1 L.N. 101: EIA/EA Regulations, 2003

On June 13th 2003, the Minister for Environment and Mineral Resources promulgated Legal Notice (L.N.) 101: Environment (Impact Assessment and Audit) Regulations, 2003 as provided for under section 147 of the EMCA. These regulations provide the framework for undertaking EIAs and EAs in Kenya by NEMA licensed Lead Experts and Firm of Experts.

An EIA or EA Study in Kenya is to be undertaken by a Kenyan duly licensed by the NEMA. The EIA/EA Regulations also provide information to project proponents on the requirements of either an EIA or EA as required by the EMCA.

The proposed project is subject to relevant provisions of these regulations and subsequently, this ESIA Study has been undertaken in accordance with the appropriate requirements.

2.2.4.2 L.N. 120: Water Quality Regulations, 2006

This regulation was promulgated on September 4th 2006 and became effective on July 1st 2007. The regulation provides for the sustainable management of water used for various purposes in Kenya. For industries in Kenya, the regulation requires that Proponents apply for an "Effluent Discharge License" (EDL) annually for discharging process wastewater either into the environment, aquatic environment or public sewers.

For effluent discharges into the environment and aquatic environment, a Proponent needs to apply directly to the NEMA. For discharges into public sewers, a Proponent needs to apply for the license to the relevant county. The regulation contains discharge limits for various environmental parameters into public sewers and the environment.

These regulations will apply to the proposed project during the construction and operational phases respectively. The EPC contractor will be required to ensure that effluent from construction activities is treated in accordance with the above regulations prior to discharge into the aquatic environment. Sampling and analysis of wastewater from all discharge points shall be undertaken using a NEMA accredited laboratory. The parameters to be sampled will be in accordance with the Fourth Schedule of the EMCA. During the operational phase, the Operations and Maintenance Company shall annually apply for an EDL to NEMA.

2.2.4.3 L.N. 121: Waste Management Regulations, 2006

During the construction phase, the proposed project will generate various types of non-hazardous and hazardous wastes. For the most part, it is expected that the wastes will be non-hazardous in nature and can be disposed in accordance with the above regulations. If however any hydrocarbons used at the site in the form of petroleum fuels come into contact with soils, then the contaminated soils will be disposed in an environmentally sound manner (ESM) in accordance with the regulations.

The Waste Management Regulations were promulgated on September 4th 2006 and became effective on July 1st 2007. This regulation is comprehensive and covers the management of various kinds of waste in Kenya. Generally it is a requirement under the regulations that a waste generator segregates their waste (hazardous and non-hazardous) by type and then disposes the wastes in an environmentally acceptable manner.

Under the regulation, it is a requirement that waste is transported using a vehicle that has an approved "Waste Transportation License" issued by NEMA. Wastes generated in Kenya must be disposed in a licensed disposal facility. Such a facility will require annual environment audits to be undertaken by NEMA registered Lead Experts.

It is further a requirement under the regulation for a Proponent to install at their premises anti-pollution equipment for treatment of various types of wastes. The treatment options shall be approved by the NEMA in consultation with the relevant lead agency.

The regulation contains definitions of hazardous wastes in the Fourth Schedule. The regulation requires that prior to generating any hazardous waste, a Proponent shall undertake an EIA Study and seek approval from the NEMA.

Labeling of hazardous wastes is mandatory under the regulation and the specific labeling requirements are provided in Rule 18. The treatment options for hazardous waste provided in Rule 19 include incineration or any other option approved by the NEMA.

2.2.4.4 L.N. 61: Noise and Excessive Vibration Control Regulations, 2009

In May 2009, the Minister for Environment and Natural Resources promulgated the above regulations for management of noise and excessive vibration at workplaces. The general prohibition states that no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment.

The regulations further provide factors that will be considered in determining whether or not noise and vibration is loud, unreasonable, unnecessary or unusual. For fixed installations, excessive vibration under these regulations is defined as any vibration emanating from the source and exceeds 0.5cm/s at 30m from the source.

Rules 13 and 14 of the regulations define the permissible noise levels for construction sites and are reproduced below. These noise limits will be applicable to the proposed project.

Table 2-1: Construction phase permissible noise levels

Facility	Maximum noise level permitted (L_{eq}) in dB(A)		
		Day	*Night*
i.)	Health facilities, educational institutions, homes for the disabled, etc.	60	35
ii.)	Residential	60	35
iii.)	Areas other than those in (i) and (ii) above	75	65

Time frame:

Day: 6.01 am – 8:00 pm (L_{eq}, 14 hours)

Night: 8:01 pm – 6:00 am (L_{eq}, 10 hours)

Rules 5 and 6 of the regulations define noise levels for various types of activities that generate noise during the operational phase of a project. The First Schedule to the regulations defines permissible noise levels to be complied with during the operational phase of a project and is reproduced below.

Table 2-2: Operational phase noise permissible levels

Zone		Sound Level Limits (dBA) (Leq, 14h)		Noise Rating Level (NR) (Leq, 14h)		Maximum allowable log equivalent (hourly measurements) in dB(A)	
		Day	Night	Day	Night	Day	Night
A.	Silent Zone	40	35	30	25	-	-
B.	Places of Worship	40	35	30	25	-	-
C.	Residential:						
	Indoor	45	35	35	25	55	45
	Outdoor	50	35	40	25		
D.	Mixed residential (with some commercial and places of entertainment)	55	35	50	25	-	-
E.	Commercial	60	35	55	25	70	70

Time frame:

Day: 6.01 am – 8:00 pm (L_{eq}, 14 hours)

Night: 8:01 pm – 6:00 am (L_{eq}, 10 hours)

The regulation further stipulates that a permit will be required during the construction and operational phase of a project if there will be equipment that will produce excessive noise or vibration during any of these two phases of the project.

The above regulations will be applicable to the proposed project during the construction and operational phases of the project respectively. For example, if any blasting is to be done, the EPC contractor shall apply for a noise permit from NEMA during the construction phase of the project. The fourth schedule of the regulations contains details of the application for a noise license while the fifth schedule provides a description of the noise permit that NEMA will grant the EPC contractor.

2.2.5 Occupational Safety and Health Act, 2007 (OSHA)

The proposed project will be undertaken in compliance with the OSHA during the construction and operational phases respectively. During the operational phase, there will be minimal activity along the transmission line corridor.

Specifically, the EPC contractor will be required to fully comply with the requirements of Legal Notice 40 titled: Building Operations and Works of Engineering Construction Rules, 1984 (BOWEC) during the construction phase of the project. The EPC contractor will develop and implement a construction health and safety plan for the construction phase in alignment with the BOWEC, OSHA and international health and safety best practices such as the IFC's "General EHS Guidelines" and "EHS Guidelines for Thermal Power Plants".

The OSHA was enacted to assure the health, safety and welfare of persons employed in workplaces, and for matters incidental thereto and connected therewith.

Part II of the Act provides the General Duties that the Occupier must comply with respect to health and safety in the workplace. Such duties include undertaking S&H risk assessments, S&H audits, notification of accidents, injuries and dangerous occurrences, etc. A number of sections under this part shall be applicable to the proposed project.

Part III of the Act provides the Administrative framework for supervision of the Act.

Part IV deals with the enforcement provisions that the DOSHS has been provided with under the Act. It discusses the instances when **Improvement** and **Prohibition Notices** can be issued as well as the powers of OSH officers. This part of the Act will be mandatory for the Occupier to comply with for the proposed project.

Part V of the Act requires all workplaces to be registered with the DOSHS. This part will be applicable for the proposed project as the Occupier will have to apply for registration of their project with the DOSHS on completion of the construction phase and before the operational phase of the project. During the construction phase, the EPC Contractor shall be required to register the project site as a construction site and be registered in the DOSHS database.

Part VI of the Act lists the requirements for occupational health provisions which include cleanliness, ventilation, overcrowding, etc. This part of the Act will apply to the Occupier during all phases of the project.

Part VII of the Act contains provisions for the safe operation of machinery and includes all prime movers and transmission equipment. Additionally this part includes the safe operation of cranes, chains, ropes, lifting tackles, pressure vessels and their statutory examination by DOSHS Approved Persons. This part of the Act will apply to the proposed project during the construction and operational phases respectively.

Part VIII of the Act contains provisions for general safety of a workplace especially fire safety. This part of the Act will apply to the proposed project during the design, construction and operational phases respectively of the project.

Part IX of the Act deals with Chemical Safety. This will be applicable to the proposed project as it will receive, store, handle and distribute materials such as petroleum fuels, lubricants, chemicals, etc. The Occupier will be required to have MSDS sheets for all hazardous materials handled in the workplace including labeling of all receptacles containing such hazardous materials.

Part X of the Act deals with the General Welfare conditions that must be present during the construction and operational phase of the project. Such conditions include first aid facilities, supply of drinking water, accommodation for clothing, ergonomics, etc. This section of the Act will be applicable to the proposed project.

Part XI of the Act contains Special Provisions on the management of health, safety and welfare. These include work permit systems, PPE requirements and medical surveillance. All sections of this part of the Act will be applicable to the proposed project during the construction and operational phase.

Part XII of the Act deals with Special Applications such as platforms erected over water and workplaces where steam boilers or hoists and lifts are used. This part of the Act will be applicable to the proposed project.

Part XIII of the Act stipulates various fines and penalties associated with non-compliance with the Act. It includes those fines and penalties that are not included in other sections of the Act and will be important for the Occupier to read and understand the penalties for non-compliance with S&H provisions.

Part XIV of the Act is the last section of the Act and contains miscellaneous provisions which are not covered elsewhere in the Act. Some sections under this part of the Act will be apply to the proposed project and it is in the interest of the Occupier to read, understand and ensure compliance with it.

Some of the important subsidiary legislation which operationalizes the Act and is applicable to the proposed project is described below.

2.2.5.1 L.N. 31: The Safety and Health Committee Rules 2004

These rules came into effect on April 28th, 2004 and require that an Occupier formalize a Safety and Health (S&H) Committee if there are a minimum of 20 persons employed in the work place. The size of the S&H Committee depends on the number of workers employed at the place of work.

For the Proponent and Contractor, the OSHA and the S&H Committee Rules 2004 are important during the construction and operational phases as they require compliance with the following measures:

- Posting of an Abstract of the Factories and Other Places of Work Act in key sections of each area of the factory or other workplace;
- Provision of first aid boxes in accordance with Legal Notice No. 160 of 1977;
- Ensuring that there are an appropriate number of certified first aiders trained by an approved institutions and that the certification of these first aiders is current;
- Provision of a General Register for recording amongst other things all incidents, accidents and occupational injuries;
- Appointment of a S&H Committee made up of an equal number of members from management and workers based on the total number of employees in the workplace;
- Training of the S&H Committee in accordance with these rules;
- Appointment of a S&H management representative for the Proponent;

The S&H Committee must meet at least quarterly, take minutes, circulate key action items on bulletin boards and may be required to send a copy of the minutes to the DOSHS provincial office.

Appropriate recordkeeping including maintenance of all current certificates related to inspection of critical equipment such as cranes, air compressors, lifts, pulleys, etc. Such inspections need to be undertaken by an approved person registered by the Director of the DOSHS.

2.2.5.2 L.N. 24: Medical Examination Rules 2005

These rules provide for Occupiers to mandatorily undertake pre-employment, periodic and termination medical evaluations of workers whose occupations are stipulated in the Second Schedule of the OSHA and the First Schedule of the above Regulation. Workers that fall under the above two schedules are required to undergo medical evaluations by a registered medical health practitioner duly registered by the DOSHS.

It will be incumbent on the EPC Contractor to ensure that Material Safety Data Sheets (MSDSs) for chemicals used in the construction phase are studied for toxicological and epidemiological information and workers trained on their safe handling, use and disposal. If any of these products present negative impacts to human health, the workers exposed to the chemicals will be required to undergo medical examinations in accordance with the above Rules.

During the operational phase, it will be the duty of the O&M Company to undertake medical examinations of those staff members that could potentially be exposed to diseases listed in the Second Schedule of the OSHA.

2.2.5.3 L.N. 25: Noise Prevention and Control Rules 2005

These rules were promulgated on March 10th 2005 for occupational noise exposures and apply to workplaces in Kenya. The regulation is applicable to the project as there will be noise potentially generated by construction equipment that may exceed the permissible noise levels given below.

The rules set the permissible level for occupational noise in any workplace (which includes construction sites) as follows:

- 90 dB(A) over an 8-hour TWA period over 24-hours; and
- 140 dB(A) peak sound level at any given time.

Additionally the rules set permissible limits for community noise levels emanating from a workplace as follows:

- 50 dB(A) during the day; and
- 45 dB(A) at night.

If noise levels exceed the above permissible levels, the Occupier is required to develop, rollout and implement a written hearing conservation program which should include the following sections as a minimum:

- Undertaking a Noise Level Survey;
- Education and training of persons affected by excessive noise;
- Engineering noise control methods;
- Hearing protection requirements;
- Posting of notices in noisy areas;
- Audiometric testing methods and frequencies for those exposed to high noises; and
- Annual program review.

The Proponent is to ensure that any equipment brought to a site in Kenya for use shall be designed or have built-in noise reduction devices that do not exceed 90 dB(A). The Proponent shall request the supplier of the machine or equipment for its noise characteristics.

There is also a requirement for a Proponent to medically examine those employees that may be exposed to continuous noise levels of 85 dB(A) as indicated in Regulation 16. If found unfit, the occupational hearing loss to the worker will be compensated as an occupational disease.

It is expected that during the construction and operational phases of the project respectively, there may be plant and equipment that exceed the threshold levels of noise stipulated under the Rules. It will therefore be incumbent on the EPC contractor and their sub-contractors to ensure that their equipment is serviced properly and/or use equipment that complies with the threshold noise values given above. If they are unable to comply with the noise limits, the EPC contractor will be required to develop, rollout and implement a written hearing conservation program during the construction phase.

2.2.5.4 L.N. 59: Fire Risk Reduction Rules, 2007

These rules were promulgated by the Minister for Labor on April 16th 2007 and apply to all workplaces. A number of sections of the rules apply to the proposed project as enumerated below.

Regulation 5 requires Proponents to ensure that fire resistant materials are used for construction of new buildings. A number of minimum specifications of materials are provided in the regulation which are defined as fire resistant materials.

Regulation 6 requires that all flammable materials be stored in appropriately designed receptacles.

Regulation 7 requires that all flammable storage tanks or flammable liquid containers be labeled with the words "Highly Flammable" in English or Kiswahili. It is therefore practical for the Proponent to use a system similar to the Hazardous Material Identification System (HMIS) of labeling their product containers. The regulation requires a Proponent to consult the product's MSDS for appropriate labeling requirements.

Regulation 8(3) requires a Proponent to have a Spill Prevention, Control and Countermeasures plan (SPCC). This may be important if there will be chemicals stored at the construction site.

Regulation 16 requires Proponents to ensure that electrical equipment is installed in accordance with the respective hazardous area classification system. It is also a requirement that all electrical equipment is inspected 6-monthly by a competent person and the Proponent is required to keep records of such inspections.

Regulation 22 provides a description of the functions of a fire-fighting team. Regulation 23 requires Proponents to mandatorily undertake fire drills at least once a year.

Regulation 33 requires Proponents to have adequate fire water storage capacity. As a minimum this regulation requires Proponents to have at least 10m^3 of dedicated fire water storage capacity.

Regulation 34 requires Proponents to develop, rollout and implement a comprehensive written Fire Safety Policy. This policy should contain a Fire Safety Policy Statement signed by the CEO, a Fire Safety Policy Manual and a brief summary of the Fire Safety Policy of the company.

Regulation 35 requires a Proponent to notify the nearest OSH area office of a fire incident within 24 hours of its occurrence and a written report sent to the Director of DOSHS within 7 days.

This regulation will be mandatory for the proposed project and it is incumbent on the EPC Contractor and O&M Company to ensure that they comply with the above requirements during the construction and operational phases of the project respectively.

2.2.5.5 L.N. 60: Hazardous Substances Rules, 2007

These rules were promulgated by the Minister of Labor on April 16th 2007 and will apply to the proposed project if it will expose workers to chemicals that can potentially be hazardous to occupational health.

The Rules state that the Proponent shall ensure that where chemicals come into contact with employees, the exposure limits set out in the First Schedule of the Regulations are not exceeded. Where employees may be exposed to two or more chemicals in the workplace the Proponent shall work out the combined exposure using the narrative given in the Second Schedule of the Regulations. The Minister of Labor is empowered to change the exposure limits given in the First Schedule of the Regulations.

It is the responsibility of the Proponent to ensure that all employees exposed to chemicals in the workplace are protected adequately from exposure to hazardous substances that may be present using the hierarchy of hazard control methods. Such methods include elimination of the chemicals, substitution of the chemicals with less hazardous ones, engineering controls, administrative controls, use of PPE and emergency response planning. If engineering controls are applied, the Proponent will undertake the maintenance and testing of the engineering controls once every 24 months using a DOSHS approved Engineering Controls Examiner who will submit his report to the Director DOSHS within 30 days.

Regulation 12 – 15 requires Proponents to have a chemical safety program developed and implemented at their workplace if chemicals will be stored and handled. The Proponent is required to maintain an inventory of all MSDSs for the chemicals stored and handled in their workplace. As a minimum, the MSDS shall comply with the format indicated in the Third Schedule of the Regulations and will be disclosed fully to the employees handling the chemical. All unused, obsolete or expired chemicals must be disposed in an environmentally sound manner. All containers which store chemicals must be labeled appropriately as indicated in the MSDS for that chemical. Training of employees on the hazards associated with handling chemicals safely in the workplace will be provided at the Proponent's cost.

Regulation 16 requires the Proponent to monitor chemical exposure levels in the workplace annually by engaging a DOSHS registered Air Quality Monitor. The cost of the exposure monitoring survey will be borne by the Proponent. The Air Quality Monitor shall submit a report to the DOSHS Director within 30 days.

Regulation 19 requires Proponents that use hazardous chemicals in the workplace to subject those employees to medical examinations in accordance with the requirements of Legal Notice 24: The Factories and Other Places of Work (Medical Examination) Rules 2005.

2.2.6 The Land Act, 2012

The proposed project is being undertaken in an area where there are no Certificates of Title. Additionally, the land on which the project will be undertaken is currently farmed by communities that live on Pate Island and who do not have a permanent abode around the project site. Involuntary resettlement will be undertaken at the project site in accordance with Kenyan laws and international best practice guidelines such as those of the IFC and AfDB.

The Proponent will lease land from a state organ to construct and operate the proposed project. As there will be compensation paid out, it is important to comply with the requirements of the Land Act, 2012 which contains provisions for involuntary resettlement of people and subsequently it is necessary to coherently work with the following institutions:

- The Ministry of Energy and Petroleum;
- The National Land Commission;
- The County Government of Lamu;
- The County Assembly of Lamu;
- The County Commissioner of Lamu;
- The LAPSSET Authority;
- The Kenya Ports Authority; and

- The Proponent.

The Land Act 2012 is the substantive law governing management of land in Kenya. It provides for the legal regime that will govern *inter alia*, the administration and management of public land and private land; contracts over land, leases, charges, compulsory acquisition, easements and related rights. The state organ responsible for land matters in Kenya is the National Land Commission (NLC).

Part VIII of the Land Act 2012 (Articles 107 – 133) describes the process that needs to be followed for compulsory acquisition of interests in public land. This part of the Land Act will be followed for securing the land upon which the proposed coal power plant will be developed.

2.2.7 County Governments Act, 2012

The County Governments Act, 2012 was promulgated to provide for county governments' powers, functions and responsibilities to deliver services and for connected purposes.

Part IX of the Act (Articles 102 – 115) state the processes that shall be followed by a County Government with respect to planning in general. Article 104 and 105 places the onus of integrated planning for the county on the County Government. Article 107 outlines the various types of plans that need to be developed by a County. Article 108 requires the County Government to develop a 5-year County Integrated Development Plan (CIDP).

Article 114 of the Act discusses planning for nationally significant projects to be undertaken in a County. According to sub-section 1 of Article 114, public hearings are mandatory regarding a nationally significant project. Once the public hearings are concluded in several locations around the project area, the County Government will submit an application for consideration of the project to the County Assembly (Article 114 sub-section 2). This article will be applicable to the proposed project and shall be complied with.

Article 115 of the Act provides a mechanism for the public to provide their views and comments about nationally significant projects in their County. One method listed in the Act is through clear and unambiguous methods for delivery of an ESIA Study for the proposed project. For the coal power plant, this section of the Act shall be applicable and the findings of the ESIA Study will be shared with the communities living in the vicinity of the project area through public meetings.

2.2.8 Public Health Act, Cap 242

The Public Health Act was promulgated for securing the health of workers and communities working around projects. It came into force on September 6^{th}, 1921 and has been revised several times with the latest revision being done in 1986.

Part IV-A: General Provisions of the Act deals with the prevention and suppression of infectious diseases and certain sections of this part will be applicable to the project.

Part IX of the Act deals with the governance of sanitation and housing associated with a project. Certain sections of this part will be applicable to the project during the construction phase of the project.

2.2.9 Physical Planning Act, Chapter 286

The Physical Planning Act was promulgated for the preparation and implementation of physical development plans and connected purposes. This Act which was promulgated in 1996 requires the Proponent of a Project to submit an ESIA Study to the respective local authority if in the opinion of the local authority the Project is anticipated to have adverse environmental impacts (Section 36 of the Act).

2.2.10 Water Act, 2002

Under the Water Act, the principle requirement for the Proponent will be to apply for a water abstraction permit from the County water services board and pay the requisite licensing fees. This will be applicable as the project will require water for construction purposes.

2.2.11 National Laws on Land Tenure

2.2.11.1 Kenya National Land policy 2009

The national land policy which was passed on 3rd of December 2009 provides a necessary and stronger framework for the governance of land and redress of historical injustices. It recognises the multiple roles of land including cultural heritage and the importance of protecting land which is definite for future generations. The national land policy acknowledges customary land rights and boldly recognises community land, and that ultimate ownership should vest in the community. The National Land Policy 2009 recognizes the multiple meanings and roles of land stating the following in section 29:

Land is not just a commodity that can be traded in the market. It represents the following multiple values which should be protected by both law and policy.

a) Land is an economic resource that should be managed productively;

b) Land is a significant resource to which members of society should have equitable access;

c) Land is a finite resource that should be utilized sustainably; and

d) Land is a cultural heritage which should therefore be conserved for future generations.

2.2.11.2 Land Tenure in the Kenyan Constitution 2010

This endorses a fundamental principle that all land in Kenya belongs to the people of Kenya collectively as a nation, as communities and as individuals'. The Constitution groups land into three categories: public, community and private. Community land is a new category of land ownership in the 2010 Constitution. Article 63 states that "community land shall vest in and be held by communities identified on the basis of ethnicity, culture or similar community interest" The Constitution recognizes community land as being inclusive of community forests, shrines and sacred natural sites.

Article 63 (2) goes on to say that community land comprises:

a) Land lawfully registered in the name of group representatives under provision of any law;

b) Land lawfully transferred to a specific community by any process of law;

c) Any other land declared to be community land by an act of parliament; and

d) Land that is-

- Lawfully held, managed or used by specific communities as community forests, grazing areas or shrines;
- Ancestral lands and lands traditionally occupied by hunter-gatherers communities or
- Lawfully held as trust land by the county government but not including any public land held in trust by the county government under article 62(2)

Further article 63(4) states that community land shall not be disposed of or otherwise used except in terms of legislation specifying the nature and extent of the rights of members of each community individually and collectively.

The legislation will also ensure that the investments in property benefit local communities (article 66 (2) of the Constitution of Kenya 2010).

2.2.12 National Laws on Culture

Culture is a central pillar to the 2010 Constitution.

The constitution recognises culture as the foundation of the nation and as the cumulative civilisation of the Kenyan people and nation and promotes respect for ethnic diversity and equality. (Chapter 4 bill of rights, particularly article 27 of the Constitution of Kenya 2010.)

The new Constitution explicitly recognises minority and marginalised groups as being inclusive of indigenous peoples. Article 260 has four definitions of marginalised communities"

a) A community that because of its relatively small population or for any other reason;

b) A traditional community that, out of a need or desire to preserve its unique culture and identity from assimilation, has remained outside the integrated social and economic life of Kenya as a whole;

c) An indigenous community that has retained and maintained a traditional life style and livelihood based on a hunter or gatherer economy; or pastoral persons and communities whether they are i) nomadic or ii) a settled community that because of its relative geographic isolation, has experienced only marginal participation in the integrated social and economic life of Kenya as a whole.

The Constitution recognises the right of communities to practice their culture and imposes duties on the state to protect and promote cultural rights of the peoples. Article 44 of the constitution states that:

a) Every person has the right to use the language, and to participate in the cultural life of the person's choice.

A person belonging to a cultural or linguistic community has the right, with other members of that community-

a) To enjoy the person's culture and use the person's language, or

b) To form, join and maintain cultural and linguistic associations and other organs of civil society

The Constitution in Article 11(1) recognizes culture as the foundation of the nation and as the cumulative civilization of the Kenyan people According to Article 11 (2)(a) states that the state shall promote all forms of national and cultural expression through literature, the arts, traditional celebrations, science, communication, information, mass media, publications, libraries and other cultural heritage

(2)(b) Continues to state that the state must recognise the role of science and indigenous technologies in the development of the nation and promote the intellectual property rights of the people of Kenya. (Parliament is empowered to enact legislation to ensure communities receive compensation or royalties for use of their cultures and cultural heritage and to recognise and protect the ownership of indigenous seeds and plant varieties, their genetic and diverse characteristics and their use by the communities of Kenya.

2.2.13 The National Museums and Heritage Act 2006

The National Museums and Heritage Act 2006 (revised in 2009) not only provides for the establishment, control, management and development of national museums but also provides for the identification, protection, conservation and transmission of natural and cultural heritage of Kenya.

The act defines "Cultural heritage" in section 2 as:

a) Monuments
b) Architectural works of monumental sculptures and paintings, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features which are of universal value from the point of view of history, art or science
c) Groups of separate or connected building which because of their architecture, there homogeneity or their place in the landscape are of outstanding value from the point of view of history, art, or science.
d) Works of humanity or the combined works of nature and humanity and areas including archaeological sites which are of outstanding value from historical aesthetic, ethnological or anthropological point of view; and includes objects of archaeological or paleontological interest objects of historical interest and protected objects

2.2.14 The Forest Act 2005

The Forest Act 2005 provides for the establishment, development and sustainable management including conservation and national utilisation of forest resources for the social economic development of the country. The act is applicable to all forests woodlands and state, local authority and private lands (section 2)

Section 33(4) recognises the need for the protection of sacred natural sites stating that

" sacred groves found in any state forest, nature reserve, local authority forest or private forest shall not be interfered with and any person who, without lawful authority fells cuts damages or removes any such grove or tree or regeneration thereof, or biodiversity therein or abets in the commission of any such act commits an offence"

All indigenous forests and woodlands are also required to be sustainably managed including conservation of water, soil, biodiversity and a habitat for wildlife, and for "cultural use and heritage" (section 41(1))

The act recognises a forest community as a group of persons who-

a) Have a traditional association with a forest for purpose of livelihood, culture and religion

b) Are registered as an association or other organisation engaged in forest conservation.

2.2.15 Fisheries Act

The Fisheries Act Cap 378 of the Laws of Kenya provides a legal framework for the management, exploitation, utilization and conservation of fisheries and other connected purposes. It regulates the landing of fish and provides for the management of fish landing areas. Article 4 of the Act empowers the director fisheries in cooperation with other appropriate agencies and other departments of government to promote the development of traditional and industrial fisheries, fish culture and related industries. The act recognizes the contribution of fishing to local livelihoods and gives fishermen rights to fish in the Kenyan fishery waters.

2.2.16 Other important legislation

The above sections highlight some of the principal Acts in Kenya that the proposed project will require to be in compliance with. The outline of legislation provided in the above sections is not exhaustive and it is possible that there may be other laws and regulations that the proposed project may need to comply with. Subsequently, the Proponent and Contractor must err on the safe side by ensuring that a legal risk assessment is carried out before commencement of the project to ensure that any Acts not listed above which are important are complied with and the necessary permits applied for prior to the construction phase of the project.

2.2.17 Legislation and guidelines that have informed the preparation of the ESIA report

The following legislation has informed the scope and content of this ESIA Study:

- Environment Management and Coordination Act, 1999
- Environment (Impact Assessment and Audit) Regulations, 2003
- Environment Management and Coordination (Water Quality) Regulations, 2006
- Environment Management and Coordination (Waste Management) Regulations, 2006
- Environment Management and Coordination (Noise and Excessive Vibration Pollution) Regulations, 2006
- Energy Act, 2006;
- County Governments Act, 2012
- Land Act, 2012
- Public Health Act;
- Water Act, 2002;
- Occupational Safety and Health Act, 2007 and its subsidiary legislation.

2.2.18 Kenya National Climate Change Response Strategy

The National Climate Change Response Strategy (NCCRS) 2010 was the first national policy document to fully acknowledge the reality of climate change. The NCCRS has been guiding policy decisions since its launch in 2010.The Strategy provides evidence of climate change impacts on different economic sectors and proposed adaptation and mitigation strategies. The purpose of this plan is to put in place robust measures needed to address most, if not all, of the challenges posed by climate variability and change. Kenya's GHG emissions are rising quickly and energy sector emissions are estimated to have increased by as much as 50% over the last decade. In order to achieve the goal of a low-carbon developed society, Kenya should pursue an energy mix that greatly relies on carbon-neutral energy sources such as geothermal and other renewables which will increase Kenya's energy security.

2.3 International Conventions, Treaties and Agreements

Kenya has ratified and domesticated several international conventions and treaties for the protection of the environment. The proposed coal fired power plant will comply with the requirements of the various conventions, treaties and agreements that Kenya has ratified. Table 3 gives the status of environmental treaties ratified by Kenya.

Table 2-3: Some of Treaties applicable to the proposed project

Topic	Treaty	Relevance of treaty to the proposed coal fired power plant	Date Treaty entered into force	Date of ratification/ accession in Kenya
Climate change and the ozone layer	United Nations Framework Convention on Climate Change (UNFCCC)	The Convention's objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. As the proposed coal fired power plant needs to implement clean coal technologies throughout the lifetime of the project in order to manage the emissions from the chimney	21/03/1994	30/08/1994
	Kyoto Protocol to the United Nations Framework Convention on Climate Change	The Kyoto Protocol (KP) operationalizes the UNFCC and Kenya is a state party to the KP. Subsequently, the proposed coal power plant will need to demonstrate that through clean coal technologies, it could reduce greenhouse gas emissions over the operational phase.	16/02/2005	25/02/2005
Biodiversity	African Convention on the Conservation of Nature and Natural Resources	The objectives of this Convention are to: 1. Enhance environmental protection; 2. Foster the conservation and sustainable use of natural resources; and 3. Harmonize and coordinate policies in these fields with a view to achieving ecologically rational, economically sound and socially acceptable development policies and programs. The proposed coal power plant aims to provide the most cost effective power to the people living in Kenya including rural areas where biomass is used for lighting purposes. By providing cheap electricity, it is hoped that deforestation will slow down thus enhancing environmental protection.	16/06/1969	12/05/1969

Topic	Treaty	Relevance of treaty to the proposed coal fired power plant	Date Treaty entered into force	Date of ratification/ accession in Kenya
	Convention on Biological Diversity (CBD)	This convention aims to ensure the conservation of biological diversity; the sustainable use of its components and the fair and equitable sharing of the benefits. The developer is in the process of planting one million new tree seedlings which will be planted in Lamu County.	29/12/1993	24/10/1994
Conservation	Convention for the Protection, Management and Development of the Marine and Coastal Environment of Eastern Africa Region (Nairobi Convention)	This convention requires all contracting parties to take appropriate steps to prevent, reduce and combat pollution of the Convention area and to ensure sound environmental management of natural resources. The convention is applicable to the proposed coal power plant as it aims to (i) prevent pollution by ships and barges that will ply the Manda Bay, (ii) prevent pollution caused by dumping solid or liquid wastes into the Manda Bay, (iii) prevent airborne pollution arising from power plant activities	10/05/1996	11/09/1990
Heritage	Convention For The Protection Of The World Cultural And Natural Heritage	The objective of this Convention is to ensure that effective and active measures are taken for the protection, conservation and presentation of the "cultural and natural heritage" on its territories. The Convention is applicable to the proposed coal power plant as there may be items of tangible or intangible cultural heritage within the project site or its environs. Secondly, the Developer should continue to support and promote the culture of the people in Lamu through cultural festivals in order to preserve this heritage. This initiative to continue sponsoring cultural festivals will assist in maintaining the outstanding cultural value of the Stone town in Lamu which is a World Heritage inscribed site	17/12/1975	05/06/1991

Topic	Treaty	Relevance of treaty to the proposed coal fired power plant	Date Treaty entered into force	Date of ratification/ accession in Kenya
Marine pollution	Convention On The Prevention Of Marine Pollution By Dumping Of Wastes And Other Matter	The objective of this Convention is to contribute to the international control and prevention of marine pollution by prohibiting the dumping of certain hazardous materials. The Convention will be applicable to the proposed coal power plant as it will prohibit "dumping" of wastes into the Manda Bay by the barges that will transport coal to the off-loading jetty. It will also prohibit anyone from deliberately dumping certain wastes from the jetty structure into the Manda Bay	30/08/1975	07/01/1976
	International Convention for the Prevention of Pollution from Ships (MARPOL)	This Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. While it may not apply directly to the proposed coal power plant, it will apply to the ships that transport coal to the Manda Bay	02/10/1983	12/09/1975
Waste management and pollution	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. The principal aims of the Convention are (i) the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal, (ii) the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management, and (iii) a regulatory system applying to cases where transboundary movements are permissible.	05/05/1992	01/06/2000

Topic	Treaty	Relevance of treaty to the proposed coal fired power plant	Date Treaty entered into force	Date of ratification/ accession in Kenya
		This Convention may apply to the proposed coal power plant if there any "hazardous wastes" generated by it as defined in the Convention which need to be disposed in an environmentally sound manner.		

2.3.1 The African Charter on Human and Peoples Rights

The African Charter on Human and Peoples Rights (ACHPR) is the African continent human rights charter, which came into force on 21st October 1986 in Nairobi and was ratified by Kenya on 23rd January 1992.

The ACHPR recognises and protects the collective rights of people, including "the unquestionable and inalienable rights to self- determination (article 20(1) and "social and cultural development (article 22(1))

2.3.2 International Covenant on Economic, Social and Cultural rights, 1966 and international covenant on civil and political rights 1966.

These recognise the economic, social and cultural rights, including rights to self-determination, health and education, political and civil rights, including right to self-determination, to life freedom of religion speech and assembly.- Kenya acceded to these laws on the 1st of May 1972.

2.3.3 Ramsar convention on Wetlands (1971, amended in 1982 and 1987)

This convention came into force on 5th October 1990. It provides for conservation and wise use of wetlands and recognises the ecological and cultural importance of wetlands.

2.3.4 UNESCO, World Heritage Convention

This convention concerns the protection of world cultural and natural heritage 1972. The convention was ratified by Kenya on 5th of June 1991. It protects cultural and natural heritage of outstanding value, including natural sites and cultural landscapes formed through interaction between humans and nature

Duties of the State are to identify, protect, conserve, rehabilitate and transmit cultural and natural heritage to future generations, integrate heritage protection into regional planning, and refrain from activities that may damage heritage. States can nominate sites of importance for natural and cultural heritage on the world Heritage list, and threatened properties on the list of world heritage in danger. The convention establishes the world heritage fund for the protection of heritage and to provide technical assistance in developing management plans. States are encouraged to promote public participation through a participatory management scheme.

2.3.5 UNESCO Convention for safeguarding the intangible cultural heritage, 2003

This was ratified by Kenya on 24th of October 2007. It recognises and protects intangible cultural heritage including intergenerational knowledge, oral traditions, practices, rituals and places relating with nature and the universe (Article 2). It promotes the widest possible participation and requires free prior and informed consent of communities in nominating intangible heritage and involvement in heritage protection (e.g. Articles 119b) and 15).

State parties can register sites of intangible cultural heritage on a representative list, and those in need of urgent safe guarding.

2.3.6 UNESCO Convention on the protection and promotion of Diversity of Cultural expressions 2005.

Kenya ratified this on the 24th of October 2007. This convention protects and promotes cultural expressions of minority and indigenous people to protect cultural diversity (e.g. Article 2).

2.3.7 UN Declaration on the Rights of Persons belonging to National or Ethnic, religious and Linguistic Minorities (1992).

The law recognises and protects cultural and religious identity of minority groups (e.g. Article 1)

2.4 Kenya Government Institutional Framework

With the promulgation of the Constitution of Kenya 2010, two levels of Government were created namely the National Government and County Government. With respect to the proposed coal fired power plant, both levels of Government are important for the successful implementation.

2.4.1 Ministry of Energy and Petroleum (MoEP)

The Ministry of Energy and Petroleum (MoEP) is the implementing ministry for the proposed coal fired power plant. It has several responsibilities including (i) development of an energy policy, (ii) development of a diverse energy mix in Kenya, (iii) fossil fuel exploration and development, (iv) rural electrification and (v) oversight role in state owned statutory bodies and parastatals.

For the coal fired power project, the MoEP issued the tender for the development of the project in January 2014. The MoEP is the implementing ministry for the coal fired power plant and is leading the Resettlement Action Plan (RAP) for the project.

2.4.2 Energy Regulatory Commission (ERC)

The Energy Regulatory Commission (ERC) was established under the Energy Act Number 4 of 2006 as a single regulator for downstream oil and gas, power generation, transmission and distribution sub-sectors in Kenya. The ERC is responsible for economic and technical regulation of electric power, renewable energy, and downstream petroleum sub-sectors.

Among other things, the ERC's functions also include tariff setting, review, licensing, enforcement, dispute settlement and approval of power purchase and network service contracts.

2.4.3 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.

2.4.4 Kenya Power

Kenya Power is a State Corporation having a Government of Kenya shareholding of 50.1% and private shareholding of 49.9% as at June 2014. It purchases electrical energy in bulk from KenGen and other power producers and carries out transmission, distribution, supply and retail of electric power.

For the coal power plant, the Kenya Power will be the sole off-taker of the 981.5MW of electrical power generated by the power plant.

2.4.5 Kenya Electricity Transmission Company (KETRACO)

The Kenya Electricity Transmission Company (KETRACO) is a Government of Kenya wholly owned company established to be responsible for the development, maintenance and operation of the national transmission grid network whose capacity is greater than 132kV. It is also responsible for facilitating regional power trade through its transmission network.

For the coal fired power plant, KETRACO will develop the 400kV overhead transmission line between the power plant and Nairobi East at the National Control Center.

2.4.6 National Land Commission (NLC)

The National Land Commission (NLC) of Kenya is an independent government commission whose establishment was provided for by the Constitution of Kenya to amongst other things, (i) manage public land on behalf of the national and county governments, (ii) initiate investigations into present or historical land injustices and recommend appropriate redress, and (iii) monitor and have oversight responsibilities over land use planning throughout the country.

With respect to the coal fired power plant, the NLC is an important state organ as it will be responsible for implementing the applicable requirements of the Land Act 2012 including the resettlement action plan (RAP) for the project and paying compensation to the project affected persons (PAPs).

2.4.7 County Government of Lamu

According to the County Governments Act 2012, a county government shall be responsible for any function assigned to it under the Constitution or by an Act of Parliament. With regard to the proposed coal fired power plant, the County Government of Lamu is responsible for among other functions, the following:

- Acquire land for the proposed coal power plant (Article 6(2)(b));
- Submit the plans and proposals of the proposed coal fired power plant to the County Assembly of Lamu for consideration (Article 30(2)(f)).

2.4.8 County Assembly of Lamu

The County Assembly’s principal function is to make laws at the County level. The County Assembly of Lamu has twenty members of the county assembly and the speaker.

Under Section 114 (2) of the County Governments Act, 2012, the County Assembly will be responsible for considering and approving the plans and proposals for the proposed coal fired power plant.

2.4.9 LAPSSET Authority

The LAPSSET Corridor Development Authority was created to plan, coordinate and manage the implementation of the Lamu Port-South Sudan-Ethiopia Transport Corridor. The LAPSSET Corridor Development Authority is domiciled in the Presidency in accordance with the Constitution of Kenya 2010.

Among other functions, the LAPSSET Corridor Development Authority is tasked with establishing an integrated implementation plan and oversee the implementation of projects including the proposed coal fired power plant.

2.5 International Policies, Guidelines and Standards

This following sub-section provides an overview of the international guidelines and standards that the proposed coal power plant will need to comply with in addition to HSE related legislation in Kenya.

The two key institutions whose environmental and social guidelines and standards will be used for the proposed coal power plant include the African Development Bank (AfDB) and the International Finance Corporation (IFC).

2.5.1 African Development Bank policies and guidelines

The African Development Bank (AfDB) Group has developed a set of policies for provision of support to the energy sector. Additionally, the AfDB has updated their existing environmental and social safeguards which are referred to as the Integrated Safeguards System (ISS). Given below is an overview of AfDB related policies that will be applicable to the proposed coal power plant.

2.5.1.1 Energy Sector Policy of the AfDB Group

The AfDB developed an Energy Sector Policy which was approved in September 2012 for provision of financial support to Regional Member Countries (RMCs) on development of modern, affordable and reliable sources of energy. Under the Policy, the AfDB further supports RMC's in the development of the energy sector in a socially, economically and environmentally sustainable manner.

According to the AfDB, the energy sector policy for coal fired power plants is based on the following framework:

1. **Development impact**: A proposed Greenfield or retrofit coal-fired power plant should have a strong developmental impact, contributing to poverty reduction and addressing national and/or regional energy security needs.
2. **Transitioning towards green growth**: Collaborate with Regional Member Countries (RMCs) to identify technologically and commercially feasible low-carbon and cost-effective strategy for energy resources.
3. **Environmentally responsible**: Take advantage of progress in technology to adequately mitigate negative environmental impacts, introducing efficient technologies, reduce GHG emissions, and diversify the energy mix.
4. **Technology**: Work closely with RMCs to ensure adoption of the most appropriate, commercially available and affordable technology for reducing GHG emissions. Assist in sourcing additional financing to invest in such technologies. Ensure that a desk-top assessment of the technical, economic and financial feasibility of abatement is undertaken, and will encourage assessment of the potential for readiness for relevant Carbon Capture and Storage technologies.
5. **Offsetting measures**: Seeks to promote United Nations Conventions on Climate Change. Ensures that its interventions comply with agreements and related standards that are ratified by its RMCs within the framework of climate-change negotiations in terms of GHG emissions, including offsetting measures. Support RMCs that express an interest in implementing offsetting measures in relation to these agreements, or on a voluntary basis.

Based on their Energy Sector Policy, the AfDB is committed to environmental and social sustainability and consequently, will help its clients to (i) assess different energy options against their ability to achieve such objectives; and (ii) gradually adopt a sustainable low-carbon growth path, underpinned by the three levers namely, renewable sources, energy efficiency and clean technologies.

The new Energy Policy is founded on nine guiding principles of which environmental and social responsibility is one of them. Under this principle, the AfDB advocates for a viable balance between economic, environmental and social considerations in a project life cycle. Under this principle, projects financed by the AfDB are required to comply with the bank's environmental and social standards as defined in the environmental and social integrated safeguards system.

Another guiding principle of the new Energy Policy is integrating responses to climate change. Under this guiding principle, the AfDB is committed to help RMCs move gradually towards environmentally friendly energy production and supply patterns. The bank will support individual African countries Bank to: (i) identify and implement low-carbon energy supply options that are technically, socially, financially and economically viable; (ii) build the requisite capacity and (iii) understand and take advantage of concessional climate financing options to increase access to cleaner energy.

The new Energy Policy envisages capacity building and knowledge management as critical success factors in enhancing energy access, security and sustainability. Towards this end the AfDB proposes to support Research-Development and Innovation in RMCs, in particular, through building and enhancing partnerships with regional and international research institutions.

Mainstreaming gender considerations is another guiding principle of the new Energy Sector Policy of the AfDB. Under this principle, the AfDB will ensure that (i) the gender implications are properly reflected in the energy-sector project cycle, and (ii) gender-related capacity building and training efforts are adequately integrated into its energy interventions.

The design of the proposed coal fired power plant in Lamu is aligned to the development objectives of the AfDB's energy sector policy in the following ways:

a) The proposed coal power plant is part of Kenya's diverse energy mix and is expected to provide the most cost effective power; this is expected to contribute towards greater economic growth and potentially, reduction in the use of biomass in the medium- to long-term;

b) The power plant will incorporate clean coal technologies such as electrostatic precipitators, wet flue gas desulfurization and low nitrous oxide burners;

c) The proposed coal power plant will utilize super-critical technology whose efficacy is higher than that of sub-critical technology; and

d) The Proponent has commenced a tree-planting campaign and about 300,000 seedlings are in the process of being planted.

2.5.1.2 AfDB Operational Guidelines for Coal Power Plants

The Operational Guidelines for Coal Power Plants were developed by the AfDB to complement its Energy Sector Policy and guide its future investments in coal. The guidelines are applicable to new coal-based power generation in Greenfield and associated transmission infrastructure for power evacuation.

Section 4 provides guidance to AfDB task teams on the approach for developing coal power plants during various stages throughout the lifetime of the project.

2.5.1.3 African Development Bank Gender Mainstreaming Policy

The AfDB Gender Policy (2001) provides a framework for action, through which the proponent will ensure equal access to women and men to project related opportunities and benefits.

The guiding principles present the key steps that are applicable for mainstreaming gender throughout the project cycle. The starting point for effective gender mainstreaming in infrastructure programs/projects is to undertake the required gender analysis.

Throughout the cycle, gender analysis will be applied in order to disaggregate women's and men's roles and responsibilities; time use and availability; resources, knowledge and capacity available to each and participation in decision making by each.

2.5.1.4 AfDB Integrated Safeguards Policy and Operational Safeguards

In 2013, the AfDB updated its environmental and social policies and developed an "Integrated Safeguards Policy" and five "Operational Safeguards". The objective of having the above tools is to enable the AfDB to be better equipped in addressing emerging environmental and social development challenges of Group funded projects.

To better articulate its safeguard policies while improving their clarity, coherence and consistency, the AfDB developed an Integrated Safeguards System (ISS). This system consists of four components namely:

a) Integrated Safeguards Policy Statement;

b) Operational Safeguards;

c) Environment and Social Assessment Procedures (ESAPs); and

d) Integrated Environmental and Social Impact Assessment (IESIA).

Currently, the AfDB has released items (a) and (b) above and will release items (c) and (d) in the near future.

With respect to the coal power plant, all five operational safeguards (OSs) will be applicable and the Proponent should demonstrate compliance with them throughout the lifetime. The table below provides a brief description of each OS.

Table 2-4: Description of AfDB's Operational Safeguards

Operational Safeguard	Description
1	This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.
2	This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and incorporates a number of refinements designed to improve the operational effectiveness of those requirements.
3	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.
4	This safeguard covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.
5	This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks.

2.5.2 IFC Performance Standards

In addition to the AfDB ISS, the proposed coal fired power project will be evaluated against the latest International Finance Corporation (IFC) Environmental and Social (E&S)

Performance Standards (PSs) dated January 2012. There are eight E&S performance standards in IFC's sustainability framework as listed below.

Table 2-5: List of IFC Performance Standards

Performance Standard	Description
1	Assessment and Management of Environmental and Social Risks and Impacts
2	Labor and Working Conditions
3	Resource Efficiency and Pollution Prevention
4	Community Health, Safety, and Security
5	Land Acquisition and Involuntary Resettlement
6	Biodiversity Conservation and Sustainable Management of Living Natural Resources
7	Indigenous Peoples
8	Cultural Heritage

Given below is a short description of the applicable IFC PSs with respect to the proposed coal fired power plant.

Table 2-6: Applicable IFC Performance Standards-Proposed Coal Power Plant

Performance Standard	Description
1	This PS highlights the importance of managing environmental and social performance throughout the life of a project by developing and implementing an effective Environmental and Social management System (ESMS). It provides guidelines on the contents and process of developing an effective ESMS.
2	This PS stresses that the fundamental rights of workers should be protected throughout the project life cycle. It stresses the need for constructive worker-management relationships, treating workers fairly, and, providing a safe and healthy work environment. These ingredients will lead to higher productivity and efficiency among workers.
3	This PS outlines a project level approach to resource efficiency and pollution prevention and control in alignment with internationally disseminated technologies and practices. It expects that project Proponents will incorporate commercially available and feasible best available technologies (BAT) for minimization of pollution emanating from project related activities.
4	This PS addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety and security that may arise from project related activities.
5	This PS recognizes that in certain projects, land acquisition and involuntary resettlement may be necessary. In order to avoid long-term hardship and impoverishment of project affected persons (PAPs), environmental damage and adverse socio-economic impacts, involuntary resettlement should be minimized or appropriate mitigation measures should be carefully planned and implemented

Performance Standard	Description
	for PAPs and host communities through a documented Resettlement Action Plan (RAP).
6	This PS sets out requirements for conserving biodiversity, maintaining ecosystem services and sustainably managing living natural resources. The requirements within this PS are based on the Convention of Biological Diversity. This PS sets out the measures that a Proponent can take to manage and mitigate adverse impacts on biodiversity and ecosystem services.
7	Not applicable to coal power project
8	This PS aims to ensure that a Proponent protects cultural heritage in the course of project activities. This PS is aligned with the Convention Concerning the Protection of World Cultural and Natural Heritage and parts of the Convention on Biological Diversity.

The proposed coal fired power plant project is expected to receive funding from international sources. Subsequently, it is imperative for the environment and social assessment process to comply with the requirements of international policies and guidelines of Development Finance Institutions (DFIs).

In addition to the above requirements, the proposed coal power plant will subscribe to local and international environmental and social standards. A brief overview of the standards is given below.

2.6 ESIA Study alignment with international environmental standards

A review of this ESIA Study was undertaken to confirm that it is aligned with the environmental and social (E&S) requirements of multi-lateral finance institutions (MFIs) and development finance institutions (DFIs). The three common referenced E&S standards used are those developed by the IFC, AfDB and the Equator Principles Finance Institutions 3 (EPFI3).

Amu Power Company Limited (APCL) is a project development company that will develop and implement a formal ESMS for the project. They will incorporate the applicable E&S requirements of the above institutions. Table 1-5 shows how the ESIA Study for the Lamu coal power plant has addressed the E&S requirements of the IFC, AfDB and EPFI3 for the project. It should be noted that the EPFI3 defaults several principles to the IFC's E&S Performance Standards.

Table 2-7 : Evaluation of ESIA Study with MFI and DFI requirements

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Assessment and Management of Environmental and Social Risks and Impacts			
Environmental and Social Management System	**Performance Standard 1: Paragraph 5** - states that the client, in coordination with other responsible government agencies and third parties to conduct a process of environmental and social assessment, and establish and maintain an ESMS appropriate to the nature and scale of the project.	**Operational Safeguard 1: Paragraph 5 –** states that appropriate and relevant environmental and social assessment tools to mainstream environmental and social considerations into Country Strategy Papers and Regional Integration Strategy Papers are applied.	**Principle 4:** states that the client is required to develop or maintain an Environmental and Social Management System (ESMS).
a) **ESMS Policy**	***Performance Standard 1: Paragraph 6*** – states that the client is required to establish an overarching policy defining the environmental and social objectives and principles that guide the project to achieve sound environmental and social performance.	***Operational Safeguard 1: Paragraph 15*** **–** states the need for compliance with the relevant legislation and standards applicable in the local jurisdiction. Also considering national or regional-level programming documents that are under implementation or in preparation.	*Principles 3 and 8 – states that the assessment* process should first address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues.
b) **Identification of Risks and Impacts**	***Performance Standard 1: Paragraph 7-12*** – states that the client is required to establish and maintain a process for identifying the	***Operational Safeguard 1: Paragraphs 6-13.*** - states that the clients are responsible for conducting the environmental and social	***Principle 2*** **–** states that the client is required to conduct an Assessment process to address the relevant environmental and social risks and

[1] International Finance Corporation Environmental and Social Performance Standards, 2012
[2] African Development Bank ISS
[3] Equator Principles III, June 2013

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	environmental and social risks and impacts of the project; the process should be consistent with good international industry practice, and should determine the appropriate and relevant methods and assessment tools.	assessment (Strategic Environmental and Social Assessment, or SESA, or Environmental and Social Impact Assessment, or ESIA) and for developing, as an integral part of project documentation, an appropriate plan for managing possible impacts.	impacts of the proposed Project. The Assessment should propose measures to minimize, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project.
c) **Management Programs**	*Performance Standard 1: Paragraphs 13-16.* – states that the client should establish management programs that, in sum, will describe mitigation and performance improvement measures and actions that address the identified environmental and social risks and impacts of the project. These programs may consist of a combination of operational procedures, practices, plans, and related supporting documents. The management programs will establish environmental and social Action Plans.	*Operational Safeguard 1: Paragraphs 14-21* – states that the mitigation hierarchy be applied: if avoidance is not possible, reduce and minimize potential adverse impacts; if reduction or minimization is not sufficient, mitigate and/or restore; and as a last resort compensate for and offset.	*Principle 4* – states that an Environmental and Social Management Plan (ESMP) should be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.
d) **Organizational Capacity and Competency**	*Performance Standard 1: Paragraphs 17-19* – states that the client is required to establish,	*Operational Safeguard 1: Paragraphs 18* – states that the client is required to develop a	*Principle 4* – states that an Environmental and Social Management Plan (ESMP) should be

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	maintain, and strengthen as necessary an organizational structure that defines roles, responsibilities, and authority to implement the ESMS. The team implementing the ESMS should have the knowledge, skills, and experience necessary to perform their work.	comprehensive and implementable ESMP with a realistic timeframe, incorporating the necessary organizational capacity (including further training requirements) and financial resources to address and manage the environmental and social risks that may occur during the full project cycle.	prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.
e) **Emergency Preparedness and Response**	*Performance Standard 1: Paragraphs 20-21.* – states that the client is required to establish and maintain an emergency preparedness and response system in collaboration with appropriate and relevant third parties to able to respond to accidental and emergency situations associated with the project.	*Operational Safeguard 1: Paragraphs 36* – states that the client establishes adequate emergency preparedness and response plans so that it is prepared to respond to accidental and emergency situations that may pose a threat to local communities, and to provide affected communities with appropriate information about emergency preparedness and response activities, resources, and responsibilities.	*Principle 4* – states that an Environmental and Social Management Plan (ESMP) should be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards.
f) **Monitoring and Review**	*Performance Standard 1: Paragraphs 22-24* – states that client is required to establish procedures to monitor and measure the effectiveness of the management program, as well as compliance with	*Operational Safeguard1: Paragraph 56* – states that the client is responsible for the implementation of the ESMP and reports on key management or monitoring tasks set out in the ESMP.	*Principles 7 and 9-* states that an independent review by an independent environmental and social consultant is required for Projects with potential high risk impacts. To provide periodic reports in a

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	any related legal and/or contractual obligations and regulatory requirements.	Environmental and social mitigation measures contained in the ESMP, Resettlement Action Plan are jointly monitored and reported during project supervision missions.	format agreed with the EPFI prepared by in-house staff or third party experts documenting compliance with the ESMPs and Equator Principles Action Plans (where applicable), and compliance with relevant local, state and host country environmental and social laws, regulations and permits
How the element has been addressed in the ESIA Study	**The need for a documented ESMS has been discussed in section 2.6.1 of the ESIA Study. Section 7 of the ESIA Study discusses the potential environmental and social risks identified for the Lamu coal power plant project, and the mitigation measures to reduce the impacts to as low as reasonably practical (ALARP). Section 8.5.10 of the ESIA Study discusses specific management programs that should be developed for the project. The organizational capacity has been discussed in the Environment Management Plan in section 8.5.12. For emergency response, section 8.5.13 of the Environment Management Plan recommends that an Emergency Response Manual be developed for the project and the manual should include specific contingency plans for credible scenarios. For monitoring and review, tables 8-1 to 8-8 provide frequencies of review of the ESMS**		
Stakeholder Engagement	*Performance Standard 1: Paragraph 25* - Stakeholder engagement is an ongoing process that may involve the following elements: stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism, and ongoing reporting to affected Communities.	*Operational Safeguard1:* *Paragraphs 45-48* - This section gives requirements on stakeholder identification; engagement process; disclosure of information and informed consultations and participation.	*Principles 5* – This principle outlines the consultation and participation process with the affected communities and other stakeholders. *Principle 10* – this is an addition to principle 5 and focuses on information disclosure and reporting.
a) **Stakeholder**	*Performance Standard 1:*	*Operational Safeguard1:*	*Principle 5* – states that the client is

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Analysis and Engagement Planning	*Paragraphs 26-28*- states that the client is required to develop and implement a Stakeholder Engagement Plan that is scaled to the project risks and impacts and development stage, and be tailored to the characteristics and interests of the affected Communities.	*Paragraphs 45-48*- The client is required to conduct a meaningful consultation based on stakeholder analysis and is preceded by disclosure of adequate project information and environmental and social information to ensure that participants are fully informed. Affected communities are given the opportunity to participate in key stages of project design and implementation and their views incorporated in various assessment reports.	required to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders.
b) **Disclosure of Information**	*Performance Standard 1: Paragraph 29*- states that the client is required to provide affected Communities with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.	*Operational Safeguard1: Paragraphs 49-54* – states that the client is required to ensure maximum disclosure, enhanced access to information, and limited exceptions at key stages during the project cycle and making documents available to the public on request, through the Integrated Safeguards Tracking System (ISTS). Information is disclosed on the AfDB websites and in appropriate national and local settings under the direct responsibility and supervision of relevant national/local	*Principle 5 -* states that the client is required to commensurate to the project's risks and impacts, make the appropriate assessment documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner. Environmental or social risks and adverse impacts, disclosure should occur early in the assessment process and on an ongoing basis.

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
		authorities.	***Principle 10 –*** states that the client should ensure that, at a minimum, a summary of the ESIA is accessible and available online.
c) **Consultation**	***Performance Standard 1: Paragraph 30 –*** states that the client is required to undertake a consultation process that provides the affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and also allows the client to consider and respond to them.	***Operational Safeguard1: Paragraphs 45-48*** The client is required to conduct a meaningful consultation based on stakeholder analysis and is preceded by disclosure of adequate project information and environmental and social information to ensure that participants are fully informed. Affected communities are given the opportunity to participate in key stages of project design and implementation and their views incorporated in various assessment reports.	***Principle 5 –*** states that during consultation and participation The client should tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. The process should be free from external manipulation, interference, coercion and intimidation.
d) **Informed Consultation and Participation**	***Performance Standard 1: Paragraph 31-*** states that the client is required to conduct an Informed Consultation and Participation process which involves a more in-depth exchange of views and information	***Operational Safeguard1: Paragraphs 48*** The client has identified vulnerable communities that would potentially be affected by the project, the borrower/client engages in	***Principle 5 –*** states that the client is required to conduct an Informed consultation and participation process if the projects potentially have significant adverse impacts on Affected Communities.

Element Description	**[1]IFC Performance Standards requirements**	**[2]AfDB Operational Safeguards requirements**	**[3]Equator Principles requirements**
	from various groups.	meaningful informed consultation and participation with the vulnerable communities, beginning as early as possible in the project cycle before the project is submitted for Board consideration and continuing throughout the project cycle.	
How the element has been addressed in the ESIA Study	**The Stakeholder Engagement Plan (SEP) – Appendix 09 of the ESIA Study developed for the Lamu coal power project includes the process and results used to undertake stakeholder identification and analysis (section 3.1). Section 3.2 discusses the methods of disclosing the information about the project and ESIA to the affected communities. Informed consultation and participation (ICP) is discussed in section 3.3 of the SEP**		
External Communications and Grievance Mechanism	*Performance Standard 1:* *Requirement 3* - This section outlines the requirements of a client in handling external grievances.	*Operational Safeguard1:* *Requirement 8.* *Paragraph 55* – states that the client should establish a grievance and redress mechanism that is accessible to the stakeholders at all times during the project cycle	*Principle 6* – states that the client is required to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.
a) **External Communication**	*Performance Standard 1: Paragraph 34* – states that the client is required to implement and maintain a procedure for external communications that includes methods to; i. receive and register external	*Operational Safeguard1: Paragraph 55* – states that the client should establish a credible, independent and empowered local grievance and redress mechanism to receive, facilitate and follow up on the resolution of affected people's grievances and concerns about the	*Principle 6* – states that the client is required to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance with the affected community being

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	communications from the public; ii. screen and assess the issues raised and determine how to address them; iii. provide, track, and document responses, if any; and iv. adjust the management program, as appropriate.	environmental and social performance of the project. The local grievance mechanism needs to be accessible to the stakeholders at all times during the project cycle, and all responses to grievances are recorded and included in project supervision formats and reports.	the main user.
b) **Grievance Mechanism for Affected Communities**	*Performance Standard 1: Paragraph 35* - The grievance mechanism should be scaled to the risks and adverse impacts of the project and have affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies.	*Operational Safeguard1: Paragraph 55* - The local grievance mechanism needs to be accessible to the stakeholders at all times during the project cycle, and all responses to grievances are recorded and included in project supervision formats and reports.	*Principle 6* The grievance mechanism should be scaled to the risks and adverse impacts of the project and have affected Communities as its primary user. It should seek to resolve concerns promptly, using an understandable and transparent consultative process that is readily accessible, and at no cost and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies.

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
How the element has been addressed in the ESIA Study	**As part of the ESIA Study, a comprehensive Grievance Mechanism (GM) was developed for the Lamu coal power project. The GM is discussed in Appendix 10 of the ESIA Study**		
Ongoing Reporting to Affected Communities	*Performance Standard 1:* *Requirement 4* *Paragraph 36. -* The client is required to provide periodic reports to the affected Communities that describe progress with implementation of the project action Plans; management program changes to the affected Communities.	*Operational Safeguard1:* *Requirement 7.* *Paragraph 54-55 –* states that after the establishment of a grievance mechanism, all responses to grievances are recorded and included in project supervision formats and reports.	*Principle 10 -* states that the client should ensure that, at a minimum, a summary of the ESIA is accessible and available online.
How the element has been addressed in the ESIA Study	**The Stakeholder Engagement Plan (SEP) developed for the project includes a program of how ongoing communications with the community about the project should be undertaken; this is covered in section 9 of the SEP.**		
Labor and Working Conditions			
Working Conditions and Management of Worker Relationship	*Performance Standard 2:* *Requirement 1* This section includes the following topics: • Human Resources Policies and Procedures;	*Operational Safeguard 5:* *Requirement 1* This section includes the following topics: • Human Resources Policies and Procedures;	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	• Working Conditions and terms of employment; • Workers' Organizations; • Non-discrimination and equal opportunity; • Retrenchment; and • Grievance Mechanism	• Working Conditions and terms of employment; • Workers' Organizations; • Non-discrimination and equal opportunity; • Retrenchment; and • Grievance Redress Mechanism	
a) Human Resources Policies and Procedures	***Performance Standard 2:*** ***Paragraph 8-9:*** states that the Client will adopt and implement human resource policies and procedures appropriate to its size and workforce. The Client will provide workers with documented information that is clear and understandable, regarding their rights under national labor and employment law and any applicable collective agreements.	***Operational Safeguard 5:*** ***Paragraphs 4-5:*** states that the Client develops and implements a human resources policy and procedures appropriate to the nature and size of the project The Client should also provide all employees with documents that contain information on their employment terms, conditions and rights including national employment law.	
b) Working Conditions and Terms of Employment	***Performance Standard 2:*** ***Paragraphs 10-12:*** states that the Client will provide workers with reasonable working conditions and terms of employment	***Operational Safeguard 5:*** ***Paragraphs 6-8:*** states that the Client provides reasonable working conditions and terms of employment that, at a minimum comply with	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	They (Client) will identify migrant workers and engage them in terms equivalent to non-migrant workers carrying out similar work Where accommodation services are provided either directly or indirectly (through third parties), the Client will prepare and implement policies on the quality and management of the accommodation	national law and this OS Migrant workers should be employed on comparable terms as non-migrant workers Where the Client is providing residential or temporary accommodation to workers, facilities shall provide all basic services i.e. water and sanitation and in certain cases medical care	
c) Workers' Organizations	*Performance Standard 2:* ***Paragraphs 13-14:*** states that the Client should allow workers to form and join workers' organizations, bargain collectively, elect worker representatives even if the law substantially restricts The Client should also not discriminate against workers who participate in these organizations	*Operational Safeguard 5:* ***Paragraphs 9-10:*** states that the Client shall allow workers to form join and participate in worker's organizations. They shall allow workers to freely elect their own representatives and engage in collective bargaining	
d) Non-Discrimination and Equal Opportunity	*Performance Standard 2:* ***Paragraphs 15-17:*** states that the Client will not employ persons on the basis of personal characteristics unrelated to job requirements.	*Operational Safeguard 5:* ***Paragraphs 11-13:*** states that the Client should not make employment decisions on the basis of personal characteristics unrelated to job requirements. i.e. race, gender,	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	They should operate on the principle of equal opportunity and fair treatment which also applies to migrant workers. The Client should also comply with national law on non-discrimination in employment.	nationality, religion, disability, sexual orientation They should operate on the principle of equal opportunity and fair treatment which also applies to migrant workers. They should also take measures to address harassment, intimidation, and/or exploitation	
e) Retrenchment	*Performance Standard 2:* ***Paragraphs 18-19:*** states that the Client will carry out an analysis of alternatives to retrenchment. If no alternatives to retrenchment are identified, a retrenchment plan should be developed and implemented to reduce the adverse impacts on the workers being retrenched. The plan will operate on the principle of non-discrimination and will reflect Client's consultation with workers, their organization, and the government where appropriate Workers should receive notice of dismissal and severance payments in	*Operational Safeguard 5:* ***Paragraph 14:*** states that the Client will carry out an analysis of alternatives to retrenchment. If no alternatives to retrenchment are identified, a retrenchment plan should be developed and implemented to reduce the adverse impacts on the workers being retrenched. The plan will operate on the principle of non-discrimination and will reflect Client's consultation with workers, their organization, and the government where appropriate	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	a timely manner. All outstanding back pay and benefits should be paid on or before dismissal		
f) Grievance Mechanism	*Performance Standard 2:* *Paragraph 20:* states that the Client should provide an easily accessible grievance mechanism for workers to raise workplace concerns and the concerns addressed promptly. The grievance mechanism should allow for anonymous complaints to be raised and addressed and should not impede access to other judicial and administrative remedies available under the law.	*Operational Safeguard 5:* *Paragraph 15:* states that a workforce grievance mechanism should be provided permanently to workers (including workers supplied by third parties) and made known to them at recruitment The grievance mechanism should not impede access to other judicial and administrative remedies available under the law or through existing arbitration procedures	
How the element has been addressed in the ESIA Study	**Working conditions and management of worker relationship is covered by the labor laws in Kenya. Section 2.2.1 of the ESIA Study states that the proposed coal power plant will be developed in compliance with the requirements of the environmental and social safeguards provided under the Constitution of Kenya 2010. Subsequently, the onus is on the EPC contractor to ensure that no worker rights are violated at the project site. Subsequently, the following rights are already covered by the above statement and should be formalized by the EPC contractor: (i) Human Resources Policies and Procedures; (ii) Working Conditions and terms of employment; (iii) Workers' Organizations; (iv) Non-discrimination and equal opportunity; (v) Retrenchment; and (vi) Grievance Mechanism**		
Protecting the Work Force	*Performance Standard 2:* *Requirement 2:*	*Operational Safeguard 5:* *Requirement 2:*	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	This section includes the following topics: • Child Labor; and • Forced Labor	This section includes the following topics: • Child Labor; and • Forced Labor	
a) Child Labor	*Performance Standard 2:* ***Paragraph 2:*** states that the Client should not employ children (persons under the age of 18) in any manner that is economically exploitative. The Client will also follow national laws that have provisions for employment of minors	*Operational Safeguard 5:* ***Paragraph 16:*** states that the Client should not employ children in any manner that is economically exploitative or likely to interfere with the child's well-being (physical, mental, spiritual, moral or social health/development).	
b) Forced labor	*Performance Standard 2:* ***Paragraph 22:*** states that the Client should not employ forced labor which consists of any work or service not voluntarily performed.	*Operational Safeguard 5:* ***Paragraphs 17-18:*** states that the Client should not employ forced labor which consists of any work or service not voluntarily performed. They should also not employ trafficked persons	
How the element has been addressed in the ESIA Study	**The Kenyan Employment Act, 2007 in Clause 52 – 65 is explicit on the protection of children and child labor. The EPC contractor for the Lamu coal power plant shall comply with the requirements of the Employment Act in Kenya with respect to (i) child labor and (ii) forced labor**		
Occupational	*Performance Standard 2:*	*Operational Safeguard 5:*	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Health and Safety	*Requirement 3:* *Paragraphs 23:* states that the Client will provide a safe and healthy work environment, taking into account basic risks and hazards in the client's work areas. These include physical, chemical, biological and radiological hazards and specific threats to women.	*Paragraphs 19-2:* states that the Client will provide a safe and healthy work environment, taking into account basic risks and hazards in the client's work areas. These include physical, chemical, biological and radiological hazards and specific threats to women. Within their ESMS, the Client should include a Health, Safety and Environmental Programme that includes plans or procedures to prevent accidents, injury and disease from work activities.	
How the element has been addressed in the ESIA Study	**Section 2.2.5. of the ESIA Study describes how the Occupational Safety and Health Act 2007 (OSHA) and its subsidiary legislation will apply to the Lamu coal power project. Additionally, occupational safety and health was covered as a potential social impact in this ESIA Study in section 7.8.12**		
Workers Engaged by Third parties	*Performance Standard 2:* *Requirement 4:* *Paragraphs 24-26:* states that the Client will ensure that the third parties who engage these workers are reputable and legitimate enterprises (have an appropriate ESMS). They will establish policies and	*Operational Safeguard 5:* *Paragraph 22:* states that the Client will ensure that the third parties who engage these workers are reputable and legitimate enterprises (have an appropriate ESMS). They will establish policies and procedures for managing and monitoring the performance of third	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	procedures for managing and monitoring the performance of third parties. Ensure that the contracted workers have access to a grievance mechanism	parties.	
How the element has been addressed in the ESIA Study	**Section 8.4 of the Environment and Social Management Plan (ESMP) of this ESIA Study provides a description of the roles and responsibilities of the EPC contractor in developing and implementing their ESMS for the Lamu coal power project. Section 8.5 provides a layout of the ESMP for the project to enable the EPC contractor develop a formal document**		
Supply Chain	*Performance Standard 2:* *Requirement 5:* *Paragraphs 27-29:* states that the Client will monitor its primary supply chain to identify any significant changes in its supply chain and new risks or incidents of child and/or forced labor and take steps to remedy them.	*Operational Safeguard 5:* *Paragraphs 23-24:* states that the Client will monitor its primary supply chain to identify any significant changes in its supply chain and new risks or incidents of child and/or forced labor and take steps to remedy them.	
How the element has been addressed in the ESIA Study	**This is covered in the environmental monitoring aspects of the ESMP in various tables.**		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Resource Efficiency and Pollution Prevention			
Resource Efficiency	*Performance Standard 3:* *Requirement 1:* *Paragraph 6 -*. The client is required to implement technically and financially feasible and cost effective measures for improving efficiency in its consumption of energy, water, as well as other resources and material inputs. Such measures will integrate principles of cleaner production mechanisms.	*Operational Safeguard 4: Paragraph 21 -* states that clients evaluate and, if appropriate, implement financially feasible and cost- effective measures for improving efficiency in the project's consumption of resources such as energy, water, raw materials, and other resources.	
Greenhouse gases	*Performance Standard 3: Paragraphs 5 and 7-8 -* the client will consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related greenhouse gases emissions during the design and operation of the project. For projects that are expected to or currently produce more than 25,000 tons of CO_2 -equivalent annually, the client should quantify direct emissions from the facilities owned or controlled	*Operational Safeguard 4: Paragraph 15 –* states that greenhouse tracking will be done on a project-by-project basis in accordance with the provisions of the UNFCCC.	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	within the physical project boundary as well as indirect emissions associated with the off-site production of energy used by the project.		
Water consumption	***Performance Standard 3: Paragraph 9*** – states that the client should adopt measures that avoid or reduce water usage so that the project's water consumption does not have significant adverse impacts on others if the project is a potentially significant consumer of water.	***Operational Safeguard 4: Paragraph 21*** - states that clients evaluate and, if appropriate, implement financially feasible and cost- effective measures for improving efficiency in the project's consumption of resources such as energy, water, raw materials, and other resources.	
Pollution Prevention	***Performance Standard 3:*** ***Requirement 2:*** ***Paragraphs 10 - 11*** - The client is required to avoid the release of pollutants or, when avoidance is not feasible, minimize and/or control the intensity and mass flow of their release. This applies to the release of pollutants to air, water, and land due to routine, non-routine, and accidental circumstances with the potential for local, regional, and transboundary impacts.	When national legislation and regulations differ from the standards and measures presented in the EHS Guidelines, clients are normally required to achieve whichever is more stringent. However, if less stringent levels or measures are appropriate to specific project circumstances, the client is required to provide full and detailed justification for any proposed alternatives through the environmental and social assessment process. The client avoids or, where avoidance	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
		is not possible, controls and reduces the generation of pollutants at their source. The client is required to prevent the discharge of pollutants into the air, surface water and groundwater, land and soil during planned activities as well as unplanned events or emergencies that may result in local, regional, and transboundary impacts. If total prevention is not feasible, the client takes specific actions to reduce or minimize the effluents or volume of discharges.	
Wastes	*Performance Standard 3: Paragraphs 5 and 12 – 12 -* The client will avoid the generation of hazardous and non-hazardous waste materials. Where waste generation cannot be avoided, the client will reduce the generation of waste, and recover and reuse waste in a manner that is safe for human health and the environment. Where waste cannot be recovered or reused, the client will treat, destroy, or dispose of it in an environmentally	*Operational Safeguard 4: Paragraphs 12-14. – the* client is required to avoid or, where avoidance is not possible, controls and reduces the generation of hazardous and non-hazardous waste at source, in compliance with applicable international conventions. If waste cannot be recovered or reduced, the client adopts treatment measures and environmentally sound disposal practices. If significant production, use or generation of hazardous materials or	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	sound manner.	waste cannot be avoided, the client looks at opportunities to recycle waste and reuse material by preparing a recycling and reutilization plan identifying recyclable material and assessing the potential for reinjection of waste in the process. Where third parties are used for hazardous waste management and disposal, the client should evaluate their legitimacy and legality for conducting hazardous waste management activities and obtains the chain-of-custody documentation for accountability purposes.	
Hazardous Materials Management	***Performance Standard 3: Paragraph 13*** - The client is required to avoid or, when avoidance is not possible, minimize and control the release of hazardous materials. Production, transportation, handling, storage, and use of hazardous materials for project activities should be assessed. The client should consider less hazardous substitutes where hazardous materials are intended to be used in manufacturing processes	***Operational Safeguard 4: Paragraph 16*** - The client is required to determine the potential hazardous materials to be used or generated throughout the lifecycle of the project and considers alternatives that use or generate less hazardous materials at an early stage of the project. *The above requirement has been met under section……of the ESIA Study.*	

Element Description	**[1]IFC Performance Standards requirements**	**[2]AfDB Operational Safeguards requirements**	**[3]Equator Principles requirements**
	or other operations.		
How the element has been addressed in the ESIA Study	**In terms of resource efficiency, Sections 3.5.4 and 3.5.5 discuss the selection of supercritical technology for the boilers and cooling water alternatives respectively for the Lamu coal power plant. The supercritical coal technology proposed for the Lamu coal power plant together with the burning of a higher specification of imported coal, will reduce the greenhouse gas emissions from the power plant. On water consumption, Lamu county is a water scarce area and APCL is investing in a sea-water reverse osmosis (SWRO) desalination plant for its uses as well as providing the community with a water connection just outside the fence line of the project.** **On pollution prevention, section 3.4.1. of this ESIA Study states that APCL will invest in clean coal technologies to significantly reduce the amount of air emissions discharged to the atmosphere.** **On waste management (which includes non-hazardous and hazardous), section 2.2.4.3 of the ESIA Study states that the proposed project shall comply as a minimum with the requirements of the Kenyan waste management regulations.**		
Community Health Safety and Security			
Community Health and Safety	*Performance Standard 4:* *Requirement 1* *Paragraph 5:* states that the Client will evaluate the risks and impacts to the health and safety of the Affected Communities during the project life-cycle and will establish preventive and control measures consistent with good international industry practice (GIIP) i.e. World Bank EHS Guidelines		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Infrastructure and Equipment Design and Safety	*Performance Standard 4:* ***Paragraph 6:*** states that the Client will design, construct, operate and decommission the structural elements or components of the project in accordance with GIIP, taking into consideration safety risks to third parties or Affected communities.		
Hazardous Materials Management and Safety	*Performance Standard 4:* ***Paragraph 7:*** states that where there is a potential for the public (including workers and their families) to be exposed to hazards, particularly those that may be life-threatening, the client will exercise special care to avoid or minimize their exposure by modifying, substituting, or eliminating the condition or material causing the potential hazards.		
Ecosystem Services	*Performance Standard 4:* ***Paragraph 8:*** states that the Client will implement mitigation measures for the project's direct impacts on priority ecosystem services which may result in adverse health and safety risks and impacts to Affected communities. The ecosystem services	*Operational Safeguard 3* ***Paragraph 32-34:*** states that the Client should perform an ecosystem services review to identify risks if it is determined that the project may affect ecosystem services. Strategies developed to	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	in this case are limited to provisioning and regulating services.	avoid/mitigate the impacts should be made in consultation with the protection agencies and local community representatives	
Community Exposure to Disease	*Performance Standard 4:* *Paragraphs 9-10:* states that the Client will avoid or minimize the potential for community exposure to water-borne, water based, water-related, and vector-borne diseases and communicable diseases that could result from project activity. They will also avoid or minimize transmission of communicable diseases that may be associated with the influx of temporary or permanent work force.		
Emergency Preparedness and Response	*Performance Standard 4:* *Paragraph 11:* states that the Client will assist and collaborate with the Affected communities, local government agencies and other relevant parties in their preparations to respond to emergency situations. The Client will document their emergency preparedness and disclose		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	the information to the Affected communities and relevant parties.		
Security Personnel	***Performance Standard 4:*** ***Requirement 2*** ***Paragraph 12-14:*** states that the Client will assess risks that their security arrangements pose to those within and outside project site. They will be guided by the principles of GIIP in relation to hiring, rules of conduct, training, equipping and monitoring of such workers and by applicable law. They will assess and document risks arising from the project's use of government security personnel deployed to provide security services. They will investigate all allegations of unlawful or abusive acts of security personnel, take action to prevent recurrence and report unlawful and abusive acts to public authorities.		
How the element has been addressed in the	**Section 7.8.11 of the ESIA Study discusses the assessment of community health and safety impacts and mitigation measures.** **On Infrastructure and Equipment Design and Safety, the Lamu coal power plant is being designed to the**		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
ESIA Study	**latest engineering design standards for supercritical coal fired power plants. The design of the power plant will incorporate Kenyan, Chinese, Americana and European engineering design standards which can be listed on request.** **On Hazardous Materials Management and Safety and emergency preparedness and response, the EPC contractor and APCL will undertake a community awareness and outreach program** **On security personnel, APCL have already undertaken a security risk assessment which can be availed on request**		
Land Acquisition and Involuntary Resettlement			
General	*Performance Standard 5:* *Requirement 1*	*Operational Safeguard 2*	
Project Design	*Performance Standard 5:* *Paragraph 8*	*Operational Safeguard 2* *Paragraphs 12-14*	
Compensation and Benefits for Displaced Persons	*Performance Standard 5:* *Paragraph 9*	*Operational Safeguard 2* *Paragraphs 31-50*	
Community Engagement	*Performance Standard 5:* *Paragraph 10*	*Operational Safeguard 2* *Paragraphs 15-20*	
Grievance Mechanism	*Performance Standard 5:* *Paragraph 11*	*Operational Safeguard 2* *Paragraphs 24-25*	
Resettlement and Livelihood Restoration	*Performance Standard 5:* *Paragraphs 12-16*	*Operational Safeguard 2* *Paragraphs 21-23,26*	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Planning and Implementation			
Displacement	*Performance Standard 5:* *Requirement 2* *Paragraphs 17-18*		
Physical Displacement	*Performance Standard 5:* *Paragraphs 19-24*	*Operational Safeguard 2* *Paragraph 3*	
Economic Displacement	*Performance Standard 5:* *Paragraphs 25-29*	*Operational Safeguard 2* *Paragraph 3*	
Private Sector Responsibilities Under Government-Managed Resettlement	*Performance Standard 5:* *Paragraphs 30-32*		
How the element has been addressed in the ESIA Study	**Land acquisition and involuntary resettlement for the Lamu coal power plant project is being led by the National Land Commission (NLC) who is the competent authority under the Lands Act 2012 for acquisition and resettlement of project affected persons (PAPs). Together with the NLC, the Ministry of Energy and Petroleum (MoEP) is undertaking a resettlement action plan (RAP) for the Lamu coal power project. APCL will provide technical support to the MoEP and NLC as required to ensure that the involuntary resettlement of PAPs is carried out in accordance with the requirements of AfDB's operational safeguard 2 and the IFC's Performance Standard 5.**		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Biodiversity Conservation and Sustainable Management of Living Natural Resources			
Protection and Conservation of Biodiversity	*Performance Standard 6:* *Requirement 1* *Paragraphs 9-10 -* defines a habitat as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. It also gives a classification of different types of habitats.	*Operational Safeguard 3:* *Requirement 2.* *Paragraph 12* - defines different types of habitats and further outlines the requirements of the client towards their conservation and protection.	
Modified Habitat	*Performance Standard 6: Paragraphs 11-12 -* Modified habitats are areas that may contain a large proportion of plant and/ or animal species of non-native origin, and/ or where human activity has substantially modified an area's primary ecological functions and species composition. The client should minimize impacts on modified biodiversity and implement mitigation measures as appropriate	*Operational Safeguard 3: Paragraphs 12, 14-15.* The client is required to incorporate the best available science and to engage internationally recognized biodiversity experts in conducting the impact assessment and in developing and implementing mitigation and management strategies.	
Natural Habitat	*Performance Standard 6: Paragraphs 13-15 -*The client is required not to significantly convert or	*Operational Safeguard 3: Paragraphs 12-15 and 17-18.* The client is required to incorporate	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	degrade natural habitats, unless there is no other viable alternatives within the region for development of the project on modified habitat; Consultation has established the views of stakeholders, including affected Communities, with respect to the extent of conversion and degradation; and any conversion or degradation is mitigated according to the mitigation hierarchy. Mitigation measures will be designed to achieve no net loss of biodiversity where feasible.	the best available science and to engage internationally recognized biodiversity experts in conducting the impact assessment and in developing and implementing mitigation and management strategies. If the project is to take place in or near a natural habitat the assessment considers the potential risks and impacts that may occur at the landscape or seascape level.	
Critical Habitat	*Performance Standard 6: Paragraphs 16-19.* The client is required not to implement any project activities unless all of the following are demonstrated: • No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical; • The project does not lead to measurable adverse impacts on	*Operational Safeguard 3: Paragraphs 12, 14-15 and 19-20.* The client is required to incorporate the best available science and to engage internationally recognized biodiversity experts in conducting the impact assessment and in developing and implementing mitigation and management strategies.	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values; • The project does not lead to a net reduction in the global and/or national/ regional population of any Critically endangered or endangered species over a reasonable period of time; • A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program. The project's mitigation strategy will be described in a biodiversity action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated. Where biodiversity offsets are proposed as part of the mitigation strategy, the client must demonstrate through an assessment that the project's significant residual impacts		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	on biodiversity will be adequately mitigated.		
Legally Protected and Internationally Recognized Areas	*Performance Standard 6: Paragraph 20* – the client is required to demonstrate that the proposed development in such areas is legally permitted; act in a manner consistent with any government recognized management plans for such areas; Consult protected area sponsors and managers, affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area.	*Operational Safeguard 3: Paragraphs 12, 15 and 22.* If the project is to take place in or near a legally protected or internationally recognized area the assessment considers the potential risks and impacts that may occur at the landscape or seascape level. The client should comply with national and local regulations for appropriate environmental management, and consult with relevant stakeholders during the preparation of management and mitigation measures. The client should ensure that any proposed development is consistent with the area's management plan or, in the absence of a management plan, with the objectives determined by the responsible natural resource, protected area, or wildlife agency. The client also determines whether the area is critical, natural or modified, and then implements the	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
		relevant requirements of OS 3. The client is required not to encourage the de-gazetting or downgrading of protected areas status.	
Invasive Alien Species	*Performance Standard 6: Paragraphs 21-23.* The client will not intentionally introduce any new alien species (not currently established in the country or region of the project) unless this is carried out in accordance with the existing regulatory framework; the client will not deliberately introduce any alien species with a high risk of invasive behavior regardless of whether such introductions are permitted under the existing regulatory framework. Where these species exist, the client should not spread them into areas in which they have not already been established, the client should take measures to eradicate them from natural habitats.	*Operational Safeguard 3: Paragraphs 23-24.* The client is required to take precautions to avoid introducing any potentially invasive alien species (that is, species not currently established in the country or region of the project) unless such an introduction is: • In accordance with any existing applicable regulatory framework undertaken by the relevant international organizations for such introduction; or • The introduction is subject to a risk assessment, which may be part of the environmental assessment, to determine the potential for invasive behavior. The client should assess the possibility of accidental or unintended introduction of invasive alien species,	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
		and identifies measures to minimize the potential for release. Where invasive alien species already exist in the area, the client should not undertake activities that may enhance their competitiveness in comparison with native/ indigenous species or promote their spread. The client may assess the feasibility and cost-effectiveness of eradicating the invasive alien species.	
Management of Ecosystem Services	*Performance Standard 6:* *Requirement 2* *Paragraphs 24-25.*	*Operational Safeguard 3:* *Requirement 9.* *Paragraph 32-34.* The client should perform an ecosystem services review to identify the risks and attempt to avoid adverse impacts on priority ecosystem services. If such impacts are unavoidable, the client should identify ways to reduce these impacts and implement restoration measures to maintain the value and functionality of those priority ecosystem services. These measures are included in the ESMP.	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Sustainable Management of Living Natural Resources	*Performance Standard 6:* *Requirement 3* *Paragraphs 26-29.* The clients who are engaged in production of natural resources are required to manage living natural resources in a sustainable manner, through the application of industry-specific good management practices and available technologies.	*Operational Safeguard 3:* *Requirement 7.* *Paragraph 30.* The client is required to ensure the natural resources are managed and in a sustainable manner, with preference for internationally recognized systems of certification of sustainable management and use.	
How the element has been addressed in the ESIA Study	**Appendix 4 of the ESIA Study for the Lamu coal power plant is the Ecological Impact Assessment (EcIA) undertaken for the Lamu coal power project. It was undertaken by specialists working for the National Museums of Kenya. The EcIA Study discusses Protection and Conservation of Biodiversity, (ii) Modified Habitat (iii) Natural Habitat, (iv) Critical Habitat, (v) Invasive Alien Species, and (vi) Ecosystem Services.** **Appendix 4 addresses the above issues and further provides mitigation measures and an environment management plan for reducing the potential ecological impacts associated with the project**		
Cultural Heritage			
Protection of Cultural Heritage in Project Design and Execution	*Performance Standard 8:* *Requirement 1* *Paragraphs 6-7:* states that the Client will identify and protect cultural heritage by ensuring that internationally recognized practices for the protection, field-based study and documentation of cultural	*Operational Safeguard 1* *Paragraph 41;* states that the Client identifies and qualifies the cultural heritage likely to be affected by the project. Experienced experts assess the project's potential impacts on this	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	heritage are implemented. The risk identification process determines whether there is a chance of impact to cultural heritage. The client will retain competent professionals to assist in the identification and protection of cultural heritage.	cultural heritage.	
Chance Find Procedures	*Performance Standard 8:* *Paragraph 8:* states that the environmental and social risks and impacts identification process should determine whether the proposed location is in areas where cultural heritage is likely to be found either during the construction or operations phase. The Client will develop provisions for managing chance finds (tangible cultural heritage encountered during project construction or operations) through a chance find procedure. They should not disturb any chance find until an assessment by competent professionals is made.	*Operational Safeguard 1* *Paragraph 41* The Client is responsible for ensuring that project sites and designs avoid significant damages to cultural heritage, including both tangible and intangible cultural heritage.	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Consultation	*Performance Standard 8:* ***Paragraph 9:*** states that the Client will consult with the Affected Communities to identify cultural heritage of importance and incorporate their views on decision making process on the cultural heritage. The consultation should also involve the relevant national and local regulatory agencies.	*Operational Safeguard 1* ***Paragraph 41:*** states that If the project is likely to affect the cultural heritage, the Client should consult with the communities that use/have used it and with relevant national regulatory agencies. The views of the communities should be incorporated into the decision-making process. Purpose of the consultation is to assess, present and agree with communities on acceptable financial and nonfinancial compensatory measures.	
Community Access	*Performance Standard 8:* ***Paragraph 10:*** states that in the event that the project site contains cultural heritage or prevents access to previously accessible cultural heritage sites being used/have been used by affected communities, the Client will allow continued access or will provide an alternative access route.		
Removal of Replicable	*Performance Standard 8:* ***Paragraph 11:*** states that where the	*Operational Safeguard 2* ***Paragraph 42:*** states that if project	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Cultural Heritage	client has encountered tangible cultural heritage that is replicable and not critical, the client will apply mitigation measures that favor avoidance. If avoidance is not feasible, a mitigation hierarchy should be implemented. The hierarchy should be as follows: ➢ Minimize adverse impacts and implement restoration measures in situ that ensure maintenance of the value and functionality of the cultural heritage; ➢ Where restoration in situ is not possible, restore the functionality of the cultural heritage in a different location; ➢ Compensate for loss of tangible cultural heritage when minimization of adverse impacts and restoration to ensure maintenance of the value and functionality of that cultural heritage	is likely to have adverse impacts on cultural heritage, the Client identifies appropriate measures for avoiding or mitigating these impacts. These measures may include avoidance, full site protection and selective mitigation, including salvage documentation.	
Removal of Non-Replicable	*Performance Standard 8:*	*Operational Safeguard 2*	

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
Cultural Heritage	*Paragraph 12:* states that the Client will not remove any non-replicable cultural heritage since removal is likely to result in irreparable damage or destruction of the cultural heritage unless all of the following conditions are met: ➢ There are no technically or financially feasible alternatives to removal; ➢ The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and ➢ Any removal of cultural heritage is conducted using the best available technique.	*Paragraph 44:* states that the Client will not remove any non-replicable cultural heritage since removal is likely to result in irreparable damage or destruction of the cultural heritage unless all of the following conditions are met: ➢ There are no technically or financially feasible alternatives to removal; ➢ The overall benefits of the project conclusively outweigh the anticipated cultural heritage loss from removal; and ➢ Any removal of cultural heritage is conducted using the best available technique.	
Critical Cultural Heritage	*Performance Standard 8:* *Paragraphs 13-15;* states that critical cultural heritage consists of one or both of the following types of cultural heritage: ➢ the internationally recognized heritage of communities who use, or have used within living memory the cultural heritage for long-		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	standing cultural purposes; or ➢ legally protected cultural heritage areas, including those proposed by host governments for such designation It also prohibits the Client from removing/altering/damaging critical cultural heritage except when the impacts are unavoidable, then they should use a process of Informed Consultation and Participation (ICP) of the affected communities. This process should be carried out and documented by external experts. If the project is located within a legally protected area, the Client: ➢ should comply with defined cultural heritage regulations; ➢ Consult local communities and other key stakeholders; and ➢ Implement programs to enhance conservation aims of the protected area		
Project's Use of Cultural Heritage	***Performance Standard 8:*** ***Requirement 2***		

Element Description	[1]IFC Performance Standards requirements	[2]AfDB Operational Safeguards requirements	[3]Equator Principles requirements
	Paragraph 16: states that if the project intends to use the cultural heritage, the Client will inform the communities of : ➢ their rights under national law; ➢ scope and nature of the project ➢ potential consequences of such developments The Client should not proceed unless it enters into a process of ICP and documents the process.		
How the element has been addressed in the ESIA Study	**Appendix 11 associated with the ESIA Study of the Lamu coal power plant, discusses the potential cultural heritage impacts arising from the construction and operational phases respectively.** **On project design and execution, two cultural heritage specialists from the National Museums of Kenya were retained for the cultural heritage impact assessment (CHIA) study. Based on their site surveys and consultation with the communities, they identified potential archaeological and cultural heritage impacts arising from the Lamu coal power project. They have proposed mitigation measures which are included in sections 7.9 and 7.10 of this ESIA Study.**		

2.7 Project Environmental and Social Standards

The coal power plant is being developed to have a lifetime of about 25 years. Subsequently, it will be developed in accordance with internationally recognized engineering standards. These engineering standards aim to eliminate to the extent possible, hazards associated with various project components from an HSE perspective. The coal fired power plant will also be designed, constructed and operated in accordance with local and international environmental and social (E&S) standards and guidelines which are enumerated below.

2.7.1 Environmental and Social Management System

In order to comply with Kenyan environmental regulatory requirements and multi-lateral finance institution requirements, APCL will develop and implement a formal Environment and Social Management System (ESMS) for the coal fired power plant. The ESMS for the coal power project will be required to be developed before commencement of the construction phase. The ESMS developed by APCL will be cascaded to the EPC contractor for compliance. The expectation is that the EPC contractor will develop and implement a similar ESMS for the construction phase of the project.

The ESMS will follow the "Plan-Do-Check-Adjust" cycle. The elements of the ESMS at a minimum, would include the items described below.

2.7.1.1 Policy & Planning (Planning phase)

- Management Leadership, Responsibilities & Accountability;
- EMS Risk Assessment & Management;
- Compliance & Other Requirements; and
- ESMS Management Planning & Programs.

2.7.1.2 Implementation & Operations (Do phase)

- Personnel, Training & Contractor Services
- Documentation & Communications;
- Facilities Design & Construction;
- Operations, Maintenance & Management of Change; and
- Community Awareness & Emergency Response.

2.7.1.3 Measurement & Checking (Check phase)

- EHS Performance Monitoring & Measurement;
- Incident Investigation, Reporting & Analysis; and
- EHS Management System Audit.

2.7.1.4 Management Review & Continual Improvement (Adjust phase)

- Management Review & Adjustment
- Implementation of ESMS corrective actions

2.7.2 Environmental and social standards for the project

The E&S standards that the proposed coal fired power plant will be subjected to during throughout the lifetime of the project are:

- Environment Management and Coordination Act, 1999 and its subsidiary legislation;
- Occupational Safety and Health Act, 2007 and its subsidiary legislation;
- The Public Health Act and its subsidiary legislation;
- The AfDB Integrated Safeguards System;
- The World Bank Group General Environmental, Health and Safety (EHS) General Guidelines;
- The World Bank Group EHS Guidelines for Thermal Power Plants; and
- Any other applicable HSE related standards and guidelines.

The IFC guidelines that the project will need to comply with are given in the following tables.

2.7.3 IFC: Environmental, Health and Safety General Guidelines

[4],[5]Table 2-8: WHO Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline value in mg/m^3
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM10	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter	1-year	35 (Interim target-1)

[4] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines

[5] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile

Parameter	Averaging Period	Guideline value in mg/m^3
PM2.5		25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 2-9: Indicative Values for Treated Sanitary Sewage Discharges[a]

Pollutant	Units	Guideline Value
pH	pH	6 – 9
BOD	mg/l	30
COD	mg/l	125
Total nitrogen	mg/l	10
Total phosphorus	mg/l	2
Oil and grease	mg/l	10
Total suspended solids	mg/l	50
Total coliform bacteria	MPN[b] /100 ml	400[a]

Notes:

[a]Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.

[b]MPN = Most Probable Number

[6]Table 2-10: Noise Level Guidelines

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional;	55	45

[6] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
educational		
Industrial; commercial	70	70

Table 2-11: Minimum Limits for Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non-working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (Corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, color inspection, fine sorting etc.)	1,000 – 3,000 lux

2.7.4 IFC: Environmental, Health and Safety General Guidelines for Thermal Power Plants

Table 2-12: Effluent guidelines

Parameter	mg/L, except pH and temp
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium – Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5

Parameter	mg/L, except pH and temp
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.
Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.	

Table 2-13: Emissions Guidelines for Boilers (in mg/Nm^3)

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide SO_2		Nitrogen Oxides (NOx)		Dry Gas, Excess O_2 (%)
Boiler	**NDA**	**DA**	**NDA**	**DA**	**NDA**	**DA**	
Solid Fuels (Plant >50 MW_{th} to <600 MW_{th})	50	30	900 – 1,500[a]	400	510[c] Or up to 1,100 if volatile matter of fuel < 10%	200	6%

General notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; CFB = circulating fluidized bed coal-fired; PC = pulverized coal- fired; Nm3 is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to the entire facility consisting of multiple units that are reasonably considered to be emitted from a common stack. Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one hour average basis and be achieved 95% of annual operating hours.
- a. Targeting the lower guidelines values and recognizing issues related to quality of available fuel, cost effectiveness of controls on smaller units, and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant).
- c. Stoker boilers may require different emissions values which should be evaluated on a case-by-case basis through the EA process.

[7]Table 2-14: Typical Air Emission Monitoring Parameters / Frequency for Thermal Power Plants

<table>
<tr><th rowspan="2">Combustion Technology / Fuel</th><th colspan="3">Emission Monitoring</th><th colspan="4">Emission stack testing</th></tr>
<tr><th>Particulate Matter (PM)</th><th>Sulfur Dioxide (SO_2)</th><th>Nitrogen Oxides (NOx)</th><th>PM</th><th>SO_2</th><th>NOx</th><th>Heavy Metals</th></tr>
<tr><td colspan="8">Boiler</td></tr>
<tr><td>Solid (Plant >50 MW_{th} to <600 MW_{th})</td><td>Continuous or indicative</td><td>Continuous if FGD is used or monitor by S Content.</td><td>Continuous or indicative</td><td colspan="4">Annual</td></tr>
<tr><td colspan="8">Note:
Continuous or indicative means "Continuously monitor emissions or continuously monitor indicative parameters". Stack emission testing is to have direct measurement of emission levels to counter check the emission monitoring system.</td></tr>
</table>

[7] Note: Detailed monitoring programs should be determined based on EA

Table 2-15: ICNIRP exposure limits for occupational exposure to electric and magnetic fields

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	10,000	500
60 Hz	8300	415
Source: ICNIRP (1998) : "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)		

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3 Need for the project

This sub-section discusses the purpose and need for the proposed 1,050MW coal fired power plant to power Kenya's economic growth. In principle, Kenya needs an additional 5000+MW of power generation capacity by September 2018. According to the Draft National Energy and Petroleum Policy dated January 20, 2015, the above 5000+MW is envisaged to be developed from a variety of energy sources including geothermal (1,646MW), wind (630MW) and coal (1,920MW) through Independent Power Producers (IPPs) under the Public Private Partnership (PPP) framework.

Sub-section 3.2 discusses the current energy mix in the country and the projected demand up to the year 2033 using the Least Cost Power Development Plan (LCPDP) blueprint while section 3.3 discusses how the proposed 1,050MW coal fired power plant fits into the 5000+MW program.

3.1. Project Background

In 2013, the Government of Kenya invited Expressions of Interest (EoI) for the design, construction and operation of a 960MW ±10% coal fired power plant to be located in Manda Bay, Lamu County. 26 companies submitted their EoI and after evaluations, the Government invited 10 bidders to submit their bids on a Build Own and Operate (BOO) basis. The project envisaged the following key components:

- A coal power plant in the range of 816 – 1056MW capacity;
- Coal Handling Facilities including Jetty and associated infrastructure;
- 400 kV switchyard at site;
- Evacuation by 400 kV transmission line to be built by KETRACO; and
- Power Purchase by KPLC under 25-year Power Purchase Agreement (PPA).

Of the 10 bidders, 3 consortia submitted their bids to the Ministry of Energy and Petroleum on April 23rd, 2014. The consortium led by Gulf Energy Limited was awarded the contract in September 1st, 2014, however one of the losing bidders through the PPP Petitions Committee tried to have the award nullified. Gulf Energy Limited and Centum Investments Limited formed a project development company called Amu Power Company Limited (APCL). After a lengthy process, the PPP Petitions Committee upheld the decision to award APCL the coal fired power plant project on January 13th, 2015.

3.2. Energy mix and demand forecast

In the fiscal year ended December 31, 2014, 69.1% of Kenya's electrical power was generated through renewable energy sources while 30.9% was generated by fossil fuel sources as indicated in Table 3-1. The table also shows that as at December 31, 2014, 68% of the installed capacity was from renewable energy sources while 32% was from fossil fuel sources.

[1]Table 3-1: Electric power generation sources and energy generated

Source of electric power		Installed capacity (December 2014)		Annual generation (FY 2013/2014)	
		(MW)	(%)	(GWh)	(%)
RENEWABLE ENERGY	Hydro	821	37.8	3,945	44.6
	Geothermal	593.5	27.3	2,008	22.7
	Wind	25	1.2	18	0.2
	Cogeneration	38	1.7	57	0.6
	Imports	-	-	85	1.0
	Total	**1477.5**	**68.0**	**6,112**	69.1
FOSSIL FUELS	MSD	579.5	26.7	2,533	28.6
	Gas Turbines	60	2.8	41	0.5
	HSD (Isolated stations)	25.8	1.2	61	0.7
	Emergency Power Plant	30	1.4	94	1.1
	Total	**695.3**	**32.0**	**2729**	30.9
Installed capacity and units generated		**2,173MW**		**8,840GWh**	

Kenya's Sessional Paper No. 4 of 2004 lays the policy framework upon which cost-effective affordable and adequate quality energy services will be made available to the domestic economy on a sustainable basis over the period 2004 – 2023. This policy recognizes that Kenya needs to develop its energy infrastructure as an enabler of the economy for present and future generations.

The energy and petroleum sector plays a critical role in the socio-economic development of a country. Indeed, petroleum and electricity as sources of energy are the primary enablers of the economy. According to the March 2013 Least Cost Power Development Plan (LCPDP) covering the period 2013 – 2033, the energy demand forecast and the peak load forecast in Kenya is expected to increase significantly and is shown in the Table 3-2.

Table 3-2: Energy demand forecast

Year	Low scenario			Reference scenario			High scenario		
	GWh	MW	Load factor (%)	GWh	MW	Load factor (%)	GWh	MW	Load factor (%)
2012	8,010	1,370	66.76	8,010	1,370	66.76	8,010	1,370	66.76
2030	45,723	8,641	60.41	81,352	14,446	64.28	114,502	19,940	65.55
2033	59,135	11,318	59.65	118,680	21,075	64.28	179,850	31,237	65.73

As at December 2014, the installed electric power generation capacity in the country was 2,173MW. The reference scenario (table 3-2) indicates that by 2030, the electricity

[1] Source: Energy Regulatory Commission

demand could be 14,446MW implying that over 12,000MW of installed capacity is required between 2015 and 2030 or an average of over 800MW per year or 1,050MW annually by 2033.

The reference scenario indicates that the country's energy demand is expected to rise from 1,370MW in 2013 to 14,446MW in 2030 and 21,075MW in 2033.

In order to meet the above demand, Kenya will need to generate electric power from a variety of renewable and fossil fuel sources. While it would be beneficial to have an energy mix made up purely of renewable energy sources, the reality is that such resources take time to develop, subsequent to which, the power generation plants need to be constructed and operated. Additionally, renewable energy sources such as wind and solar provide peaking load instead of base load due to their intermittent availability.

3.3. 5000+MW Project

Demand for electricity in Kenya has been increasing since 2004 due to accelerated growth. The peak demand increased from 899MW in 2004/2005 to 1,470MW in 2013/2014 to 1,512 by December 2014. This increased trend of electricity consumption saw the electricity consumer base increase from just over 700,000 consumers in 2004/2005 to over 2,700,000 consumers by June 2014. Kenya Power aims at connecting 70% of the Kenyan population to grid electricity by 2017.

According to the Draft National Energy and Petroleum Policy 2015, peak demand is projected to grow from 1512MW as at December, 2014 to 3,400MW by 2016 and to 5,359MW by 2018. To meet this demand, an additional 5,000 MW of new generation is to be developed by 2017 to bring total installed capacity to at least 6,600MW. Annual energy consumption is projected to increase from 8,841GWh in 2013/14 to 32,862GWh in 2016/17.

It is projected that by 2030, peak demand will be 18,000MW against an installed capacity of 24,000MW

With the introduction of devolution and County Governments in 2013, it is anticipated that electricity demand will increase significantly due to the increased economic opportunities. According to the Ministry of Energy and Petroleum, some reasonably foreseeable energy intensive economic projects are listed below and their approximate energy demand:

1. Standard Gauge Railway – ~1200MW;
2. Steel smelting and rolling mills – ~2,000MW;
3. Konza City Technopolis – ~650MW; and
4. LAPSSET projects in Lamu – ~350MW.

The total energy demand of the above projects is about 4,200MW. In order to be prepared to cost effectively supply energy to projects such as those mentioned above, the Government of Kenya developed a roadmap in October 2013 to generate an additional 5000+MW of power generation capacity in 40 months.

In order to meet the exponential demand of electricity, the proposed 1,050MW coal power plant in Lamu will be a crucial part of Kenya's energy mix to provide affordable electricity to its commercial and residential customers. The project is the first large scale project to be approved under the PPP framework under the National Treasury.

Coal is an abundant, affordable, competitive, reliable and easily accessible source of energy especially for energy generation. At a tariff rate of US$ cents 7.53/kWh, the proposed Lamu coal power plant is expected to be the cheapest source of electricity in Kenya. By comparison, the tariff for geothermal is approximately US$ cents 9/kWh and for wind and solar, it is US$ cents 12/kWh.

The proposed project is one of several power plants under the 5000+MW program that the Ministry of Energy and Petroleum must develop in order to meet the growing energy needs. Given in Table 3-3 are the anticipated power generation projects by type over the 40 month period beginning October 2013.

Table 3-3: New generation capacity additions in MW from October 2013

Technology	New capacity additions (MW) No. of months from start of the 5000+MW program							
	6	12	18	24	30	36	40	Total
Hydro	24	0	0	0	0	0	0	24
Thermal	87	163	0	0	0	0	0	250
Geothermal	90	176	190	50	205	150	785	1,646
Wind	0	0	20	60	300	250	0	630
Coal	0	0	0	0	960	0	960	1,920
LNG	0	0	0	700	350	0	0	1,050
Co-generation	0	0	18	0	0	0	0	18
Total	**201**	**339**	**228**	**810**	**1,815**	**400**	**1,745**	**5,538**

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4 Description of the project

4.1 Introduction

This chapter provides a description of the proposed 1,050MW coal fired power plant to be built and operated in the Kwasasi area of Hindi division, Lamu County, Kenya. It discusses (i) types of technologies available for coal fired power generation, and (ii) a description of the type of technology that will be used for the proposed power plant.

The Proposed Development will generate up to 1,050MW gross electrical output. The Proposed Development will be capable of producing circa 981.5MW net electricity through the use of coal from various sources. The difference between the net and gross outputs consists of parasitic load and emergency standby generators. The coal will be procured based on a Government to Government negotiated price and will be a pass through cost to the consumer.

It is envisaged that the Proposed Development will have a design life of 30 years and an operating life of up to 50 years and so decommissioning would be currently anticipated to commence in approximately 2070.

4.2 Approval of project by County Executive and Assembly of Lamu

The proposed coal fired power plant is situated in an area where the land tenure is defined as Community Land. The County Governments Act, 2012 states that any project of national significance shall before being approved, be subjected to mandatory public hearings. Subsequent to this, the County Assembly shall considered and approved or rejected.

For the proposed coal fired powered plant, extensive public/stakeholder consultation meetings were held throughout the ESIA phase to discuss the project and its impacts. Subsequently, APCL presented a Concept Paper to the County Assembly of Lamu on June 23, 2015 for consideration.

On July 8, 2015, the County Assembly considered the proposed coal fired power plant and in accordance with the powers vested to it under the Kenya Constitution 2010 and the County Governments Act, 2012, approved the following:

- Construction of the 1,050MW coal fired power plant;
- Lease of an 880 acre parcel of land in the Kwasasi area; and
- Concession of 2000 acres for limestone mining in Witu.

The County Assembly further requested the National Land Commission to commence the land allocation process and submit the land allocation and compensation scheme to them for consideration and approval.

On July 14, 2015, the County Government of Lamu approved the development and operation of the 1,050MW coal fired power plant and the concession area in Witu for limestone mining.

Copies of the approval letters from the County Assembly and County Executive of Lamu are provided in Appendix 14 of this ESIA Study.

4.3 Overview of the project

The proposed Lamu coal power plant will have a nominal plant gross output of 1,050MW and will utilize three (3) coal fired thermal generating units, each producing a minimum net electrical output of 350MW. The plant will be capable of firing on a variety of coals as indicated in table 3-5. Light Diesel Oil will be used for start-up purposes.

The heavy components for the coal fired power plant will be delivered to the site by sea tanker and will be unloaded at either a new purpose-built jetty or an existing jetty or a temporary construction phase landing site. Light Diesel Oil will be delivered to the site by road tanker from Mombasa. Suitable fuel storage and fuel transfer/unloading provisions will be provided as part of the balance of plant.

The electrical output from the units will be exported to the grid system via a new 400kV substation to be built by KETRACO. This will be constructed and should be completed in advance of the required back-energization date for the coal power plant.

The condenser is based on a once through cooling system, utilizing seawater as a cooling medium. The seawater will be extracted from the Manda Bay via a dedicated seawater intake canal system, which will be constructed as part of the construction works. Cooling water from the condenser outlets will be returned to the Manda Bay via a dedicated submerged pipe and outfall system.

The flue gases from the boilers will pass through electrostatic precipitators to remove particulate matter and be treated in a wet flue gas desulphurization (FGD) plant, utilizing a seawater scrubbing technique. The process will utilize seawater which has already passed through the condenser as part of the plant cooling system supplemented by seawater taken directly from the intake. The FGD process will be designed to remove a significant percentage of the Sulphur dioxide contained within the flue gases, in order to comply with current IFC (International Finance Corporation) Environment, Health and Safety (EHS) Guidelines for thermal power plants.

The IFC requirements for NOx emissions will be fully met by supply of low NOx combustors for the boilers. A provision has been made for SCR equipment utilizing a urea/ammonia based system to achieve the required emissions levels.

Water used by the site shall be provided through a dedicated desalination and water treatment plant. This plant will produce potable (drinking) water, demineralized water (for make up to the boiler) and service water for general use on site. The desalination plant will be of the sea water reverse osmosis (SWRO) type.

Coal will transported to Manda Bay via ocean going vessels to one of the three new berths currently under construction in the Kililana area. From the berth, coal will be crushed and transported via a land based conveyor to the coal stockyard within the power plant.

Limestone for the wet flue gas desulfurization system will be transported via sea from Kiongwe near Mpeketoni in Lamu County to the power plant.

An outline of the process will be as follows:

- Coal will be delivered to a berth in Manda Bay via large ocean going vessels; from here, the coal will be transported on a land based conveyor system to the power plant site.
- The coal will be unloaded from the conveyor system and stored in the coal stockyard; a stacker reclaimer will be used to stack the coal within the stockyard;
- There will 3 x 350 MW supercritical boilers which will generate and supply steam to generators for production of electricity;

- The fuel will be moved from the coal stockyard to each of the three boilers where it will be combusted, generating gases and bottom ash residues;
- Bottom ash will settle at the bottom of the boiler and will be disposed in the ash yard;
- The steam generated through each boiler will be passed through a steam turbine to generate electricity for use within the power station and for export to the national grid;
- Flue gases will be cleaned in the Electrostatic Precipitator (ESP) and Flue Gas Desulfurization (FGD) system to control emissions of particulates and sulfur oxides; and
- The cleaned exhaust gases will be released to atmosphere via a stack circa 210 m high.

The facility will operate 24 hours per day, seven days per week with programmed offline periods for maintenance.

4.4 Characteristics of the Power plant

The main characteristics of the proposed power plant are as follows:

- The power plant shall have a nominal plant gross output of 1,050MW and shall utilize three (3) coal fired thermal generating units, each producing a minimum net electrical output of 350MW. The plant shall be capable of firing on a variety of coals as indicated in Table 3-5. Light Diesel Oil will be used for start-up purposes.
- The heavy components for the coal fired power plant will be delivered to the site by sea tanker and will be unloaded at either a new purpose-built jetty or existing jetty or a temporary construction phase landing site. Light Diesel Oil will be delivered to the site by road tanker from Mombasa. Suitable fuel storage and fuel transfer/unloading provisions will be provided as part of the balance of plant.
- The electrical output from the units will be exported to the grid system via a new 400kV substation to be built by KETRACO. This will be constructed and should be completed in advance of the required back-energization date for the coal power plant.
- The condenser is based on a once through cooling system, utilizing seawater as a cooling medium. The seawater will be extracted from the Manda Bay via a dedicated seawater intake canal system, which will be constructed as part of the construction works. Cooling water from the condenser outlets will be returned to the Manda Bay via a dedicated submerged pipe and outfall system.
- The flue gases from the boilers will pass through electrostatic precipitators to remove particulate matter and be treated in a wet flue gas desulphurization (FGD) plant, utilizing a seawater scrubbing technique. The process will utilize seawater which has already passed through the condenser as part of the plant cooling system supplemented by seawater taken directly from the intake. The FGD process will be designed to remove a significant percentage of the Sulphur dioxide contained within the flue gases, in order to comply with current IFC (International Finance Corporation) Environment, Health and Safety (EHS) Guidelines for thermal power plants.
- The IFC requirements for NOx emissions will be fully met by supply of low NOx combustors for the boilers. A provision has been made for SCR equipment utilizing a urea/ammonia based system to achieve the required emissions levels.
- Water used by the site shall be provided by a dedicated desalination and water treatment plant. This plant will produce potable (drinking) water, demineralized water (for make up to the boiler) and service water for general use on site. The desalination plant will be of the sea water reverse osmosis (SWRO) type.

4.5 Power plant design parameters

The design of the Proposed Development has followed an iterative process based on preliminary environmental assessments, engagement with contractors and equipment providers and past experience of the EPC Contractor on similar types of power plants successfully built and operated. In particular, the design for the Proposed Development has been shaped by lessons learned from the evolution and construction of similar types of power stations in different parts of the world.

Given below are various parameters and specifications to which the coal power plant is being designed.

Given below in table 4-1 are site particulars for the proposed coal fired power plant.

Table 4-1 Site particulars

Item	Description	Units	Particulars
1	**SITE AMBIENT DATA**		
1.1	Site location		Kwasasi, Hindi division, about 20km north of Lamu town
1.2	Site elevation above sea level		6 – 12m (average)
	Design ambient conditions (site rating)		
1.3	Design ambient pressure	Bar (a)	1.013
1.4	Design ambient temperature (dry bulb)	^0C	30.4
1.5	Design relative humidity	%	70
	Ambient temperature (dry bulb)		
1.6	Highest maximum (recorded)	^0C	36.6
1.7	Maximum yearly average	^0C	31.4
1.8	Maximum daily average	^0C	36.6
1.9	Design maximum temperature	^0C	40
1.10	Lowest minimum (recorded)	^0C	21.7
	Relative humidity		
1.11	Minimum	%	52
1.12	Yearly average	%	70
	Precipitation		
1.13	Mean annual rainfall	mm	1050
1.14	Max 24 hour rainfall	mm	656
	Wind speed		
1.15	Prevailing wind direction		S
1.16	Average wind speed	m/s	3.4
1.17	Max 10 year wind speed	m/s	15.4

Item	Description	Units	Particulars
1.18	Maximum recorded wind speed	m/s	15.4
	Seismic		
1.19	Seismic zone classification		Not seismically active
2	**WATER SUPPLY DATA**		
2.1	Raw water source		Manda Bay
2.2	Raw water type/designation		Sea water
2.3	Seawater conditions relative to MSL		Survey Time：From 2015/4/28 17:20 to 2015/5/27 11:40
	a) Minimum temperature	^{0}C	27.2
	b) Maximum temperature	^{0}C	30.3
	c) Design temperature	^{0}C	27
	d) Design high water	m	3.55
	e) Mean high water	m	2.44
	f) Mean low water	m	0.2
	g) Design low water	m	-0.39
3	**SEAWATER ANALYSIS**		
3.1	Total plate count (at 37^{0}C)	cfu/ml	Not detected
3.2	pH		7.87
3.3	Appearance in water		Unobjectionable
3.4	Odor		Odorless
3.5	Total dissolved solids	mg/l	37,570
3.6	Sulfate (as SO_4)	mg/l	1055.75
3.7	Chloride (as Cl)	mg/l	22,592.99
3.8	Nitrate (as NO_3)	mg/l	1.5
3.9	Total hardness	mg/l	1341.17
3.10	BOD_5 (at 20^{0}C)	mg/l	41.21
3.11	Total suspended solids	mg/l	2
3.12	COD	mg/l	87
3.13	Dissolved oxygen	mg/l	5.80
3.14	Oil and grease	%wt	Nil
3.15	Nitrite (as NO_2)	mg/l	Nil
3.16	Methyl orange alkalinity	mg/l $CaCO_3$	120.0

Item	Description	Units	Particulars
3.17	Phenolpthalin alkalinity	mg/l $CaCO_3$	20.0
3.18	Ammonia (as NH_3)	mg/l	11.87
3.19	Ammonia (as N)	mg/l	9.76
3.20	Conductivity at 25^{0}C	μS/cm	57800
3.21	Fluoride (as F)	mg/l	3.36
3.22	Specific gravity (Pyknometer)		1.0265
3.23	Free carbon dioxide	mg/l	Nil
3.24	Aluminum (as Al)	mg/l	<0.04
3.25	Iron (as Fe)	mg/l	<0.007
3.26	Manganese (as Mn)	mg/l	<0.002
3.27	Potassium (as K)	mg/l	503.44
3.28	Sodium (as Na)	mg/l	15,684.50
3.29	Barium (as Ba)	mg/l	<0.002
3.30	Total Phosphorus (as P)	mg/l	Nil
3.31	Strontium (as Sr)	mg/l	<0.0005
3.32	Silica (as Si)	mg/l	34.63
3.33	Magnesium (as Mg)	mg/l	181.79
3.34	Calcium (as Ca)	mg/l	237.31
3.35	Bicarbonate (as $CaCO_3$)	mg/l	90.0
3.36	Carbonate (as CO_3)	mg/l	40.0
4	**ELECTRICAL SYSTEM PARAMETERS**		
4.1	Transmission system	kV	400
4.2	Nominal voltage	kV	240
4.3	Nominal frequency	Hz	50-60
4.4	Frequency variation	Hz	10

4.5.1 Fuel specifications

4.5.1.1 Coal specification

A coal study was undertaken by APCL for the proposed coal power plant. In order to carry out the coal study, specifications of coal as provided in the Request for Proposal by the Government of Kenya were provided to the Consultant. Subsequently, given in Table 4-2 are the specifications to which the coal power plant in Lamu will be designed.

Table 4-2: Coal specifications

Parameter	Imported coal		Kenyan coal
	Eskom	New Vaal	
Calorific value (MJ/kg) LHV	21	16	18
Mass fraction of ash in coal as received – A_{ar} (%)	30	40	30
Mass fraction of volatile in coal as received – V_{ar} (%)	23	16	30
Total organic carbon (%)	44	36	55
Mass fraction of water in coal as received – M_{ar} (%)	4	6	11
Mass fraction of Sulfur in coal as received – S_{ar} (%)	1	0.5	2.4
Relative density			1.28

4.5.1.2 Light diesel oil specification

The light diesel oil specifications proposed for the black start generator and auxiliary boiler is given in Table 4-3.

Table 4-3: Light Diesel Oil specifications

Property	Units	Limits	
		Minimum	Maximum
Cetane number		51.0	
Cetane index		48.0	
Density at 15^{0}C	kg/m^3	820	870
Density at 20^{0}C	kg/m^3	817	867
ASTM color		-	3.5
Polycyclic aromatic hydrocarbons	% (v/v)	-	11
Sulfur content	mg/kg		50
Flash point	^{0}C	66	
Carbon residue (on 10% distillation residue)	%(m/m)		0.15
Ash content	%(m/m)		0.01
Water content	mg/kg		200
Copper strip corrosion (3 hour at 50^{0}C) rating		Class 1	
Oxidation stability	g/m^3		25
Lubricity, corrected wear scar diameter (wsd 1.4) at 60^{0}C	μm		450
Viscosity at 40^{0}C	mm^2/s	2.0	5.3
Cloud point	^{0}C	To be reported	

Property	Units	Limits	
		Minimum	Maximum
Cold filter plugging point (CFPP)	^0C	-	12
Sediment	%(m/m)	-	0.01
Neutralization value: Strong acid No. (KOH) Total acid No. (KOH)	 mg/g mg/g	Nil	 Nil 0.5
Distillation • **Initial boiling point** • **Recovered at 250^{0}C** • **Recovered at 350^{0}C** • **95% recovered at ^{0}C** • **Final boiling point**	 ^0C %(v/v) %(v/v) %(v/v) ^0C	To be reported - 85 - -	To be reported 65 - 360 400

4.6 Details of the Proposed Power Plant

The proposed power plant will comprise a coal fired power station and associated buildings, structures and plant, including:

- 3×350MW high-pressure supercritical units with condensing steam turbines operating at base load capacity;
- Coal receiving system including a coal berth, coal handling equipment and a conveyor system approximately 15km long;
- Coal stock yard which will have 38 days' storage, including 20 days of Security Stock;
- Ash yard having a storage capacity of 15 years';
- Limestone receiving system and gypsum handling system;
- Once-through sea water cooling system;
- Flue gas air quality conditioning equipment including a chimney. This includes a flue gas desulphurization system and electrostatic precipitators;
- Sea water desalination facilities to meet the demand for the power plant's process water, service/fire water as well as water for domestic use;
- Sub-station and switchyard facilities up to the 400 kV overhead line gantries for power evacuation into the KETRACO 400 kV system.
- Distributed control system (DCS) which will be used for monitoring and control of plant operation;
- Buildings, roads, and other structures for the Project;
- Auxiliary boiler and black-start diesel generator (DG); and
- A permanent workers' colony for the operational phase of the project having a capacity to accommodate 250 – 300 persons.

Key features of the balance of plant will include:

- A vehicular access road, pedestrian footpaths and routes;
- Security gatehouses and barriers;
- A Heavy Goods Vehicle holding area;
- Staff and visitor car parking;
- An outage contractor compound;
- An effluent treatment plant;
- Telecoms and utilities apparatus and connections;
- A foul sewer drainage and treatment system;
- External lighting;
- Fencing, boundary treatment and other means of enclosure;
- Signage;
- CCTV and other security measures; and
- Hard and soft landscaping and biodiversity enhancement measures.

A site plan showing the location and components of the coal power plant is given in Figure 4-1.

Figure 4-1: Site plan showing the proposed coal power plant site

4.6.1 Coal supply and delivery to project jetty

4.6.1.1 Coal supply

The proposed 1,050MW coal power plant is designed to utilize a variety of coal specifications as provided in the Request for Proposal document issued in 2013/2014. The RFP provided specifications for one type of Kenyan coal and two types of South African coal.

The coal consumption will depend on the calorific value of the coal to be used in the power plant. Based on the design coal calorific value of 21MJ/kg – 27MJ/kg (net as received basis), the power plant will consume between 2.4Mt and 3.1Mt. On average it is envisaged that the power plant will burn about 2.8Mt of coal per annum.

Based on a coal supply and transportation study done by others, there are six possible locations from which the coal can be sourced namely Australia, Colombia, Indonesia, Mozambique, Russia and South Africa. Based on an analysis conducted under the above study, it is recommended that the power plant should source its long term supply from the geographically closest and least cost source countries of Mozambique and South Africa. It is also possible to source coal from Indonesia and Australia.

Based on the above, coal deliveries are expected to occur from large mining companies in South Africa and Mozambique. Two alternative types of vessels could potentially be used for delivery of the coal namely a Supramax type vessel having a cargo capacity of 53,000 tons and a self-unloading rate of 12,000 tons per day or a Capesize vessel having a cargo capacity of 169,000 tons and an unloading rate of 20,000 tons per day.

Coal can be delivered in Supramax or Capesize vessels from either Richards Bay, South Africa or Nacala, Mozambique. Coal will likely be delivered in geared Supramax vessels that will arrive on average once every six to seven days. The one way voyage time for such vessels from Richards Bay to Manda Bay is approximately 14.6 days while from Nacala to Manda bay, the voyage time is 10.4 days.

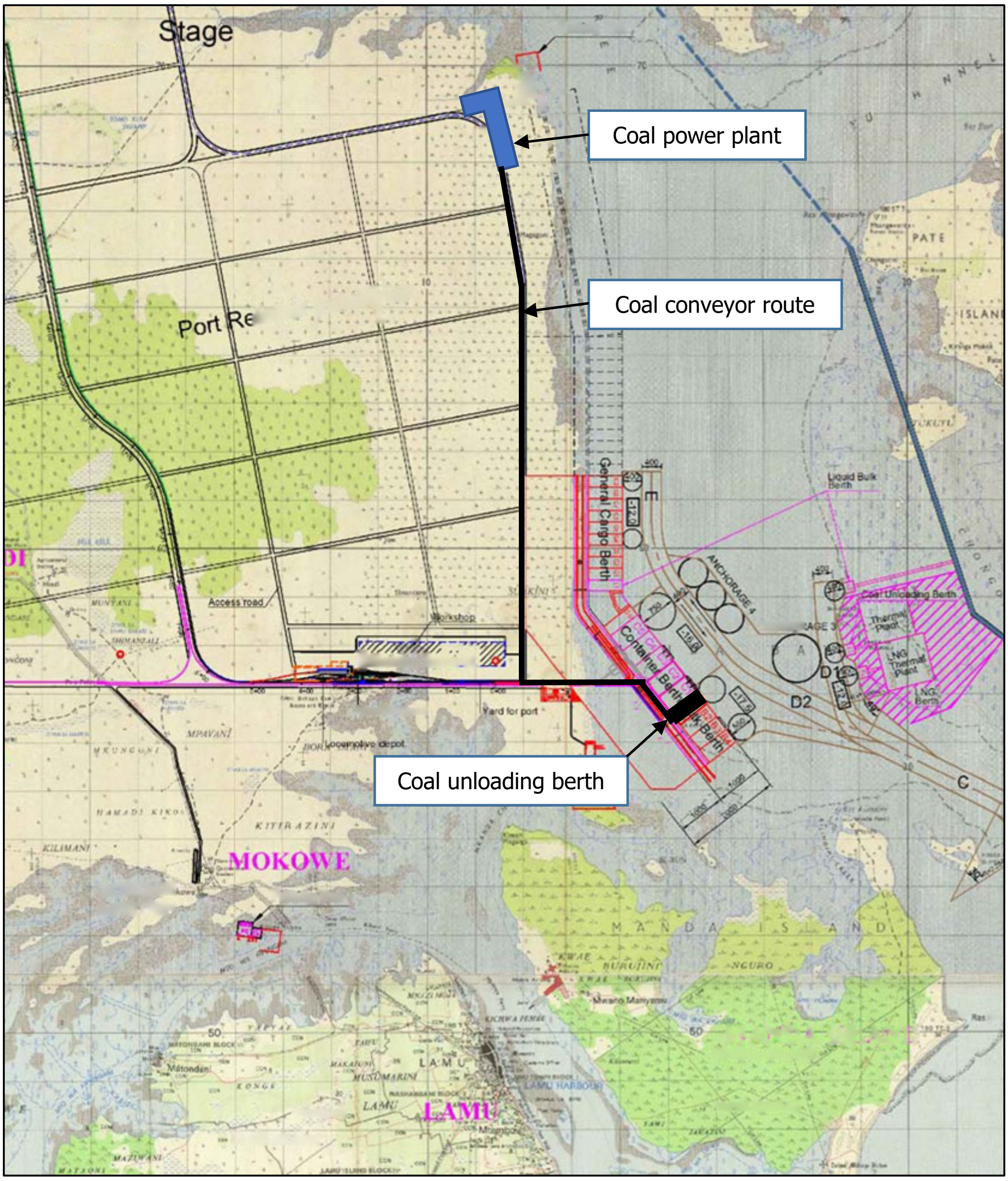
The design of the power plant also includes a provision for receiving coal using rail cars. This will allow the power plant to utilize the coal discovered in various parts of the country when commercially viable to mine. The design of the rail system will be done in future.

4.6.1.2 Coal delivery to project site

Initially, the design of the project included a purpose built coal jetty for receiving coal in bulk. However, this changed in January 2016 when the Ministry of Energy and Petroleum (MOEP) directed that coal for the power plant be imported using one of the three berths currently under construction by the Central Government in the Kililana area. An approximate location of the coal unloading berth and coal conveyor routing is shown in Figure 4-2. The design of the coal conveyor system is currently in the design phase and was unavailable at the time of undertaking this ESIA Study and consequently, no environmental and social impacts have been identified or assessed.

In general, coal will be unloaded from the coal carrier by the ship's unloading gear to a hopper and transferred to a conveyor system. Through a series of transfer towers, the coal will be transhipped to the coal stockyard within the proposed power plant. The project is designed with the option of receiving coal via rail if and when the Kenyan coal becomes available.

Figure 4-2: Coal receipt and approximate conveyor routing



4.6.2 Coal storage yard

The proposed power plant is expected to use about 10,000 metric tons of coal per day when the power plant is at full operation. Subsequently, there will be two coal storage yards divided into four stockpiles and having a capacity of 420,000tons. This will provide supply of 30 days for the 3 boilers operating at 100% boiler Maximum Continuous Rating (MCR) load (based on Kenya coal). The storage capacity includes a 20 day security stock to meet the RFP requirements and ten days active or operational reserve.

2 bucket wheel stacker and reclaimer will be equipped in each coal yard. Each has a stacking capacity of 1500t/h and reclaiming capacity of 1000t/h. 3 bulldozers and 2 front loaders will be supplied to facilitate coal movement in areas out of the arm reach of the stacker/ reclaimers. Two ground reception bunkers will also be supplied to allow for emergency unit loading in the event of stacker/ reclaimer outages. A single reversible belt conveyor in each coal storage yard will be supplied. The belt will have a width of 1400mm, and an operating speed of 2.5m/sec for a capacity of 1500t/h. Figure 4-3 shows a preliminary layout of the coal stock yard.

Figure 4-3: Coal stockyard indicative layout

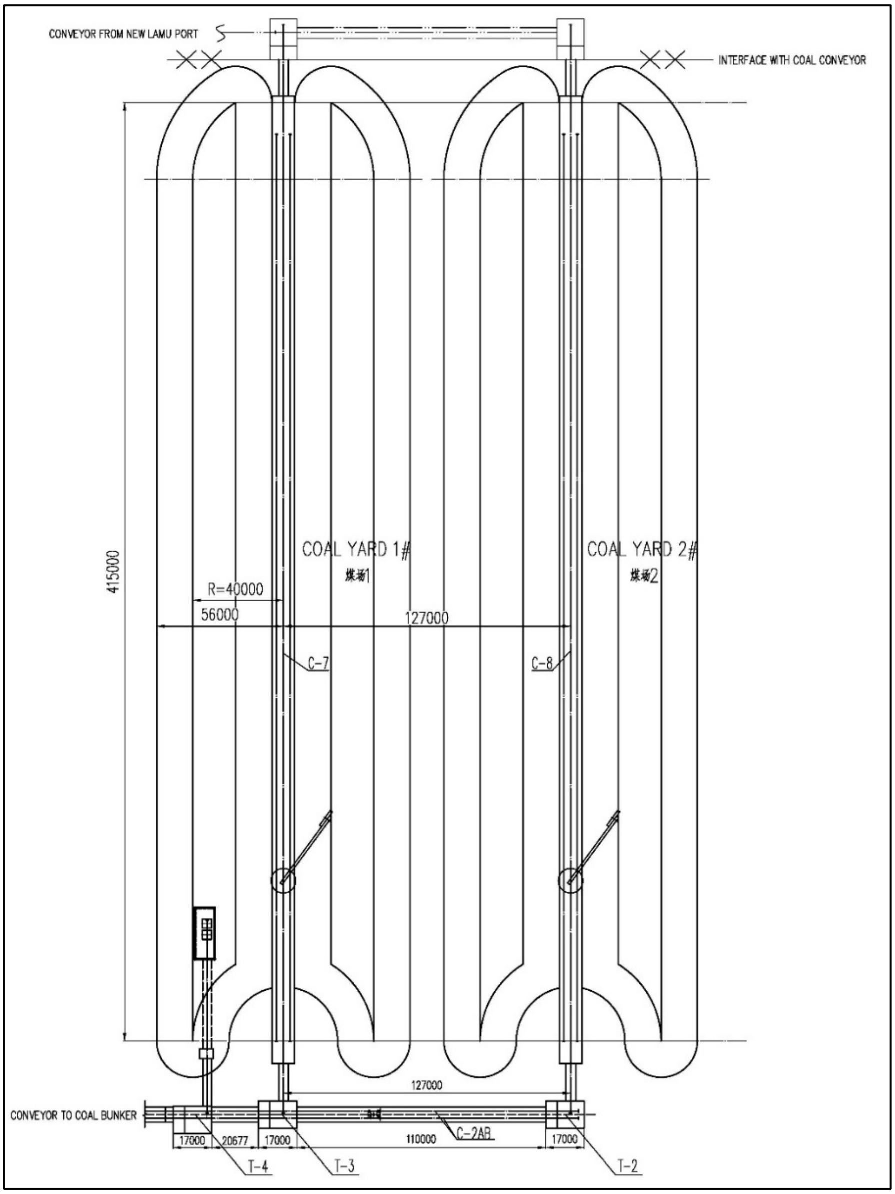


Figure 4-4 shows an image of a typical coal stock yard with bucket stackers/reclaimers; Figure 4-5 shows a cross-section of the coal stock yard for the proposed coal power plant in Lamu while Figure 4-6 shows preliminary details of the coal stockyard foundation.

Figure 4-4: Image of typical coal stockpiles and bucket stackers/reclaimers

Figure 4-5Cross-section of coal yard

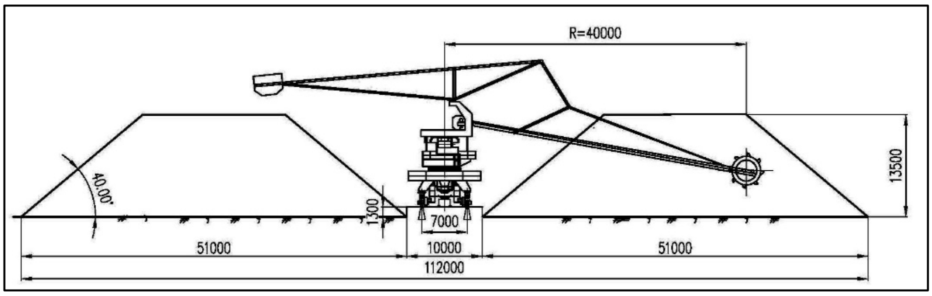
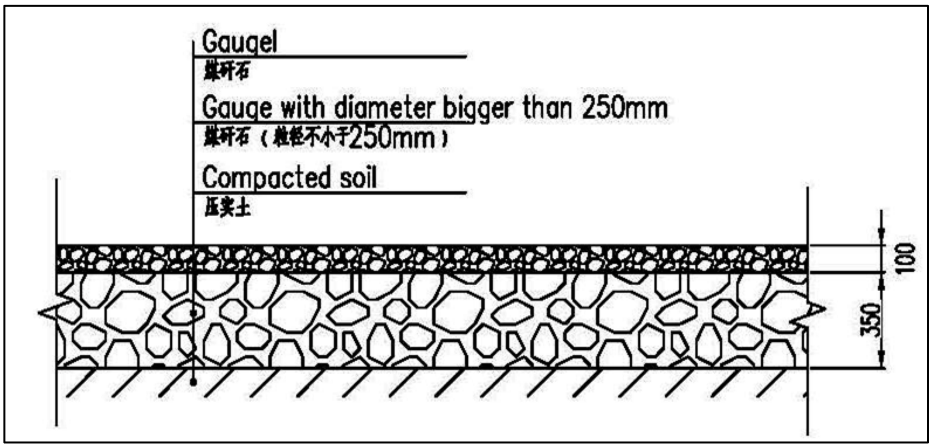


Figure 4-6: Coal stockyard preliminary foundation details



In order to facilitate movement of coal in areas that the stacker/reclaimer is unable to reach, the project will employ bulldozers and front wheel loaders (see Figure 4-7). Additionally, the project will use a compactor and water spray system for long term storage of coal. Two ground reception bunkers will be provided to allow for emergency unit loading in the event of stacker/reclaimer outages.

Figure 4-7: Front end wheel loader in operation within a coal stock yard

A trough design conveyor system or a closed pipe will be used to convey the coal from berth to the stock yard and another similar system to convey the coal from the stock yard to the boiler unit bunkers. The speed of the conveyor system will be controlled to avoid spillage of coal and/or prevent belt lift-off.

The sections of the conveyor system that are exposed to natural weather will be provided with smooth galvanized continuous covers and wind guards for the return belt. Drip pans will be provided wherever the conveyor crosses roads or goes over buildings.

For unintended events or consequences, the conveyor system will be provided with a pull type emergency stop switch on either side.

A coal processing system will be provided for the power plant. This system will contain screens and hammer crushers to mill the coal to the required size; the imported coal is expected to have a nominal of ≤300mm and shall be crushed to the required size of ≤30 mm.

Magnetic separators will be used to remove any metals prior to coal processing, for example, suspension magnets which can extract iron and iron-bearing components from bulk materials. Magnetic separators remove iron tramp, and protect conveyors, grinders, mills and other processing equipment against wear and damage.

To control dust to the air from the coal storage area, a permanent water sprinkler system shall be provided. The coal storage area will need a coal setting basin that can be cleaned with a loader and sump pumps in a separate bay for handling overflow and runoff.

The entire coal handling system, including the coal conveyors, shall be completely encapsulated by dust proof enclosures. At areas where dust formation is expected, e.g. at transfer points, dust shall be collected by suction systems with filters. Collected dust shall be returned to the main coal flow.

4.6.3 Power plant

The principal components of the power plant are as follows:

Coal preparation equipment: Prior to consumption in the power plant, coal would pass through preparation equipment such as crushers and pulverisers'. These processes would take place in closed areas to minimize the release of dust.

Pulverized coal-fired boiler(s): Three supercritical pulverized coal-fired boilers will be constructed at the project site to produce steam for the steam turbine generator(s). The boilers would be designed to maximize efficiency and minimize air pollution during the combustion process. For an initial period of say 5 – 10 years, the boilers will be fuelled by imported coal and use low sulphur diesel as fuel for start-up and flame stabilization;

Steam turbine generator(s): Each pulverized coal-fired boiler would have a dedicated steam turbine generator. The steam turbine generators would use steam produced by the boilers to drive electric generators. Each steam turbine generator is expected to have a nominal generating capacity of 350MW. The maximum net generating capacity of the three combined steam turbine generators is expected to be approximately 1,050MW. The steam used in the steam turbine generators would exhaust from the steam turbine generator into a condenser.

Condenser(s): A condenser would attach to each steam turbine to receive exhaust steam. Inside the condenser, the exhaust steam would condense to its liquid state for reuse in the boiler.

Plant electric switchyard: An electric switchyard will be located on the power plant site to step up the voltage of electricity produced to 400 kilovolts (kV). The switchyard may include circuit breakers, disconnect switches, generator step-up transformers, auxiliary power transformers, steel structures and a control building. KETRACO will build a 520km long double circuit transmission line from the power plant to the Kenya Power Nairobi Control Center (NCC) from where electrical power will be distributed to the country and beyond.

Water treatment: The power plant would include water treatment facilities for raw water, feed water to the plant, condensate and once through cooling water in order to maintain water quality for the process equipment. The water treatment facilities would include a desalination plant, water treatment building, water storage tanks, chemical storage tanks, clarifiers and demineralizers.

Additional facilities: the power plant area may also include various buildings to house equipment and conduct administration, operations and maintenance activities; warehouses; electrical switchgear buildings; various pumps, motors and fans; fuel and chemical storage tanks/areas; lime/limestone, ammonia and mercury sorbent storage and handling equipment; fire protection, security and safety systems; stormwater facilities; continuous emissions monitoring systems; and back-up electric generators.

4.6.4 Air pollution control equipment

The emissions control equipment for each pulverized coal-fired boiler would consist of low nitrogen oxide burners, wet flue gas desulfurization and electro-static precipitators. Exhaust gases from the boilers would flow through the emissions control equipment before being discharged to the atmosphere through the stack(s). The emissions control equipment is efficient in reducing nitrogen oxide, sulphur dioxide, particulate matter and hazardous air pollutants such as mercury. The systems would be designed to meet or exceed the World Bank Group's 2008 air emission guidelines stipulated within their document titled "EHS Guidelines for Thermal Power Plants".

Pulverized coal-fired boiler stack(s): The power plant will include a pulverized coal-fired boiler stack connected to each boiler; the three stacks will be contained within a reinforced concrete chimney whose height will be approximately 210m tall. Each of the pulverized coal-fired boiler stacks will be connected to a state-of-the-art Continuous Emissions Monitoring System (CEMS) for recording the exit concentration of pollutants of concern.

4.6.5 Ash yard

An ash yard will be built to receive the coal combustion residuals such as bottom ash, fly ash and gypsum emanating from the power plant combustion processes. The ash yard is located towards the north of the power plant as shown in Figure 4-1. The annual ash and gypsum reject load of one unit will be about 592,900m^3. The ash yard dimensions are approximately 900m x 1270m which is adequate for storing ash and gypsum for a period of 15 years. The elevation of the ash pile will reach an elevation of about 25.8m with a volume of 26,740,000 m^3 for the three boiler units.

According to the preliminary design, the ash yard will be designed to prevent sub-surface soil and groundwater contamination by leachates. The design of the ash yard permeability will comply the Chinese standard GB 18599-2001 titled "Standards for pollution control on the storage and disposal site for general industrial solid wastes". This standard states that if the permeability coefficient of the natural base layer is greater than 1.0×10^{-7}cm/s, there should be natural or artificial material to build an impermeable layer whose thickness should produce an anti-seepage capacity which is equal to that of a clay layer having a permeability coefficient of 1.0×10^{-7}cm/s and be at least 1.5m thick.

For the proposed coal fired power plant, the impermeable layers of the ash yard foundation will be composed of three layers namely, (a) a compacted clay layer made by compacting soil or undisturbed soil after mechanized compaction layer by layer; (b) a geomembrane liner whose permeability coefficient is less than 1.0×10^{-7}cm/s; and (c) a protection layer which is made out of a sand bed having a thickness of 200mm. A typical image of the foundation is given in Figure 4-8.

Figure 4-8: Image showing typical barrier lining system for ash yard

In addition to the above, the project will install at least ten groundwater monitoring wells around the external perimeter of the ash yard. These wells will be used for monitoring the quality of groundwater during the operational phase of the project. The monitoring wells will be made of galvanized steel pipes having slits in the pipes. The borehole casing will be surrounded with clastic stones for filtering.

The ash yard will be surrounded by a 7.0m wide ring road with drains and an ash water treatment pool. The ash yard will be equipped with facilities for sprinklers to spray water periodically depending on the condition of the piled ash to avoid dust emissions. The permanent slope of the ash yard will be maintained taking into consideration stability requirement. Suitable measures will be undertaken in the detailed engineering design to avoid erosion of ash pile during monsoon and collapse of portion of ash pile.

4.6.6 Ash handling system

A pressurized dense phase pneumatic conveyance system is planned to remove ash collected. The ash collected in the ESP hoppers will be emptied into the transport system through a system of segregating valves. The collected ash will be conveyed to 3x12m diameter storage silos.

Bottom ash will be conveyed to bottom ash silo through dry slag conveyor. Pyrites in the mills will be conveyed by an electric vehicle after emptying the mills via a pneumatically operated dump gate to the vehicle bin.

4.6.6.1 Fly ash handling system

A fly ash conveying system will be installed on each unit with the capability to handle 150% of the expected daily maximum ash collection for the design coal and 120% at the maximum design ash collection temperature. Ash temperature from the ESP will be considered to be at not more than 120^0C. The effective storage capacity will be designed to be not less than $1400m^3$. A wet mixer and dry ash unloader will be provided at the silo unloading chute for dustless transport to the pile.

4.6.6.2 Bottom ash handling system

A dry mechanical bottom ash disposal system will be installed on each boiler. The capacity of each system will be sized for not less than 250% of maximum expected bottom ash collection. The system will include a dry slag conveyor, slag crusher and bucket elevator. The bottom ash dropping from the shaft will be conveyed to ash silo through the dry slag conveyor, slag crusher and bucket elevator. The ash silo bottom half facilitates unloading ash for removal.

4.6.6.3 Compressed air system

Separate air systems are provided for the ash handling system and one for instrumentation and house service air will be provided. All of the compressors will be located in one building along with air drying and filtering, and receiver vessels.

4.6.6.4 Mill rejects system

The design of the mill rejects or pyrites collection system considered saving investments, simplifying system, power saving, and maintenance fee deduction, and the small quantity of mill rejects. The mill rejects system for this project is designed to be removed with an electric vehicle. The mill rejects shall be exhausted continuously from coal mill to mill rejects hopper. The inlet valve of mill rejects hopper shall be closed when it is full. Then the outlet gate of mill rejects hopper shall be opened so that the mill rejects can be exhausted to mobile mill rejects hopper. The mobile mill rejects hopper shall be transferred into the tippler out of boiler house by fork-lift truck. The last procedure shall be the transfer to ash disposal area by the auto-dumper and relevant processing.

4.6.7 Solid waste disposal

An on-site solid waste disposal facility will be constructed and operated for the disposal of coal combustion by-products including fly ash, bottom ash, economizer ash, scrubber by-products and coal rejects. Additionally, the solid waste disposal facility will treat inert, non-hazardous industrial wastes generated onsite including construction and maintenance debris.

Some types of waste (for example, office wastes, oil, liquids, etc.) would be hauled to an offsite disposal facility licensed by NEMA. Wastes generated during construction activities would be recycled to the extent practical.

The solid waste disposal facility would be designed in accordance with applicable international standards. The facility would include environmental protection measures to prevent the release of contaminants to the environment, including surface and ground water. Such measures would include a bottom liner and leachate collection and control system, a surface water runoff management system with a sediment retention basin, and a ground water quality monitoring program. The monitoring program will consist of wells located up-gradient of the solid waste disposal facility to obtain samples representative of background water quality, and other wells located down-gradient of the disposal facility to ensure the detection of potential contaminants. Samples will be collected quarterly at the wells during project operation and into the post-closure period and analyzed for a list of targeted elements of environmental concern associated with South African or Kenyan coal.

4.6.8 Water supply system

The power plant would require water for construction, process, cooling, potable, and fire protection purposes. Under normal operating conditions, the water use rates would typically be as stated in Table 4-8.

Table 4-4: Approximate water demand from various project sources

Type of water system	Approximate quantity generated
Maximum circulating water	42,168 m^3/hour
Make-up water flow	1,100 m^3/hour
Oily wastewater system	96 m^3/day
Coal wastewater system	192 m^3/day
Sanitary sewage system	96 m^3/day
Desulfurization wastewater system	480 m^3/day

4.6.9 Workers' housing

During the construction phase, it is anticipated that there will be 2000 – 3000 workers at the project site. Temporary worker accommodation will be provided for a significant number of these workers.

The power plant site would include an onsite construction worker housing area with the facilities necessary to support up to 1,000 workers during construction. The remaining 1000 – 2000 workers of the peak construction work force would reside in offsite housing.

The onsite construction worker housing facilities would be located within the power plant site. Onsite community facilities would include housing, kitchen/dining facilities, water and fire protection facilities, sanitary facilities, medical facilities, security and administrative facilities, recreational facilities, and parking. Recreational facilities may include indoor facilities such as TV rooms, game rooms, and gym area and outdoor facilities such as basketball courts and ball fields. Medical facilities would be limited to first response and will include an ambulance station onsite.

Modular, dormitory style community housing facilities would be used as the living quarters to accommodate 1000 or more workers onsite. Each dormitory would be prefabricated and erected on a concrete slab. Each dormitory would include private or communal wash/toilet areas.

The primary infrastructure to support the construction worker housing would be potable water systems, sanitary wastewater treatment, and electric power and communication lines. Potable water would be provided using the water supply system for the power plant. Sanitary wastewater would be collected and treated with an onsite package wastewater treatment plant.

Electric power would be established through the use of diesel generators, as required.

Parking areas would be provided throughout the construction area and surfaced with crushed aggregate or gravels. Refuse materials would be collected regularly and transported to an offsite, licensed landfill by a NEMA registered road contractor.

Upon completion of power plant construction, modular housing and buildings would be removed from the power plant site. Selected facilities used to support the onsite housing may be converted to permanent use to support the permanent operations and maintenance of the power plant. Depending on the size of the power plant initially built, future expansion of the plant would require the re-establishment of the construction worker housing on the power plant site.

During the operational phase, it is envisaged that there will be up to 500 workers who will be based within the power plant. An area of about 7 Ha within the project site has been set aside for housing the operational phase workers.

4.6.9.1 Ash handling and storage system

One of the coal combustion products (CCPs) is fly ash and bottom ash. Fly ash will be generated from the Electrostatic Precipitators (ESPs) connected to each boiler, while bottom ash will be generated as a result of the coal burning process. CCPs can be used for road paving, manufacture of concrete blocks, manufacture of cement, etc.

For the removal of bottom ash, a mechanical dry type ash conveying system shall be installed. The function of the bottom ash handling system is to collect, store, and transport bottom ash from boiler furnace to bottom ash storage silo (see Figure 4-9 for a bottom ash silo). The system will include a dry bottom ash hopper, dry slag conveyor, slag crusher and bucket elevator. The bottom ash (slag) falls by gravity into the bottom hopper of the combustion chamber and shall be conveyed to the bottom ash silo through the dry slag conveyor, slag crusher and bucket elevator. The ash system will be able to be isolated from the furnace to allow for repairs with the unit on line.

For the removal of fly ash from the Electrostatic Precipitators (ESPs), a pneumatic pressure conveying system shall be provided. Fly ash will be conveyed by means of dense phase pneumatic pressure conveying system from ESP hoppers and economizer hoppers to the fly ash silo. An image of a fly ash silo is shown in Figure 4-10.

Bottom ash and fly ash shall be transported and dumped to the ash yard through trucks. The truck ash unloading area shall be equipped with dust control measures such as fencing and water misting stations. Ash in storage on the ground shall be treated or covered to prevent emissions of dust from the pile.

Figure 4-9: Bottom ash silo with truck loading facility

Figure 4-10: Fly ash silos under construction

The ash yard shall be designed to store bottom ash, fly ash, gypsum and mill reject. Trucks will convey bottom ash and fly ash from the power plant to the ash yard. Gypsum which will be generated through the wet flue gas desulfurization (FGD) process, will similarly be conveyed to the ash yard. The ash yard is located towards the north of the power plant and will be designed for storing ash and gypsum for a period of 15 years' plant operation.

4.7 Supporting facilities

4.7.1 Site access

From Mokowe jetty, the site can be accessed through the C112 road to Bobo Primary School and from here, there is a narrow access track about 15km long which leads to the project site as shown in Figure 4-11; the distance between Mokowe to the project site is approximately 28km. another alternative is to use an access track that runs northwards along the Kenya Navy base boundary to the project site.

The environmental and social impacts of the access road will be considered when a route selection has been determined and a Variation to the EIA License will be applied.

Figure 4-11: Access routes to the project site from Mokowe jetty

4.7.2 Diesel oil supply and storage system

For the black start generators and auxiliary boiler there will be a light diesel oil (LDO) storage and piping system. The LDO area will have up to three (3) above ground storage tanks each having a capacity of 500m^3, a fuel off-loading area, etc.

The fuel oil system shall be designed to unload, store, and transfer LDO for boiler (unit) startup, and to supply the emergency diesel generator, black start diesel generator and diesel-driven fire pump.

Adequate grounding pads shall be provided on each tank for connection to the ground grid.

4.7.3 Water intake and plant feed

The proposed coal fired power plant will require water for a variety of purposes such as:

- Boiler makeup including losses from sampling, etc.;
- Make up to auxiliary cooling and air conditioning systems;
- Service water for various purpose;
- Firefighting reserve water; and
- Potable water for plant, staff colony and social services.

In order to meet clean water requirements for the power plant, a sea water reverse osmosis (SWRO) system will be installed which will abstract water from Manda Bay. As part of the Proponent's corporate social responsibility, the SWRO system will contain a potable water outlet at the fence of the project for the Kwasasi community's needs; it will be the responsibility of the County Government to tap the water from the outlet provided by the Proponent and distribute water to the residents living in the Kwasasi area.

The raw seawater will be treated by dosing flocculation and clarification in a raw water pre-treatment station and then delivered to the desalination plant. The coagulant dosing system and coagulant aid dosing system will each be provided with a dissolving tank, solution tank, dosing pumps and related control system; additionally, a mechanical clarifier will be provided.

After pre-treatment such as coagulation, clarification and sedimentation, the raw sea water will be sent to the desalination and demineralization plant, with the following flow path: self-cleaning filter, ultrafiltration (UF) and first stage SWRO. The output water will be stored in tanks, and be transferred to the process water systems via dedicated pumps; flow into potable water basins and firefighting water basins will be through gravity.

The Total Dissolved Solids (TDS) of the produced water will meet the requirements of service water and potable water (KEBS and WHO water quality standards). The treated water of the first stage reverse osmosis will be forwarded to various facilities, i.e., coal handling plant, HVAC system, cooling water for CW pump, etc.

Potable water from the SWRO will flow into a potable water basin by gravity. From the potable water basin, the distribution of water will be through separate pumps for the power plant and staff colony. Fire water from the first stage RO will flow into fire water storage basins by gravity.

To meet the water quality requirement of the steam-water cycle, a second reverse osmosis pass will be made. From the first stage, the SWRO will permeate into the water tank through the feed pump.

The output water from second stage RO will be stored in tanks, and be transferred to the demineralization system. The water will then be processed through a cation exchanger, anion exchanger and mixed bed exchanger to produce boiler quality water. The demineralized water plant shall be designed with redundancy for each unit such that when one set of equipment is in maintenance, the other will be adequate to meet the requirements of system operation. A neutralization system including tank, pumps, pH instrumentation and controls will be included.

To prevent bio-fouling of the once-through cooling system, plant feed water system to SWRO and potable water system, sodium hypochlorite solution will be dosed. The sodium hypochlorite will be generated by electrolyzing the concentrated sea water from SWRO system. If necessary, salt addition system will be provided.

Under normal operating conditions, the water balance for the power plant indicates that there will be a net zero discharge into the environment. The reused water system will supply water to following:

- Wash and dust suppression water to Coal Handling Plant
- Water for FGD
- Wash and spray water for Ash Handling plant

4.7.4 Compressed air system

The coal fired power plant will be equipped with compressed air for the ash handling, instrument air and service air systems respectively. The service air system shall supply compressed air for general cleaning, maintenance, atomization etc. services to following locations:

- Compressed air at various locations throughout the power house building, boiler area and mill area.
- Supply compressed air to the coal tripper room.
- Provide a compressed air supply to all remote areas including (but not limited to) the ESP, FGD, water treatment, ash handling, waste disposal, circulating water Intake area and coal handling areas.
- The service air system shall also provide to the requirements of atomizing air, if required for LDO burners of the boiler.

Additionally, the instrument air system shall supply clean and dry oil-free air for the operation of various pneumatically controlled valves, transmitters, controllers, positioners, dust collectors and HVAC equipment in the main building and to all remote areas of the plant.

4.7.5 Firefighting and detection system

The proposed coal fire power plant including the workers colony will have an elaborate fire protection system. The fire protection system will include a water firefighting system, portable fire extinguishers, chemical fire extinguishing system, foam fire extinguishing system and fire alarm and detection system. The fixed firewater protection system will include an indoor and outdoor fire hydrant system and water spray system.

The source of fire water will be fresh water from the seawater desalination system. An appropriately sized firefighting water storage tank will be provided as the special use for storing firefighting water. There will be two fire pumps, an electric duty pump and a diesel standby one; the fire hydrant system will maintain a residual pressure through two electric jockey pumps (1 service and 1 spare) and one pressure tank.

A fire station with an adequate number of fire trucks will be provided for the power plant and colony protection.

4.7.6 Station lifting and hoisting equipment

Lifting and hoisting equipment will be provided in areas where equipment heavier than 500kg is installed. A rigging steel beam will be provided in areas where any equipment/component weighing from 45 kg to 500 kg is installed and needs to be handled during maintenance.

4.7.7 Wastewater treatment plant

A wastewater treatment plant will be installed at the power plant and will take wastewater produced from the turbine building, surface drainage (except rainfall drainage) and domestic and sewage waste water from the whole site for treatment. The design of the wastewater system will take cognizance of the effluent discharge limits promulgated under Kenya's Environment Management and Coordination (Water Quality) Regulations, 2006 as well as the World Bank's EHS Guidelines for effluent quality from thermal power plants. An annual Effluent Discharge License (EDL) will be applied for by the Employer.

The wastewater treatment system shall be designed to collect and treat the various process effluent produced within the plant during normal, start up and shut down condition.

Wastewater collected from the various area of the plant will be pre-treated separately and transferred to the waste water treatment plant. Wastewater from the storage tank shall be directed to an inclined plate sedimentation tank (or clarifier) via a pipe mixer and flocculation tanks through wastewater transfer pumps. Treated water from the inclined plate sedimentation tank (or clarifier) shall be transferred to the final neutralization pond by gravity and reused inside the plant.

4.7.8 Heating, ventilation and air conditioning (HVAC) system

A heating, ventilation and air conditioning (HVAC) system will be installed at the power plant and specifically at the powerhouse, auxiliary buildings, non-plant buildings within the plant's boundary and dust extraction system.

The indoor heating, ventilation and air-conditioning of other plant buildings, workshop and structure will have design parameters that comply with the relevant technical requirement, process requirements, Technical Code for Heating, Ventilation and Air Conditioning Design of Fossil Fuel Power Plant and Technical Specification for Design of thermal Power Plants.

4.7.9 Hydrogen generation system

A hydrogen supply system will be designed to produce hydrogen gas at a pressure, purity and dryness suitable for use in the turbine generator cooling systems. For the hydrogen cooling system, a salt water hydrogen generation system will be designed as the supply source of hydrogen.

4.7.10 Nitrogen and carbon dioxide cylinders

The power plant will require the use of nitrogen and carbon dioxide for various activities. Nitrogen will be used for equipment blanketing for corrosion protection while carbon dioxide will be used for fire protection and for purging the generator hydrogen cooling system.

The power plant would include up to three generating units, which will be constructed sequentially. This section describes the activities that will be undertaken for constructing the proposed 981.5MW coal fired power plant.

4.8 Hazard prevention and emergency planning

4.8.1 Health and Safety

APCL aims to protect human health by safely and responsibly managing site activities. APCL has developed a framework Health, Safety and Environment (HSE) management system which the EPC contractor will be required to align with.

During the construction phase, the EPC Contractor and its sub-contractors shall comply with the requirements of Kenya's Occupational Safety and Health Act, 2007 (OSHA) and all its applicable subsidiary legislation. The EPC contractor will be required to develop and implement a comprehensive written Safety and Health (S&H) management plan for preventing accidents and injuries arising out of work related activities. The S&H management plan should be developed based on the requirements of OHSAS 18001 or the proposed ISO 45000 standard for S&H management systems. The S&H plan will be developed to include all activities undertaken on-site within the power plant as well as off-site. The EPC contractor will employ suitably qualified S&H professionals to manage this crucial function and the will be headed by a S&H Manager.

During the operational phase of the project, the Operations and Maintenance (O&M) Company will develop and implement a formal Environmental and Social Management System (ESMS). The ESMS will be aligned with the requirements of the OSHA, International Finance Corporation (IFC) E&S Performance Standards and recognized international best practices for the safe management of a coal power plant.

4.8.2 Emergency response planning

The proposed power plant will be required to have in place an Emergency Response Plan (ERP) for credible emergency scenarios during the construction and operational phases respectively. The ERP shall be specific to the project site and developed based on realistic potential emergency scenarios. In general, the ERP will be comprehensive and contain the following aspects:

- Identification of the emergency scenarios (based on an emergency response risk assessment);
- Specific emergency response procedures (based on the outcome of the identification of specific emergency scenarios);

- Trained emergency response teams (providing initial and refresher training of the entire emergency response team based on a training needs analysis);
- Emergency contacts and communication systems/protocols (including communication with Affected Communities and media when necessary);
- Procedures for interaction with government authorities including mutual aid and response agreements (first responders, public health, Safety and Health, environmental authorities);
- Permanently stationed emergency equipment and facilities (e.g., first aid stations, firefighting equipment, spill response equipment, personal protection equipment for the emergency response teams);
- Protocols for the use of the emergency equipment and facilities;
- Clear identification of evacuation routes and muster points;
- Emergency drills and their periodicity based on assigned emergency levels or tiers (drills undertaken for various emergency scenarios on a regular basis, say bi-monthly);
- Decontamination procedures and means to proceed with urgent remedial measures to contain, limit and reduce pollution within the physical boundaries of the project property and assets to the extent possible.

The EPC Contractor will develop and implement a construction phase ERP based on a formal emergency response risk assessment; during the operational phase, the O&M Company will develop and implement an ERP also based on a formal emergency response risk assessment.

As there will be activities undertaken off-site and associated with the proposed power plant, it is imperative that the ERP contain the management of off-site emergencies. The respective communities should be involved in emergency response management as part of APCL's community awareness and outreach program.

The contents of the ERP for each phase of the project will contain the following elements as a minimum:

- Administration (policy, purpose, distribution, definitions, etc.);
- Organization of emergency areas (command centers, medical stations, etc.);
- Roles and responsibilities;
- Communication systems;
- Emergency response procedures;
- Emergency resources;
- Training and updating;
- Checklists (role and action list and equipment checklist); and
- Business Continuity and Contingency.

4.9 Construction program and methods

APCL has appointed The Power Construction Corporation of China (POWERCHINA) as the EPC contractor for the proposed Lamu coal power plant; POWERCHINA may appoint subcontractors to undertake the associated civil works. APCL is committed to ensure the safe working environment for all employees and contractors. A Construction Method Statement (CMS) will be prepared by the EPC contractor. This CMS will set out the key measures to be employed during the main works phase to control health and safety and minimise the impacts on the local environment.

The entire site preparation and construction programme is anticipated to take approximately 42 months from commencement to commissioning. Figure 4-12 shows an indicative construction programme.

The specific activities associated with the construction of the project will be determined following detailed engineering design. A general description of the possible activities that may be required as part of the construction of the land based facilities is provided below. It should be noted that construction activities may be conducted sequentially, in parallel or in phases, as appropriate. The specific sequence and activities will be determined by the EPC contractor during and following detailed engineering design.

4.9.1 Preliminary works

The preliminary works for the construction of the proposed power plant and other land based facilities are generally expected to include the following activities:

- Construction of access roads to the site;
- Installation of required utilities for construction;
- Construction of a water desalination plant for construction related activities;
- Construction of a sanitary and process waste collection disposal system;
- Construction of a wastewater handling system to control run-off from the site;
- Site clearing, grubbing and grading;
- Construction of temporary construction facilities and site office;
- Surfacing of construction laydown areas;
- Construction of roads within the site;
- Construction of all foundations and sub-structures, including shoring and superstructures for all buildings and process units;
- Construction of storm drainage system;
- Construction of seawater circulating water intake and discharge structures; and
- Construction of cable and pipe trenches and ducts.

Erosion control and dust suppression measures will be implemented to reduce the potential environmental effects of activities on the creek in the north of the project site and Manda Bay. All plant, equipment, buildings and services would be supplied, erected, operated and maintained in accordance with Chinese, Kenyan and US standards.

4.9.2 Surveying and clearing

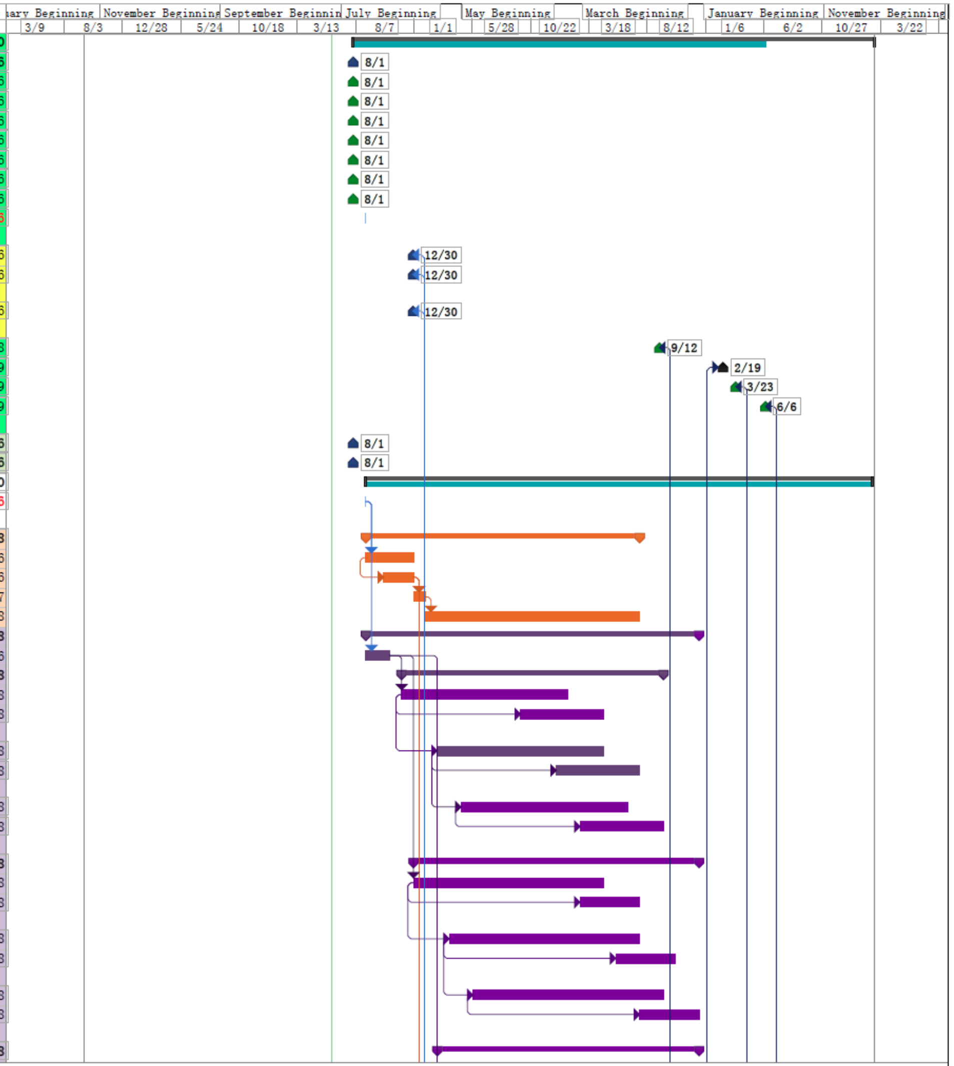
The project site including the construction laydown area will be surveyed to accurately determine actual contours in order to optimize cut and fill operations consistent with layout requirements of the power plant parts.

Clearing would be required to establish the land based aspects of the project. Merchantable wood would be sold to local contractors. All cleared merchantable timber will be sold and any remaining cleared vegetation will be stored on site for disposal.

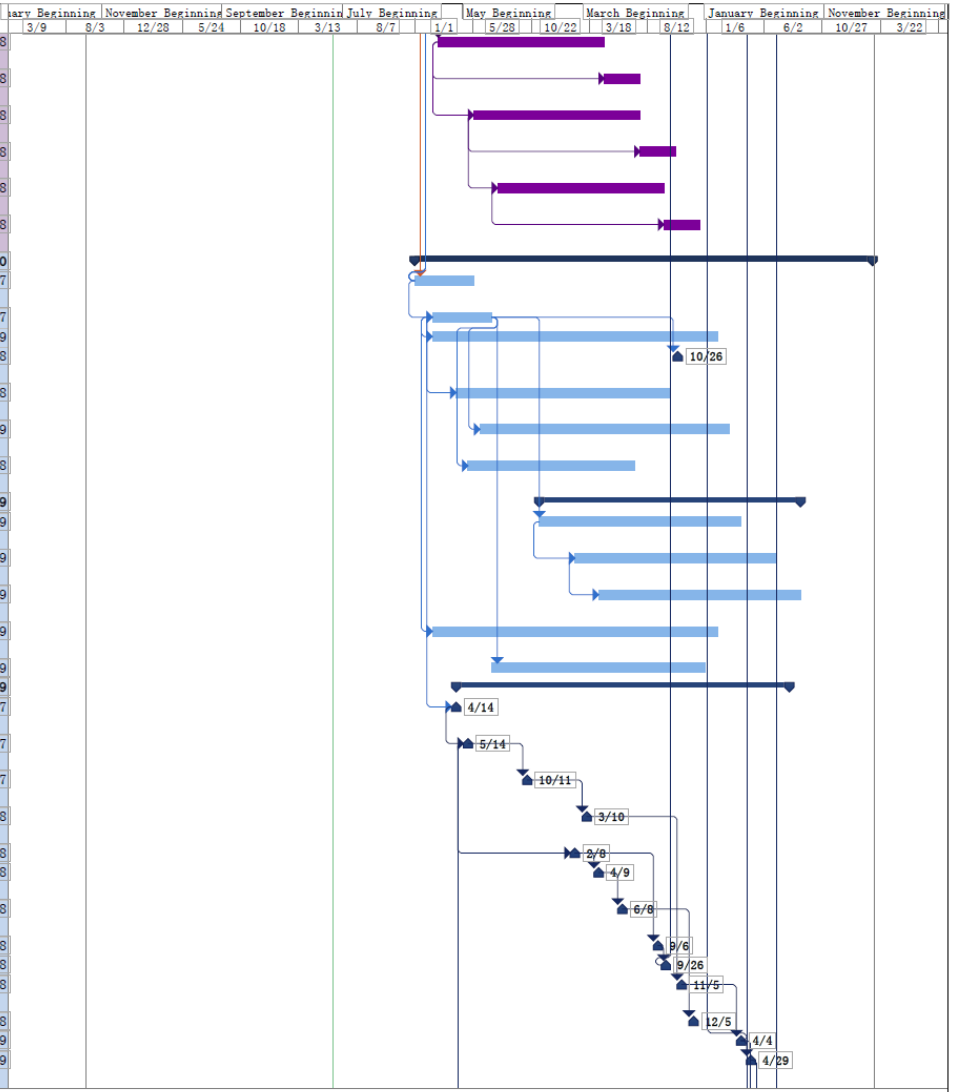
Site leveling will be accomplished using a combination of machines (dozers and scrapers). It is expected, depending on the final location of the power block, that the majority or all of the excavated material will be used in the site leveling.

Figure 4-12: Proposed Construction Schedule for coal power plant

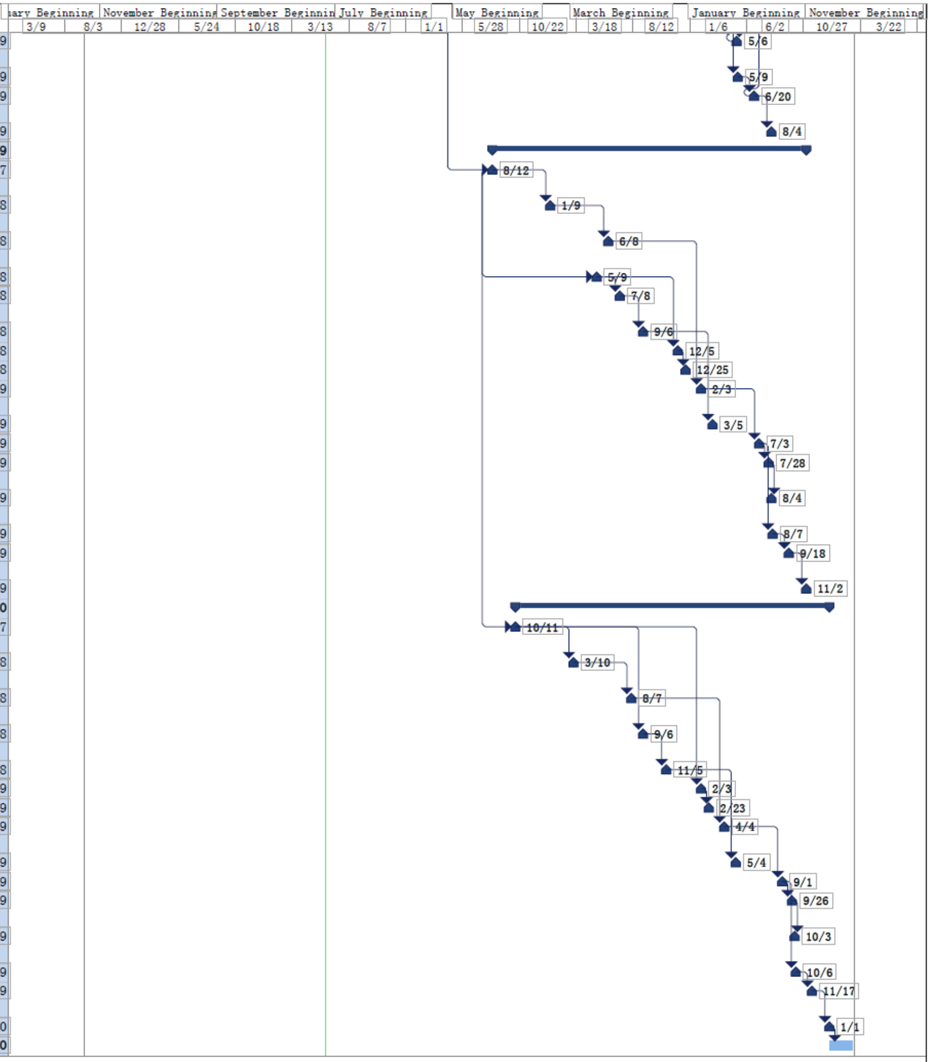
ID	Task Name	Duration	Start	Finish
1	**The Employer**	**1314 days**	**Mon 8/1/16**	**Fri 3/6/20**
2	**CPs for NTP Issuing**	**0 days**	**Mon 8/1/16**	**Mon 8/1/16**
3	PPA finalized	0 days	Mon 8/1/16	Mon 8/1/16
4	FSA finalized	0 days	Mon 8/1/16	Mon 8/1/16
5	Grid Interconnection Agreement finalized	0 days	Mon 8/1/16	Mon 8/1/16
6	Land acquisition	0 days	Mon 8/1/16	Mon 8/1/16
7	Access to site (onshore and offshore)	0 days	Mon 8/1/16	Mon 8/1/16
8	Feasibility Study Report finalized	0 days	Mon 8/1/16	Mon 8/1/16
9	Security Study Report finalized	0 days	Mon 8/1/16	Mon 8/1/16
10	The Advanced payment paid and NTP issued	1 day	Thu 9/1/16	Thu 9/1/16
11	Construction Power to Site	0 days	Fri 12/30/16	Fri 12/30/16
12	Access Road to Site Available from the highway	0 days	Fri 12/30/16	Fri 12/30/16
13	Access Road to Site Avaliable from the jetty	0 days	Fri 12/30/16	Fri 12/30/16
14	Backfeed Power Avaliable from Power Grid	0 days	Wed 9/12/18	Wed 9/12/18
15	Fuel Oil Delivery to Site	0 days	Tue 2/19/19	Tue 2/19/19
16	Coal Delivery to Site	0 days	Sat 3/23/19	Sat 3/23/19
17	Availability for Synchronization with Power Grid	0 days	Thu 6/6/19	Thu 6/6/19
18	**Permits Acquired by the Employer**	**0 days**	**Mon 8/1/16**	**Mon 8/1/16**
19	**Permits Acquired by the Contractor**	**0 days**	**Mon 8/1/16**	**Mon 8/1/16**
20	EPC	1278 days	Thu 9/1/16	Sun 3/1/20
21	The Advanced Payment1 available and NTP received	1 day	Thu 9/1/16	Thu 9/1/16
22	**Engineering**	**690 days**	**Fri 9/2/16**	**Mon 7/23/18**
23	Survey	120 days	Fri 9/2/16	Fri 12/30/16
24	Final basic design	75 days	Mon 10/17/16	Fri 12/30/16
25	Final basic design review	30 days	Sat 12/31/16	Sun 1/29/17
26	Detail design	540 days	Mon 1/30/17	Mon 7/23/18
27	**Procurement**	**840 days**	**Fri 9/2/16**	**Thu 12/20/18**
28	Bidding for main equipment	60 days	Fri 9/2/16	Mon 10/31/16
29	**Boiler manufacture and transport**	**660 days**	**Thu 12/1/16**	**Fri 9/21/18**
30	#1锅炉生产 #1 Boiler manufacture	420 days	Thu 12/1/16	Wed 1/24/18
31	#1锅炉运输（到现场） #1Boiler transport(to site)	210 days	Wed 9/27/17	Tue 4/24/18
32	#2锅炉生产 #2 Boiler manufacture	420 days	Wed 3/1/17	Tue 4/24/18
33	#2锅炉运输（到现场）#2 Boiler transport(to site)	210 days	Tue 12/26/17	Mon 7/23/18
34	#3锅炉生产 #3 Boiler manufacture	420 days	Sun 4/30/17	Sat 6/23/18
35	#3锅炉运输（到现场）#3 Boiler transport(to site)	210 days	Sat 2/24/18	Fri 9/21/18
36	**Turbine manufacture and transport**	**720 days**	**Sat 12/31/16**	**Thu 12/20/18**
37	#1汽机生产 #1 Turbine manufacture	480 days	Sat 12/31/16	Tue 4/24/18
38	#1汽机运输（到现场）#1 Turbine transport(to site)	150 days	Sat 2/24/18	Mon 7/23/18
39	#2汽机生产 #2 Turbine manufacture	480 days	Fri 3/31/17	Mon 7/23/18
40	#2汽机运输（到现场）#2 Turbine transport(to site)	150 days	Fri 5/25/18	Sun 10/21/18
41	#3汽机生产 #3 Turbine manufacture	480 days	Tue 5/30/17	Fri 9/21/18
42	#3汽机运输（到现场）#3 Turbine transport(to site)	150 days	Tue 7/24/18	Thu 12/20/18
43	**Generator manufacture and transport**	**660 days**	**Wed 3/1/17**	**Thu 12/20/18**



ID	Task Name	Duration	Start	Finish
44	#1发电机生产 #1 Generator manufacture	420 days	Wed 3/1/17	Tue 4/24/18
45	#1发电机运输（到现场）#1 Generator transport(to site)	90 days	Wed 4/25/18	Mon 7/23/18
46	#2发电机生产 #2 Generator manufacture	420 days	Tue 5/30/17	Mon 7/23/18
47	#2发电机运输（到现场）#2 Generator transport(to site)	90 days	Tue 7/24/18	Sun 10/21/18
48	#3发电机生产 #3 Generator manufacture	420 days	Sat 7/29/17	Fri 9/21/18
49	#3发电机运输（到现场）#3 Generator transport(to site)	90 days	Sat 9/22/18	Thu 12/20/18
50	**Construction and commissioning**	**1157 days**	**Sat 12/31/16**	**Sun 3/1/20**
51	场平及临建 Site levelling and temporary facilities	150 days	Sat 12/31/16	Mon 5/29/17
52	地基处理 Foundation works	150 days	Tue 2/14/17	Thu 7/13/17
53	烟囱施工 Chimney construction	720 days	Tue 2/14/17	Sun 2/3/19
54	制出合格除盐水 Production of qualified DM water	0 days	Fri 10/26/18	Fri 10/26/18
55	Circulating water system building and installation	540 days	Sat 4/15/17	Sat 10/6/18
56	输煤系统建筑安装 Coal handling system building and installation	630 days	Wed 6/14/17	Tue 3/5/19
57	升压站（含厂外开关站）Switch yard(including off-plant switchyard)	420 days	Mon 5/15/17	Sun 7/8/18
58	**脱硫建筑安装 FGD system**	**660 days**	**Sat 11/11/17**	**Sun 9/1/19**
59	#1机组脱硫建筑安装 Unit1 FGD building and installation	510 days	Sat 11/11/17	Thu 4/4/19
60	#2机组脱硫建筑安装 Unit1 FGD building and installation	510 days	Fri 2/9/18	Wed 7/3/19
61	#3机组脱硫建筑安装 Unit3 FGD building and installation	510 days	Tue 4/10/18	Sun 9/1/19
62	运煤码头施工 Coal transporting jetty construction	720 days	Tue 2/14/17	Sun 2/3/19
63	电厂生活区施工 Colony construction	540 days	Fri 7/14/17	Fri 1/4/19
64	**#1机组里程碑 Unit1 milestone**	**842 days**	**Fri 4/14/17**	**Sun 8/4/19**
65	主厂房开始开挖 Main power house excavation commencement	0 days	Fri 4/14/17	Fri 4/14/17
66	第一罐混泥土浇筑 Concrete casting commencement	0 days	Sun 5/14/17	Sun 5/14/17
67	锅炉钢结构开吊 Boiler steel structure lifting commencement	0 days	Wed 10/11/17	Wed 10/11/17
68	大板梁全部就位 Ceiling girder in position	0 days	Sat 3/10/18	Sat 3/10/18
69	主厂房屋面断水 Completion of roof for m	0 days	Thu 2/8/18	Thu 2/8/18
70	汽机基础交安 Turbine foundation handover for installation	0 days	Mon 4/9/18	Mon 4/9/18
71	汽机台板就位 Turbine deck is in position	0 days	Fri 6/8/18	Fri 6/8/18
72	DCS带电 DCS is powered	0 days	Thu 9/6/18	Thu 9/6/18
73	倒送电 Back-feed Power	0 days	Wed 9/26/18	Wed 9/26/18
74	锅炉水压试验完成 Completion of hydraulic test for boiler	0 days	Mon 11/5/18	Mon 11/5/18
75	汽机扣盖 Upper casing box-up	0 days	Wed 12/5/18	Wed 12/5/18
76	酸洗完成Chemical cleaning completion	0 days	Thu 4/4/19	Thu 4/4/19
77	锅炉首次燃油点火 Boiler initial fire on fuel	0 days	Mon 4/29/19	Mon 4/29/19



ID	Task Name	Duration	Start	Finish
78	锅炉首次燃煤点火 Boiler initial fire on coal	0 days	Mon 5/6/19	Mon 5/6/19
79	吹管完成 Steam blowing completion	0 days	Thu 5/9/19	Thu 5/9/19
80	首次并网发电 Unit initial synchronization	0 days	Thu 6/20/19	Thu 6/20/19
81	进入单机商业运行 Unit COD	0 days	Sun 8/4/19	Sun 8/4/19
82	**#2机组里程碑 Unit2 milestone**	**812 days**	**Sat 8/12/17**	**Sat 11/2/19**
83	第一罐混泥土浇筑 Concrete casting commencement	0 days	Sat 8/12/17	Sat 8/12/17
84	锅炉钢结构开吊 Boiler steel structure lifting commencement	0 days	Tue 1/9/18	Tue 1/9/18
85	大板梁全部就位 Ceiling girder in position	0 days	Fri 6/8/18	Fri 6/8/18
86	主厂房屋面断水 Completion of roof for m	0 days	Wed 5/9/18	Wed 5/9/18
87	汽机基础交安 Turbine foundation handover for installation	0 days	Sun 7/8/18	Sun 7/8/18
88	汽机台板就位 Turbine deck is posioned	0 days	Thu 9/6/18	Thu 9/6/18
89	DCS带电 DCS is powered	0 days	Wed 12/5/18	Wed 12/5/18
90	倒送电 Back charge	0 days	Tue 12/25/18	Tue 12/25/18
91	锅炉水压试验完成 Completion of hydraulic test for boiler	0 days	Sun 2/3/19	Sun 2/3/19
92	汽机扣盖 Upper casing box-up	0 days	Tue 3/5/19	Tue 3/5/19
93	酸洗完成Chemical cleaning completion	0 days	Wed 7/3/19	Wed 7/3/19
94	锅炉首次燃油点火 Boiler initial fire on fuel	0 days	Sun 7/28/19	Sun 7/28/19
95	锅炉首次燃煤点火 Boiler initial fire on coal	0 days	Sun 8/4/19	Sun 8/4/19
96	吹管完成 Steam blowing completion	0 days	Wed 8/7/19	Wed 8/7/19
97	首次并网发电 Unit initial synchronization	0 days	Wed 9/18/19	Wed 9/18/19
98	进入单机商业运行 Unit COD	0 days	Sat 11/2/19	Sat 11/2/19
99	**#3机组里程碑 Unit3 milestone**	**812 days**	**Wed 10/11/17**	**Wed 1/1/20**
100	第一罐混泥土浇筑 Concrete casting commencement	0 days	Wed 10/11/17	Wed 10/11/17
101	锅炉钢结构开吊 Boiler steel structure lifting commencement	0 days	Sat 3/10/18	Sat 3/10/18
102	大板梁全部就位 Ceiling girder in position	0 days	Tue 8/7/18	Tue 8/7/18
103	汽机基础交安 Turbine foundation handover for installation	0 days	Thu 9/6/18	Thu 9/6/18
104	汽机台板就位 Turbine deck is posioned	0 days	Mon 11/5/18	Mon 11/5/18
105	DCS带电 DCS is powered	0 days	Sun 2/3/19	Sun 2/3/19
106	倒送电 Back charge	0 days	Sat 2/23/19	Sat 2/23/19
107	锅炉水压试验完成 Completion of hydraulic test for boiler	0 days	Thu 4/4/19	Thu 4/4/19
108	汽机扣盖 Upper casing box-up	0 days	Sat 5/4/19	Sat 5/4/19
109	酸洗完成Chemical cleaning completion	0 days	Sun 9/1/19	Sun 9/1/19
110	锅炉首次燃油点火 Boiler initial fire on fuel	0 days	Thu 9/26/19	Thu 9/26/19
111	锅炉首次燃煤点火 Boiler initial fire on coal	0 days	Thu 10/3/19	Thu 10/3/19
112	吹管完成 Steam blowing completion	0 days	Sun 10/6/19	Sun 10/6/19
113	首次并网发电 Unit initial synchronization	0 days	Sun 11/17/19	Sun 11/17/19
114	进入单机商业运行 Unit COD	0 days	Wed 1/1/20	Wed 1/1/20
115	**进入全厂商业运行 Plant COD**	**60 days**	**Thu 1/2/20**	**Sun 3/1/20**



4.9.3 Grading and levelling

Any top soil removed during site clearing and subsequent grubbing will be stock-piled on site. The top soil will be reused during landscaping operations and site contouring once construction is complete.

Site grading will be required to establish building and power plant hardstanding, roads, car parks and balance of plant facilities. Engineering fill, gravel and rock will be sourced from nearby existing borrow pits or quarries.

The watering needs of the project (e.g. watering for dust suppression, concrete production, etc.) during construction will be sourced from the desalination plant.

4.9.4 Borrow pits

One or more borrow areas would be established to provide earth and rock materials during site preparation and throughout the construction process. The materials would be used for concrete and asphalt mixes, road base, lining of dikes, and rock surfaced areas. A fence, berm, or signs would be established at the borrow area entry to prevent public access. Upon completion of construction, the borrow area(s) would be re-contoured and reclaimed in accordance with good industry international practices.

The location of the borrow pit(s) will be based on lab tests to determine the suitability of earth and rock for construction of the power plant. This will be determined during the detailed engineering design phase of the project.

4.9.5 Construction of temporary facilities

The project will develop a plan to accommodate the work force and management staff. This will comprise a camp site for the EPC contractor, APCL complete with accommodation blocks, offices, lunch rooms, wash rooms, amenity areas, parking lots, warehousing facilities and maintenance areas.

The approximate construction areas envisaged for the temporary facilities are as follows:

- A temporary office area of 4400m^2 for centralized office work.
- Equipment and material storage area, including: 3000m^2 Storage House, 5,000m^2 Storage Shed, 18,000m^2 Storage Yard 1 and 15,000m^2 Storage Yard 2;
- 2 concrete Plant (including gravel storage yard), each with planned area of 8,000m^2.
- A steel and formwork workshop and a daily use material storage yard, with a total planned area of 6,000m^2.
- Areas for Pre-assembly, each with an area of 8400m^2.
- A tool room for construction teams, with a planned area of 6,000m^2.

Facilities containing toilet and washrooms will be serviced using bio-digesters for treatment. Such bio-digesters which meet the NEMA effluent discharge requirements, have been used extensively in the Turkana area by companies such as Tullow Oil during the exploration campaign. Portable toilets will also be used where needed and will be contracted to a supplier who will be responsible for their maintenance and disposal of the waste.

It is envisaged that an on-site batch ready mix concrete plant will be required for the project and will be constructed near the power plant facilities.

The EPC contractor requires approximately 4MW of electrical power to run the various electrical plant and equipment used for construction of the power plant project. The Kenya Power will provide an electrical connection to the site via a 33kV overhead distribution line from the Hindi sub-station; the routing of the electrical poles will follow existing roads in which case no new wayleaves need to be negotiated. Diesel generators may be used if temporary power is unavailable from the local supply network or on unserved areas of the site.

4.9.6 Physical construction and equipment installation

Following construction of the temporary facilities, physical construction of the land based facilities will be completed.

4.9.6.1 Pile driving

Given the subsurface soil conditions and bearing capacities at project site, the design philosophy is to use mass concrete foundations anchored to the bedrock where necessary. Significant piling may be necessary within the project site if the bedrock is not close to the surface and the soils are not geotechnically stable. Piles will be driven using conventional impact pile drivers and the number of piles required will be confirmed during the detailed design phase.

Where piling is required, piling times will be controlled to minimize risk to construction workers and noise. Piling activity will be carried out during daylight hours, Monday to Saturday, wherever feasible.

4.9.6.2 Pouring of footing and foundations

The construction of the footings and foundations will require concrete mixed in an on-site batch plant thus reducing the need for truck traffic on local roads; it will still be necessary to transport sand, cement and aggregate to the project site.

Pouring of footings and foundations will be made using conventional formwork and similar methods. Rebar cages will be pre-fabricated wherever possible for direct placement to the foundations. The use of system formwork will be maximized to minimize wood consumption and waste. For large pours or pours of group foundations, concrete pumps will be used. Small concrete component will be pre-cast (e.g. manholes, sleepers).

4.9.6.3 Erection of building and structures

The construction of buildings and structures will be conducted using conventional materials (e.g. steel, wood, fiberglass, sheet metal and similar materials) and using conventional construction methods. Some buildings will be pre-engineered and pre-fabricated off-site and transported to the site (e.g. security buildings). To reduce the construction time, pre-fabricated components will be imported to the site to the extent possible, and erected on site. Mobile cranes will be used to erect and complete the assembly of heavy plant components and equipment.

Buildings and ancillary facilities will be constructed using standard methods and built to applicable codes, with reference to public safety, fire protection and structural sufficiency. The primary purpose of the codes is the promotion of public safety through the application of appropriate uniform building standards.

4.9.6.4 Large module construction and transportation

Major pieces of machinery, units and other equipment whose weight is between 40 and 250 tons would be fabricated in China and delivered to the power plant site as packaged units for installation. Such major components (e.g. main transformers, stators, rotors) would not be constructed on site, but constructed off-site in a modular fashion, transported to the site and assembled after delivery. The off-site fabrication of large modules as opposed to building on-site provides for more timely construction and reduces the need for large volumes of labour resources on-site that might otherwise be difficult to supply from Lamu County or Kenya.

The large modules will be delivered to the project site via barge or ship, unloaded at a barge unloading facility (location yet to be decided), and transported to the project site via a heavy haul road. Alternatively, some smaller modules and equipment may also be delivered to the site by truck using the existing C112 road from Mombasa to the project site.

Large modules of the power plant will be constructed and commissioned to the extent practical in module fabrication yards in China and elsewhere depending on the capacity, capability and transport logistics of each module yard. The large modules will be delivered mostly by sea and of-loaded at the barge landing facility to minimize traffic associated with equipment deliveries as well as prevent damage to road infrastructure from these very large and heavy units. From the barge landing facility, the large modules will be transported to the power plant site using self-propelled transporters and heavy lift cranes. Once in position, the modules will be laid on their foundation, erected, connected to the process (i.e. final structural, piping, mechanical, electrical and instrumentation connections) and tested prior to commissioning.

4.9.6.5 Construction of site access roads, heavy haul road and on-site roads

Road construction requires the creation of a continuous Right-of-Way (ROW) overcoming geographic obstacles and having grades low enough to permit vehicle travel and to meet road construction standards. Most of the road infrastructure and network to access the proposed project site does not exist and consequently, existing roads will need to be upgraded and some may need to be re-routed and/or upgraded by widening, improving the sub-base, and resurfacing and finishing to serve as a suitable access road to the power plant.

In the case of the heavy haul road, a shallow grade will be maintained in order to facilitate the movement of the self-propelled modular transporters. The radii and gradient should be designed and staked out to best suit the natural ground levels and minimize the amount of cut and fill.

As applicable, construction will begin with the laying of geotechnically stable sub-base bedding material. Depending on its physical and chemical properties, any excavated material may be used for road construction if not needed for construction of the power plant facilities. Fill, gravel and rock will also be sourced as needed from borrow pits and quarries in Lamu County or beyond.

The top soil and vegetation removed during the clearing and grubbing stage will be stockpiled for subsequent rehabilitation of the extraction area. The topsoil will be stripped and stockpiled nearby for possible rehabilitation of newly constructed embankments along the road. Stumps and roots will be removed and holes filled as required before the earthworks begin. Final rehabilitation after completion of road construction will include seeding and planting of vegetation.

Processes during earthworks include clearing and grubbing, excavation, embankment or roadbed construction including placing of fill materials, compacting, construction and trimming and shaping of side slopes. In cases where the sub-grade (native soil) will not support the design loads the sub-grade is improved by excavation to enhance the sub-grade performance. The embankment fill is placed by the compacted layer method, where a layer of fill is spread at a specified thickness and then compacted to a specific density and the process repeated until the desired grade is reached.

The completed roadways will be finished by paving, chip sealing or stabilized with a gravel surface depending on the serviceability requirement of the road. The type of road surface will depend on economic factors and expected usage. Safety improvements such as traffic signs, crash barriers and other forms of road surface furniture will be installed as necessary to complete the roadway.

A variety of road building heavy equipment will be used throughout the roadway construction, including bulldozers, graders, rollers, pavers and other similar heavy equipment.

4.9.7 Commissioning

Following the completion of all construction activities, the power plant and balance of plant will be commissioned with individual units or processes commissioned in sequence as they become available for commissioning and initial operation. The three units of the power plant will be commissioned in 36, 39 and 42 months respectively from the Notice-To-Proceed (NTP) date.

Commissioning of the power plant will in general involve the following steps:

- Completion of documentation of all control systems;
- Training of operators and employees;
- Checking and sign-off of control systems and instrumentation;
- Preparing utilities for use (i.e. firewater, process water, air, sewer system, etc.);
- Testing each individual 350MW power unit and associated electrical, mechanical and process control systems and associated instrumentation, to ensure readiness for operation; and
- Performance testing of the equipment to verify compliance with the performance guarantee of the suppliers.

Following commissioning, the project will be available for commercial operation.

A commissioning manual will be prepared prior to start-up of the power plant. The manual will provide detailed procedures for commissioning the power plant and balance of plant and will describe the commissioning sequence, testing program and emergency and contingency response procedures during the commissioning process.

4.9.8 Road transportation

Construction related road traffic during the construction phase of the project will be comprised of:

- Automobiles and pick-ups; and
- Trucks (light and heavy trucks for various services, heavy equipment and transport of equipment and construction materials).

Truck traffic during the construction phase will be reduced significantly as the large and heavy modules of the power plant are transported via sea to the barge off-loading facility. These modules will be transported from the shore to the project site using self-propelled modular transporters over the heavy haul road to be constructed for the project.

The EPC contractor will build a construction camp within the project site to house several expatriate and local workers. It is anticipated that during peak construction there will be over 2,978 workers working at the project site. A number of these workers will be accommodated within the construction camp while others will find accommodation outside of it. The EPC contractor will explore the means of providing transportation to workers to and from the project site and finalized during the detailed engineering design phase. Some construction related traffic will occur from passenger vehicles to the project site (e.g. from construction management personnel).

At the time of conducting this ESIA Study, minimal information was available on the use of various transport modes for movement of goods and people to and from the project site. Subsequently, a comprehensive transport study should be undertaken prior to the construction phase of the project to evaluate the impacts of transport on the project.

4.9.9 Employment and expenditure

Construction of the project is expected to commence in the last quarter of 2016 subject to receiving all regulatory approvals and securing financing.

It is envisaged that the first unit will be commissioned in 36 months from the construction commencement date, followed by the second unit in 39 months and the third unit in 42 months from the construction start date respectively.

Normal construction hours are expected to fall between 6:00am – 6:00pm Monday through Sunday. However, these hours may require adjustment because of scheduling constraints and other time-sensitive matters.

About 60% of this workforce will be Kenyan while the remaining 40% will be Chinese. During construction, direct project employment (Kenyan and Chinese workers) in various trades would average approximately 1,800 over 42 months, peaking at approximately 2,978 in the eighteenth month as shown in Figure 4-13. Figure 4-14 shows the Kenyan staff strength needs over the 42 month construction period.

Trades that will likely be required will include: boilermakers, carpenters, electricians, steel fixers, masons, surveyors, pipe fitters, instrumentation technicians, iron workers, welders and other craft workers. Additional skilled workers will be required including truck drivers, utility van drivers, heavy equipment operators, crane operators, tug operators, barge operators, industrial divers, labourers and excavator operators.

Figure 4-13: Estimated staff strength (Kenyan and Chinese) for the construction phase of the project

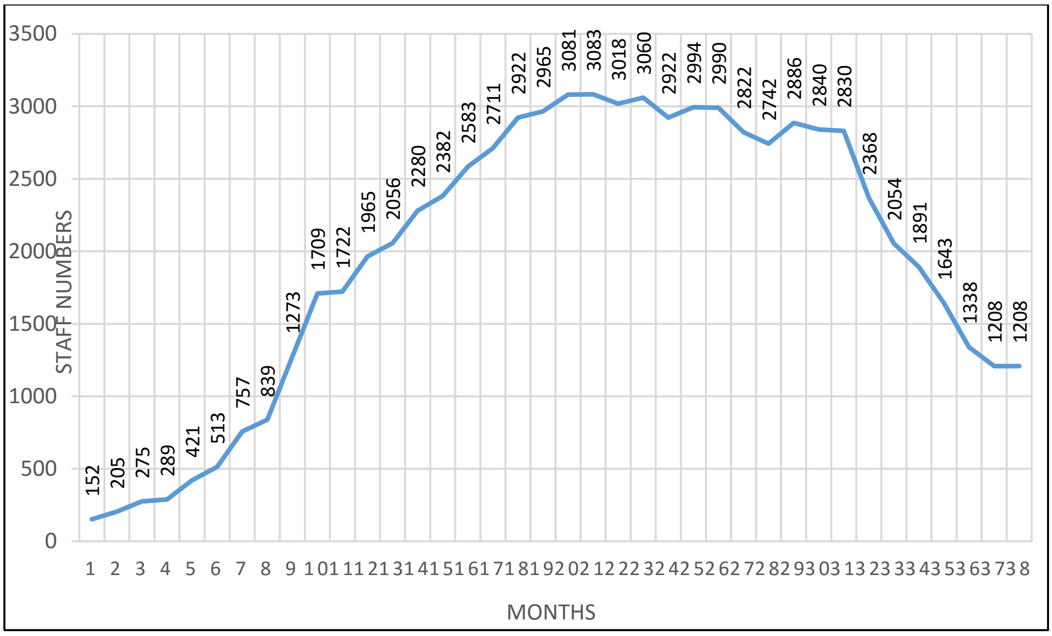
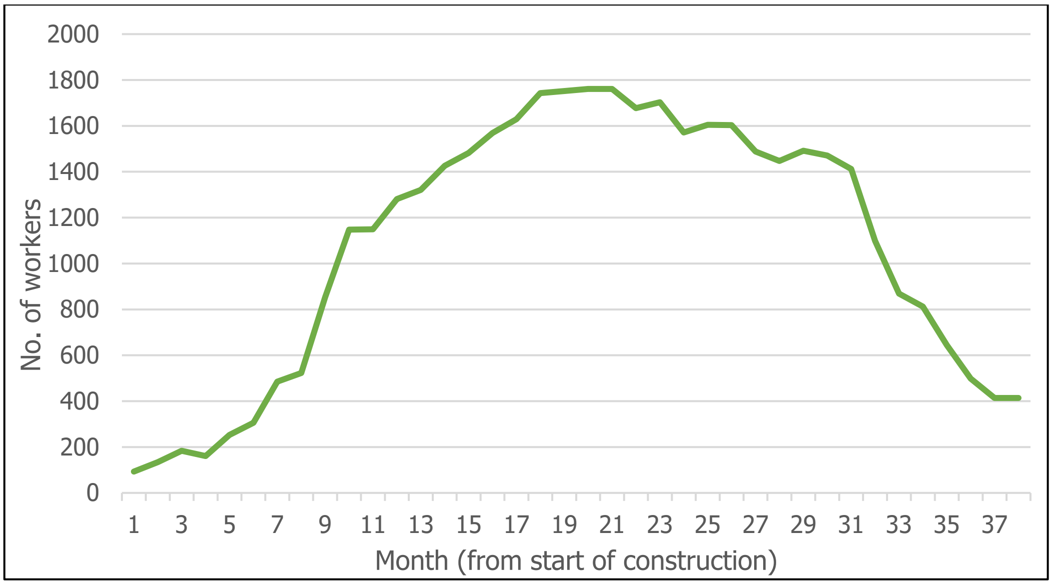


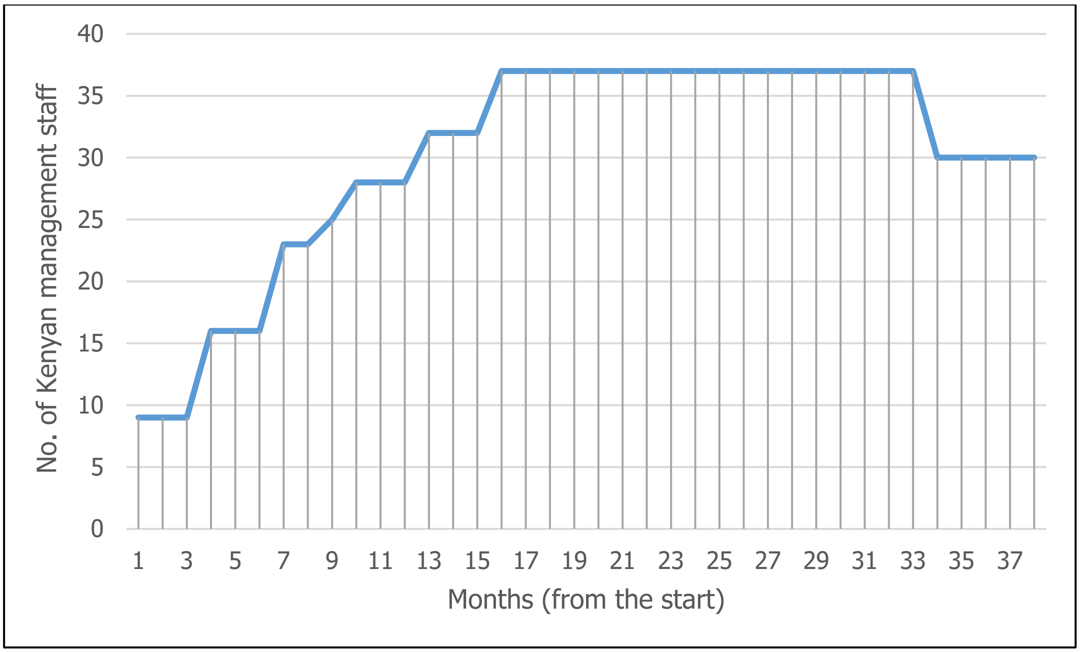
Figure 4-14: Graph showing Kenyan construction personnel requirements



In addition to the above, the Kenyan workforce that will be involved in the contract management during the construction phase are shown distributed graphically in Figure 4-15. Kenyan staff required for administrative type jobs include (i) Administration & Logistics, (ii) Safety Supervision, (iii) Engineering Technique, (iv) Material and Equipment Management, and (v) Internal Security.

The total number of construction management staff, engineers, commercial supply chain staff and project execution personnel that will also be directly employed during construction will be about 64 over the 42 month construction period of which an average of 30 persons will be Kenyan nationals.

Figure 4-15: Graph showing No. of Kenyan contract management staff



Additionally, there will be several indirect jobs and spin-off economic activities in Lamu County will result from the large influx of workers, off-site manufacturing and local expenditures associated with the project.

4.9.10 Workers' accommodation

During the construction phase, there will be a need to accommodate the EPC contractor's expatriate workers, APCL project staff, the Project Management Consultant's (PMC's) staff members and some local Kenyan construction workers over the construction phase of 42 months.

APCL is in the process of selecting a camp solutions provider for the accommodation needs of their staff and that of the PMC. The EPC contractor will construct a camp for their expatriate Chinese workers (about 1,700 persons) as well as for their Kenyan workers.

Housing and accommodation options will continue to be reviewed and assessed throughout the design phase and the selected accommodation strategy/strategies will be determined as the engineering design unfolds.

As part of the power plant, there will be a permanent workers colony that will be built to accommodate those workers that will operate and maintain the project during the operational phase. The design details of permanent workers' colony will evolve as part of the detailed engineering design of the project.

Given below are the general standards for workers' accommodation that the project will have to comply with during the construction and operational phase of the project.

The workers' accommodation will be located in order to prevent exposure to wind, fire and floods. Further, the living facilities will be designed so that their location is unaffected by environmental or operational impacts (e.g. noise, emissions, dust). In order to prevent stagnation of water, the accommodation facilities will have adequate drainage facilities to avoid accumulation of stagnant water. All living facilities will be provided with adequate ventilation and/or air conditioning systems, natural and artificial lighting.

The project will install a desalination plant which will be the source of potable water for among other things, the living and accommodation facilities. The drinking water will be stored in appropriate tanks which will be covered to prevent pollution; the potable water will meet KEBS standards for drinking water as a minimum.

The project will generate a variety of wastes and effluent during the construction and operational phases. Lamu County lacks waste management facilities and sewage treatment plants. As the project area is not served by any wastewater and waste infrastructure, the EPC contractor will install an effluent treatment plant for managing sewage generated by the project. For waste management, the EPC contractor will provide separate bins for plastics, organic wastes (e.g. food wastes) and paper. For vector control, the EPC contractor will contract a third party company for pest extermination, vector control and disinfection of the living facilities.

The workers' accommodation will comprise rooms/dormitories that are kept in good condition always through regular cleaning, ventilation and easily cleanable flooring material. Sanitary facilities will be provided in the same buildings and there shall be separate male and female facilities. Each person will have a minimum of $10m^3$ (volume) or $4m^2$ (surface area) of space with a minimum ceiling height being 2.1m in each dormitory. In collective rooms, workers will be provided with some privacy using mobile partitions or curtains and subsequently, these rooms will be designed to accommodate between 2 and 8 workers; the doors and windows should be lockable and each bed will be provided with mosquito nets.

Each worker in the dormitory will be provided with his/her own bed and the practice of "hot-bedding" will be avoided. Spacing between beds will be at least 1m to allow for movement of a worker around the bed. Double deck bunks will be discouraged for fire safety and hygiene reasons and their use will be minimized. Where they are necessary, the bunks will be designed such that the space between the lower and upper bunk of the bed is between 0.7m and 1.1m; triple deck bunks will be prohibited. Workers will be provided with a comfortable mattress, pillow, cover and clean bedding; all linen will be laundered frequently and applied with mosquito repellents and disinfectants. For storage of personal effects, an individual cupboard will be provided having a volume of about $0.5m^3$ and 1m shelf unit. Separate storage facilities will be provided for street clothes and Personal Protective Equipment (PPE) which should include drying/airing areas.

In order to maintain good standards of personal hygiene, sanitary facilities will be provided which include urinals, wash basins and showers. The sanitary facilities will be designed to ensure that there is adequate privacy by having floor to ceiling partitions and lockable doors. The sanitary facilities will be cleaned frequently and kept in fully working condition at all times. Separate male and female sanitary facilities will be provided throughout the camp accommodation facilities.

In order to prevent the spread of infectious disease and avoid contamination, there will be a minimum of 1 toilet for 15 persons. The toilet facilities will generally be located between 30m and 60m from rooms/dormitories. Toilet rooms will be well-lit, have good ventilation and have sufficient wash hand basins.

The rooms/dormitories will be provided with an appropriate and adequate number (1 shower for 15 persons) of shower and other sanitary facilities (1 wash hand basin for every 15 persons) which will be maintained and cleaned regularly. The flooring for shower facilities will be made of washable material, non-slip surface, damp-proof and properly drained. The showers will be conveniently located and will be provided with an adequate supply of hot and cold running water.

The workers' camp will have mess facilities and a laundry. The catering contract will be outsourced to a contractor for managing the kitchens and canteens. The cooking facilities within the kitchen areas will be sufficient for preparing food and will conform to high standards of safety and hygiene. The working space for each kitchen worker will be about $1m^2$ to $1.5m^2$; the dining area will be adequately furnished with tables, benches, chairs, individual drinking cups and plates. All food preparation areas will be designed to provide food hygiene practices including protection against contamination between and during food preparation. Wall surfaces adjacent to cooking areas will be made out of fire resistant materials. All kitchen floors, ceiling and wall surfaces adjacent to or above food preparation and cooking areas will be built using durable, non-absorbent, easily cleanable, non-toxic materials.

There will be a medical facility provided by the EPC contractor for the construction phase of the project. The medical facility will be located within the workers' accommodation area. Medical facilities will include provision of special facilities such as an emergency room, pharmacy, triage, etc. The on-site medical facility will be manned by sufficiently trained and adequate staff members including nurses, clinical officers, etc. Additionally, there will be first aid kits distributed throughout the project site. The contents of the first aid kits will at a minimum comply with the requirements of Legal Notice 160 of 1977 titled: The Factories and Other Places of Work (First Aid) Rules.

The project site will contain basic leisure and social facilities such as exercise and recreational facilities. Some of the facilities that will be considered include a gym, jogging tracks, TV rooms, table tennis, Pool/Billiards, etc. Additionally, the communication reception is poor in the project area; subsequently, APCL will work with either Safaricom or Airtel to install a base transmitter station within the project site to enable workers communicate with the outside world.

The project site is in an area where the predominant religion is Islam and subsequently, prayer facilities will be provided at the project site for the workers that subscribe to the faith.

4.10 Operation

Once the construction is completed and the project commissioned, the power plant will become operational. A discussion of the planned activities during the operational phase is given below.

4.10.1 Operation and maintenance of the power plant

Throughout the operational phase, the power plant performance will be monitored to meet all regulatory and lender requirements to operate such a plant. A number of hazards associated with the proposed coal power plant have been eliminated or engineered out. Subsequently, as conceived and designed, given use of best available proven technology economically viable, modern day emission control and advanced process control systems that will be built and operated at the new power plant, the process will inherently provide a high level of mitigation of the potential environmental effects caused by emissions, releases and wastes.

The majority of the power plant operations will be controlled by highly skilled and trained operators in the control room via computer-controlled sensors and systems. Operation will consist of among other things, monitoring and controlling the power plant unit systems, pressures, temperatures and environmental performance of the emissions. Operating manuals written in English will be produced for the overall process, individual units and various maintenance tasks. Proven industry practices will be followed that result in an efficient and environmentally responsible facility. The facility will be operated to comply with all regulatory requirements. An Operations and Maintenance Manual will be developed to outline the safe operation and emergency and contingency response procedures to be followed during operation of the power plant.

There will also be hands-on operation throughout the power plant which will consist of regular physical system checks, testing, inspection and maintenance. Operators will be able to continuously monitor environmental performance from the control room from the Continuous Emissions Monitoring System (CEMS), ambient air quality, and grab samplers (as applicable), and adjust the process operation accordingly to maintain acceptable power plant performance and ensure compliance with environmental legislation.

Operators will be fully aware and will keep track of personnel working in various areas of the power plant, thus contributing to security and safety throughout the facility. Appropriate work orders and a Permit-To-Work (PTW) system will be required prior to entering and executing work in any area of the power plant. A PTW will be required for any non-routine or potentially high consequence activity to be carried out in the power plant such as working at heights, confined space entry, hot works, etc.

Routine preventive and predictive maintenance will be scheduled and conducted on an on-going basis to facilitate the safe, reliable and efficient operation of the power plant and balance of plant. Any major scheduled outages will be scheduled on an as-needed basis to facilitate the ongoing maintenance of the power plant and ensure optimal performance and continuous improvement.

4.10.2 Emission control and management of effluents and wastes

4.10.2.1 Operation of environmental control systems

The various environmental control systems associated with the power plant operation (low-NO_x burners, Electrostatic Precipitators (ESPs), wet Flue Gas Desulfurization (FGD) and ambient air quality monitoring systems) will be operated to ensure the acceptable environmental performance of the power plant and balance of plant in compliance with environmental legislation. The performance of these systems will be continuously monitored by plant operators to facilitate compliance so that ambient air quality standards and objectives are not exceeded. Systems will be maintained in accordance with the Original Equipment Manufacturers (OEM's) specifications.

4.10.2.2 Operation of wastewater treatment system

The proposed power plant wastewater treatment system will be sized to treat wastewater that will be generated from the operation of the project. The wastewater treatment plant and associated systems will be operated to confirm that the effluent from the process areas is in compliance with Kenyan environmental discharge standards. Continuous and grab sampling of the effluent will be conducted and the samples analysed in the on-site laboratory for important effluent characteristics to confirm acceptable environmental performance.

Maintenance and upgrading of the wastewater treatment plant will be conducted as necessary to meet the manufacturer's specifications. Waste products (e.g. sludge) will be periodically removed by dredging or other means and disposed off through NEMA licensed road contractors.

4.10.2.3 Air quality and effluent release monitoring

The project will use a Continuous Emissions Monitoring System (CEMS) on all three flues to confirm process efficiency and conformance with environmental legislation. These systems will most likely consist of multi-component gas analysers that include sensors, digital signal processing equipment and software. Data from the gas analyser will be displayed in the control room.

Effluent from the wastewater treatment plant will be monitored for quality before being released to the environment. Based on the water balance diagram for the project, there will be no treated effluent discharged into the environment. The exception will be during the wet season where treated effluent will be discharged into the Manda Bay.

An ambient air quality monitoring program will be implemented in and around the fall-out areas identified in the air dispersion modelling study for the project. Such a program will be undertaken for the first two years of operation and if found within acceptable air quality limits, will cease thereafter.

4.10.2.4 Water supply and use

Freshwater will be used in several processes within the power plant. Under normal operating conditions, the average demand of water at maximum continuous rating will be about 408m^3/h which will be supplied from the desalination plant. Of this amount, 208m^3/h will be sent to the reuse water storage tank where it will be distributed for various uses. The remaining water will be used in washing water for main building (5m^3/h), potable water for power plant (5m^3/h), boiler feed water treatment plant (71.7m^3/h), cooling water for hydrogen generation station (3m^3/h), cooling water for breakwater camera (2.7m^3/h), and cooling water for oil pump house (10m 3/h). Another 85.5m^3/h will be used for the Workers' permanent colony, potable water for the coal wharf, process water for the coal wharf, makeup water for the air conditioner, and, unforeseen water.

There will be an oily wastewater treatment station that will treat 4m^3/h of oily wastewater from the transformer area, LDO tank farm, LDO pump house and washing water from the main building. The treated wastewater will be pumped to the Industrial Wastewater Treatment Station to be built at the project site.

There will be an Industrial Wastewater Treatment System which will handle about 18.3m^3/h of effluent emanating from various sources including treated effluent from the domestic sewage treatment station (4m^3/h), acid-alkali wastewater (0.3m^3/h) from the boiler feedwater treatment plant, acid and alkali wastewater from condensate polishing regeneration system (2m^3/h) and coal dust pre-settling tank (8m^3/h).

4.10.2.5 Cooling water system

Under continuous maximum rating conditions, the three units will use 126,504m^3/h of seawater for cooling water for the condenser and cooling water for the open cycle cooling system.

The power plant control system will regulate the cooling water flow and pumps as required to maintain optimum cooling in the condenser.

4.10.3 Roadway maintenance

The power plant access roads, heavy haul road and on-site roads will be continuously maintained to facilitate safe movement of vehicles. Maintenance procedures will be developed in the later planning stages, however, maintenance of the road network may include:

- Pavement management;
- Road repairs,
- Sidewalk construction and maintenance;
- Weed control;
- Road sweeping; and
- Litter pickup.

4.11 Decommissioning

The proposed power plant will be designed, built and maintained to operate efficiently to produce electrical power for transmission to the national grid. The expected design life of the power plant and balance of plant is 30 years or more. The life of the project may be extended if the project continues to generate and sell power at a cost effective rate, there is an active maintenance program, the power plant is refurbished or equipment replaced as needed.

For the purposes of this ESIA Study, the power plant will be operated for a period of 30 years or more and any decommissioning or abandonment has not been contemplated by APCL, nor would it be possible to predict with any certainty, the potential requirements for decommissioning or abandonment of the project this far into the future.

The operation of the project will be conducted in a manner which will minimize the potential for adverse environmental effects by following operating procedures, conducting proper preventive and predictive maintenance and implementing good housekeeping practices and environmental management practices to minimize the potential for unintentional releases, and site contamination. As such, while some remediation is likely to be necessary, it is likely that the decommissioning would be focused on the removal of the physical works, remediation and the restoration of the area to suitable environmental conditions.

When the project is nearing the end of its useful life, a decommissioning and abandonment plan will be developed in accordance with the regulations applicable at that time. The decommissioning and abandonment plan would specify the procedures that would be followed with respect to the decommissioning, removal and disposal of site equipment and structures, and for site remediation if required. The decommissioning and abandonment plan would be developed to reflect the environmental requirements in place at the time of decommissioning including consideration of the waste disposal, diversion or recycling requirements that would exist at that time.

Energy would be consumed during decommissioning. Power consumption and timeframes for this process are expected to be less than that for construction. Typical equipment for demolition of this type would include cranes, forklifts, trucks, oxy-acetylene cutting equipment and portable generators.

Where possible, materials from decommissioning would be recycled or reused to reduce the total quantity of solid waste disposed and conserve natural resources required for their production.

4.11.1 Removal of facilities and site reclamation

The activities to be conducted during decommissioning are likely to involve the removal of all physical structures and units, the disposal of wastes and transport to an appropriate disposal site, and the rehabilitation of the site to acceptable standards. The main activities associated with removal of facilities and site reclamation are expected to include but not limited to the following:

- All physical structures including the buildings, infrastructure within the power plant block, balance of plant structures such as tanks, pipelines, berths, coal conveyor system, roads and related infrastructure will be removed from the site;
- All remaining materials, equipment and supplies will be removed from the site including any remaining fuels and hazardous materials;
- All structures and disassembled materials will be stacked in designated areas for removal;
- Reusable materials no longer required by the company at other sites will be offered for sale;
- All wastes will be disposed off in an approved manner using NEMA licensed transport companies;
- When the LDO storage tank system is decommissioned, all products will be removed from the system and the tank and associated piping removed from the ground. Any contaminated soils will be removed and the site cleaned and restored;
- All hazardous wastes will be transported to approved hazardous waste storage and disposal sites. All disturbed areas will rehabilitated and re-vegetated. Re-vegetation will be accomplished with plants and trees that are common to the area.

Further specific details will be provided in the decommissioning and abandonment plan once developed at the appropriate time during the life of the facility.

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5 Environmental Setting

An assessment of potential environmental and social impacts of the Project required development of a detailed environmental and social baseline of the study area. The study area for the ESIA study is defined specifically for each type of biophysical and social environment aspect. Baseline information has been developed using secondary literature as well as surveys conducted in the study area. References to the secondary information are provided in the text.

The proposed Lamu coal fired power plant is situated in the Kwasasi area of Hindi sub-county, Lamu County as shown in Figure 4-1.

5.1 Land use

The County Government of Lamu is in the process of developing a spatial plan for land use within the county. This plan is envisaged to include various land uses including commercial, industrial, residential, etc.

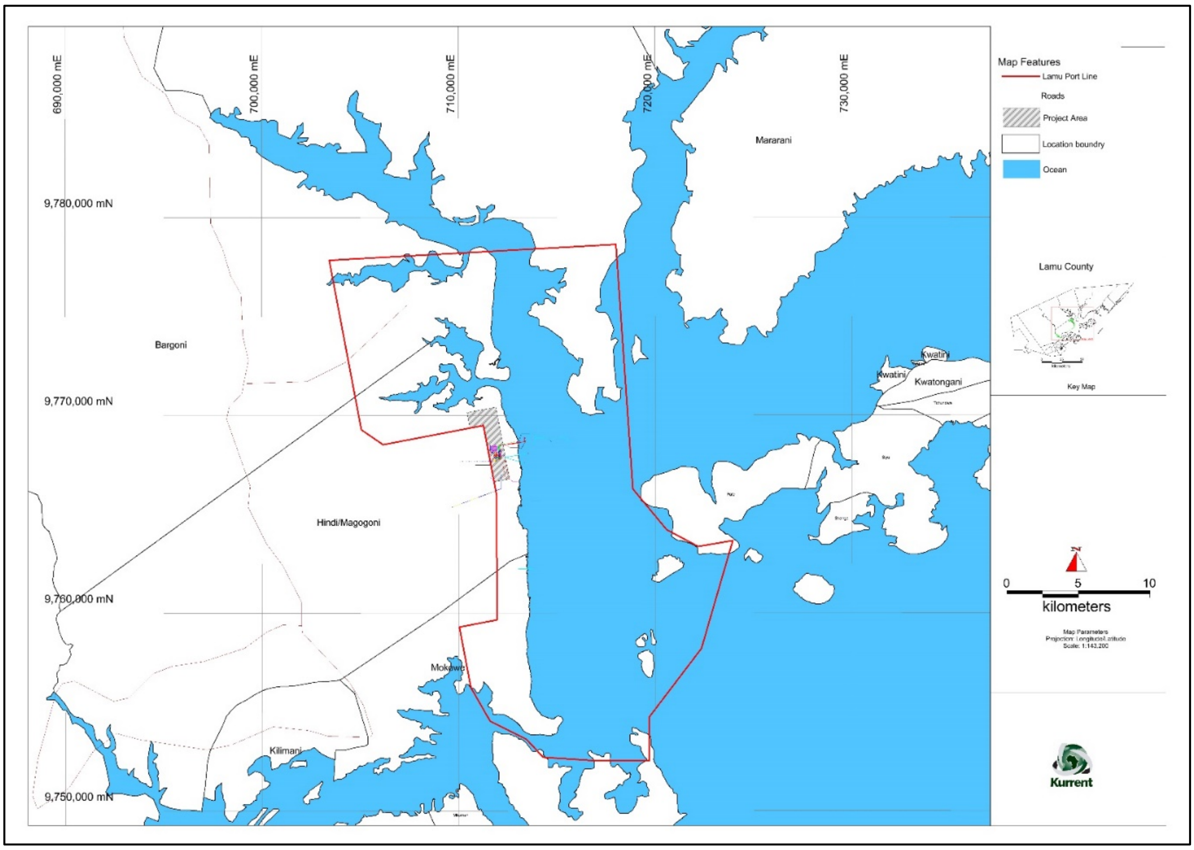
With the development of the Lamu Port South Sudan Ethiopia Transport (LAPSSET) corridor project, land use within its footprint area will change from the existing agricultural use to commercial and industrial use.

The land tenure around the proposed Lamu coal power plant is communal and held in trust for the community by the County Government of Lamu. Together with other LAPSSET related projects in Lamu, the land use at the proposed project site will convert from communal to commercial or industrial.

Through interviews conducted during the baseline field surveys, it was established that the communities within the Lamu coal power plant project area and its environs practice subsistence agriculture. Some pastoralists were also observed grazing their cattle in the project area.

Additionally, the tidal areas within Manda Bay contain sizable percentages of mangroves which provide ecosystem services to the communities. Mangroves provide provisioning services to the local communities within the Kwasasi area.

Figure 5-1: Image showing approximate location of project



5.2 Setting the Study Limits

The study limits for the proposed power plant vary from one bio-physical and social element to another. Each specialist study has required setting up of its own study limit based on secondary literature reviews and a site reconnaissance visit in January 2015. Based on this, given in Table 5-1 is the study limit for each type of specialist study undertaken in the ESIA.

Table 5-1: Setting the study limits for the ESIA

Specialist study	Study limit
Air quality	A grid of 50km x 50km from the centre of the project site
Marine ecology and sea water quality	The Manda Bay estuary specifically a radius of about 2km from the proposed jetty location
Terrestrial ecology	Project footprint area and its immediate environs
Noise and vibration	Project footprint area and its immediate environs
Hydrology	Project footprint area and its immediate environs
Hydrogeology	Project footprint area and its immediate environs
Soils and geology	Project footprint area and its immediate environs

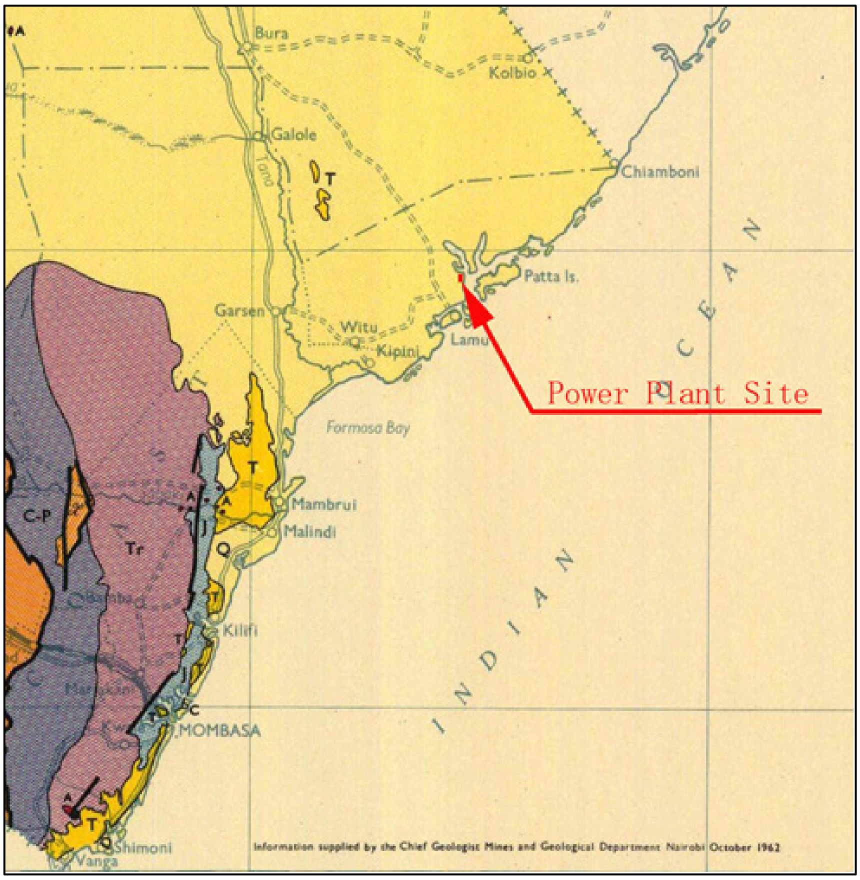
Specialist study	Study limit
Social impacts	Key parts of Lamu County near the project area (e.g. Hindi/Magogoni, Mokowe, Bargoni, Lamu island, Faza, Chundwa, Mtangawanda, Pate, Manda, etc.)
Cultural heritage	Project footprint area including surrounding areas and Lamu stone town
Visual impacts	A 5km radius from the center of the project site
Health and safety	Project footprint area and its immediate environs

5.3 Geology

According to the geological map of Kenya (Figure 5-2), the project site is mainly covered by the Quaternary overburden layer, without any deep fault distribution around the site, and there is also no obvious fault distribution in the site with reference to data of nearby projects.

According to Meteorological Department in Kenya, the earthquake magnitude around the project site is generally less than 5 on the Richter scale; this reflects that neo-tectonic movement is weak in the site. Based on the above factors, it is deciphered that the geological tectonic conditions within the project site and its environs would be of good stability.

Figure 5-2: Geological Map of the Plant Site



The site specific geologic characteristics are given in the following sub-section.

5.3.1 Site specific geology

The study area is covered by superficial soils and marine sediments. The oldest rocks are Tertiary limestones and are largely covered by Quaternary limestones. Marine sands and clays occur in a belt varying from 16 to 24 km wide, sub-parallel to the present coast-line. Their surface is covered by sandy soils which are fluviatile in character. The Quaternary marine sediments contain raised coral reefs and wind-blown dunes sands which are often red in colour. These outcrop between the Tertiary sediments and the present coast. The Pleistocene sands and clays, like those of the Tertiary, were probably deposited under deltaic conditions in this region.

The Quaternary soils are usually grey sands and clays outcropping over the Tertiary marine sediments. Black cotton soils are present along drainage channels and are also found overlying the Tertiary and Quaternary sediments along the drainage channels. Red soils in the area may be merely better drained variants of the common grey sandy soils but they may also represent tertiary dunes or valley deposits. The alluvium of the Tana River Valley is of Quaternary age.

5.3.2 Topography and geomorphology

The project site is the bonding zone of coastal plain and the Manda Bay, with Manda Bay located on the east, terrestrial land on the west, and a wide and short seasonal gully (flooding area in spring tides) on the north.

5.4 Soil Resources

The parent material of the soils in the district originates from marine sediments. These soils are shallow and generally poor for agricultural purposes. They are also prone to waterlogging. Soils in the bottomlands and in the plains to the west of the county have high fertility while those in coastal plains have low to moderate fertility. The soils formed on former coastal beach ridges and on sand dunes also have low to very low fertility.

5.4.1 Types, capacity and uses

The project area is overlain by relatively shallow mainly black cotton soils which in some areas grade into more grayish colored loamy soils. The soils of the Kwasasi sub-location in Lamu area are classified as below. (Speck, 1978, Sombroek et al, 1982).

The quaternary soils are usually grey sands clays outcropping in and of the Tertiary marine sediments, which yield off white or buff sandy soils by reworking. Black cotton soils are present along drainage channels and are also found overlaying the tertiary and quaternary sediments along the drainage channels.

5.4.2 Fertility and potential uses of the land for agriculture

The land on which the proposed coal fired power plant is to be built is currently used for subsistence agriculture. Farmer's cultivate pockets of land to grow maize, sim sim, and other food crops which they use for subsistence purposes or as cash crops. As stated above, land in the coastal plains which includes the proposed project area, have low to moderate fertility.

5.5 Water Resources

5.5.1 Surface water

There are no rivers near the proposed project site and surface water mainly accumulates on the site during the rainy season. The topography of the site is such that the land generally slopes eastwards towards the Manda Bay; subsequently, surface water will mainly drain to the sea from west to east in a scattered mode.

The project site is at a higher elevation than the seasonal gully located towards the north of the project site; therefore the site potentially accumulates water in rainy season on the west, while sea tides on the east will have minimal flood influence on the site.

5.5.1.1 Water uses

Lamu County is generally a water scarce region of the country. The only fresh water sources are the sand dunes located on Lamu island and shallow wells dug by communities on the mainland.

Within the Kwasasi area where the proposed project is to be situated, residents walk long distances to source for water. Amu Power has purchased above ground water storage tanks for delivering water regularly to the communities living in Kwasasi.

5.5.1.2 Water quality

Most streams in the County are seasonal and far from settled areas. The water obtained from most wells is of poor quality owing to the chemical nature of the aquifers. Wells must also be protected from contamination to reduce the incidence of water-borne diseases.

5.5.2 Groundwater

Groundwater within the project area is confined to pore water in loose rocks. A geotechnical survey was undertaken at the project site onshore and offshore to determine the subsurface soil and groundwater conditions. The geotechnical survey was carried out between January and March 2015 during the local drought season; stable underground water levels were measured in each drill hole and it was determined that the depth to ground water is basically the same as the sea level.

5.5.2.1 Hydrogeological characteristics

Through the geotechnical investigation carried out at the project site, it was established that the depth to ground water within the site varies between 2.8m and 7.8m. Data for depth to groundwater was collected over a period of four months in the rainy season to determine the average depths to groundwater for purposes of foundation design.

5.5.2.2 Groundwater recharge data and potential yield

The stratum on the site is mainly sand with good water permeability, good water storage conditions, and large amount of groundwater; the site is connected to the sea and is at an elevation of between 3 and 14m above sea level. The project site has good groundwater recharge and discharge conditions; the site has good water accumulation conditions, and with the surface stratum being sand having with good water permeability, the accumulated surface water (in rainy season) will effectively be able to recharge the groundwater on the site.

5.6 Air Quality

The construction, commissioning and operation of the proposed coal fired power project may have potential negative impacts upon the ambient air quality of the local area. To determine the baseline conditions around the project site and its environs, an air quality survey was undertaken by SGS Kenya Limited on February 10th – 17th, 2015. The coordinates and locations of the baseline air quality survey are presented below.

Table 5-2: Baseline air quality monitoring locations

Sampling point	Coordinates		Site description
	Latitude	Longitude	
Bargoni village	S02°02’50.4”	E040°47’10.0”	This is a village along Hindi-Kiunga road and its baseline data is highly impacted by traffic along the road and emissions from the houses
Ngini village	S02°03’46.7”	E040°53’40.6”	This is a small residential village off Hindi- Kiunga road. Its baseline air data will be impacted by domestic emissions from the houses
Bobo village	S02°07’59.5”	E040°49’38.7”	A village along Hindi- Kiunga road. The baseline data from this point is impacted by traffic and smoke from the commercial shades.
Mokowe Primary School	S02°14’09.4”	E040°51’00.7”	This is a school within Mokowe town. Mokowe town is considered an industrial set up hence the baseline air quality data will be influenced by traffic
Jipe village	S02°11’14.7”	E040°49’57.1”	This is a residential village mostly inhabited by farmers and most of its baseline air quality influence would be domestic smoke.
Hindi area	S02°10’48.3”	E040°48’59.1”	Hindi is a busy shopping centre with relatively heavy traffic

Sampling point	Coordinates		Site description
	Latitude	Longitude	
			influencing on the baseline air quality data.
Masjid mosque – Pate island	S02°08’49.5”	E040°59’89.2”	This area is mostly inhabited by fishermen and farmers with domestic activities as the most probable sources of baseline air data
Mikanjuni island opposite a resort – Pate island	S02°04’24.8”	E040°58’29.6”	This area is an island surrounded by the ocean. The baseline air quality at this point would be impacted by fishermen’s boat.
Mtangawanda jetty – Pate island	S02°06’37.7”	E040°58’22.2”	The area’s baseline air quality data is highly impacted by traffic of vehicles and motorcycles from the Jetty to Pate Island. Domstic smoke from the surrounding shades also contributes to air data.
Kwasasi – project site	S02°05’19.9”	E040°53’28.9”	This point is within the project area with sim sim farming as a major operation within the area. Sources of baseline air influence would be motorcycles and domestic smoke.

Figure 5-3: Baseline air quality sampling locations

Passive sampling tubes were used for collecting baseline air quality data on sulfur oxides and nitrous oxides. Passive sampling involves adsorption of the pollutant gas in a capture tube. The capture tubes/filters are then sent to accredited laboratories for analysis in accordance with standard methodologies (ion chromatography/GCMS). The laboratory results and sampling duration information are used to calculate the gases concentrations. Figure 5-4 shows an image of passive sampling tubes mounted on a tree to collect ambient air quality data. The tubes were left in place for a period exceeding 30 days.

Figure 5-4: Image showing passive diffusion tubes mounted on a tree branch

Minivol air samplers were used at the selected locations for fine particulate monitoring. The Minivol portable air sampler (figure 5-5) is an ambient air sampler for particulate matter. The sampler is positioned with the intake upward in an unobstructed area, free from any obstruction to airflow. The sampler is fitted with a PM_{10} inlet, which only allows for particles of an aerodynamic diameter of less than 10 μm (PM_{10}) to pass through it for PM10 sampling and a $PM_{2.5}$ inlet, which only allows for particles of an aerodynamic diameter of less than 2.5μm ($PM_{2.5}$) to pass through it for PM2.5 sampling. The sample was drawn through the unit at a predetermined flow rate and collected onto filter papers over typically 4-hr sampling periods. Figure 4-5 below shows an image of the Minivol sampler.

Figure 5-5: Image of Minivol air sampler mounted to collect particulate matter

While not a reference method sampler, the mass concentrations of the MiniVol™ TAS gives results that closely agree with reference method concentrations in accuracy and precision. The MiniVol™ TAS features a programmable timer, a constant flow control system, an elapsed time totalizer, rechargeable battery packs, and an all-weather enclosure.

5.6.1 Climate and meteorology

The average weather conditions observed during the survey period were mainly dry with clear skies. Day temperatures peaked at 32^0C and lowest at 23^0C during the day. Wind speed was typically be-tween 5m/s and 9m/s. the recorded humidity was between 54 to 59%.

5.6.2 Baseline ambient air quality results

Results of ambient air quality active measurements conducted from February 10^{th} – 17^{th}, 2015 are presented in table 5-3 to 5-6.

Table 5-3: Measurement results for PM2.5

Location ID	Start Date	Finish Date	PM2.5 (µg/m^3)
Bargoni village	10-Jan- 15 @ 12:20hrs	10-Jan-15 @ 16: 25hrs	18
Mtangawanda jetty (Pate island)	11-Jan- 15 @ 12:15hrs	11-Jan-15 @ 16: 15hrs	1
Mikanjuni island	11-Jan- 15 @ 12:45hrs	11-Jan-15 @ 16: 30hrs	0.45

Location ID	Start Date	Finish Date	PM2.5 (µg/m³)
Masjid mosque (Pate island)	11-Jan- 15 @ 11:20hrs	11-Jan-15 @ 15: 25hrs	0.34
Hindi mosque	12-Jan- 15 @ 08:20hrs	12-Jan-15 @ 12: 20hrs	0.13
Jipe village	12-Jan- 15 @ 09:20hrs	12-Jan-15 @ 13: 20hrs	0.13
Mokowe Primary School	12-Jan- 15 @ 13:50hrs	12-Jan-15 @ 17: 50hrs	0.28
Bobo village	13-Jan- 15 @ 09:05hrs	13-Jan-15 @ 13: 05hrs	0.28
Ingini village	13-Jan- 15 @ 11:20hrs	13-Jan-15 @ 15: 20hrs	0.07
Kwasasi (project site)	15-Jan- 15 @ 08:55hrs	15Jan-15 @ 12: 55hrs	0.61

Table 5-4: Measurement results for PM10

Location ID	Start Date	Finish Date	PM10 (µg/m3)
Bargoni village	10-Jan- 15 @ 12:20hrs	10-Jan-15 @ 16: 25hrs	16.52
Mtangawanda jetty (Pate island)	11-Jan- 15 @ 12:15hrs	11-Jan-15 @ 16: 15hrs	0.34
Mikanjuni island	11-Jan- 15 @ 12:45hrs	11-Jan-15 @ 16: 30hrs	0.61
Masjid mosque (Pate island)	11-Jan- 15 @ 11:20hrs	11-Jan-15 @ 15: 25hrs	0.44
Hindi mosque	12-Jan- 15 @ 08:20hrs	12-Jan-15 @ 12: 20hrs	0.67
Jipe village	12-Jan- 15 @ 09:20hrs	12-Jan-15 @ 13: 20hrs	0.23
Mokowe Primary School	12-Jan- 15 @ 13:50hrs	12-Jan-15 @ 17: 50hrs	0.32
Bobo village	13-Jan- 15 @ 09:05hrs	13-Jan-15 @ 13: 05hrs	0.18
Ingini village	13-Jan- 15 @ 11:20hrs	13-Jan-15 @ 15: 20hrs	0.31
Kwasasi (project site)	15-Jan- 15 @ 08:55hrs	15Jan-15 @ 12: 55hrs	3.67

Table 5-5: SO_2 Monitoring Results

Monitoring Point	Monitoring Duration (minutes)	SO2 Results ($\mu g/m^3$)
Bargoni village	888	BDL
Ngini village	816	BDL
Bobo village	745	BDL
Jipe village	735	BDL
Hindi	840	-
Mokowe primary school	730	BDL
Mikanjuni island	864	BDL
Mtangawanda jetty – Pate island	820	-
Masjid mosque – Pate island	865	BDL
Project site - Kwasasi	768	BDL

Key:

BDL: Findings were below the detection limits i.e. 1.0µg/filter (10 $\mu g/m^3$)

" – " The sampling diffusion tubes were either destroyed or missing

Table 5-6: NO_2 Monitoring Results

Monitoring Point	Monitoring duration (minutes)	NO_X Results ($\mu g/m^3$)
Bargoni village	888	17.3
Ngini village	816	9.42
Bobo village	745	15.5
Jipe village	735	5.2
Hindi	840	-
Mokowe primary school	730	3.2
Mikanjuni island	864	2.2
Mtangawanda jetty – Pate island	820	-
Masjid mosque – Pate island	865	26.6
Project site - Kwasasi	768	10.0

5.6.3 Meteorological conditions

The climate of Lamu County is difficult to describe accurately because there are very few recording stations. However, the climate is related to the regional climatic patterns, the bi-annual movement of the Inter-tropical Convergence Zone and the two Monsoons, namely the North-Eastern ('Kazkazi') and the South-Eastern ('Kuzi').

5.6.3.1 Temperature

Table 5-7 indicates the average, average maximum and average minimum temperature data in Lamu measured over a period of 15 years. It also indicates the lowest and highest recorded temperature.

[1]Table 5-7: Air temperature records in Lamu

Parameter	Yearly average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average temperature (^{0}C)	27	28	28	29	28	27	26	25	25	26	27	28	28
Average high temperature (^{0}C)	28	30	30	31	30	28	27	26	26	27	28	30	30
Average low temperature (^{0}C)	26	26	26	27	27	26	25	24	24	25	25	26	26
Highest recorded temperature (^{0}C)	39	33	35	37	38	36	30	29	30	32	37	39	35
Lowest recorded temperature (^{0}C)	15	17	17	16	15	18	20	17	20	20	18	16	16

5.6.3.2 Wind

Figure 5-6 presents the mean monthly wind statistics for Lamu island based on observations taken between 06/2010 - 07/2015 daily from 7am to 7pm local time.

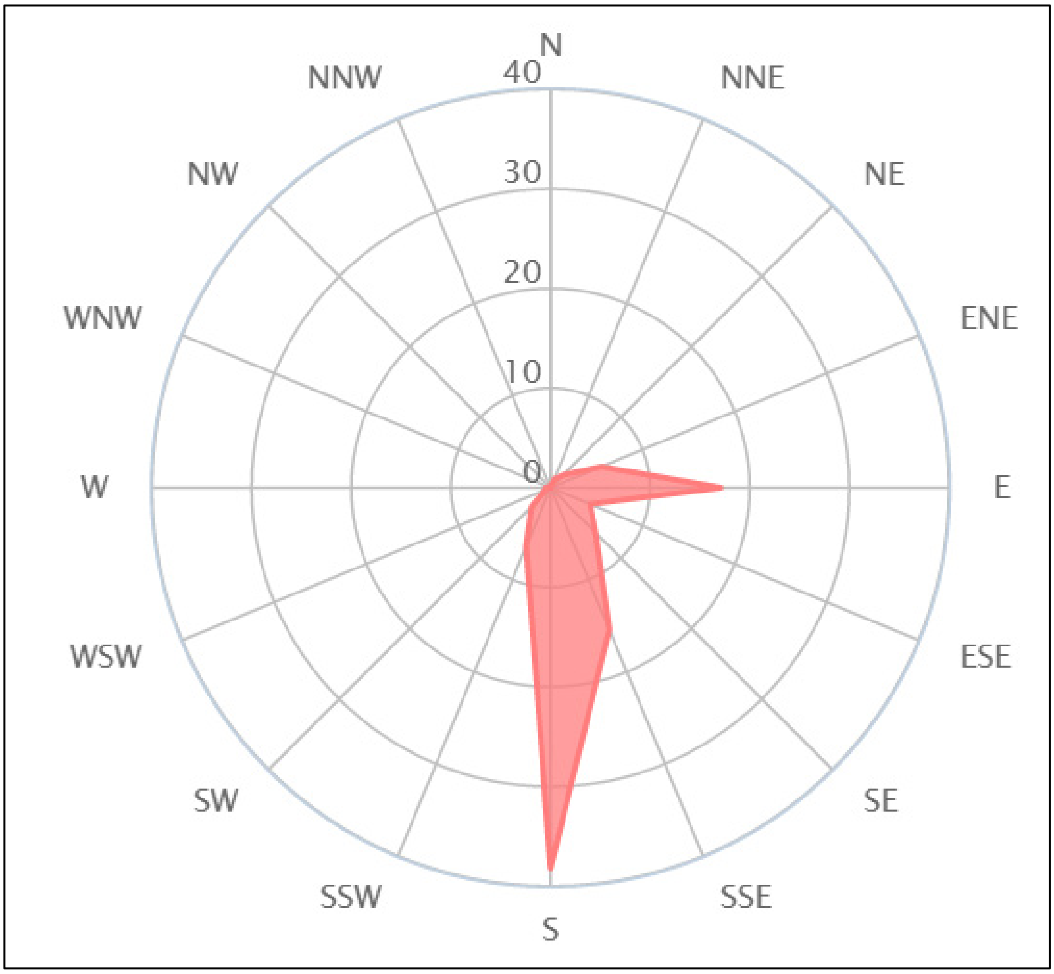
[1] Source: http://www.weatherbase.com (sampling period of 15 years – accessed July 2015)

[2]Figure 5-6: Mean monthly wind statistics for Lamu

Month of year	Jan 01	Feb 02	Mar 03	Apr 04	May 05	Jun 06	Jul 07	Aug 08	Sep 09	Oct 10	Nov 11	Dec 12	Year 1-12
Dominant Wind dir.	←	←	←	↑	↑	↑	↑	↑	↑	↑	↖	←	↑
Wind probability >= 4 Beaufort (%)	31	31	19	27	34	43	18	25	29	13	11	19	25
Average Wind speed (kts)	10	10	9	10	10	10	9	9	10	8	7	9	9
Average air temp. (°C)	29	30	31	32	29	28	28	28	29	30	30	31	29

Figure 5-7 shows the all year wind direction distribution for Lamu island based on observations taken between 06/2010 - 07/2015 daily from 7am to 7pm local time. Prevailing winds are from the South (38.2% of the time) and East (17.1% of the time) – source: http://www.windfinder.com/windstatistics/lamu_manda_airport - accessed on August 13, 2015.

[3]Figure 5-7: All year wind direction distribution for Lamu island



[2] Source: http://www.windfinder.com/windstatistics/lamu_manda_airport (accessed July 2015)
[3] Source: http://www.windfinder.com/windstatistics/lamu_manda_airport (accessed July 2015)

The numbers on the diagrams represent the percentages of time in which the average wind was blowing from a certain direction. The radius of each of the twelve segments represents the percentage of time that the wind blows from each direction segment.

5.6.3.3 Rainfall

The rainfall pattern in Lamu is bimodal with the long rains falling throughout the county from mid-April to the end of June with light showers in July. May is the wettest month. The short rains fall in November and December. January to March are usually dry months. The degree of reliability of the short rains decreases from south to north.

The amount of rainfall in the long rains decreases from a strip of about 10 km wide from the coastline into the hinterland at a rate of about 100 mm per 5 km. The short rains increase from the coastline for the first 10 km and then decrease again. The highest average annual rainfall above 1000 mm occurs about 5-20 km inland. It is however, interrupted by Mkunumbi Bay. Generally, rains in the County are likely to be heavy every 3 or 4 years and relatively light in the intervening periods. The County lies within the 600 to 1,000 mm isohyets and has three rainfall zones. The northern part of the County is semi-arid with an average annual rainfall of just over 500 mm. In the middle section, an annual rainfall of 750 mm is common. In the Southern coastal parts, rainfall in excess of 1,000 mm per year is common. The average annual rainfall thus decreases from south to north. Throughout most of the district, there is more than 30% chance of receiving less than 500 mm of rain in any one year, and in the more semi-arid north, there is more than 30% chance of receiving less than 380 mm in a year.

Rainfall data for Lamu is shown in Table 5-8.

[4]Table 5-8: Average monthly rainfall (1906 - 1985) in Lamu in millimeters

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
5.6	2.7	24.8	134.7	360.1	169.0	81.4	41.5	40.2	41.7	33.0	26.2	961.3

5.6.3.4 Relative humidity

Table 5-9 shows the relative average monthly humidity in percentage (%) measured in Lamu over a 5 year period.

[5]Table 5-9: Average monthly morning, evening and dew point humidity at Lamu (%)

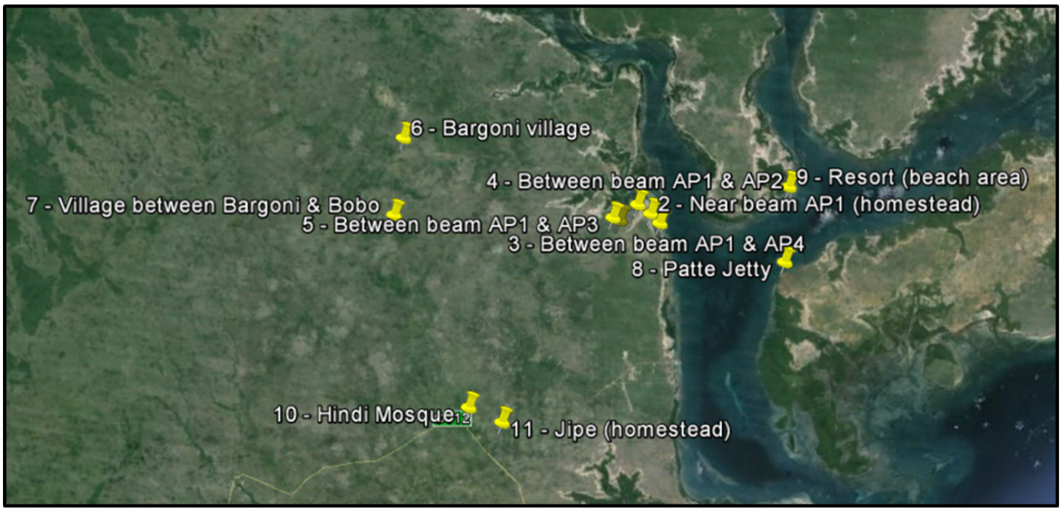
Parameter	Yearly average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Morning	87	88	88	87	88	87	82	81	82	84	88	91	91
Evening	67	62	61	61	70	76	72	70	69	68	66	66	65
Dew point	22	22	22	23	24	23	21	21	21	21	22	23	23

[4] Source: http://www.worldclimate.com/cgi-bin/data.pl?ref=S02E040+2100+63772W – accessed on August 13, 2015
[5] Source: http://www.weatherbase.com (sampling period of 15 years – accessed July 2015)

5.7 Noise quality

An ambient noise survey was conducted for the Project for period of 6 days from 10th January 2015 to the 15th of January 2015. The results of this survey were used to undertake noise modelling based on the types of equipment that will be used during the construction and operational phases of the project. A total of 11 daytime noise measurements were taken at locations along the Project boundary and various locations extending more than 1.5 km from the Project boundary as shown in Figure 5-8.

Figure 5-8: Locations of Ambient Noise Monitoring Locations



5.7.1 Sensitive areas

From a survey of the Google Earth satellite imagery and project drawings provided by the EPC contractor, eleven (11) locations were included in the baseline survey carried in January 2015. These locations and receptors are detailed in Figure 5-9 and 5-10 and Table 5-10 below.

Figure 5-9: Locations of Ambient Noise Monitoring Locations (All Locations)

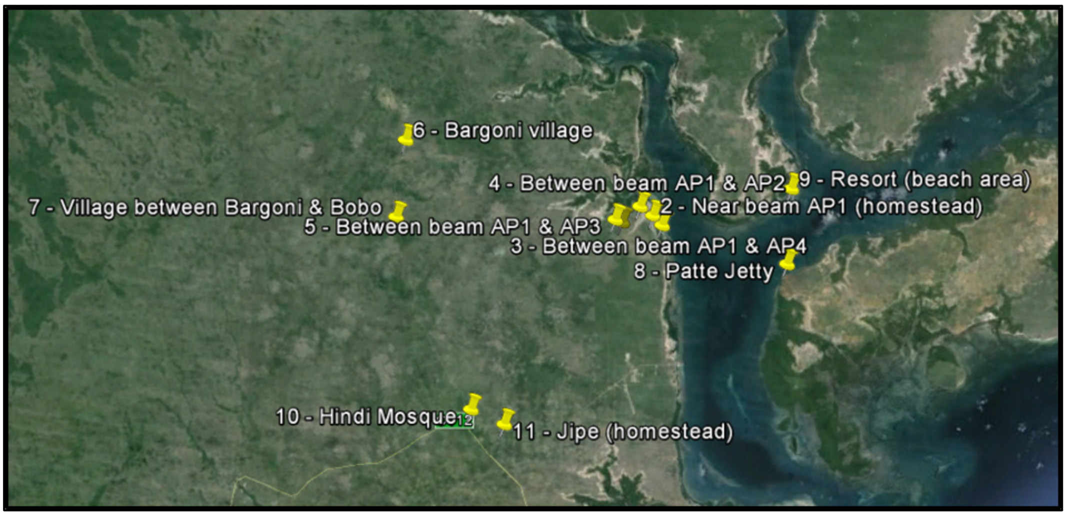


Figure 5-10: Locations of Ambient Noise Monitoring Locations (up to 1.5 km from Project Boundary)

The measurement of baseline noise is used to determine the ambient noise climate of the Project area. For the purposes of this modelling assessment, it is considered most conservative to adopt the lowest L_{Aeq} value measured on the site boundary (record No. 3 - Between beam AP1 & AP4) for use as the baseline noise level for any other locations on the boundary for which no measurement was collected, which in this case is equal to 43.8 dB(A).

5.7.2 Noise levels

The baseline noise levels measured at the eleven receptors identified are given below.

Table 5-10: Baseline Noise Levels and Receptor Descriptions

No.	Description	Coordinates	Noise Level L_{Aeq} (dB(A))				Ambient Noise Description
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	
1	Near beam AP4 (homestead)	S02°05'19.6" E040°53'30.0"	53.0	31.9	54.2	85.8	(No record)
2	Near beam AP1 (homestead)	S02°05'09.3" E040°54'25.0"	47.3	39.0	50.9	68.6	(No record)
3	Between beam AP1 & AP4	S02°05'26.4" E040°54'41.0"	43.8	39.8	46.3	58.8	Waves from the ocean
4	Between beam AP1 & AP2	S02°04'52.8" E040°54'02.4"	49.4	44.2	51.7	66.9	General domestic noise

No.	Description	Coordinates	Noise Level L_{Aeq} (dB(A))				Ambient Noise Description
			L_{Aeq}	L_{A90}	L_{A10}	L_{Amax}	
5	Between beam AP1 & AP3	S02°05'15.5" E040°53'18.3"	44.1	31.9	43.8	60.2	Birds
6	Bargoni village	S02°02'49.6" E040°47'10.0"	42.2	35.0	42.6	64.5	Noise from the mosque, traffic and domestic noise
7	Village between Bargoni & Bobo	S02°05'05.6" E040°46'51.4"	43.2	37.3	46.9	54.2	General public noise
8	Patte Jetty	S02°06'38.0" E040°58'21.0"	58.9	55.4	61.0	71.2	Traffic (motor vehicles and motorcycles), boats, ocean waves and general public noise
9	Resort (beach area)	S02°04'24.8" E040°58'30.1"	46.9	44.3	48.9	52.1	Ocean breeze
10	Hindi Mosque	S02°10'47.8" E040°48'59.1"	51.0	46.4	53.2	65.1	Traffic along Hindi road
11	Jipe (homestead)	S02°11'14.9" E040°49'57.4"	47.5	43.0	50.2	59.5	Domestic noise from chicken/ hens and dog barking

Based on initial screening, a number of NSRs were selected for assessment in this study as shown in Table 5-11. This selection has been based on the location/receptors proximity to the Project facility, and sensitivity to the construction and operational phases of the Project.

Table 5-11: Selected NSRs for Noise Impact Assessment

Noise Sensitive Receptor and Description		IFC receptor classification	Ambient Day/Night time Noise Limits[1] dB(A)	Baseline Day Time Ambient Noise dB(A)
NSR1 [2]	Near beam AP4 (homestead)	Residential	55 / 45	53.0
NSR2 [2]	Near beam AP1 (homestead)	Residential	55 / 45	47.3
NSR3 [2]	Between beam AP1 & AP4	Residential	55 / 45	43.8

Noise Sensitive Receptor and Description		IFC receptor classification	Ambient Day/Night time Noise Limits[1] dB(A)	Baseline Day Time Ambient Noise dB(A)
NSR4 [2]	Between beam AP1 & AP2	Residential	55 / 45	49.4
NSR5 [2]	Between beam AP1 & AP3	Residential	55 / 45	44.1
NSR6 [3]	Dormitory (Northwest corner)	Residential	55 / 45	43.8
NSR7 [3]	Dormitory (Northeast corner)	Residential	55 / 45	43.8
NSR8 [3]	Worker Camp (Northwest corner)	Residential	55 / 45	43.8
NSR9 [3]	Worker Camp (Northeast corner)	Residential	55 / 45	43.8
NSR10 [3]	Worker Camp (Southwest corner)	Residential	55 / 45	43.8

Note 1: Standards in accordance with IFC EHS guidelines noise limits
Note 2: NSRs 1 to 5 are classified as existing receptors
Note 3: NSRs 6 to 10 are classified as new receptors associated with worker accommodation areas

NSRs 1 to 5 are existing receptors and are representative of the impact to the existing community. NSRs 6 to 10 are considered representative of locations which will be constructed for the purpose of accommodation of workers. As these NSRs fall within the boundary of the Project site, the land use classification is technically industrial, however, given that they are designed to accommodate workers, they have been classified as residential receptors under the IFC guidelines. In the case of new NSRs, assessment was done using a direct comparison against the IFC standard, and not the change in noise from the existing ambient noise levels.

5.8 Marine ecology and sea water quality

5.8.1 Marine Biodiversity

Marine resources in Lamu County are well represented by three major communities: mangroves, sea grasses and coral reefs. The proposed Lamu coal power plant will be located next to Manda Bay that is well sheltered from the open ocean. This area is in the Northern Monsoon Current Coast ecoregion, with closer ties to the Somali coast and northern locations than to the East African Coastal Current (EACC) to the south. It experiences seasonal reversal in the flow of the two currents in response to monsoon seasons. This affects the oceanography of the area, which is characterized by upwelling of cooler nutrient rich waters.

The upwelling results in a highly productive marine ecosystem with rich populations of fish, crustaceans and mollusks, and high abundance of migratory species such as seabirds and turtles. The three main marine ecosystems (i.e., mangroves, sea grasses and coral reefs) are strongly interlinked and dependent on each other ecologically. The mangroves protect sea grasses and coral reefs from terrestrial natural and anthropogenic influences e.g., sedimentation and pollution while coral reefs protects mangroves and sea grasses from strong waves. Sea grasses filter sediments and take-up nutrients and in the process control sediments from reaching coral reefs, which are so sensitive to turbid water.

5.8.1.1 Mangroves

Mangroves of Lamu constitute 75% of mangrove forest cover in Kenya that is approximately 45,960 ha or 3.0 % of the country's forest cover (Kirui et al. 2012). Mangroves of Lamu are found in creeks, protected bays and islands, mostly in intertidal zones that have continuous seepage or discharge of ground freshwater. Seven of the nine species of mangroves found in Kenya occur in Lamu, with *Rhizophora mucronata, Ceriop tagal* and *Avicennia* marina being the dominant species (Abuodha & Kairo 2001; Taylor et al. 2003). Mangroves forests provide a wide range of ecosystem goods (including fuel wood, medicine, food, construction materials) and services (including fisheries nursery grounds, sediment trapping and sewage phytoremediation) that are of immense value to local, national and global communities (Barbier et al. 2008).

5.8.1.2 Sea grasses

Sea grasses occur between mangroves and coral reefs zones in the intertidal and subtidal areas, though they have ability to grow in 40m under water. The West Indian Ocean (WIO) region has 13 sea grasses species (Gullström et al. 2002), compared to global richness of 60 species (Short et al. 2007). In addition the East African region together south Asia and south Australia to eastern Pacific with 24 species constitute one of the six recognized global bioregions based on taxonomy and physical separation of the world's oceans. Just like the other sections of marine system in Kenya, Lamu has large areas under seagrasses area and are well represented by roughly 13 species (Short et al. 2007). Sea grasses have very high primary production and a complex habitat structure that support a variety of benthic, demersal and pelagic organisms. Many fish and shellfish species, including those of commercial interest, are attracted to seagrass habitats for foraging and shelter, especially during their juvenile life stages (Gullström et al. 2002). Seagrasses found in Kenya grow on limestone type of soils that are muddy. The organic loading is critical to growth of seagrasses, because it affects the oxygen content which they need to avoid anoxic conditions.

5.8.1.3 Coral reefs

Coral reefs are well represented along the Kenyan coastline. A 200km fringing reef dominates in the south while in the north the fringing reef is broken and occur in patches due discharges from rivers and cold upwelling Somali Currents. Compilation of coral information in the WIO for the last decade found 369 species of corals, with the majority (90%) being broadly distributed from East Africa to theWest Pacific (Obura 2012). In addition biogeographical assessment shows that coral reef communities in the south (Malindi to Dar re Salam) were significantly different from those in north (Kiunga and Somali). About two million people live on the Kenyan coast, mainly around Mombasa, with a significant percentage of them using reefs for fishing and tourism activities (Obura et al. 2002).

5.8.1.4 Sandy beaches

Sandy beaches are well represented in the Lamu. However the project area coast has narrow stretch (50 to 100m) wide, that was interspersed with mangroves forests. Sandy beaches are important feeding grounds for numerous bird species as well as habits for crabs and marine turtles.

5.8.2 Marine baseline survey

In order to carry out coastal wetlands and marine ecological assessment for the proposed 1,050MW coal power plant, a general survey was conducted for the entire footprint area of the coal power plant to assess the presence and distribution of coastal wetlands and marines critical habitats. This was carried out with the help of key informants' who provided important local ecological information on distribution and abundances of species and habitats. Key informants included chairmen of mangrove cutter associations, Beach Management Units (BMU), local leaders and administrators. Ecological information obtained was corroborated with government records and published data and literature in journals and reports.

For the marine habitats, three transects were made from shore line to the deepest point in ocean area where a jetty and several structures will be erected for intake and discharge of water for the cooling system (Figure 5-11). Each transect started from the highest watermark (HWM), perpendicular to the shore line, to a distance of between 3km to 6 km off-shore. Sampling of mangroves, sea grasses and coral reefs was carried along the three transects employing gradsect or gradient-directed transects (Bullock 2013). The method comprises establishing transects to sample intentionally the full range of floristic variation over a study area by placing quadrants at the points along the gradsect or point quadrats or line transects.

In the mangrove sections, sampling consisted of walking along transects and recording all mangroves species present in 10x10m quadrants, spaced 20 metres apart. Also observations were made on the general conditions of mangrove forest, soil and presence of human activities such as fishing, tree harvesting and natural phenomena such as beach erosion. One composite sediment sample was taken for analysis of soil physical and chemical properties as well as heavy metals.

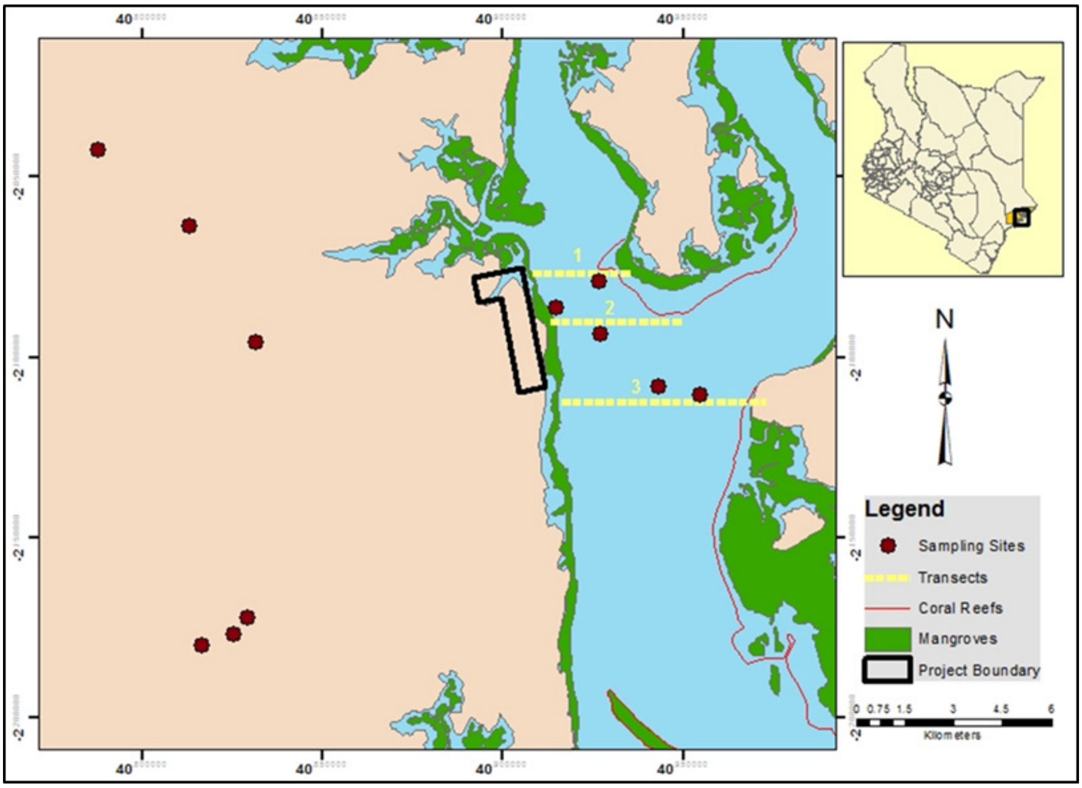
Occurrences of sea grasses were assessed by establishing quadrants of 10x10m, 250 metres apart along the three transects. In each quadrant the dominant species were used to characterize that zone or area.

Diving survey techniques were used to assess distribution and occurrences of coral reef. The area under coral reefs, sea grasses, sand and boulders was estimated along the three transects, primarily where water samples for water quality analyses were taken. More information on the general topography, distribution of sea grasses and coral reefs was solicited from key informants, fishers, mangrove cutters, fisheries and forestry officers. This information was enhanced with information published on marine biodiversity resources in the area.

Other marine taxonomic groups assessed in the study area were fisheries, macroinvertebrates, birds, sponges and algae. Information on occurrences of fishery species was solicited from key informants, representatives of BMUs and mangroves cutters who have local knowledge on where fish spawn, feed and dwell. This information was enriched with data and information obtained from Lamu County Fisheries Department and published literature (Anam & Mostarda 2012) including macroinvertebrates, birds, sponges and algae recorded along the coastline in mangroves, beaches and sea grasses meadows.

The IUCN red list for threatened species was used to determine species of conservation importance within the project zone of influence. The conservation status of species was determined by searching the scientific names of observed species on IUCN's online database. Emphasis was laid on species that were Critically Endangered, Endangered, Vulnerable, or Near-Threatened. In addition, national checklists were also used to document vulnerable species. All habitats recognized as important and critical for biodiversity conservation within Lamu County were identified and their major biodiversity concerns within them profiled. These included National Parks, National reserves and important biodiversity areas. The likelihood of species ranging into the proposed project site was also reviewed.

Figure 5-11: Map showing three marine transects



5.8.2.1 Marine habitats characterization

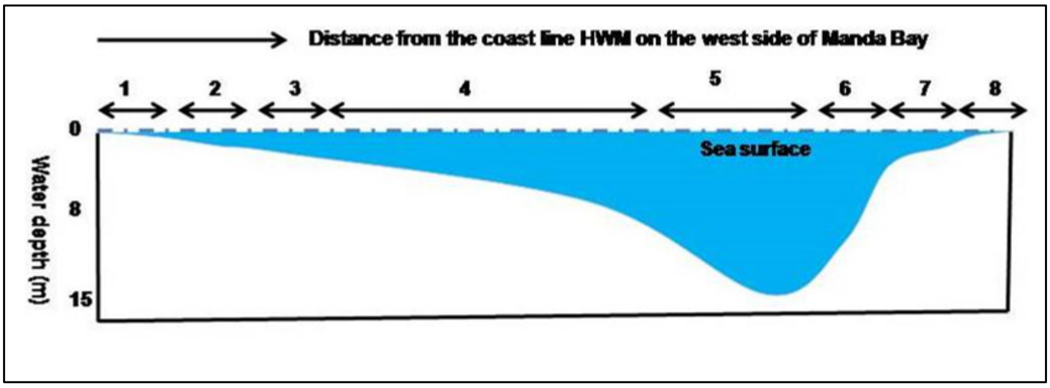
Marine habitats were characterized along three transects (Figure 5-11). It involved profiling and describing topography and substrate of the sea bottom along transects as well as location of various habitats from and at which depth from the Highest Water Mark (HWM). Generally three different topography types constituted the bottom of the ocean at Manda Bay in response to sea bed topography and slope gradient. The sea bed from HWM up to a distance of 2km offshore is very gentle sloping gradients and shallow up to a depth of 5m. Then followed a by steep gradient for the next one to two km with depth ranging from 6 to 60 metres.

Transect 1: The topography from the HWM is flat with sand deposits for 100 metres, followed by patches of mangroves forests with muddy-silty-sandy substrates for 100 metres and then 100 metres of exposed sandy and muddy beaches (Figure 5-12). From the lowest water mark (LWM) is gentle sloping seabed of sand, silt, rocky and sea grasses beds for 1.5 km (Table 5-12). Between 400m – 1500m from the shoreline, the water is moderate to clear and goes up to a depth of 9m. The length of Transect 1 was approximately 3km.

Table 5-12: Sea bed habitats, zones and topography characterization at Transect 1

Zone (from shore seawards)	Zone (m)	Depth from the HWM (m)	Sea bed habitats and coverage
1	150m	0m	100% sandy
2	150m	0.5-2m	100% mangroves, 100% silt-sandy and muddy substrates
3	100m	2-3m	100% silt-sandy
4	1500m	3-9m	50% sandy-muddy bottom and 50% rocks covered with sea grasses and algae
5	500m	9-15m	100% sandy – rocky bottom, 20 % coral reef patches
6	300m	9-3m	50% sandy-muddy bottom 50% rocks covered sea grasses and algae
7	200m	3-3m	100% mangroves, 70% silt muddy and 30% sandy.
8	100m	0-1m	100% sandy

[6]Figure 5-12: Bottom cross-section profile at Transect 1



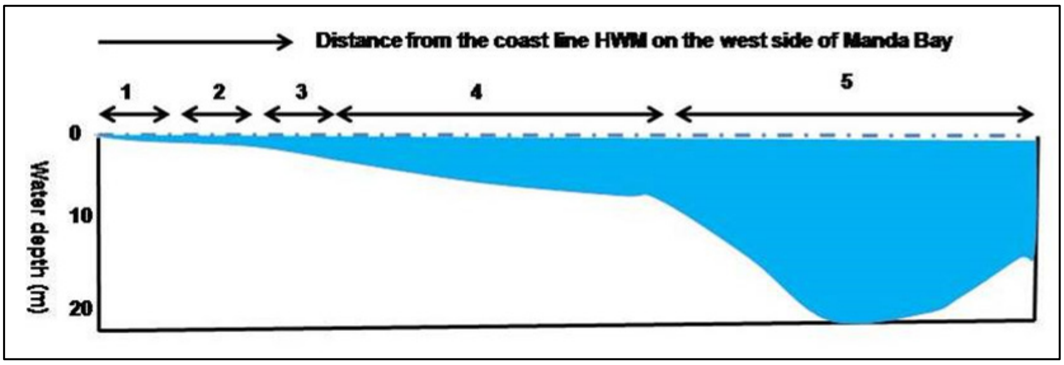
Transect 2: The topography from the HWM is flat with sand deposits for 100 metres, followed by a stretch of mangroves forests with muddy-silty-sandy substrates for 200 metres and then 100 metres of exposed sandy-muddy beaches (Figure 5-13). From LWM, the sea bed is gentle sloping and consists of sand, silt, rocky and sea grasses beds for 1.5 km (Table 5-13). The water is moderate to clear and goes up to a depth of 8m. It is then connects with deep sections of Manda Bay (9m to 20m). The bottom is covered by coral reefs, sea grasses and sandy areas. Transect Two is approximately 3.5km.

[6] Numbers 1 to 8 refers to zones' habitats and coverage as give in Table 4-10

Table 5-13: Bottom zonation and coverage at Transect 2

Zone (from shore seawards)	Zone (m)	Depth from the HWM (m)	Sea bed habitats and coverage
1	100m	0m	100% sandy
2	200m	0.5-2m	100% mangroves, 100% silt-sandy and muddy substrates.
3	100m	2-3m	100% silt-sandy
4	1500m	3-9m	30% sandy-muddy bottom and 70% rocks covered with sea grasses and algae
5	1000m	9-20m	50% coral reefs, 30% sea grasses and 20% rock bottom

[7]Figure 5-13: Bottom cross-section profile at Transect 2



Transect 3: The topography from the HWM is flat with sand deposits for 200 metres, followed by mangroves forests with muddy-silt-sandy substrates for 300 metres and then 200 metres of exposed slightly muddy sandy beaches. From the LWM, the seabed is gentle sloping with sand, silt, rocky and sea grasses beds for 1.6km (Table 5-14, Figure 5-14). The water is moderate to clear and attaining a depth of 10 metres. It is then followed by the deep sections of Manda Bay (11 to 25 metres) covering a width of 3km. The sea bed is covered with rocks, coral reefs, sea grasses and sand. Transect 3 is approximately 6km wide.

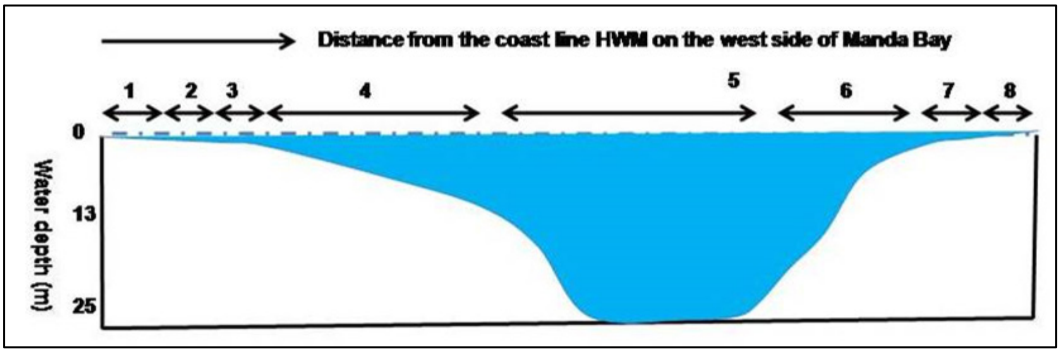
Table 5-14: Bottom zonation and coverage at Transect 3

Zone (from shore seawards)	Zone (m)	Depth from the HWM (m)	Bottom coverage
1	200m	0m	100% sandy
2	300m	0.5-2m	100% mangroves, 100% sandy-silty muddy bottom
3	200m	2-3m	100% silty sandy

[7] Numbers 1 to 5 describe zones' habitats and coverage as given in Table 4-11

Zone (from shore seawards)	Zone (m)	Depth from the HWM (m)	Bottom coverage
4	1600m	3-9m	50% sandy-muddy bottom and 50% rocks covered with sea grasses and algae
5	2500m	9-15m	100% sandy – rocky bottom, 20 % Coral reef patches
6	1000m	9-3m	50% sandy-muddy bottom 50% rocks covered sea grasses and algae
7	100m	3-3m	100% mangroves, 70% silt muddy and 30% sandy.
8	100m	0-1m	100% sandy-muddy bottom

Figure 5-14: Bottom cross-section profile at Transect 3. Numbers 1 to 8 describes habitats and coverage as given in Table 12



5.8.3 Coastal wetlands, marine water quality and sediment assessment

Water and sediment from marine and freshwater habitats around the project site are shown in Figure 5-15. Samples for coastal wetlands were collected from both freshwater sites (sites 2, 8, 10 and 13) and boreholes (6 and 9) whilst those of marine habitats were obtained from sites labeled as 1, 2, 4, 5 and 15-18. Sediment samples were obtained from four marines sites (1, 3, 13 and 18), with only one from Mbele Mbele wetland (Site 8). All samples were collected independently by SGS Kenya Limited and analyzed at the Laboratory in Mombasa according to applicable local and international standards and guidelines for sampling and analysis. Measured levels will act as baseline levels for future monitoring.

Measured water quality parameters are those whose limits have been set in the NEMA's water quality regulation (Environment Management and Coordination (Water Quality) Regulations, 2006). They include total suspended solids (mg/l), total dissolved solids (mg/l), Fluoride as F- (mg/l), Residual chlorine (mg/l), oil and greases % wt, total Nitrogen (mg/l), total cyanide (mg/l), phosphate in water (mg/l), chemical oxygen demand (mg/l), total phenols (mg/l), BOD 5 @ 20oC (mg/l), sulphides (mg/l), salinity (ppt), arsenic as As (mg/l), cadmium as Cd (mg/l), chromium as Cr (mg/l), copper as Cu (mg/l), iron as Fe (mg/l), nickel as Ni (mg/l), selenium as Se (mg/l), zinc as Zn (mg/l), total phosphorus as PO4 (mg/l), total coliform count (MPN/100ml), E. coli (MPN/100ml), permanganate index (mg/l) and anionic surfactants as MBAS (mg/l).

Similarly sediment analyses determined total cyanide (mg/kg), TPH C6-C44 (mg/kg), TPH C10 - C16 (mg/kg), TPH C16 - C22 (mg/kg), pH, arsenic as As (mg/kg), cadmium as Cd (mg/kg), chromium as Cr (mg/kg), copper as Cu (mg/kg), iron as Fe (mg/kg), nickel as Ni (mg/kg), lead as Pb (mg/kg), selenium as Se (mg/kg), zinc as Zn (mg/kg), mercury as Hg (mg/kg), total phenol (mg/kg), total nitrogen (C%), phosphates as PO4 mg/kg, organic matter (% wt), sulphides mg/l and total carbon (C %).

The results of the sampling and analysis are provided in table 5-15.

Figure 5-15: Marine water and sediment quality sampling locations

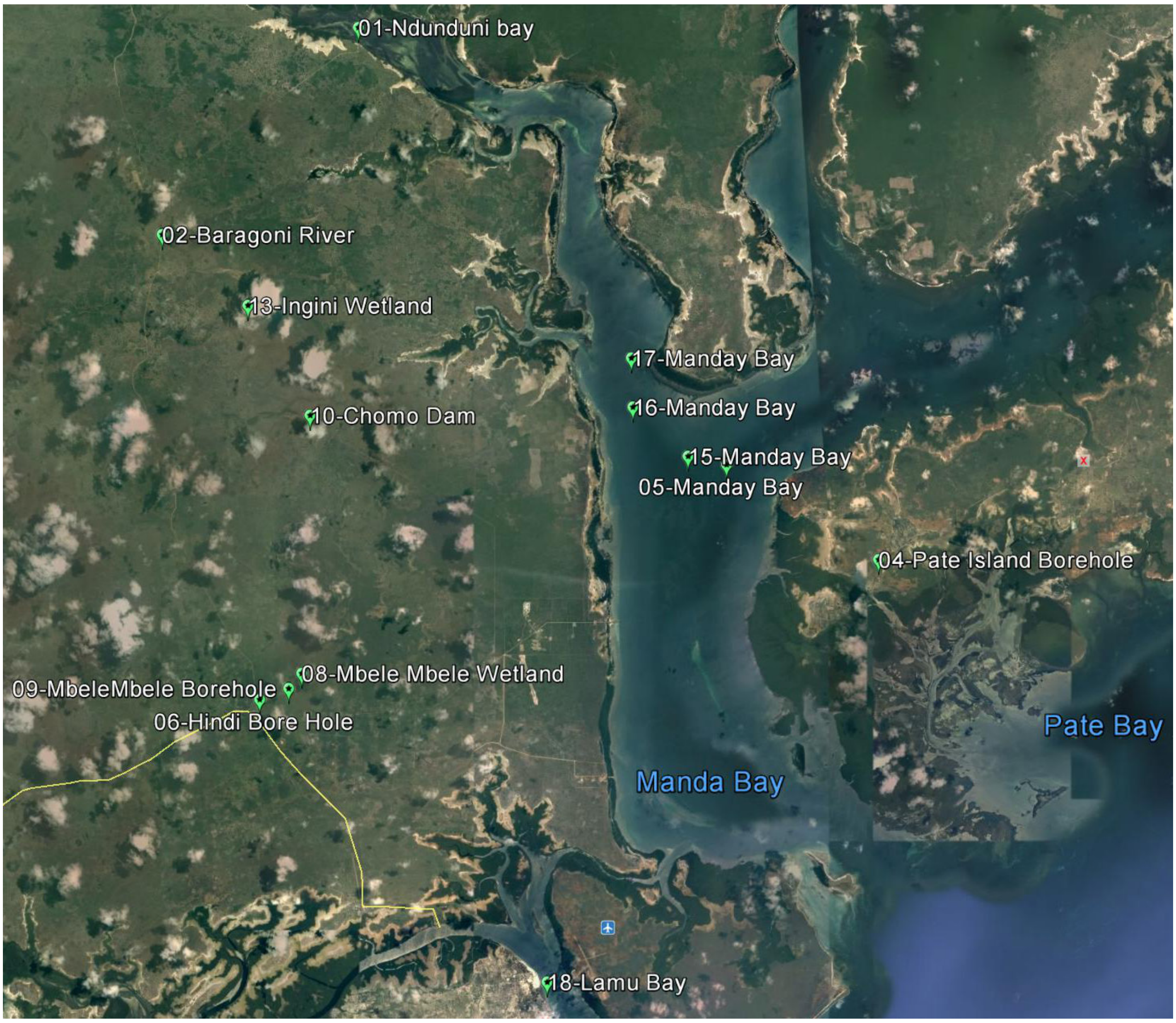


Table 5-15: Water quality measurements for Coastal wetlands, boreholes and marine

Site Number	1	2	4	5	6	8	9	10	13	15	16	17	18
Types of habitat	Marine	Coastal wetland	Bore hole	Marine	Bore hole	Coastal wetland	Bore hole	Coastal wetland	Coastal wetland	Marine	Marine	Marine	Marine
Site Name	Ndununi Bay	Baragoni River	Pate Island Borehole	Manday Bay	Hindi Bore Hole	Mbele Mbele Wetland	Mbele Mbele Borehole	Chomo Dam	Ingini Wetland	Manday Bay	Manday Bay	Manday Bay	Lamu Bay
Latitude (south)	-1.98125	-2.04256	-2.13872	-2.1106	-2.1801	-2.17236	-2.17684	-2.09603	-2.06352	-2.10814	-2.09359	-2.07908	-2.26372
Longitude (East)	40.845766	40.78765	40.99983	40.95481	40.81652	40.82898	40.82512	40.83148	40.81308	40.94342	40.92707	40.92661	40.90167
Ambient temperature (°C)	30.5	30.9	29	29.4	26.6	31.4	25.7	29.1	29	26.9	27.3	28.9	28.3
Temperature	29.4	28.3	26.1	30	28.8	31	29.6	29.6	29.7	28	28.5	28	28
pH	7.4	6.8	7.2	6.13	6.7	6.73		6.92	7.22	7.84	7.79	7.89	7.62
Total Suspended Solids (mg/l)	2	6	5	2	2	8	2	4	2	2	2	2	5
Total Dissolved Solids (mg/l)	31860	133	4512	30660	1036.8	265	468	67.2	30360	31560	31680	30600	32886
Fluoride as F- (mg/l)	1.77	0.55	0.96	1.93	0.41	0.47	0.21	0.1	1.77	2.54	1.52	1.7	1.5
Residual chlorine (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Oil and Greases % wt	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Total Nitrogen (mg/l)	5.8	0.9	64.84	0.99	38.74	10.6	45.66	9.28	3.8	4.42	4.7	1.46	133.63

Site Number	1	2	4	5	6	8	9	10	13	15	16	17	18
Types of habitat	Marine	Coastal wetland	Bore hole	Marine	Bore hole	Coastal wetland	Bore hole	Coastal wetland	Coastal wetland	Marine	Marine	Marine	Marine
Site Name	Ndununi Bay	Baragoni River	Pate Island Borehole	Manday Bay	Hindi Bore Hole	Mbele Mbele Wetland	Mbele Mbele Borehole	Chomo Dam	Ingini Wetland	Manday Bay	Manday Bay	Manday Bay	Lamu Bay
Latitude (south)	-1.98125	-2.04256	-2.13872	-2.1106	-2.1801	-2.17236	-2.17684	-2.09603	-2.06352	-2.10814	-2.09359	-2.07908	-2.26372
Longitude (East)	40.845766	40.78765	40.99983	40.95481	40.81652	40.82898	40.82512	40.83148	40.81308	40.94342	40.92707	40.92661	40.90167
Total Cyanide (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Phosphate In Water (mg/l)	0.9	0.2	0.9	0.9	0.1	7.7	0.3	Nil	Nil	1.1	0.3	0.3	0.1
Chemical Oxygen Demand (mg/l)	1876	577	225	1204	659	647	452	1176	2058	1526	975	475	596
Total Phenols (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BOD 5 @ 20°C (mg/l)	1038	320	125	669	366	356	235	528	1022	704	483	250	351
Sulphides (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Salinity (ppt)	34.7	1.2	4.1	33	1.8	1.3	1.5	0.9	31.8	34.1	34.1	32.7	35.3
Arsenic as As (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium as Cd (mg/l)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004

Site Number	1	2	4	5	6	8	9	10	13	15	16	17	18
Types of habitat	**Marine**	**Coastal wetland**	**Bore hole**	**Marine**	**Bore hole**	**Coastal wetland**	**Bore hole**	**Coastal wetland**	**Coastal wetland**	**Marine**	**Marine**	**Marine**	**Marine**
Site Name	**Ndununi Bay**	**Baragoni River**	**Pate Island Borehole**	**Manday Bay**	**Hindi Bore Hole**	**Mbele Mbele Wetland**	**Mbele Mbele Borehole**	**Chomo Dam**	**Ingini Wetland**	**Manday Bay**	**Manday Bay**	**Manday Bay**	**Lamu Bay**
Latitude (south)	**-1.98125**	**-2.04256**	**-2.13872**	**-2.1106**	**-2.1801**	**-2.17236**	**-2.17684**	**-2.09603**	**-2.06352**	**-2.10814**	**-2.09359**	**-2.07908**	**-2.26372**
Longitude (East)	**40.845766**	**40.78765**	**40.99983**	**40.95481**	**40.81652**	**40.82898**	**40.82512**	**40.83148**	**40.81308**	**40.94342**	**40.92707**	**40.92661**	**40.90167**
Chromium as Cr (mg/l)	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007
Copper as Cu (mg/l)	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Iron as Fe (mg/l)	<0.007	1.02	<0.007	<0.007	<0.007	12.57	<0.007	2.92	<0.007	<0.007	<0.007	<0.007	0.34
Nickel as Ni (mg/l)	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Selenium as Se (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc as Zn (mg/l)	<0.002	0.02	<0.002	<0.002	0.01	<0.002	0.02	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Total Phosphorus as PO_4 (mg/l)	0.02	0.27	0.63	0.14	0.26	12.23	0.07	0.17	0.02	0.13	0.05	0.08	0.18
Total coliform count (MPN/100ml)	23	Nd	110	23	240	>1800	79	240	8	11	23	22	>1800
E. coli (MPN/100ml)	8	Nd	8	Nd	13	>1800	23	14	Nd	Nd	2	2	>1800

Site Number	1	2	4	5	6	8	9	10	13	15	16	17	18
Types of habitat	Marine	Coastal wetland	Bore hole	Marine	Bore hole	Coastal wetland	Bore hole	Coastal wetland	Coastal wetland	Marine	Marine	Marine	Marine
Site Name	Ndununi Bay	Baragoni River	Pate Island Borehole	Manday Bay	Hindi Bore Hole	Mbele Mbele Wetland	Mbele Mbele Borehole	Chomo Dam	Ingini Wetland	Manday Bay	Manday Bay	Manday Bay	Lamu Bay
Latitude (south)	-1.98125	-2.04256	-2.13872	-2.1106	-2.1801	-2.17236	-2.17684	-2.09603	-2.06352	-2.10814	-2.09359	-2.07908	-2.26372
Longitude (East)	40.845766	40.78765	40.99983	40.95481	40.81652	40.82898	40.82512	40.83148	40.81308	40.94342	40.92707	40.92661	40.90167
Permanganate Index (mg/l)	Nil	Nil	1.96	Nil	0.16	Nil	1.57	4.81	0.49	Nil	Nil	Nil	Nil
Anionic Surfactants as MBAS (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

5.9 Terrestrial ecology

A terrestrial ecological assessment was carried out over the project area and its environs. The ecological impact assessment was conducted by specialists from the National Museums of Kenya, some of whom are national focal points for their respective discipline. Assessments carried out included:

a) Vegetation and plants;

b) Avifauna;

c) Herpetofauna;

d) Invertebrate fauna; and

e) Mammals.

Each specialist undertook a review of secondary literature on ecology available for Lamu County and the project site; this provided guidance on the field survey methods for baseline data collection.

Given below is the methodology that was employed for collection of field data on each of the above terrestrial ecological aspects.

5.9.1 Plant Survey

The plant and vegetation habitat baseline data gathering was desktop-based coupled with a rapid assessment of the site. Data was obtained specifically from the 'Recorded Plants of Kenya: A Reference Manual Giving Plant Names and their Locations in Kenya', (Waliaula, 1991) and the 'Plant Specimen Database of the East African Herbarium', a Botanical Research and Herbarium Management (BRAHMS) software support, which gives detailed account of plant species diversity and distribution.

In the rapid assessment, a plotless method as developed by Hall and Swaine (1981) and used in modification by Mwachala, et al. (2004) was used to record the plant species from 8th – 14th January, 2015. Vascular plant species were recorded and specimens collected using standard methods (Foreman & Bridson, 1992). Most of the species were identified on site whereas the difficult and unique ones were collected for confirmation at the East African Herbarium. Identification of indigenous vascular plants followed Agnew (2013), Beentje (1994) and the various publications of 'Flora of Tropical East Africa (FTEA)', (Polhill, 1952-2012) which together with the 'List of East African Plants (LEAP)', (Mwachala et al. 2011) were useful in taxonomic authentication and species distribution.

The conservation status of the species was based on the IUCN Redlist publication (IUCN, 2013) and listing undertaken by the East African Plant Redlist Authority (EAPRLA), (I-VIII, since 2006). Plants and animals species protected against trade are covered in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2015) website.

5.9.2 Avifauna Survey

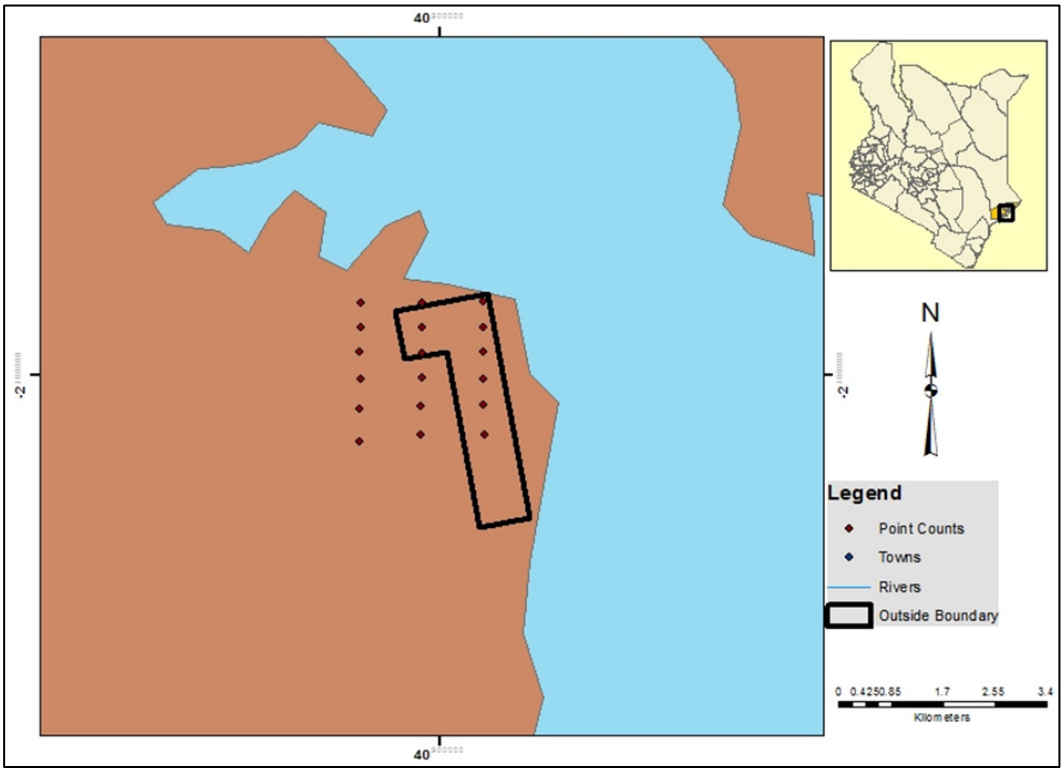
Two survey types were used to build an inventory of the bird species and their relative abundance at the site of PLCPP. These were: (i) Distribution and Abundance Surveys, where Fixed Point Counts and Timed Species Counts were used. These were used to build a species list for the site, record numbers, status (conservation, breeding and migratory status) and distribution of birds. Fixed width point counts (PCs) were set every 200m along 2km transect running North-South across the site. Three transects were set at the project site and planned buffer zone (Figure 5-16). The variables recorded for each such fixed point count included: time, species, number (number of adults/juveniles/chicks), activity (flushed, flying-display, flying-commute, perched-calling etc), cue i.e. seen or heard, distance to bird in (m), height above ground, fixed radius of count (m) and additional notes.

Timed species-counts (TSCs) method is ideal for building complete species lists quickly, and to establish the relative abundance of canopy and mid-level bird species. As many as possible 40-minute TSCs were conducted across the site and adjacent areas to cover all the different microhabitats on site. TSCs are essentially repeated lists on which are indicated the first time each species is first positively identified by sight and sound. For analysis species receive a cumulative score according to when they were first sighted on each count (ii) Vantage Point Surveys which although attempted to quantify flight activity of birds over the site and provide data for collision and displacement risk, the success was limited due to security and logistical problems on the ground.

Vantage point observations provide details on bird flight movement over the study site. An activity that is likely to be disrupted by the proposed development. Four vantage points-North, South, East and West were identified prior to the field visit and marked. We planned to spend a full day (6 a.m. to 6p.m.) at each vantage point but we only managed one point (see gaps and limitations). Ideally Vantage Point watches should be divided into three hour shifts distributed throughout the day (early morning, midday, late afternoon), to allow for observer fatigue and boredom but this was not possible. Ideally these vantage watches should be extended across a 12 month monitoring period and should provide an adequate (if minimal) sample of bird movements around the facility in relation to a representative cross-section of conditions and times of day.

The variables to be recorded for each vantage point survey include species, number (number of adults/juveniles), cloud cover, visibility, flight mode, flight direction, flight height and the movement is plotted on a topographical map.

Figure 5-16: Locations of avifauna point counts



Specialized equipment was used for gathering data accurately, quickly and efficiently. Equipment used were Binoculars (KOWA 10x42), Spotting Scope (KOWA TSN-2 60x), Field Guide (Birds of Kenya and Northern Tanzania, Zimmerman et al, 1999), GPS (Garmin E-trex 30) and a digital camera. Though avifauna field work requires a team of at least two field personnel (a spotter and recorder), we used only one person for this work.

5.9.3 Herpetofauna Survey

The study took place in the transition period between the dry and the wet season. During the study it rained only for three days whereas the rest of the days fluctuated between cloudy- misty morning and sunny afternoons. At night it was mostly cloudy and misty with some nights having slight showers.

The herpetofauna ecological field study encompassed the following: identification of habitats and microhabitats, identification of species of conservation importance as indicated by IUCN, and identification of adjacent sites and counties of Conservation Importance. A combination of field visit (Figure 5-16) and review of published literature including reports, scientific papers, maps and databases from National Museums of Kenya was used.

Amphibian and reptile sampling of species and habitats were accomplished by use of standardized time limited searches supplemented by visual encounter surveys and interviews to locals.

5.9.3.1 Time limited searches (TLS)

A 30 minute sampling period making up one time limited search (TLS) by two observers was carried out in different parts of the study site. Searches were done in all possible and amphibian micro-habitats such as wetlands, tree barks, under stones, decomposing logs, tree stumps, holes, shrubs, bushes including digging within loose soils (Karns1986, Sutherlands 1986, Heyer *et al*. 1994; Dodd, 2003). All the different species and number of reptiles and amphibians found were recorded. All the time limited searches were carried out during the day.

5.9.3.2 Visual encounter surveys (VES)

This un-standardized method used only for qualitative and semi-quantitative data mainly for presence or absence of species (Rödel & Ernst, 2004). Due to its flexibility and being opportunistic it contributes a lot in generation of species inventories.

Voucher specimens were fixed in 10% formalin after euthanasia. All the materials collected have been deposited at National Museums of Kenya (NMK), Nairobi herpetological collection. Global Positioning System (GPS) data for each point where specimens and important habitats were recorded using a Garmin receiver.

5.9.3.3 Interviews

Locals were asked question pertaining to reptiles and amphibians they encounter in the area. Initially the locals were asked to describe the species and later shown a picture of the animal in guide books (i.e. Spawls et al. 2002 and Channing and Howell, 2006).

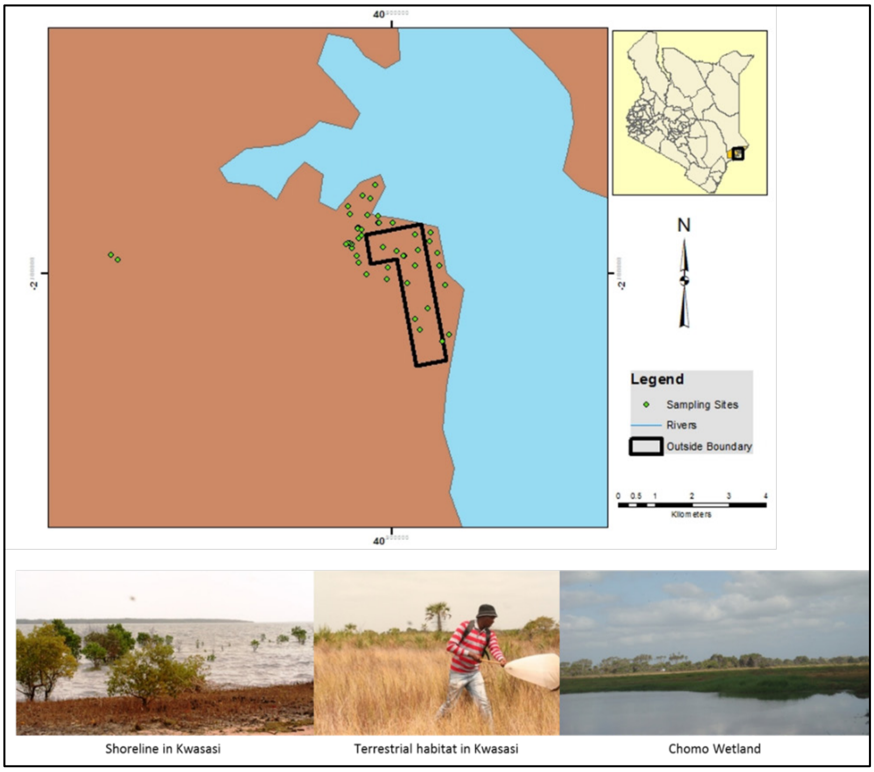
The IUCN red list for threatened species was used to determine species of conservation importance within the project site. The conservation status of species was determined by searching the scientific names of observed species on IUCN's online database. Emphasis was laid on species that were Critically Endangered, Endangered, Vulnerable, or Near-Threatened. In addition, national checklists were also used to document vulnerable species.

Figure 5-17: Sampling of herpetofauna in different habitats

5.9.4 Invertebrates Survey

Invertebrates were sampled in the terrestrial, fresh water habitats as well as in the marine ecosystem adjacent to the study site as shown in Figure 5-17. Five invertebrate sampling methods were employed. These are briefly described below together with images (Figures 5-18 – 5-24) showing invertebrate sampling methods.

Figure 5-18: Map of the study site showing the sampling points (SP) in Kwasasi



5.9.4.1 Sweep netting

This involved the use of sweep nets to collect flying invertebrates as well as those resting on vegetation. Due to the great association of invertebrates and plants, sweeping was selectively done in areas with vegetation cover as some areas had been burnt by the local community at the time of survey.

Figure 5-19: Sweep netting (left) and insect sorting and preservation in Kwasasi, Lamu County

5.9.4.2 Pond netting

Pond net method was employed to sample aquatic invertebrates both fresh water and marine habitats. It involved making scoops in the water and emptying the collection on to a sorting tray.

Figure 5-20: Pond netting in the sea (left) and A dragonfly from Chomo wetland in Kwasasi (right)

5.9.4.3 Pan trapping

Pan trapping targeted the flower visitors which are in most cases pollinators. It involved the use of flowers mimicking yellow and blue colored plates in which water with a few drops of liquid detergent had been added. In total 30 plates were used, 15 of which were yellow and 15 blue. On each trapping day, three clusters of plated were laid. Each cluster comprised of 5 yellow and 5 blue plates. The clusters were laid in three separate areas of the study site; in the two extreme ends and in the middle. They were laid in areas with many plants with flowers to maximize on collection. The traps were left in the field for two days in each point. Specimens were then collected by passing the water through a plastic sieve and put in storage vials containing ethanol.

Figure 5-21: A yellow and blue pan traps in Kwasasi, Lamu County

5.9.4.4 Pit fall trapping

Plastic cups were dug into the ground such that their openings were at the same level as the ground. They targeted the ground crawling invertebrates such as ground beetles, wild cockroaches, millipedes and scorpions. The cups were half filled with water into which little detergent and ethanol had been added. In total 15 cups were employed and laid in three separate clusters of 5 cups each. The cups were set around next to identified bushes with a lot of detritus as most ground crawling invertebrates hide in them till dusk. The clusters were located in three separate areas of the study site; in the two extreme ends and in the middle. Specimens were then collected as with pan traps.

Figure 5-22: A pit fall trap in the project site (left) and harvesting the pitfall traps (right)

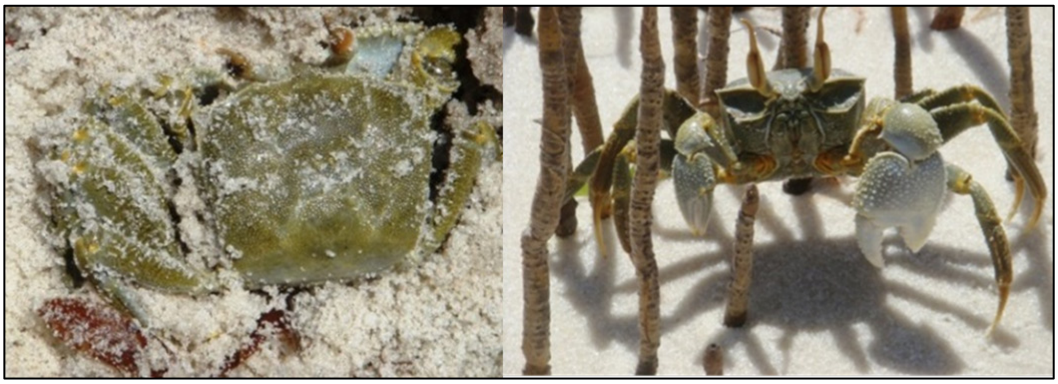
5.9.4.5 Hand picking

This method mainly targeted the marine invertebrates along the shoreline. The slow moving or sessile specimens were hand-picked and put into preservation vials. During this exercise the entire shore where this project will be located was sampled.

Figure 5-23: Hand picking of marine invertebrates along the sea in Kwasasi, Lamu County

All collected invertebrates specimens were preserved in vials containing absolute ethanol and transported to the Invertebrates Zoology Section in National Museums of Kenya for processing, identification and storage.

Figure 5-24: A horn-eyed ghost crab along the beach in Kwasasi, Lamu County



5.9.4.6 Specimen processing and identification

Terrestrial invertebrates mainly insects were first mounted on entomological pins before drying in ovens. Specimens were identified using identification keys and those difficult ones using reference collections at the Museum.

Figure 5-25: Specimens processing and identification at the Museum in Nairobi

5.9.5 Mammal Survey

Mammals were surveyed along random transects, paths and roads. The observer walked along transects paths at the speed of about 0.5km/h commencing 0630h to 1300h. Whenever an animal was detected, the following were recorded: i) Species, ii) detection sign (sighting, call, dung/pellets, spoor/footprints) and iii) location along transect.

5.10 Waste management

There is limited literature available on municipal solid waste management in Kenya and none for Lamu County. Disposal of waste in Lamu County is a significant problem as the town was not built for its current population size and waste management as there are no properly engineered waste management facilities in the County. The first County Integrated Development Plan (CIDP) for the period 2013 – 2017 developed by the Lamu County Government, identified solid waste and sewage management as key priorities under the sanitation. Under the CIDP, programs for implementation over a period of 4 years commencing 2014 includes development and implementation of a waste management strategy whose budget in 2013 was US$1.5 million. While specific initiatives have not been presented, the County Government's monitoring indictors include:

- Number of tones of wasted collected and disposed;
- Number of waste collection tools and equipment procured; and
- Number of waste management infrastructure put in place (incinerators, sewage systems).

There are a couple of dump sites on Lamu Island; the island does not have any sewage treatment plants and traditionally sewage has been in the form of pit latrines. In the Hindi/Magogoni sub-county where the proposed coal fired power plant is to be located, there are no properly engineered landfills or sewage treatment plants which can handle wastes generated by the proposed project.

The proposed coal power plant will generate a variety of wastes during the construction and operational phases of the project. Some of the details are described below.

During the construction phase, domestic and industrial wastes such as, timber skids, sewage, used lube oils and general refuse will be generated. At this stage, the estimated quantities of different types of waste streams cannot be estimated due to the lack of information. Regardless of this, all wastes generated from the project activities will need to be disposed in accordance with the Environment Management and Coordination (Waste Management) Regulations, 2006 (Legal Notice 121). There shall be a strong emphasis placed on housekeeping and cleanliness at the site in order to promote safety and minimize environmental impact. The characteristics of the wastes to be generated by the project are described below.

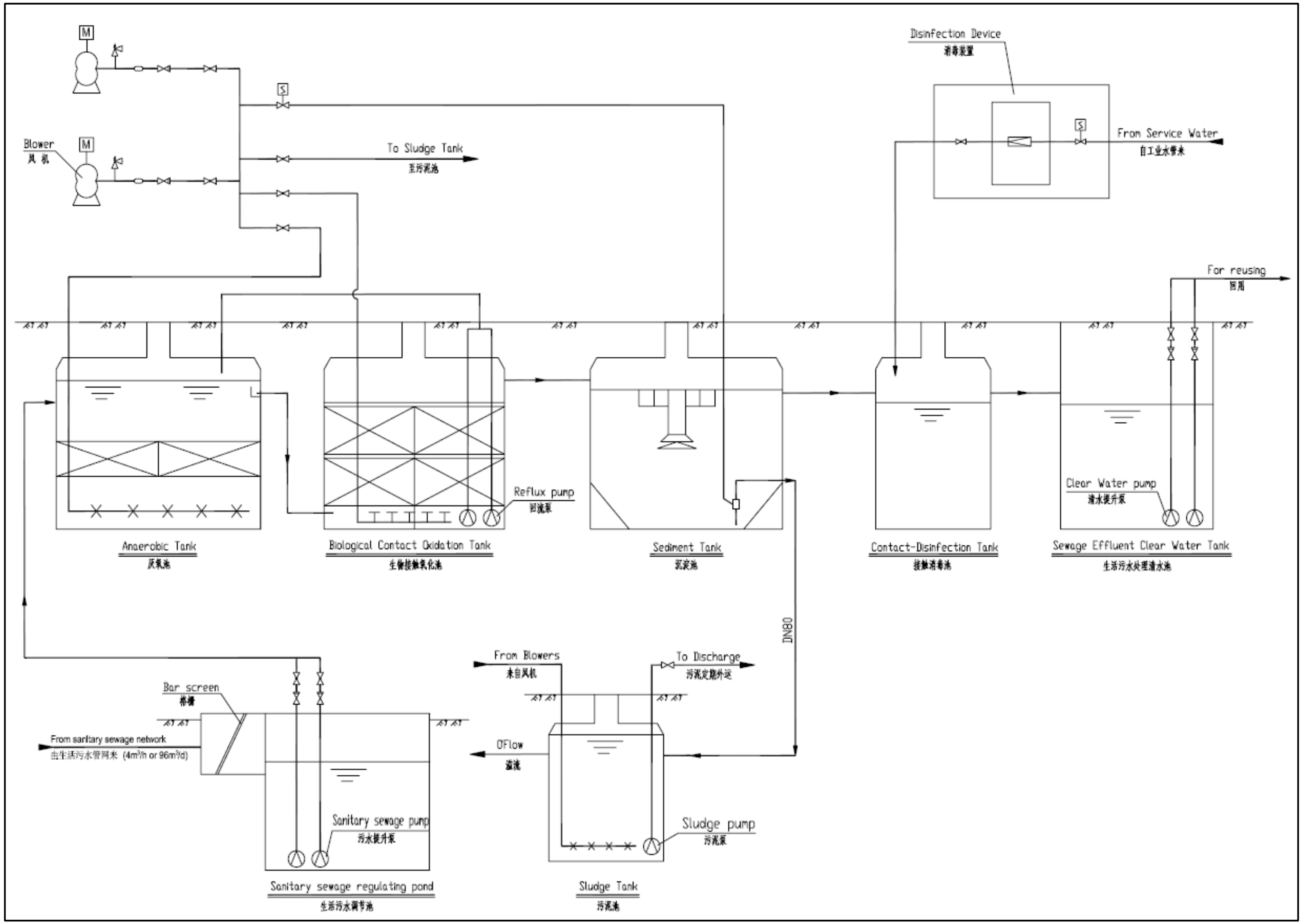
5.10.1 Domestic Wastes-construction and operational phases

The construction teams working at the project site or staying within the workers' camp are expected to be supplied with various forms of foodstuffs in a cafeteria or packed in plastic or other types of containers. This is expected to occur throughout the construction phase. Food and related types of domestic wastes generated by workers will need to be managed properly to avoid vermin. The management of such waste will be incorporated by the EPC Contractor in the Construction HSE Management Plan.

The sanitary sewage system at the proposed Lamu coal power plant will consist of sewage disposed through indoor sanitary utensils of all buildings in the power plant. It is estimated that all buildings within the power plant will generate about 96m^3/day of sanitary sewage for treatment. The sewage will first be collected in septic tanks by gravity, then flow into the sanitary sewage regulating pond through a bar screen so as to get rid of the large-sized solid impurities, then pumped into Buried Sanitary Sewage Treatment Equipment for biological contact oxidation treatment. The equipment will mainly be composed of an anaerobic tank, biological contact oxidation tank, sedimentation tank, sludge tank and disinfection tank. In the process, the oxygenated sewage will flow through the fillings in the tank to form biofilms at the fillings. After the sewage contacts the biofilms, it gets purified under the biological actions of the biofilms. The treated water is finally fed back to reuse water system where it will be used for dust suppression.

The effluent from the sewage treatment facility must comply with the discharge standards set out in the Environment Management and Coordination (Water Quality) Regulations 2006 (Legal Notice 120). A schematic of the sanitary sewage treatment system is shown in figure 5-26.

Figure 5-26: Schematic of the sewage treatment plant for the operational phase



5.10.2 Site Construction Waste-construction phase

The project is expected to generate waste from the site construction activities which includes:

- Demolition wastes;
- Excavated soils and vegetation;
- Construction equipment maintenance wastes;
- X-ray films;
- Dusts and fumes;
- Scrap metals;
- Packaging materials, etc.

As the quantities of the above categories of wastes is unavailable currently, the EPC Contractor will dispose the wastes in accordance with the applicable requirements of the Environment Management and Coordination (Waste Management) Regulations 2006 (Legal Notice 121).

5.10.3 Dust-construction and operational phases

The construction activities that will occur particularly during the site excavation process may potentially generate a considerable amount of dust and other particulates that will be released into the atmosphere. Additionally, dust may be generated from construction vehicles moving between the project site and various locations where construction materials are required to be transported from.

5.10.4 Smoke Emissions-construction and operational phases

The construction plant, machinery, equipment and trucks brought in by the EPC Contractor are expected to generate gaseous emissions when in operation during the construction activities. The concentration of emissions will depend on the maintenance levels of the equipment, machinery and trucks used by the Contractor.

5.10.5 Coal combustion products-operational phase

Coal combustion products include fly ash, bottom ash and gypsum. Fly ash and bottom ash are expected to be the primary waste generated by the Lamu coal fired power plant. The ash handling system will be designed to handle the maximum expected ash production output from 3 x 350MW boiler units. Fly ash and bottom ash will be removed separately; a dry ash mechanical conveying system for bottom ash (and economizer ash) and a pneumatic system for removal of fly ash from the hoppers. All ash will be transported to the ash yard on site via trucks minimizing dust. The ash quantity expected to be generated by the coal power plant is given in Table 5-16.

Table 5-16: Quantity of ash to be generated by Lamu coal power plant

Ash quality	1 x 350MW ash quantity (tons/hour)		
	Eskom (General)	New Vaal	Kenyan coal
Fly ash quantity	40.48	72.09	48.09
Bottom ash quantity	4.50	8.01	5.34
All ash quantity	44.98	80.10	53.43
Mill rejects quantity	1.19	1.58	1.40

The fly ash will be collected in 3 x 12m diameter storage silos.

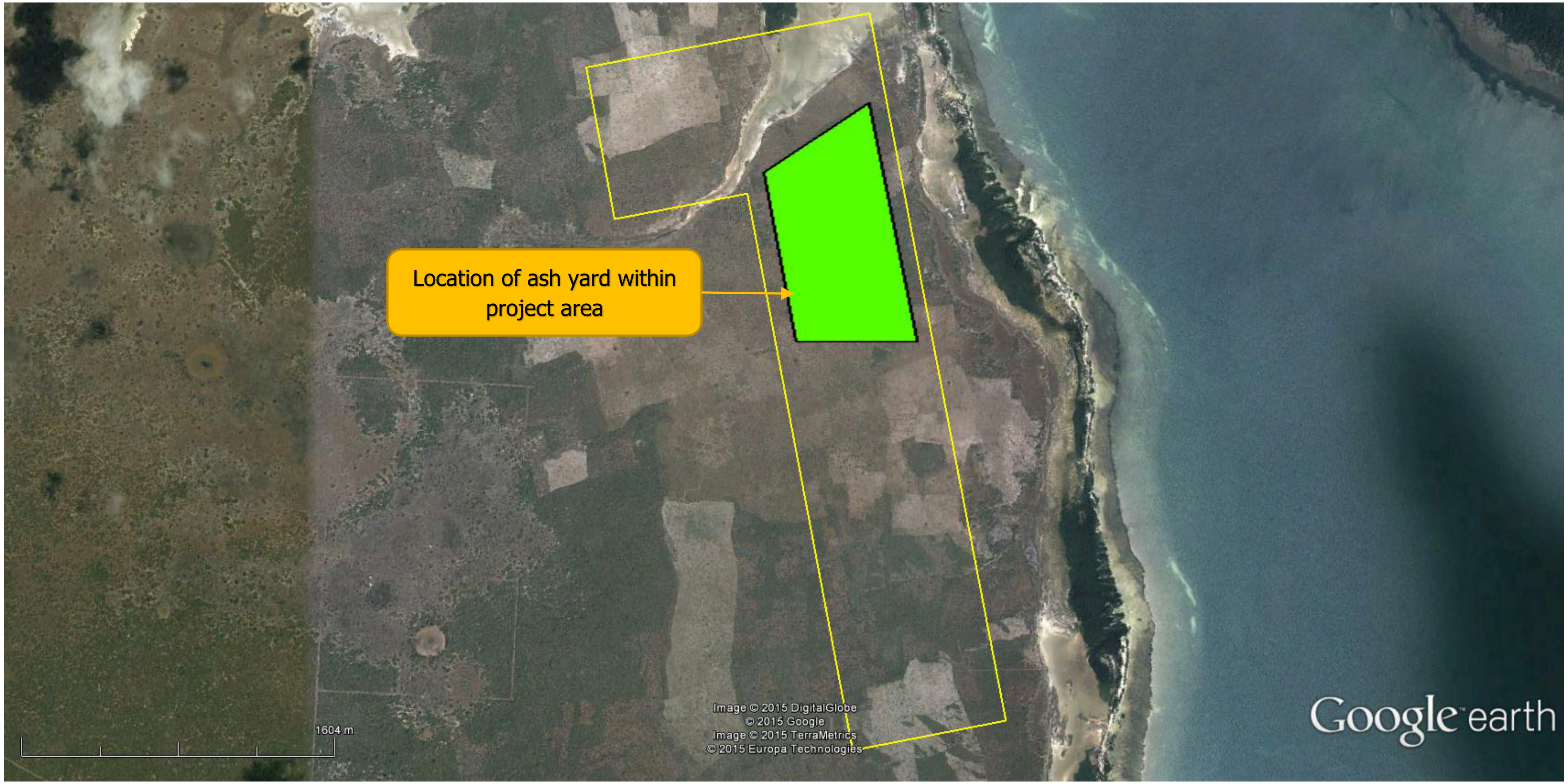
Bottom ash will be conveyed to bottom ash silo through dry slag conveyor. Pyrites in the mills will be conveyed by an electric vehicle after emptying the mills via a pneumatically operated dump gate to the vehicle bin.

The annual ash and gypsum reject load of one unit for this project is approximately 592,900 m^3. Trucks will convey bottom ash and fly ash in form power plant to the ash yard. Gypsum will be similarly conveyed to ash yard. The ash yard is located to the west of the power plant.

The ash yard occupies an area of ~162 acres (~65.8 hectares) and will be properly engineered for the life of the project; its locations is shown in Figure 5-27. The area is adequate for storing ash and gypsum for a period of 15 years. 3 units as the ash pile reaches an elevation of 25.80m with a volume of 26,740,000 m3 on completion of 15 years.

The HDPE penetration protective layer is arranged at the bottom of the ash field which will prevent the ash water from polluting the environment. The ash yard will have a total of six monitoring wells monitoring the ash yard underground water quality. The ash yard is surrounded by a 7.0 m ring road and drains, with an ash water treatment pool. The ash yard is equipped with facilities for sprinklers to spray water periodically depending on the condition of the piled ash to avoid dust pollution. The permanent slope in the ash yard will be maintained based on stability requirements at the project site.

Figure 5-27: Image showing extent of ash yard within coal power plant



5.11 Socio-economic and cultural environment

5.11.1 Data Sources

Baseline data has been developed using secondary literature as well primary information collated through stakeholder and community consultations conducted in the Study Area between January 2015 and June 2015. References to the secondary information are provided in the text.

The main secondary sources of information utilized for this baseline study include official statistics such as census reports, economic surveys, Lamu County Development Plans, maps and other available documentation on the history of the people and the area from a broad selection of recent and reliable sources, both published and unpublished. The main sources of information include:

- Kenya Population and Housing Census, 2009;
- Lamu County Integrated Development Plan (CIDP), 2013- 2017 – Revised June 2014;
- Kenya National Bureau of Statistics (KNBS) Statistical Abstracts of 2013 and 2014;
- Kenya Economic Surveys of 2013 and 2014;
- Information collected during consultations with the Lamu County Government officials;
- Information collected during consultations with the community and other stakeholders;
- Kenya National Bureau of Statistics (KNBS) and Society for International Development (SID) - Exploring Kenya's Inequalities - Lamu County (2013); and
- Other published material from the private sector, civil society and non-governmental organizations (NGOs) working within Lamu County.

5.11.2 Study area

Unless otherwise stated or implied by the context, the 'Study Area' for this study refers to Lamu County, where the proposed project will be located. While the study covers Lamu County as a whole, emphasis is placed on the proposed project site and the communities proximate to it.

Lamu County is located within the North-Eastern Coast of Kenya. It consists of a mainland and the Lamu Archipelago composed of 65 islands. The eminent islands are Pate, Lamu, Kiwayu and Manda. The proposed project site lies on the mainland.

The County covers a total land surface area of 6273.1 square kilometers with 130 kilometers of coastline and a water mass covering 308 square kilometers. The County lies between latitude 1 ^{0} 40, 2 ^{0} 30 South and longitude 40 ^{0} 15 and 40 ^{0} 35 East. It borders the Indian Ocean to the South and South East, Garissa County to the North, Somalia to North East and Tana River to the South West and West.

Lamu County has two parliamentary constituencies - Lamu East and Lamu West - and a total of ten county wards namely Shella, Mkomani, Hindi, Mkunumbi, Hongwe, Bahari, Witu, Faza, Basuba and kiunga. The proposed project site lies within Hindi ward in Lamu West constituency and covers an approximate 975.4 acres (394.9 ha.).

Table 5-17 shows Lamu County's constituencies, county wards and their sub-locations while Figure 5-28 displays Lamu County, the location boundaries and illustrates the location of the proposed project site. Figures 5-29 – 5-32 show various views of Lamu County.

Table 5-17: Lamu County area, constituency and wards

Constituency	County wards	Land Area (sq. Km)	Sub-locations
Lamu West	Shella	54.7	Shella and Manda
	Mkomani	172.5	Mkomani; Langoni; Matondoni and Kipungan
	Hindi	1150.8	Hindi; Bargoni; Mokowe and Kilimani
	Mkunumbi	1366.1	Mkunumbi; Mapenya; Uziwa and Ndambwe
	Hongwe	128.5	Hongwe and Bomani
	Bahari	123.3	Bahari; Tewe; Kiongwe and Central
	Witu	975.4	Pandanguo; Chalamula; Moa and Witu
Lamu East	Faza	79.2	Ndau; Kwatini; Kwatongani; Tchundwa; Myabogi; Siyu; Pate; Shanga and Kiwayuu
	Basuba	1708.7	Mararani; Mangai and Milimani
	Kiunga	513.9	Rubu/Mwabore; Mkokoni and Kizingitini
Total		**6273.1**	

Figure 5-28: Map of Lamu County illustrating the proposed project site

5.11.3 Views of the study area

Figure 5-29: Lamu town sea front

Figure 5-30: Kwasasi village - proposed project site

Figure 5-31: Mtangawanda, Pate Island

Figure 5-32: Sea front, Pate Island

5.11.4 Demography

5.11.4.1 Ethnic composition

Lamu County's population is a fusion of indigenous communities and a migrant community composed of individuals who have settled in Lamu for business and employment purposes. The main indigenous communities are listed below. It is important to note that all four are recorded as indigenous minority groups in Kenya.

- Orma - semi-nomadic pastoralists whose main source of livelihood is the rearing of cattle, goats and sheep.
- Sanye – one of the smallest sub-groups in Kenya. They have a Cushitic background and are traditionally hunters and gatherers. They engage in minimal farming that is mainly for subsistence.

- Boni (Aweer) – traditionally forest dwellers and hunter-gatherers. They mainly depend on the natural resources of the area for food and building material. The Boni engage in minimal farming.
- Bajuni - these trace their roots from Bantu and Arab descent. They mainly derive their livelihoods from fishing, farming

Other indigenous communities include the Korei, Swahili, Arabs, Kikuyu, Mijikenda, Pokomo/Riverine, Somali, Luo, Luhya, Taita and many others. The main ethnic group is the Bajuni. They make up about 46% of the total population. The Bajuni live in villages in the archipelago, e.g. Faza, Pate and Kizingitini and along the coastal mainland. The Boni make up 5% of the total population and reside mainly on the northern mainland. The Orma make up 2% of the population and are found in the southern part of the mainland. The Swahili/Shirazi and the Arabs, who constitute 1% and 6% of the population respectively, are mainly in the trading centres. The Kikuyu, Luo and Luhya together comprise about 24% of total of total population and the majority of them are in the Lake Kenyatta Settlement Scheme.

5.11.4.2 Population demographics

According to the 2009 National Census, which is the most recent population census conducted in the country, the population of Lamu County was at a total of 101,539 persons. The annual growth rate is recorded at 2.47%. Growth projections for the year 2015 stand at 124,092. This is projected to increase to 137,180 by 2017 (CIDP 2013- 2017). It is important to note that these projections do not take into account macro development initiatives such as LAPPSET, scheduled to be implemented in the County. That withstanding, the population is expected to grow more rapidly with the implementation of LAPPSET and its related projects. Table 5-18 illustrates Lamu County population projections by age.

[8]Table 5-18: Lamu County population projections by age

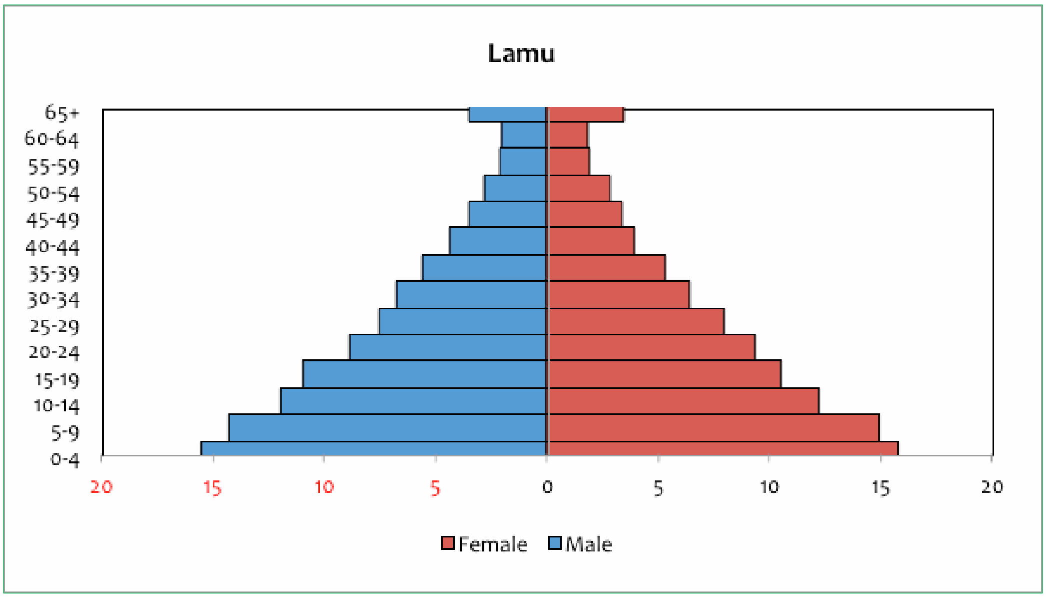
Age	2009 census			2015 projections			2017 projections		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	8,038	7,681	15,719	9,823	9,387	19,210	10,503	10,503	21,005
5-9	7,375	7,184	14,559	9,013	8,780	17,793	9,636	9,636	19,272
10-14	6,148	5,904	12,052	7,514	7,215	14,729	8,033	8,033	16,066
15-19	5,722	5,095	10,817	6,993	6,227	13,220	7,476	7,476	14,953
20-24	5,020	4,577	9,597	6,135	5,594	11,729	6,559	6,559	13,118
25-29	4,155	3,905	8,060	5,078	4,772	9,850	5,429	5,429	10,858
30-34	3,713	3,125	6,838	4,538	3,819	8,357	4,851	4,851	9,703
35-39	3,070	2,579	5,649	3,752	3,152	6,904	4,011	4,011	8,023
40-44	2,363	1,918	4,281	2,888	2,344	5,232	3,088	3,088	6,175
45-49	1,890	1,644	3,534	2,310	2,009	4,319	2,469	2,469	4,939
50-54	1,522	1,384	2,906	1,860	1,691	3,551	1,989	1,989	3,977
55-59	1,113	927	2,040	1,360	1,133	2,493	1,454	1,454	2,909
60-64	1,051	890	1,941	1,284	1,088	2,372	1,373	1,373	2,746
65-69	583	468	1,051	712	572	1,284	762	762	1,524

[8] Lamu County Integrated Development Plan (CIDP), 2013- 2017

Age	2009 census			2015 projections			2017 projections		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
70-74	533	476	1,009	651	582	1,233	696	696	1,393
75-79	228	197	425	279	241	519	298	298	596
80+	478	527	1,005	584	644	1,228	625	625	1,249
85+	43	13	56	53	16	68	56	56	112
TOTAL	**53,045**	**48,494**	**101,539**	**64,827**	**59,265**	**124,092**	**71,664**	**65,515**	**137,180**

Lamu County is stated to be at the onset of a fertility decline with 39.8% of households comprising of 0-3 members while 36% of households comprise of 4-6 members. The County has an age distribution of: 0 -14 years (41.7 %), 15 - 64 years (54.8 %), 65+ years (3.5 %). Figure 5-33 shows the Lamu County Population Pyramid.

[9]Figure 5-33: Lamu Population Pyramid



Lamu town is the main urban centre in the County with 20,572 inhabitants, as per the 2015 population projection. This is expected to grow to about 21,994 by 2017. With the envisioned macro-economic development programmes, such as LAPPSET, it is expected that new urban centres will emerge to cater for the rapidly expanding economy as well as expansion of existing market centres such as Mpeketoni and Hindi.

[9] KNBS & SID - Exploring Kenya's Inequalities - Lamu County (2013)

5.11.5 Culture

Lamu County is host to a myriad of rich ecological, archeological and cultural resources. Recorded to date back to at least the 12th century, Lamu Old Town is the oldest surviving Swahili town in East Africa. It is also the administrative capital of Lamu County today. In December 2001, Lamu Old Town was inscribed as a world heritage site by UNESCO's World Heritage Centre. It is the best-preserved Swahili settlement, retaining its original character and functions. The town is built in coral stone and mangrove timber, and is characterized by simple structural forms enriched by distinctive features such as inner courtyard, verandas and elaborated carved wooden doors. There are over 160 historic houses clustered in within the Stone Town.

Islam is the predominant religion in Lamu County, stemming from the strong influence of the Arab and Swahili cultures. The County is regarded as an important religious centre for Islam in East Africa. Swahili is the main language. The County has a very rich and pronounced Swahili culture and is a dominant cultural centre reputable for its historic past and traditional socio-cultural traditions that have been upheld to date. These traditions include religion, dressing, food, traditional medicine and crafts. Master craftsmen such as the boat builders of Matondoni and Kizingitini, masons, jewellers and woodcarvers of Lamu, leather workers of Siyu, all play dignified roles as custodians of heritage. Transfer of creative knowledge and skills to young people continues through the age-old practice of apprenticeship ensuring survival of the heritage. Figure 5-34 shows a boat builder in Mtangawanda, Pate Island.

Figure 5-34: A traditional boat builder in Mtangawanda, Pate Island

5.11.6 Gender

Majority of the local communities in Lamu County, including those within and proximate to the proposed project site are recorded as indigenous minority groups in Kenya and are considered marginalized. Women from minority and indigenous communities face multiple forms of marginalization as recognized in the Kenyan Constitution (2010). The constitution also considers women as a whole as a marginalized group along with children, the disabled, the elderly among others. In 2012, Kenya was ranked 46 out of 86 countries in the OECD Social Institutions and Gender Index, which assesses countries based on the existence of discriminatory social institutions, such as early marriage, discriminatory inheritance practices, violence against women, son preference, restricted access to public space and restricted access to land and credit. That notwithstanding, the constitutional changes geared towards affording women legal protections related to equality are yet to be fully realized. For instance, despite constituting half of the population, women only hold title to between 1% and 5% of land in Kenya[10].

Lamu County has a 52% - 48% male to female gender distribution as recorded in the 2009 National Census. Consultations held with women from the local communities highlighted the following as key challenges faced by the local women:

- Traditional and cultural biases in the allocation of roles and opportunities
- Difficulty in accessing maternal healthcare and high maternal mortality rates
- Discriminative cultural practices such as early marriages
- The triple burden of child bearing, economic production and home making, more so with the increasing number of female headed households
- Poor education levels underlined by non-progression to tertiary level training. There exist disparities in school attendance as female students constitute 47% of the total student population in the County while male students constitute 53%[11].
- Lack of adequate representation at levels of decision making and governance
- Lack of asset ownership, with emphasis on land. This has substantially undermined their access to credit services to start or improve business enterprises

5.11.7 Livelihoods

Lamu County's labor force stands at 54% of the population evenly distributed between male and female. This labor is however unskilled hence engaged in manual activities mainly in agriculture and homemaking. The County records high poverty levels standing at 31.6 %[12]. The main economic activities include employment, tourism, fishing, and agriculture (crop production and livestock husbandry). These are outlined below.

[10] challenges at the intersection of gender and ethnic identity in Kenya (2012)
[11] KNBS Statistical abstract 2014
[12] KNBS & SID - Exploring Kenya's Inequalities - Lamu County (2013)

5.11.7.1 Employment

The main contributors to employment in Lamu County include tourism, public sector service, agriculture, fisheries and livestock production. The labor force is mainly unskilled or semi-skilled. 17% of the residents with no formal education, 18% of those with a primary education and 33% of those with a secondary level of education or above are working for pay. Underemployment rate for the ages between 15 and 64 is recorded at 12.3% while the unemployment rate is at 5% as compared to the national rate of 9% as shown in table 5-19.

Table 5-19: Overall Employment by Education Levels in Lamu County

Education Level	Work for pay	Family business	Family Agricultural Holding	Intern / Volunteer	Retired/ Home-maker	Fulltime Student	Incapacitated	No work
Total %	20.9	10.8	39.4	0.9	13.1	9.2	0.4	5.3
None %	16.8	12.8	36.9	1.4	24.4	0.7	1.2	5.8
Primary %	18.1	10.3	45.0	0.7	11.3	9.3	0.2	5.1
Secondary +%	32.6	9.6	28.5	1.0	4.4	18.8	0.2	5.0

5.11.7.2 Tourism

Tourism is one of the key contributors to the economy of Lamu. This is influenced by the County's rich cultural identity, diverse flora and fauna, and listing of several world heritage sites. The main tourist attractions are Boni - Dodori National Reserve, Lamu Museum, Lamu Fort, Siyu Fort, Takwa Ruins, Swahili House, German Post Office, Lamu Old Town, Kiunga Marine National Reserve and 130 km of sandy beach coastline. The County has 183 hotels with a total bed capacity of 1,881.

5.11.7.3 Fishing

Fishing is the second largest driver of the Lamu economy. The County produces over 1,500 metric tons of fish annually valued at KShs111.8 million. 75% is from marine fishing and 25% from fish pond programmes on the main land and ox-bow lakes and water masses along the Tana River delta. A sample of typical boats used for fishing in the County is shown in Figure 5-35.

Figure 5-35: Fishermen at sea

5.11.7.4 Crop production

Crop production is mainly undertaken on the main land by small-scale farmers under rain fed conditions where annual rainfall ranges from 540 millimeters to 1,000 millimeters per year. In the County about 80% of the crops are grown during long rains while the remaining 20% are grown during short rains. The County has approximately 650,000ha of agricultural land with the overall average farms measuring 4ha each. The major crops grown include maize; sorghum; cow peas; cassava; green grams; bananas; sesame; mangoes; cotton; coconut bixa and mangroves. [13]42% of households' income is from cotton production, 14% bananas, 8% maize, 7% cassava, 6% bixa, 5% mangrove and 18% from the rest.

Figure 5-36: Harvesting of Sesame at Kwasasi

[13] Lamu County Integrated Development Plan (CIDP), 2013- 2017

5.11.7.5 Livestock husbandry

Livestock rearing is largely undertaken on the main land. The main livestock types include cattle, goats, sheep and poultry. Donkeys are also reared for local transport. The husbandry culture is generally free-range with few farmers practicing intensive feeding/ zero-grazing. Lamu County also provides grazing land for nomadic pastoralists from the surrounding Garissa and Tana River Counties which experience extended periods of drought. It is estimated that number of indigenous cattle within the County is approximately 5,000, while immigrant cattle number over 50,000.

Figure 5-37: Herd of cattle grazing by pastoralists in Roka

Figure 5-38: Community livestock watering point at Chomo

5.11.7.6 Education

Lamu County's education index stands at 0.68. [14]A total of 33% of Lamu County residents have no formal education while 54% have attained primary level of education only. Only 13% of Lamu County residents have secondary level of education or above. Lamu West constituency has the highest share of residents with secondary level of education or above. The County's literacy level is estimated at [14]70% but this proportion represents the highly exposed residents of Lamu west Sub County. Literacy levels for Lamu East are estimated to be less than 30%.

As of 2013, there were 74 primary schools, 11 high schools, and 4 tertiary institutions (Polytechnics) in the County. The county's Teacher to Pupil Ratio is 1: 40 for public primary schools and 1:39 for public high schools[15].

Figure 5-39: Bargoni primary school in Hindi Division

The County's primary and secondary school enrolment rates by year and school attendance and highest education level attained by sex are displayed through tables 5-20 and 5-21 below respectively.

[14] Lamu County Integrated Development Plan (CIDP), 2013- 2017
[15] KNBS Statistical abstract 2014

Table 5-20: Primary and secondary school enrolment by year

Education level	2007	2008	2009	2010	2011	2012	2013
Primary school enrolment	22,633	23,178	22,337	24,815	26,076	28,139	28,185
Secondary school enrolment	2,982	3,375	3,721	4,177	4,712	4,854	5,273

Table 5-21: Primary and secondary school enroment by gender

	Pre-Primary	Primary	Secondary	Tertiary	University	Total
Male	3,849	12,202	1,986	97	75	18,209
Female	3,703	10,985	1,414	93	35	16,230
Total	**7,552**	**23,187**	**3,400**	**190**	**110**	**34,439**

5.11.7.7 Health

According to the Kenya economic survey 2013, the number of health facilities listed in Lamu County was 42. There are: 1 district hospital; 2 sub-district hospitals; 20 dispensaries; 6 health centres; 12 medical clinics and; 1 nursing home. Of these, 24 are Government owned, 3 are owned by faith-based organizations, 1 is NGO owned and 14 are privately owned. These comprise of 3 level five facilities, 5 health centres, 1 nursing home and 33 dispensaries with a total bed capacity of 172 beds.

The recorded population per facility stands at 2,361 while bed distribution is recorded at 31. (Bed distribution is the number of beds per 1,000 age adjusted numbers of residents in a county). The average distance to the nearest health centre is approximately 5 kilometers.

As of 2013, the County's health personnel comprised of 4 medical doctors, 24 clinical officers, 94 nurses, 17 public health officers, 5 pharmacists and 30 technical personnel. The Doctor to Population Ratio is recorded at 1:36,343 (Lamu County Integrated Development Plan (CIDP), 2013- 2017)

Hindi ward, within which the proposed project site lies, is served by 4 health facilities namely Mokowe health centre, Hindi dispensary, Hindi Prison dispensary and Bargoni NYS dispensary. Lamu District Hospital is the main referral facility for the ward, with patients having to cross to Lamu by sea on boats from the Mokowe Jetty.

Figure 5-40: Mokowe health centre

Figure 5-41: Staff housing facilities at Mokowe health center

The prevalent diseases experienced in the County include malaria, respiratory tract infections and skin diseases (KNBS Statistical extract 2014). Infant mortality rates stand at 72/1000 while under five mortality rates are recorded at 123/1000.

5.11.8 Infrastructure and Services

5.11.8.1 Water

The County's main sources of water include rain water, ground water which is mostly saline, surface water from dams, pans, lakes, seasonal rivers and the ocean. In Lamu County, 52.9% of residents use improved sources of water while the rest rely on unimproved sources. (Improved sources of water comprise protected spring, protected well, borehole, piped water into household, and rain water collection while unimproved sources include ponds, dam, lake, stream/river, unprotected springs, unprotected wells, and water vendor). The average distance of household to access clean water is approximately 5km.

[16]Table 5-22: Source of water by County and Constituency

County and Constituency	Unimproved Sources	Improved Sources
Lamu County	47.1%	52.9%
Lamu East Constituency	82.6%	17.4%
Lamu West Constituency	39.0%	61.0%

5.11.8.2 Sanitation

Approximately 22.5% of households in Lamu County have no access to sanitation infrastructure, both improved and unimproved. These households utilize open fields and bushes for sanitation. 77.5% Lamu County households have access to sanitation infrastructure. Of these, 57% utilize improved sanitation compared to 61% nationally. Improved sanitation include flush/pour flush (to piped sewer system, septic tank, and pit latrine), ventilated improved pit latrine, pit latrine with slab, and composting toilet. 43% utilize unimproved sanitation. Unimproved sanitation include: public or shared latrine; flush/pour flush to elsewhere (not into a pit, septic tank, or sewer); pit latrine without slab; open pit latrine; bucket latrines; and hanging toilet / latrine.

Table 5-23: Sanitation and waste disposal by County and Constituency

County and Constituency	Improved Sanitation	Unimproved Sanitation
Lamu County	56.68%	43.32%
Lamu East Constituency	71.88%	28.12%
Lamu West Constituency	53.19%	46.81%

[16] KNBS & SID - Exploring Kenya's Inequalities - Lamu County (2013)

5.11.9 Transport

Lamu County is accessible by air, sea and road. The County has no rail transport.

5.11.9.1 Air transport infrastructure

Lamu County has 13 airstrips. Of these, 11 are public and 2 are privately owned. Manda airstrip is the main airstrip offering passenger travel with 3 airline companies providing daily passenger flights. Other airstrips in the County include: Manda point 11, Manda Bay Naval, Mokowe, Kiunga, Kiwayu Island and Kiwayu mainland (Mkokoni) which are fairly maintained. Other airstrips are: Witu, Mkunumbi, Faza, Kizingitini. These are under bad condition. Tenewi and Mangai are closed due to the LAPSSET project.

5.11.9.2 Road transport infrastructure

The County ranks 9th out of the 47 counties with the least road network density, standing at less than 20km/100km2 as compared to Nairobi which stands at over 430km/100km2 (road density determines the accessibility within the county, which is the ease with which goods and services and can be reached). The County's total road network stands at 688.6 Km with only 6 Km in bitumen standard (tarmac), 161.1 Km gravel surface, and 521.5 Km earth surface. Majority of the roads in the County offer rough travel by vehicles and are impassable during the rainy season.

There are two main roads that offer access into the County. These are:

- Mokowe - Garsen road
- Mokowe –Kiunga road

14-seater vans (Matatu) and commercial motorbikes (Boda boda) are the main means of public transportation within the mainland. Donkeys are the main form of transportation in Lamu Town with an estimated population of 2,200 donkeys being used for farming and transportation of provisions.

5.11.9.3 Sea transport infrastructure

There are 8 jetties in the County which include: Amu, Mokowe, Manda, Matondoni, Lamu customs, Fisheries and Hospital jetty. Amu, Matondani and Mokowe jetties are in good condition and are used by passengers, fishermen and for loading goods coming in and out of the Island. The rest are in poor conditions. Dhows, Semi-motorized dhows and speedboats are the main transport means for on-sea travel.

Figure 5-42: Lamu Customs (KPA) Jetty

Figure 5-43: Mokowe Jetty

5.11.9.4 Information and Communication Infrastructure

As of 2014, there were 2,600 fixed line telephone connections concentrated in Lamu town. Mobile phone network and connectivity covered 60% of the county with 51% of the residents owning mobile phones. Internet penetration was at 15%. Radio and television signals are extremely poor while the key national newspapers are distributed on average 1 -2 days late. Postal services are provided by the National Postal Corporation and other private courier service providers. [17]

5.11.10 Housing

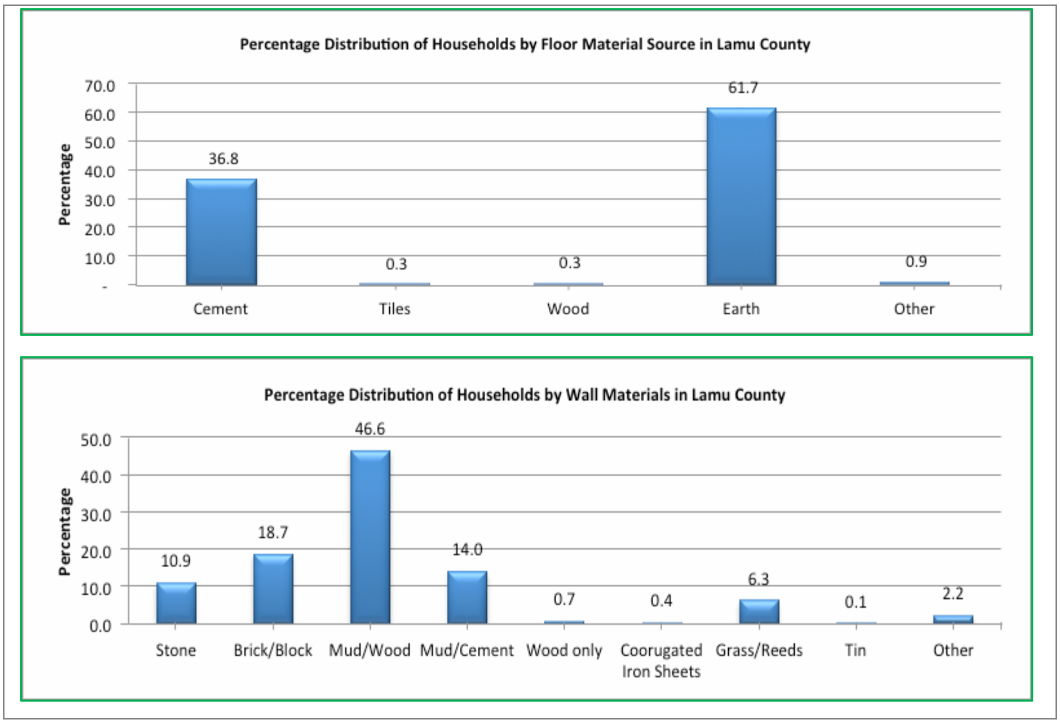
Housing is described according to the floor, wall and roofing materials.

30% of homes in the County have either brick or stone walls while 61% have mud/wood or mud/cement walls. 1% of the homes have wood walls. Less than 1% has corrugated iron walls while 6% have grass/thatched walls and 2% have tin or other walls[18].

37% of residents have homes with cement floors, while 62% have earth floors. Less than 1% has wood or tile floors[18].

11% of residents in the County have homes with concrete roofs, while 32% have corrugated iron sheet roofs. Grass and thatch roofs constitute 50% of homes, with less than 1% of the homes having mud/dung roofs[18.]

Figure 5-44: Lamu County percentage distribution of households by floor, wall and roofing materials



[17] Lamu County Integrated Development Plan (CIDP), 2013- 2017
[18] KNBS & SID - Exploring Kenya's Inequalities - Lamu County (2013)

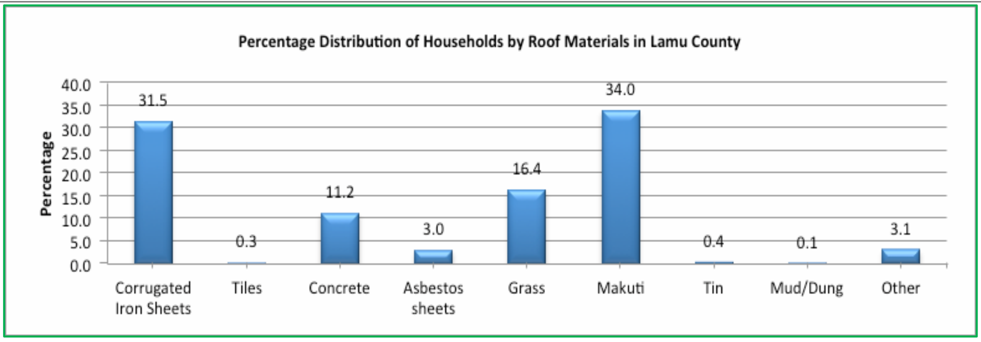


Figure 5-45: Mud/wood walls, earth floors and thatch roofed homes in Mtangawanda, Pate Island

5.11.11 Land use

Lamu County has a land surface area of 6273.1 square kilometers composed of 5,517 square kilometers of arable land 649.7 square kilometers of non-arable land, 130 square kilometers of coastline and 308 square kilometers of under water land mass. Lamu West takes 63.3% of land surface area at 3971.3 square kilometers while Lamu East takes up 36.7%. The County falls within 4 agro-ecological zones namely:

- Coconut Cassava zone (CL3)
- Cashew nut-Cassava zone (CL4)
- Livestock millet zone (CL5)
- Lowland ranching zone.(CL6)

Only 13,000 households in Lamu County have title deeds for the land they own. This translates to 42% of the total number of households in the County. The principal type of land tenure is trust/ancestral land holding. Majority of landowners are keeping their land parcels idle, without much economic activity. Most of the settlements are unplanned with scattered populations.

5.11.12 Energy

In Lamu County, the chief fuel source for cooking is firewood as utilized by 71% of the households. 23% of the households use charcoal, while 3% use paraffin. Only 1% of residents use liquefied petroleum gas (LPG). The main fuel source for lighting, as utilized by 39% of households, is tin lamps. A further 33% use lanterns while 17% of residents use electricity. 2% use fuel wood as a fuel source for lighting[19].

5.11.13 Political and Social Organizations

As of 2013, there 19 active Non-Governmental Organizations involved in various activities including capacity building, civic education, poverty eradication, HIV and Aids initiatives, women empowerment, disaster preparedness and protection of marine ecosystem; There were 33 registered cooperatives of which only 13 are active (KNBS Statistical abstract 2014)

According to the Ministry of Gender, youth and social services, Lamu County offices, there are 3,551 registered self-help groups within Lamu County undertaking activities around enterprise development, poverty eradication, drought management, HIV and Aids. 546 of these based in Hindi division. They are segmented into Youths groups, women groups, CBOs as shown in the Table 5-24 below.

Table 5-24: Civil society groups active in Lamu County

Registered Social groups within Lamu County		Registered Social groups within Hindi Division	
Self Help Groups	1,599	Self Help Groups	275
Women Groups	1,063	Women Groups	72
Youth Groups	579	Youth Groups	183
CBOs	175	CBOs	11
Persons with Disability	98	Persons with Disability	2
Support Groups	37	Support Groups	3
Total	**3,551**	**Total**	**546**

5.12 Visual impacts

Visual impacts can be defined as those impacts of the development upon views in the landscape and overall impact on visual amenity. Landscape impacts are defined as those impacts upon specific landscape elements which give rise to the landscape character of the site and its surroundings and impacts upon any special interests in and around the site.

No standards exist with regard to landscape or visual impact in any of the applicable IFC sector specific guidance, specifically Thermal Power Plants.

[19] Lamu County Integrated Development Plan (CIDP), 2013- 2017

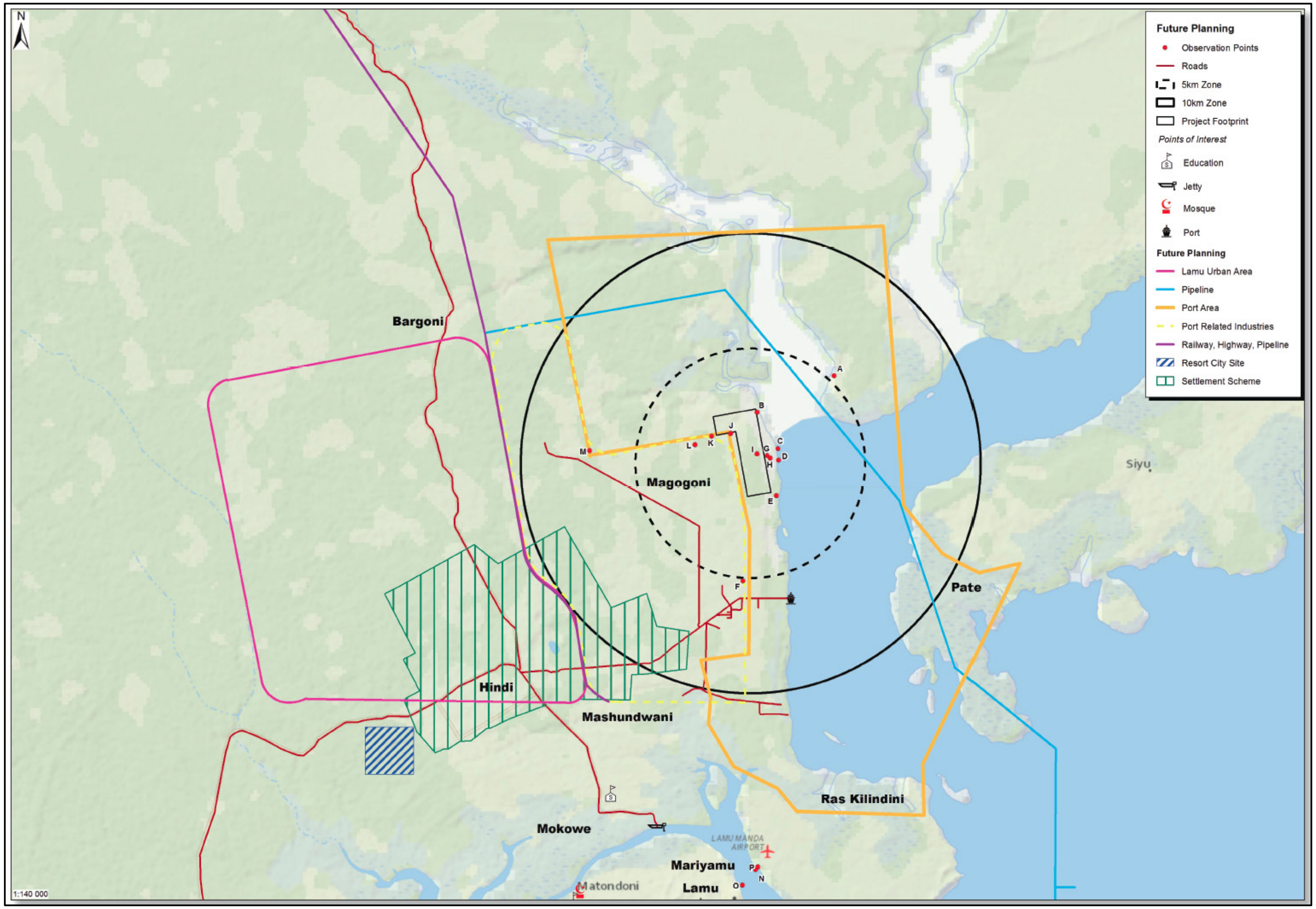
The landscape around the proposed coal fired power plant has a very low visual absorption capacity largely due to the flat topography of the area and the lack of micro-topographical features such as natural vegetation that can screen views of the project and the project will therefore be highly visible. The viewshed analysis and photomontages show that the project will be very visible and the line of sight analysis indicates that the 210m chimney will be visible from areas located more than 10km away from the project and draw people's attention to the project.

The project will also be located outside any defined urban edge or industrial area and will therefore create an initial change to the fabric and character of the landscape. The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. A project located within the view-shed of a tourist resort may for example be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive. As the Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor is implemented the visual character of the area surrounding the project site will change to a commercially developed zone. The projects impact on the visual character of the area will therefore decrease over time as the area surrounding the power station changes to a commercial zone.

5.12.1 Points of Interest

The project will be a high intensity and large-scale infrastructure project lying outside any defined urban edge or industrial area and will therefore create an initial change to the fabric and character of the landscape. The inter-relationship with land uses in adjacent lands can affect the visual sensitivity of an area. A project located within the view-shed of a tourist resort may for example be very sensitive, whereas an area surrounded by commercially developed lands may not be visually sensitive. As the Lamu Port South Sudan Ethiopia (LAPSSET) transport corridor is implemented the visual character of the area surrounding the project site will change to a commercially developed zone (figure 4-45). The projects impact on the visual character of the area will therefore decrease over time as the area surrounding the power station is developed into a commercial area.

Figure 5-46: LAPSSET area of development including Lamu coal power plant site



Protection of visual values usually becomes more important as the number of viewers increase. The project area in general is not used by large numbers of people and the visual sensitivity should therefore be less. If local people and tourists in the area have only a brief glimpse of the planned infrastructure, the visual modification may not be of great concern and the visual sensitivity low. Local people and tourist in the area are generally moving slowly through the area either by foot, boat or motorbike creating longer viewing periods of the project that increases the visual modification and sensitivity.

No formal residential, tourist and/or recreation areas with a strong visual orientation towards the project exist in close proximity to the project that will increase the visual sensitivity of the project. The current main users of the project area and surrounding areas is very much limited to local subsistence farmers with very few recreational sightseers. Recreational sightseers are more sensitive to any changes in visual quality, whereas the farmers in the area who pass through the area on a regular basis may not be as sensitive to the change created by the project.

No special areas such as wilderness areas or national parks that require special consideration for the protection of the visual values occur in close proximity to the project area. Lamu town occurs within the background zone so the project will not be visible except for the 210m high concrete chimney

5.12.2 Landscape units

The project will be located approximately 20km north of Lamu town along the shoreline in the Manda Bay area. Soil types located in the project area dictate the type of vegetation that occur. Silt and sand support scrub bush, scattered palms and swamp grass. In areas less susceptible to flooding, the silty clays support thick bush consisting of palms, indigenous trees and scrubs. Grassy open swampy areas dominate where there are drainage problems due to the low altitude. In general the project area is dominated by evergreen and semi-evergreen bushland and thicket interrupted by pockets of woodland and scrub woodland with scattered trees.

Mangroves strips occur along the shoreline of the project area and the intertidal environment of the creeks and basins supports significant area of mangrove forests. Mangroves in the Lamu area constitute 70% of mangrove forest cover in Kenya and is are a major sources of wood for construction of houses, making charcoal and boats.

Coral reefs are found in the form of coral flats, lagoons, reef platforms and fringing reef. Sea grass zones occur between the Mangroves and coral reefs along the shoreline of the project area. Small sandy beaches are scattered in between the patches of mangrove forests.

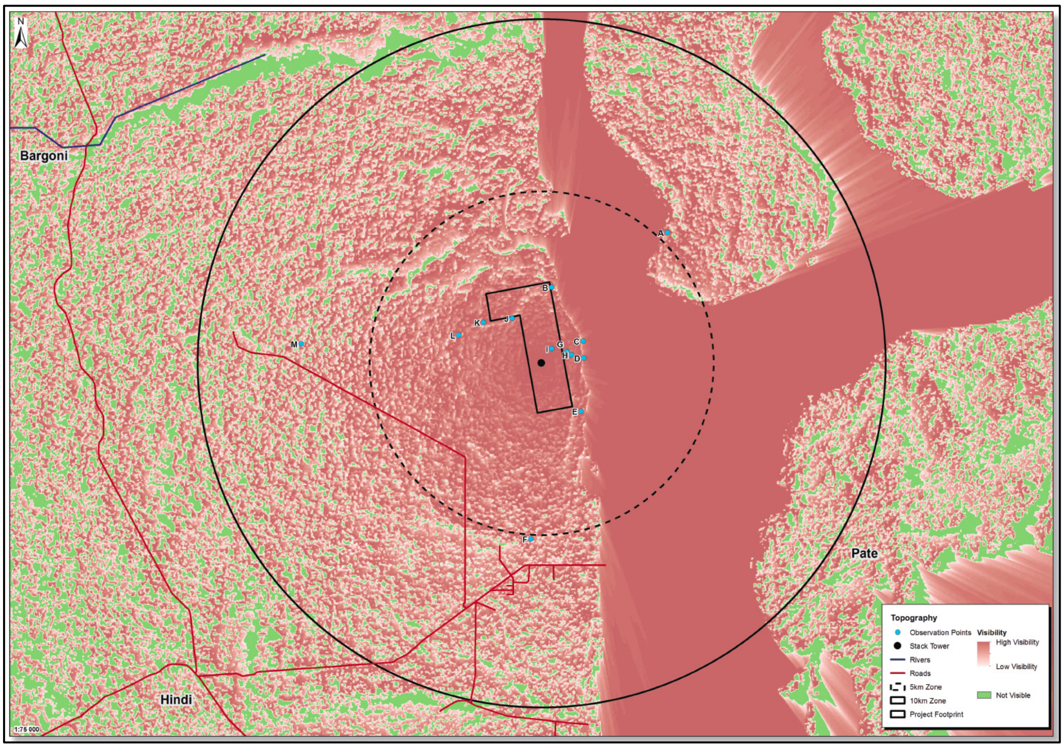
The coastal belt of Kenya comprises of the following main topographical features which are closely related to the geological characteristics of the area: the Coastal Plain, the Foot Plateau, the Coastal Range and the Nyika. The altitude of the Coastal Plain is generally less than 45 m above sea level. Lamu County is generally flat and lies between zero and 50 metres above the sea level. The project area has very flat topography and is approximately 20 m above sea level.

5.12.3 Visibilities

The visual modification of a development is assumed to be the highest when the observer is very close to it and has a direct line of site. The greater the viewing distances, the lower the visual sensitivity. Visibility reduces dramatically in the background and seldom seen zones that in turn decreases the visual modification created by the infrastructure due to the increased viewing distance.

The view shed analysis for the proposed project (based on topography alone) indicates that project components will be visible to people moving within the foreground-middle ground zone (the area that can be seen for a distance of 0 - 10 kilometers) around the project. The project will be highly visible within the 5km zone around the project and a low visibility is experienced beyond the 10km zone (figure 5-46) except for the reinforced concrete chimney whose height will be approximately 210m tall and will be visible beyond the 10km zone.

Figure 5-47: Viewshed analysis showing visibility of the power plant



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6 Project alternatives

This chapter provides a description of the alternatives considered for the proposed 1,050MW coal fired power plant to be built and operated in the Kwasasi area of Hindi division, Lamu County, Kenya.

The following alternative aspects are ordinarily considered for proposed developments:

- Location – what is the best site for a proposed development and any infrastructure associated with it?
- Scheduling – relates to project development and potential time constraints.
- Energy supply – relates to the different energy mixes that can supply the same amount of power as the proposed project;
- Technology – relates to improved efficiencies in an operation, e.g. sub-critical, super-critical and ultra-super-critical.
- No-go option – implications of not proceeding with the project.

6.1 Location alternatives

The location of the proposed coal power plant was determined by the Government of Kenya (through the Ministry of Energy and Petroleum-MoEP) who are responsible for providing land to establish the power plant. It is understood that the MoEP identified the proposed coal power plant location based on technical, environmental and operational criteria which includes transportation of coal in bulk. One of the criteria was to have the coal power plant site located away from populated areas as well as away from other LAPSSET project activities as the site will probably be designated under the Protected Areas Act.

The proposed 1,050MW coal fired power plant will consume about 3.6 million tons of coal per annum or about 10,000 tons per day. Quantities such as these can be delivered cost effectively either by rail or sea.

Based on the cost of the Standard Gauge Railway in Kenya (~US$8 Million/km), a rail line from Kitui (where the Kenyan coal discoveries have been made) to Lamu would cost over US$2.8 Billion (assuming a distance of ~350km). This is a prohibitive cost at this time and therefore the rail option can be discarded for now. The other option is to import the coal and have it delivered to Kenya to a port. Unfortunately, the port of Mombasa is densely built up and congested; consequently, large coal tankers would cause detrimental coal dust impacts within the port.

The only option for a port site for receiving coal in bulk therefore was Lamu and this site was selected as it is the genesis of the LAPSSET where other projects are envisaged to be built. Lamu is a coastal location and has a natural deep harbor. Based on the above requirements, it was established that the power plant should be located within Manda Bay.

Three options shown in Figure 6-1 were identified within the Manda Bay and could be used as the site of the power plant. All three locations provide viable transport routes for supply of coal in bulk.

Figure 6-1 : Alternative locations for the power plant site

Alternative 1 was a location recommended in the 2011 LAPSSET Study, where the proposed coal power plant was to be situated on Shindakazi Island (part of Pate Island). A sub-sea transmission line was envisaged from this location across Manda Bay to the mainland and then to Nairobi. This location was excluded for the following reasons:

a) The area is soggy and the cost of constructing the power plant infrastructure would be enormous;

b) It is a difficult location as it would be extremely difficult for construction plant and equipment to access the site;

c) If the sub-sea transmission line was accidentally severed, the entire country would suffer a major blackout;

d) There could be potential adverse visual impacts as the power plant would be conspicuously visible from the tourist location of Shela and north of Manda Island.

Alternative 2 is a location immediately after the proposed 32 berths. The size of land available was ~205 Ha (500 acres) and was rectangular in shape-2km x 1km. This land had a buffer zone of 500m all-round the main plot size for security purposes. This alternative was not selected as its boundaries were outside the port area in Manda Bay which and it was a requirement that the power plant site should be within the port area.

Alternative 3 is a location that is ~363 Ha (880 acres) and is in the shape of an inverted "L". This site has been identified as the most appropriate out of the three as it falls within the port area in Manda Bay. The frontage of the site is ~3.7km long facing the Manda Bay and the width is ~800m. The final size and shape will be confirmed once all baseline geotechnical studies have been completed by the designers of the project in China.

Of the three alternatives, the County Assembly and the County Government of Lamu has approved Alternative 3 for the construction of the 1,050MW coal power plant.

6.2 Energy supply alternatives

This section discusses and evaluates alternative energy sources that can be considered for achieving the same objectives as the proposed 1,050MW coal fired power plant (such as nuclear, hydropower, geothermal, wind and solar); additionally, this section evaluates the advantages and disadvantages of each type of energy source that was considered.

In Kenya, firm load (base load) power plants can be developed using nuclear, hydro-power, geothermal and coal based technologies. Non-firm load power plants include wind, solar and mini-hydro power plants. Kenya has set itself a target of adding an additional 5000+MW of power generation capacity using a diverse energy mix by the end of 2017. It is therefore important to evaluate energy supply alternatives which satisfy technical, commercial, environmental and social criteria. These are discussed below.

6.2.1 Nuclear power

A nuclear power plant is a viable alternative to the proposed project and can provide firm load electricity. Kenya is progressing the development of nuclear energy and according to the Kenya Nuclear Energy Board (KNEB) website (accessed on November 13, 2015), the country envisages to have its first nuclear power plant operational by 2025.

The advantages of a nuclear power plant are that:

- Generation of electricity is considered clean as it doesn't generate greenhouse gas emissions;

- It requires less fuel and offers more energy, that is, it represents a significant saving on raw materials, transport, handling and extraction of nuclear fuel. The cost of nuclear fuel (overall uranium) is about 20% of the cost of energy generated;
- The production of electrical energy is continuous. The load factor of a nuclear power plant is almost 90% of annual time and subsequently, reduces the price volatility in tariffs that would otherwise be associated with other liquid fuels.

The disadvantages of nuclear power plants include:

- The capacity to develop a nuclear power plant in Kenya is at least 10 – 15 years away and Kenya's energy demand is increasing rapidly;
- One of the main disadvantages is the difficulty of managing nuclear waste. It takes many years to eliminate its radioactivity and risks associated with it. Kenya lacks the competencies and know-how on management of nuclear wastes;
- It has a guaranteed take structure which may not work in Kenya;
- The site selection criteria must include a sufficient supply of cooling water and the power plant should be sited away from populations;
- The minimum size of a nuclear power plant is about 1000MW and with a load factor of 90%, will lock out other sources of power generation from the energy mix;
- Nuclear plants have a limited life. The investment for the construction of a nuclear plant is very high and must be recovered as soon as possible, so it raises the cost of electricity generated. In other words, the energy generated is cheap compared to the cost of fuel, but the recovery of its construction is much more expensive.

Given the above, nuclear power cannot be considered an option for the existing 5000+MW power generation program being promoted by the Kenya Government.

6.2.2 Large hydro power

According to data from the Energy Regulatory Commission, Kenya's installed hydropower electricity generation at the end of 2014 was 821MW (38.7% of the total power generation). Most of the hydropower generated in the country emanates from the Tana and Athi catchment areas in central Kenya which has better hydrology than other parts of the country. However, due to the changing climatic conditions, there is an increased competition for water between human population increases and that required for power generation. Until the fourth quarter of 2014, hydropower traditionally provided base load electricity to the national grid, however, this has now been overtaken by geothermal energy. Further, the country has no plans of developing a hydropower project in the 1000MW range that is currently required.

The advantages of hydropower generation plants include:

- They are a renewable source of energy;
- During the operational phase, it does not cause pollution in the form of greenhouse gas emissions like fossil fuel power plants;
- Hydropower is generally a reliable source of energy as long as there is sufficient water in the dam;
- It is a flexible source of energy as adjusting the water flow and output electricity is easy;
- Compared to fossil fuel and nuclear energy plants, it is much safer as no fuel involved.

The disadvantages of large scale hydropower plants are:

- They require large tracts of land that get inundated with water behind the dame walls;
- There would be massive displacement of people for such a project;
- The siting of such plants requires physical features similar to gorges where the walls can be erected;
- Good hydrology is necessary for building up water storage. Currently, there is competition for water between the increasing population in central Kenya and water storage in the dams;
- Kenya has minimal potential for a large scale hydropower plant;
- There are localized climatic change environmental health impacts to communities where such power plants are built;
- The development cycle for such plants is about 10 years and it would take another 4 – 6 years to reach the Commercial Operations Date; and
- The load factor for a hydropower plant is about 40%.

6.2.3 Geothermal power

According to the ERC statistics, the total installed capacity of geothermal power plants in Kenya was 593.5MW contributing 27.3% of total power generation in the country. Geothermal power is firm power, clean and renewable and the Kenya Government is progressing the development of this type of power in the 5000+MW program.

The advantages of geothermal power generation are:

- It is a reliable source of energy (has a load factor of about 95%) unlike solar and wind and is good for meeting the base load energy demand;
- Geothermal resource comes from the earth's crust and is naturally replenished through rainfall;
- It is considered environmentally friendly with minimal emissions of greenhouse gases;
- Harnessing geothermal energy does not involve any fuels, which means less cost fluctuations and stable electricity prices;
- Geothermal energy is available everywhere, although only some resources are profitably exploitable.

The disadvantages of geothermal power generation are:

- There are heavy upfront costs associated with geothermal exploration which has a high risks associated with it, a typical geothermal exploration well costs about US$7 Million/well which locks out private developers;
- The average yield for each well is about 5MW and there needs to be a 20% reserve steam or about 6MW;
- The development time from the exploration phase to commercial operation date (COD) is at least 7 years;
- It would be difficult for Kenya to currently afford a large scale geothermal power plant of 1000MW capacity given the following development estimated costs:
    - Resource cost = US$7 million/well assuming 100% success rate. If each successful well yields 5MW, the resource cost is US$1.4 million/MW;
    - Steam gathering system cost ~US$1.5 million/MW;

- The power plant cost ~ US$2 million/MW;
- From the foregoing, the total estimated cost/MW of a 1000MW geothermal power plant would be ~US$4.9 billion which is extremely expensive.

- According to the Ministry of Energy and Petroleum (MoEP) Feed in Tariff (FiT) 2012, the tariff for a geothermal plant starts at US¢8.80/kWhour and the percentage escalable portion is 20% in the first 12 years and 15% thereafter; and
- It is not easy to shut a well once it starts producing power.

6.2.4 Natural gas power

Natural gas is being used in a number of countries around the world for heating and power generation. For example, in the USA, natural gas power generation accounted for 27% of the total power generation in 2014. For Kenya to economically produce power using natural gas as a fuel source, commercial discoveries of the commodity need to be discovered. Secondly, a natural gas fired power plant need to be closely located near the source of the gas for it to be economical.

The advantages of using natural gas in producing power include:

- A power plant that utilizes natural gas is quick to set up with a development period being about 24 months;
- Natural gas power plants operate at a load factor of about 85% and have the lowest project cost at about US$1 – 1.2 million/MW (this cost excludes import and regasification);
- It's considered a cleaner fuel than other fossil fuels but still emits carbon dioxide;
- Natural Gas can provide electricity 24 hours, 7 days a week unlike other sources of renewable energy;

The disadvantages of natural gas fired power plants include:

- The liquefied natural gas (LNG) import terminal and regasification facility is expensive to build and takes over 24 months to establish;
- A floating storage regasification facility (FSRU) is the most expensive supply option for natural gas to a power plant; the FSRU itself requires parasitic load to operate it;
- While it is a cleaner fuel, natural gas power plants emit carbon dioxide emissions into the environment;
- Term contracts for LNG are between US$10 – US$12/million British thermal units (Btu); this implies that the levelised cost of electricity would be in the range of US¢ 11 – 12/kWh.

6.2.5 Coal fired power

Coal is one of the most important sources of energy for mankind providing an easy way to generate energy in a cheap manner. The relative abundance and low costs of using coal has made it the first choice of fuel for building power plants in the world. In the USA, coal fired power plants accounted for 39% of total electricity generated in 2014. In South Africa, coal fired power generation accounts for about 94% of the total electricity generated.

The proposed project will be Kenya's first coal fired power plant. The advantages of a coal fired power plant include:

- It is fairly quick to set up a coal power plant; for example, the proposed 1,050MW coal fired power plant in Lamu will take about 36 months to develop and construct;
- Coal fired power plants can generate electricity continuously, predictably and reliably unlike other forms of renewable energy like wind and solar that are intermittent in nature;
- The capital investment required for coal fired power plants is relatively less at $1-2/watt of thermal capacity; wind energy is slightly higher while solar is even higher;
- The coal prices are steady and in the long term they are predicted to reduce;
- Coal is one of the cheapest forms of energy making it the energy of choice in developing countries like Kenya. The proposed coal fired power plant in Lamu has the lowest levelised cost of electricity (LCOE) at US¢7.52/kWhour;
- Coal power plants have high load factors in excess of 85%. They can generate power almost 24/7 and only need to be shutdown for periodic maintenance;
- There have been efficiency improvements in types of coal fired power plants from sub-critical technology to super-critical to ultra-super critical;
- Generally, coal fired plants are considered safer than nuclear power plants. A coal power plant's failure is certainly not likely to cause catastrophic events such as a nuclear meltdown would. Additionally, the welfare and productivity of coal industry employees has greatly improved over the years. In fact, injuries, time lost, and fatalities have decreased significantly in the past years.

The disadvantages of coal fired power plants are:

- They use coal as a fuel source which is non-renewable;
- They release carbon dioxide which had been sequestered for millions of years in the dead bodies of plant and animals. This transfers the carbon from within the earth to the environment leading to global warming; and
- Thermal plants like coal fired plants emit harmful substances to the environment. These include mercury, sulfur dioxide, carbon monoxide, mercury, selenium, and arsenic.

6.2.6 Medium speed diesel power

Kenya has a number of medium speed diesel (MSD) fired power plants in the coast region, Nairobi, Athi River and Thika among other locations. As at December 2014, MSD power plants accounted for 26.7% of total power generation in Kenya or 579.5MW. There are a number of advantages and disadvantages of such plants which are outlined below.

The advantages of MSD power plants include:

- They have a quick development cycle (about 12 months);
- They require a low capital expenditure to develop (about US$1 million/MW);
- They are flexible plants for base loads and peaking loads;
- They require smaller footprints than other types of power generation technologies; and
- They have a load factor of about 85%.

The disadvantages of MSD fired power plants include:

- They emit carbon dioxide, sulfur dioxide and nitrous oxides into the environment;

- As MSD power plants utilize liquid fuels as the energy source, their levelised cost of electricity (LCOE) is one of the highest at about US¢20/kWhour;
- The variability of liquid fossil fuels prices makes the tariff largely variable.

6.2.7 Solar power

Solar Power is a form of energy whose costs are continuously declining compared to other forms of energy. In Kenya, utility scale solar power plants are currently in the development stage. It will take a while before such power plants reach commercial operations date (COD).

The advantages of solar power plants include:

- Solar power plants (solar PV) are quick to establish (<12 months);
- Solar power does not lead to any major mining activity, does not lead to significant GHG emissions and does not lead to health hazards;
- Solar power does not require fuel like wind energy and the Operation and Maintenance costs are extremely low;
- Solar power plants do not lead to pollution disasters; and
- Solar power potential is almost infinite compared to the limited and peak features of other forms of energy like wind, geothermal, oil, gas and others.

The disadvantages of solar power plants are as follows:

- One of the biggest problems of solar power (solar PV) is that it is intermittent in nature as it generates energy only when the sun shines. Consequently, solar power generation in Kenya should not exceed 10% of the average electricity demand due to the variable nature of power generation, otherwise the grid may become unstable;
- The cost of a solar power plant is about US$ 1 – 1.4 million/MW and the load factor is 25%;
- According to the 2012 Feed in Tariff, the tariff in Kenya for solar power is US¢12/kWhour which is relatively higher than other fuel sources;
- The land requirements for solar power plants are high about 4 hectares/MW which implies that for a 1000MW solar power plant, about 4000 hectares would be required; and
- As solar power is not firm power, it cannot be stored and used as base load especially since peak electrical demand in Kenya is between 5:00pm and 10:00pm and the solar map of Kenya shows that the maximum solar power can be generated between 9:00am and 3:00pm;

6.2.8 Wind power

Wind Power has become the biggest source of renewable energy in the world after nuclear energy (if nuclear is considered to be renewable energy). The reason for the huge increase in wind energy has been the sharply falling costs which have roughly become equivalent to gas fired energy. While solar energy costs are still falling, they are still way above the costs of fossil fuel energy.

Kenya is progressing the development of wind energy as part of the energy mix. There are a number of wind energy projects in the pipeline and a 300MW wind farm is currently under construction in Lake Turkana.

The advantages of wind energy are:

- Unlike other forms of electrical generation where fuel is shipped to a processing plant, wind energy generates electricity at the source of fuel, which is free;
- The price of electricity from fossil fuels and nuclear power can fluctuate greatly due to highly variable mining and transportation costs. Wind can help buffer these costs because the price of fuel is fixed and free;
- The development time for a wind farm is about 24 – 30 months.

The disadvantages of wind power plants include the following:

- Wind is a variable resource and the turbines produce electricity only when the wind blows. Just like solar energy, wind power generation in Kenya should not exceed 10% of average electricity demand otherwise the grid could become unstable due to the variable nature of power generation;
- As it is a variable resource, the power generated by a wind farm is non-firm and therefore cannot be depended upon as a base load power producer;
- Under the Feed in Tariff of 2012, the tariff for wind power is US¢11/kWhour with an escalable percentage portion of 12% which makes this a relatively expensive power generation technology;
- The visual impact and aesthetics created by a wind farm makes people consider wind turbines to have an undesirable experience;
- Wind farms are suited to particular regions of a country where coastal or hilly areas are present;
- Though wind energy is non-polluting, the turbines may create a lot of noise especially the low frequency type which can adversely impact sleep;
- Wind farms create shadow flicker which has potential environmental health impacts associated with epilepsy in some people.

6.2.9 Summary of firm options for energy supply alternatives

Kenya requires least cost steady state power plants in order to actualize the Government's initiative to add 5000+MW of new power generation capacity by the end of 2017. Additionally, the firm power must be developed on a least cost basis in order to reduce the consumer prices; currently, this can only be achieved through a coal power plant. Subsequently, the benefits of developing the proposed 1,050MW coal fired power plant in Lamu are given below.

- Given the current electricity supply options and consumer cost, the proposed coal fired power plant is the most viable option as it has the lowest levelised cost of electricity (LCOE) of US¢7.52/kWhour;
- The proposed coal fired power plant has a relative quick development timeline to the commercial operations date (COD) and is second to a natural gas fired power plant;
- The technology for coal fired power plants is proven over several years and continuous improvements are being made in order to make them more efficient and environmentally sustainable;
- There are easily available professionals available globally that can build and operate coal fired power plants unlike say, nuclear power plants which require highly specialized skills set not available everywhere; and

- Due to its LCOE, the coal fired power plant goes to the top of the merit order for power generation.

6.3 Scheduling alternatives

Scheduling alternatives relates to the timing of developing the proposed coal fired power plant and time constraints for establishing it.

Since the devolution to County Governments, numerous economic activities are beginning to spring up which require electricity. The increased demand for power is arising from activities such as mining, production of iron and steel products from local iron ore deposits, irrigation of large tracts of land for food security and agro-based industry. Other energy intensive activities that require power include; operation of petroleum pipelines for both crude and refined fuel oils, petrochemicals production including urea, steel products based manufacturing such as motor vehicle body parts and earth moving equipment, electrification of designated rail lines, installation of escalators at shopping malls and airports, and new economic zones. Without adequate and cost effective electricity, the above activities will be constrained.

Recognizing the above, the Government of Kenya initiated a 40-month program commencing in September 2013 to install 5000+MW of new power generation projects from the following sources to meet the growing electricity demands in the country:

- Geothermal: 1646MW
- Natural gas: 1,050MW
- Wind: 630MW
- Coal: 1920MW

Currently, there is minimal activity in meeting electricity demands from natural gas; the other two renewable sources (geothermal and wind) are at various stages of early development. The only new geothermal capacity which has been injected into the grid out of the 1646MW is 280MW (5% of the 5000+MW). The proposed coal power plant will provide about 20% of the 5000+MW program at the most cost effective tariff to the consumer.

From a scheduling perspective, the Government needs to accelerate power generation from coal in order to supply baseload electricity to the numerous activities that are springing up in the counties.

6.4 Technology alternatives

Technology alternatives considered for the proposed 1,050MW coal fired power plant project include:

- Fuel combustion technologies; and
- Cooling system technologies.

6.4.1 Fuel combustion technologies

There are two types of fuel combustion technologies namely, conventional pulverized coal fired or circulating fluidized bed technology. A basic description of the two types of technologies is given below.

Circulating fluidized bed boiler technology. Fluidized bed combustion (FBC) is a technology used in power plants. There are different designs of FBCs namely, atmospheric systems (FBC) and pressurized systems (PFBC) and within these there are two minor groups namely bubbling (BFB) and circulating fluidized bed (CFB).

Fluidized beds suspend solid fuel (coal) on upward blowing jets of air during the combustion process which results in a turbulent mixing of gas and solids. The tumbling action much like a bubbling fluid, provides effective chemical reactions and heat transfer. The CFB has a cyclone filter to separate solid material from hot flue gases which leave the exhaust of the furnace. The solids from the filter are re-circulated into the bed.

Pulverized coal fired boiler technology. In this type of technology, electricity is produced by burning pulverized coal and air in a boiler which heats water to produce steam that drives a generator. There are three types of pulverized coal boilers namely, subcritical, supercritical and ultra-supercritical. The steam flows through a series of steam turbines which spin an electrical generator to produce electricity. The exhaust steam from the turbines is cooled, condensed back into water and returned to the steam generator to start the process over. These types of technologies provide most of the electrical energy used in many countries.

Through technical feasibility studies undertaken for the project by the developer, **supercritical pulverized coal fired boiler technology** has been selected as the preferred solution for the implementation of the Lamu coal fired power plant. This is the alternative assessed within this ESIA Study.

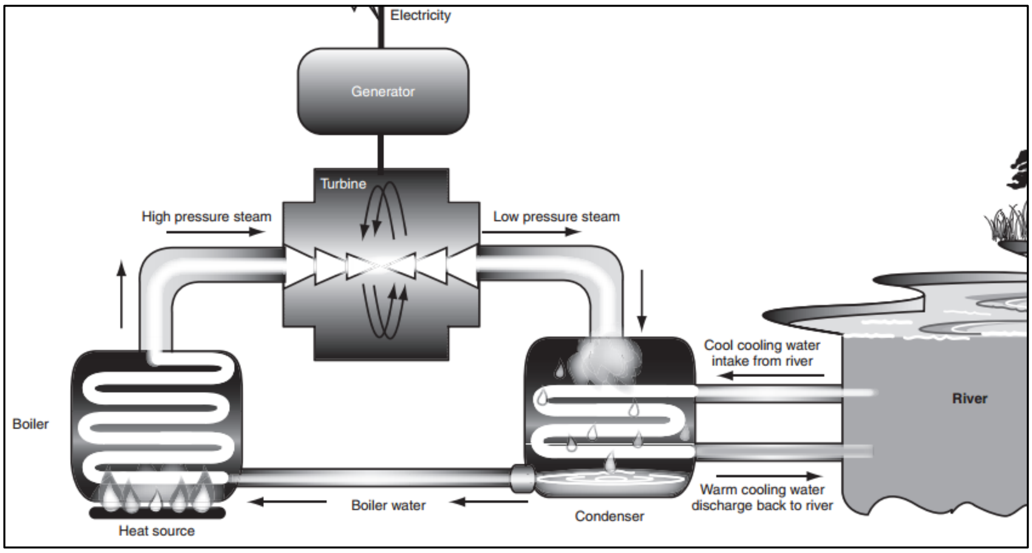
6.5 Cooling system technologies

Currently, there are four types of cooling systems for steam-electric power plants that are commonly used around the world namely (i) once-through cooling, (ii) closed-cycle wet cooling, (iii) dry-cooling, and (iv) hybrid cooling. Each of them is described below.

6.5.1 Once-Through Cooling

Once-through systems withdraw water from a natural source (typically a lake, river, or ocean), use it to extract waste heat from the steam cycle, and then return it to the water body at a slightly elevated temperature (see schematic in Figure 6-2). The system consists of a steam condenser, typically of the shell-and-tube type, circulating water pumps, circulating water lines, intake and discharge structures, and in most cases, some water treatment equipment, typically chlorination for biofouling control.

Figure 6-2: Illustration of once-through cooling water system

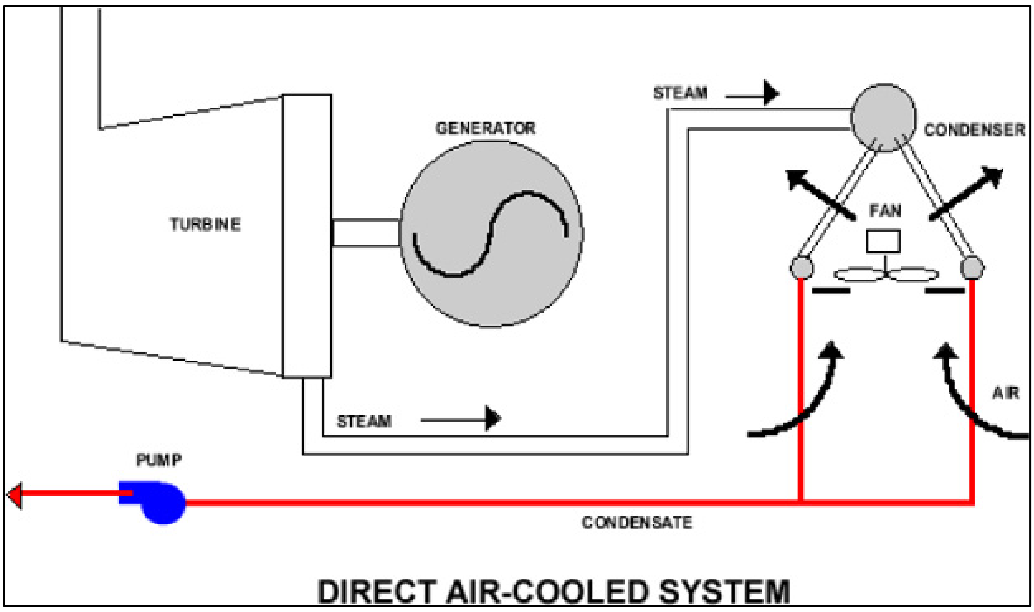


6.5.2 Direct dry cooling

Dry cooling systems reject the heat of condensation directly to the atmosphere with no consumptive use of cooling water. Systems are of two types: direct and indirect dry cooling.

In this system (Figure 6-3), the steam from the turbines goes to the dry-cooling element or heat exchanger. Fans are used to blow air over the condenser causing water vapour to change into liquid. The liquid (water) is pumped back to the boiler for reuse. No cooling towers are required for this system; therefore water loss by evaporation is prevented. Issues associated with this technology include increased noise levels as a result of additional fans required.

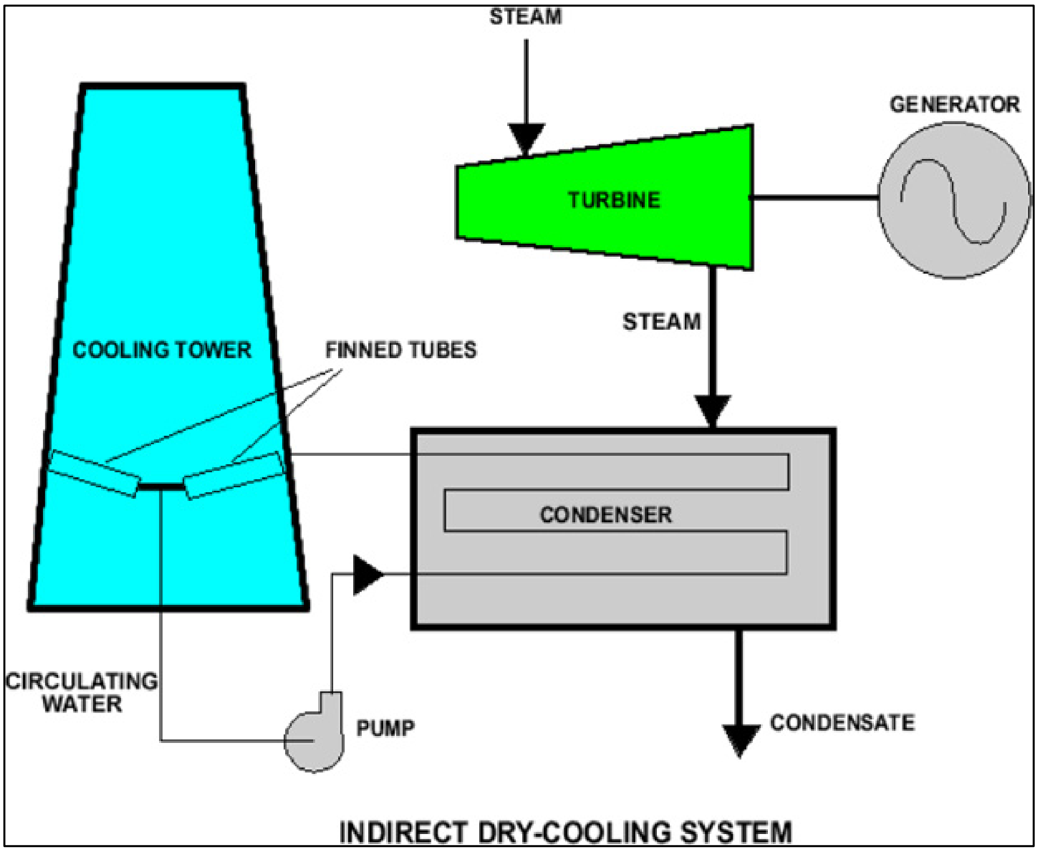
Figure 6-3 : Direct dry cooling system illustration



6.5.3 Indirect dry cooling

This method is illustrated in Figure 6-4. A cooling tower and cooling water (from a water resource) is required. Warm water from the condenser is pumped to cooling towers. Within the cooling tower, bundles of cooling elements are arranged in rings. Cooling water is sent into the elements and cooled water returns to the condenser for reuse. The system prevents water loss by evaporation, as it is a closed system. Associated issues include additional visual impacts associated with large cooling towers required. Indirect systems are more costly and less efficient than direct dry cooling system, because of the two-step heat transfer path to the atmosphere, the circulating water pumping power requirement, and the temperature rise of the cooling water as an additional temperature difference between the ambient air and the steam condensing temperature.

Figure 6-4: Indirect dry cooling system ilustration



Based on technical feasibility studies carried out, the proposed Lamu coal fired power plant will be designed based on the once-through cooling system as it provides the highest efficiency for cooling using the supercritical boiler technology. This is the alternative addressed in this ESIA Study.

6.6 Operational alternatives – pollution control

Due to potential environmental and health impacts associated with the operation of the coal power plant, methods are considered for ash management and air emissions control.

6.6.1 Ash management

The ash management system at the proposed power plant will use dry ashing (no water used). Wet ashing utilizes large amounts of water and is therefore not considered suitable for this location.

Above ground ash dumping (where ash is stacked in an ash yard within the power station and the ash dump is rehabilitated using topsoil and vegetation) will be utilized. The ash yard will be designed with three layers of protection namely an (i) an in-situ compacted clay layer about 1.5m thick complete with perimeter retainer walls, (ii) an impermeable liner to prevent leachate entering the subsurface and groundwater, and (iii) a 0.15m thick sand layer.

Wastewater generated at the power plant will be treated and utilized for dust suppression as the ash dump.

6.6.2 Air emission control

Burning of coal releases CO_2, SO_x, NO_x and particulates into the atmosphere. The proposed Lamu coal power project will utilize the latest clean coal technologies available including electrostatic precipitators, wet flue gas desulfurization units and low nitrous oxide burners to minimize the air emission impacts.

6.7 The “do-nothing” alternative

The do-nothing alternative is the option of not constructing the proposed 1,050MW coal power plant. This alternative would result in no environmental or social impacts in the project area.

However, not undertaking the project will also mean that Kenya will be unable to produce the electricity that it needs under the 5000+MW program which could have adverse socio-economic impacts.

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7 Methodology for assessing impacts

The purpose of impact assessment is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The potentially significant environmental impacts were identified based on the nature of the receiving environment, a review of the proposed activities, and the issues raised in the public participation process.

7.1 Methodology

In the impact assessment stage of an EIA, identified issues are analyzed and expected impacts are defined. This analysis identifies:

- The types of impact;
- Predicts the magnitude;
- Probability of occurrence;
- Extent of the impact; and
- Determines the overall significance of the impact.

7.2 Identification of environmental and social aspects and impacts

The outstanding environmental issues identified as having significance will be assessed using the methodology described below.

First, the issues raised will be described giving consideration to the associated activity and the aspect of that activity that is likely to result in an impact. The nature of the impact will also be described. Once this has been undertaken the significance of the impact can be determined. The following definitions will apply:

- An **activity** is a distinct process or task undertaken by an organization for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organization.
- An **environmental aspect** is an element of an organizations activities, products and services which can interact with the environment. The interaction of an aspect with the environment may result in an impact.
- **Environmental impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. Receptors can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as aquifers, flora and paleontology. Impacts on the environment can lead to changes in existing conditions; the impacts can be direct, indirect or cumulative. Direct impacts refer to changes in environmental components that result from direct cause-effect consequences of interactions between the environment and project activities. Indirect impacts result from cause-effect consequences of interactions between the

environment and direct impacts. Cumulative impacts refer to the accumulation of changes to the environment caused by human activities.

Aspects and impacts associated with the proposed development have been differentiated into construction and operation phases of the project.

7.3 Description of aspects and impacts

The accumulated knowledge and the findings of the environmental investigations form the basis for the prediction of impacts. Once a potential impact has been determined during the scoping process, it is necessary to identify which project activity will cause the impact, the probability of occurrence of the impact, and its magnitude and extent (spatial and temporal). This information is important for evaluating the significance of the impact, and for defining mitigation and monitoring strategies. The aspects and impacts identified will therefore be described according to the definitions below.

7.3.1 Extent

The extent for each aspect, receptor and impact will be defined. The geographical coverage (spatial scope) description will take account of the following factors:

- The physical extent/distribution of the aspect, receptor and proposed impact; and
- The nature of the baseline environment within the area of impact.

For example, the impacts of noise are likely to be confined to a smaller geographical area than the impacts of atmospheric emissions, which may be experienced at some distance. The significance of impacts also varies spatially. Many will be significant only within the immediate vicinity of the site or within the surrounding community, whilst others may be significant at a local (project) or regional (county) level.

The **extent** of the impact will be rated on the following scale:

Localized (At localized scale and a few hectares in extent)	1
Study area (The proposed site and its immediate environs)	2
Regional (County level)	3
National (Country)	4
International (Beyond Kenya)	5

7.3.2 Duration

Duration refers to the length of time that the aspect may cause a change either positively or negatively on the environment.

The environmental assessment will distinguish between different **time periods** by assigning a rating to duration based on the following scale:

Very short (0 – 1 Years)	1
Short term (1 – 5 Years)	2
Medium term (5 – 15 years)	3

Long term (>15 years)	4
Permanent	5

7.3.3 Magnitude

The **magnitude** of an environmental aspect is determined by the degree of change to the baseline environment, and includes consideration of the following factors:

- The reversibility of the impact;
- The sensitivity of the receptor to the stressor;
- The impact duration, its permanency and whether it increases or decreases with time; Whether the aspect is controversial or would set a precedent; and
- The threat to environmental and health standards and objectives.

The magnitude of each of the impacts will be rated on the following scale:

Small and will have no effect on the environment	0
Minor and will not result in an impact on the processes	2
Low and will cause a slight impact on the processes	4
Moderate and will result in process continuing but in a modified way	6
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

7.3.4 Probability of impact

The **probability** or **frequency** of the impact occurring refers to how often the issue may impact either positively or negatively on the environment. After describing the frequency the findings will be indicated on the following scale:

Highly improbable (<20% chance of occurring)	1
Improbable (20 – 40% chance of occurring)	2
Probable (>40% - 70% chance of occurring)	3
Highly probable (>70% - 90% chance of occurring)	4
Definite (>90% - 100% chance of occurring)	5

7.4 Method of assessing the significance of impacts

The purpose of impact evaluation is to assign relative significance to predicted impacts associated with the project, and to determine the manner in which impacts are to be avoided, mitigated or managed. The information presented above in terms of identifying and describing the aspects and impacts will be summarized in a tabular form and a significance will be assigned with supporting rational. Significance will be determined before and after mitigation, taking into consideration all the factors described above.

A definition of a "significant impact" for the purposes of the study is: "An impact which, either in isolation or in combination with others, could in the opinion of the specialist, have a material influence on the decision-making process, including the specification of mitigating measures."

7.5 Significance determination

The environmental significance rating is an attempt to evaluate the importance of a particular impact, the consequence and likelihood of which has already been assessed by the relevant specialist. The description and assessment of the aspects and impacts undertaken is presented in a consolidated table (Table 7-1) with the significance of the impact assigned using the process and matrix detailed below.

The sum of the first three criteria (extent, duration and magnitude) provides a collective score for the CONSEQUENCE of each impact. The last criteria determines the PROBABILITY of the impact occurring. The product of CONSEQUENCE and PROBABILITY leads to the assessment of the SIGNIFICANCE of the impact, shown in the significance matrix below.

Table 7-1: Significance Assessment Matrix

		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

In order to evaluate the mitigation threshold, the ratings in Table 7-2 are used.

Table 7-2: Mitigation Ratings Table

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 develop in the area

7.6 Mitigation

Measures to avoid, reduce or manage impacts consistent with best practice will be proposed and the effectiveness of such measures assessed in terms of their ability to avoid, remove an impact entirely, render it insignificant or reduce its magnitude.

In assessing the significance of the impact, natural and existing mitigation will be taken into account. Natural and existing mitigation measures are defined as natural conditions, conditions inherent in the project design and existing management measures that alleviate (control, moderate or curb) impacts. In addition, the significance of impacts will be assessed taking into account any mitigation measures that are proposed.

An Environmental and Social Management Plan (ESMP) has been prepared and is provided in Section 11 of this report. This plan specifies the methods and procedures for managing the environmental aspects of the proposed development. Monitoring requirements are also be detailed within the plan, particularly for those environmental aspects that give rise to potentially significant impacts.

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8 Assessment of social and environmental impacts

8.1 Introduction

This section provides an assessment of the social and environmental impacts associated with the proposed coal fired power plant. For each impact, the assessment has been conducted pre-mitigation and post mitigation using the methodology described in Section 7 of this report.

Potential social and environmental impacts identified for the proposed coal fired power plant are listed below. The process of identifying the potential social and environmental impacts included the following:

1. Secondary literature review by each environmental and social specialist that was part of the ESIA team;
2. Field surveys which included collection of baseline information, interviews with the local communities living in and around the project environs;
3. Inputs by various specialists associated with the ESIA Study.

Based on the above, the Consultant identified the following aspects and impacts for assessment:

Table 8-1 Aspects and impacts assessed for the project

Aspect	Impacts assessed
Air quality	• Atmospheric emissions during the construction phase; • Air emissions during the operational phase
Noise	• Noise from construction related activities • Noise from operational phase activities
Thermal effluent	• Discharge of once-through cooling water
Climate change	• Environmental impacts of climate change • Greenhouse gas risks
Waste management	• Construction site waste management • Construction phase off-site waste management • Operational phase waste management
Water resources	• Improper management of wastewater • Contamination of groundwater
Soils and geology	• Soil erosion impacts
Biodiversity	• Impacts on terrestrial flora • Impacts on terrestrial fauna • Impacts on marine ecology
Landscape and visual	• Visual impacts of power plant

Aspect	Impacts assessed
Socio-economic	• Creation of direct, indirect and induced employment • Economic growth • Capacity building • Land acquisition and involuntary resettlement • Disruption and loss of livelihoods • Disruption of the social fabric • Strain on existing infrastructure and social amenities • Change in cultural heritage
Health and safety	• Impact on community health and safety • Occupational health and safety concerns
Cultural heritage	• Impacts associated with WHS OUV • Impacts on archaeology • Loss of plants of cultural value • Impacts on graves

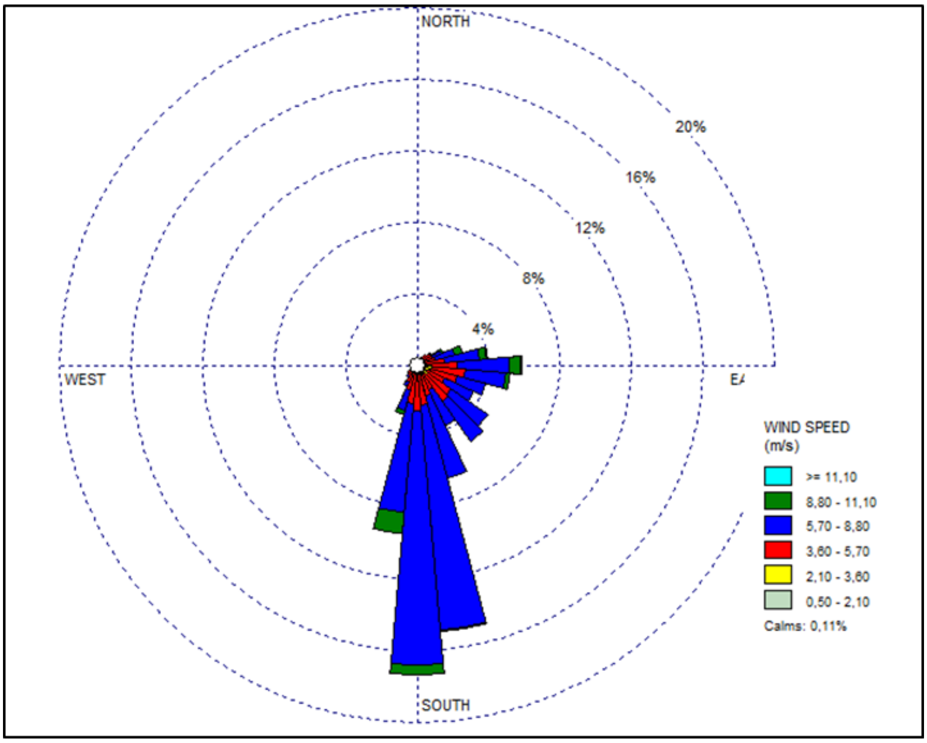
The above impacts are addressed in the remainder of this section.

8.2 Air quality

Section 5.6 of the ESIA Study and tables 5-4 to 5-6 show the results of the ambient air quality survey that was undertaken for the proposed Lamu coal fired power plant. These results were used to undertake a comprehensive air dispersion modeling study for the construction and operational phases of the project. Given in the following sections are the results of the modeling study for the construction and operational phases of the project respectively, potential air quality impacts, mitigation measures and residual impacts.

The prevailing wind directions within the general project area are from the south and easterly regions. Wind directions from the other sectors occur relatively infrequently. The wind rose for the project site is presented in figure 8-1 below.

Figure 8-1 : Wind Rose for the Project Site (2009-2013)



8.2.1 Atmospheric emissions during the construction phase

Without mitigation measures, the construction of the proposed coal power plant may have potential negative impacts on the ambient air quality of the local area.

It is anticipated that the most significant components of such emissions, from an environmental perspective, will be combustion (exhaust) gases and particulate matter associated with site clearance and the operation of earth moving equipment.

The following equipment or activities will lead to atmospheric emissions during construction:

a) Earthmoving operations (associated with land clearing and site preparation);

b) Construction and delivery vehicle emissions (diesel powered equipment, cranes, excavators, barges and ships);

c) Cement batching operations; and

d) Power generation at the worker camps, laydown areas and the Project site.

The effect of early construction activities such as ground breaking, earth moving, levelling, excavation, foundation work, using sand and cement for building, movement of vehicles and trucks, is considered temporary and adverse.

Similarly, the impacts of emissions from traffic related to construction activities are considered temporary and negative.

The effect of emissions from volatile hazardous materials (oils, solvents) stored on site is also considered temporary and adverse, because the quantities of such materials are relatively small.

Given the absence of paved roads on the proposed site, emissions from vehicles transporting materials onto the site during construction phase have temporary and negative effects.

Table 8-2 summarises the estimated emissions from construction plant and vehicles involved the construction phase activities of the Project.

Table 8-2 Estimated emission quantities fro mconstruction plant and equipment

Pollutant	Emission Quantity (tons)/Peak Year
CO	356
CO_2	109,305
NO_x	764
SO_2	78
PM_{10}	716

The impact significance for the construction phase is assessed based on dust and gaseous emissions from the construction plant and equipment.

Table 8-3: Impact significance for air emissions from construction activities-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should develop and implement a Construction Environment Management Plan (with reference to the management of air quality during the construction phase) once detailed information relating to the construction methodology and schedule is available (prior to commencement); • The EPC contractor should compact access roads from the entrance to the site and spray with water to minimize the dust generated from the vehicles and trucks; • The EPC contractor should ensure that deliveries of equipment/plant to the site are efficiently managed to reduce the number of trips; • The EPC contractor should consider minimization of ground-works when high winds are present; • The EPC contractor should undertake land grading, improvement or moving of materials during periods of low winds. • Large sand piles should be avoided where possible, with dust suppression sprays being utilized on any piles during periods where the wind speed exceeds 15km/h.			

	• A visual assessment of dust emissions should be undertaken by the EPC contractor on a regular basis. • Designated roads should be made clear to the drivers and signs for the directions and speed limit will be placed all along the roads. • Where sand and other dusty material (e.g. cement) is transported to the site, trucks will not be overloaded and will be appropriately covered / sheeted to eliminate the contamination to the air. • Sand and other materials will be stored in specific designated areas and will be properly stored at the site and will be water-sprayed or covered. • Exhaust fumes and particulates emitted from trucks and vehicles should be minimised by assuring the use of good condition vehicles. These will be tested to ensure the compliance with local standards. • Lorries and trucks engines should be turned off while waiting on site to minimise the exhaust emissions. • Dusty materials stockpiles and dusty activities such as stone cutting and grinding to be sited away from the site boundaries and/or effectively screened. • Fires and material burning will not be allowed on the Project site. • Hazardous materials stored and used on site with potential gas emissions (e.g. VOCs) will be located in well-ventilated secure areas away from major transport routes.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

8.2.2 Atmospheric emissions during the operational phase

Key emission sources during the operational phase of the project include the SO_x, NO_x, PM_{10} and $PM_{2.5}$ emanating from stationary and mobile sources. The stationary sources include the main boilers, auxiliary boiler and black-start generators; the mobile sources include fugitive emissions from (i) materials handling and transfer, (ii) heavy duty vehicles, (iii) stockpile loading and unloading, (iv) wind erosion, (v) paved roads, and (vi) unpaved roads.

The air quality impacts of the proposed coal power plant have been assessed using baseline information gathered through desk and field studies, analysis of the information provided by the EPC contractor and advanced air modelling using preliminary design and technical information. The stack heights have been determined based on Good International Industry Practice to avoid excessive ground level concentrations and minimize impacts.

The specifications of the coal that can be utilized in the proposed Lamu coal fired power plant are given in Table 8-4 below.

Table 8-4: Coal fuel specifications

Parameter	Imported Coal (S. Africa)		Kenyan Coal
	Eskom	New Vaal	
Calorific Value (MJ/kg) Lower Heating Value	21	16	18
Total Organic Carbon (%)	44	36	55
Sulphur Content (%)	1	0.5	2.4
Plant Coal Consumption (tonnes / day)	10,685	14,248	12,600

During the operation of the power plant, a number of activities and plant equipment will result in air emissions which have the potential to impact upon the ambient air quality within the coal power plant and surrounding areas. In order to adequately assess the potential impacts to the air environment during the operational phase of the proposed plant, it is therefore necessary to undertake predictive air dispersion modelling. The following aspects are considered:

- Emission characteristics from the power plant; the air dispersion model is run to estimate the stack emission impact. The purpose is to determine the permissible environmental limits to satisfy at source environmental and ground concentration.
- This study determines the requirements for the sea water scrubbing FGD system with SO_X removal capacity from coal having a sulfur content of 0.5 – 1%.

In order to estimate ground level concentrations for each study pollutant, an atmospheric dispersion modelling study was undertaken using the US EPA preferred CALPUFF and AERMOD dispersion models. Four scenarios were defined for purposes of modelling as shown below.

Table 8-5: Air dispersion modeling scenarios

Scenario	Description	Normal or Abnormal Operation	Duration	US EPA Model Used	Pollutants Considered
Scenario 1	Normal Operations of the Lamu Power Station including the three main boilers operating at 100% load	Normal	Continuous	CALPUFF	NO_2, SO_2, PM_{10}, $PM_{2.5}$, mercury
Scenario 2	Fugitive dust from coal and ash handling and storage activities including dust mitigation controls (including emissions from three main boilers)	Normal	Continuous	AERMOD	PM_{10} and $PM_{2.5}$*

Scenario	Description	Normal or Abnormal Operation	Duration	US EPA Model Used	Pollutants Considered
Scenario 3	Total suspended particulates (TSP) fallout for selected metals as a result of fugitive dust from ash operations	Normal	Continuous	AERMOD	Selected metals (arsenic, cadmium, nickel, lead and mercury)
Scenario 4	Black Start of Power Station	Emergency	Less than 5% of the year	CALPUFF	NO_2 and SO_2

During operation of power plant, the main source of air pollution comes from combustion of coal in the boilers. In the proposed project, imported coal will be used as primary fuel to generate electricity, however the generating units are designed to be able to use coal from a variety of sources including Kenya; additionally, light distillate oil (LDO) will be used for start-up or emergency purposes if Kenya Power is unable to supply the power needed for start-up.

The air emission impacts associated with the operation of the power plant are permanent and of adverse significance without any mitigation measures. These effects are associated with SO_2, NO_x and PM emissions in absence or failure of adequate pollution control equipment.

Table 8-6: Impact significance for air emissions from power plant-operational phase

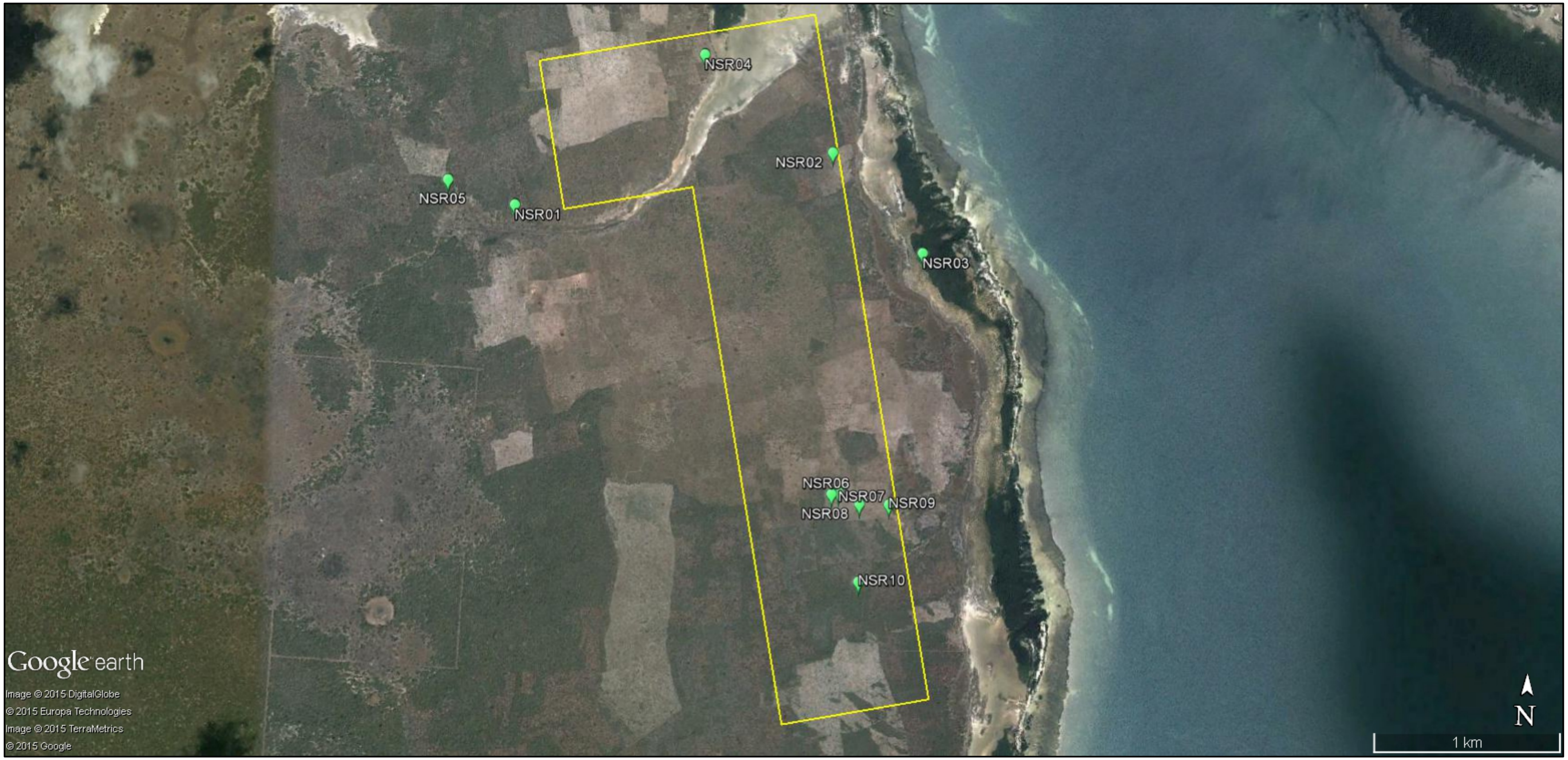
Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long term	Moderate	Highly probable
	3	4	6	4
	Result: (-52) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor shall install a wet flue gas desulfurization (FGD) system to remove sulfur dioxide from the flue gas before the flue gas is emitted to the environment. One FGD plant of the seawater type shall be installed for each unit. The FGD system shall be designed to meet the SO_2 emission limits recommended by the International Finance Corporation (IFC) EHS Guidelines for Thermal Power Plants of 2008. • The EPC contractor shall use low NO_x burners to reduce the nitrous oxide emissions before the flue gas is discharged to the atmosphere. The nitrous oxide emissions will be required to meet the limits recommended under the IFC EHS Guidelines for Thermal Power Plants of 2008. • The EPC contractor shall design and install an electrostatic precipitator (ESP) for the power plant. The ESP shall be installed upstream of the FGD/chimney and downstream of the air heaters in			

	order to meet the environmental emission limits regulated by IFC EHS Guidelines for Thermal Power Plants of 2008. • The EPC contractor shall install a continuous emission monitoring system (CEMS) mounted within the stack. The CEMS will be capable of continuously monitoring the NO_x, SO_x, CO_2, and PM_{10}, emissions to ensure compliant conditions are maintained through appropriate process controls. In addition, the monitoring of other stack parameters such as oxygen, carbon monoxide and temperature will also ensure that the plant is operated efficiently to maintain compliance with the specified air emission standards and ambient air quality standards; • The O&M Company will ensure compliance with the requirements of air quality in accordance with L.N. 34: Air Quality Regulations, 2014 and project air quality standards • Stack monitoring data collected during commissioning and the subsequent 25-year operation period will be reported to NEMA on an annual basis as part of the statutory environmental audit and will be subject to inspection by external environmental auditors to verify the performance and compliance status; • Fugitive emissions from the coal power plant site during operation will be controlled by an inspection and maintenance program that will be detailed in alignment with an Environmental Management System (equivalent to ISO 14001) that will be developed at the start of operations and maintained throughout the 25 year plant operational period. • Regular maintenance of plant at the proposed facility will also be carried out in order to optimize and minimize emissions.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long term	Minor	Improbable
	3	4	2	2
	Result: (-18) Low negative			

8.3 Noise

Noise sensitive receptors were identified during the screening and scoping phase of this ESIA Study. A total of 10 noise sensitive receptors (NSRs) were identified for the construction and operational phase noise assessment. NSRs 1 – 5 are existing receptors within the project area and its immediate environs; NSRs 6 – 10 are new receptors all located within the power plant project footprint area. The location of the 10 NSRs is shown in Figure 8-2.

Figure 8-2: Location of noise sensitive receptors used used for predicitng noise impacts



8.3.1 Noise from construction related activities

During the construction phase, noise will be generated by construction plant and equipment; this will be the predominant noise and is evaluated in this section. Precise details of the construction schedule or equipment requirements are not yet finalized; however, the assessment was conducted based on assumed impact durations and equipment numbers for the construction of the project facilities. Given below is the assumed inventory of construction equipment that will be used for development of the power plant.

Table 8-7 Assumed construcion equipment inventory

Plant/Activity	Number of units	Lp @ 10m	Reference [1]
I. Earth Work Equipment			
Backhoe Excavator	6	78	C.2 No. 3
Dozer	4	79	C.2 No. 11
Loader	10	68	C.2 No. 8
II. Transportation Equipment			
Autodumper (Large)	20	76	C.4 No. 4
Autodumper (Small)	10	78	C.4 No. 7
Water Tank Truck	4	76	C.4 No. 76
III. Concrete and mortar Equipment			
Concrete Mixing Plant	2	80	C.4 No. 20
Concrete batching machine	2	N/A	N/A
Material loader (a)	4	68	C.2 No. 8
Material loader (b)	2	68	C.2 No. 8
Concrete mixing transportation cart	10	76	C.4 No. 22
Concrete pump truck	2	77	C.4 No.21
Concrete transport pump	4	67	C.4 No. 24
Mortar mixer	8	61	C.4 No. 23
IV. Lifting Equipment			
Track type crane (a)	1	67	C.3 No. 28
Track type crane (b)	1	67	C.4 No. 46
Truck crane	2	70	C.4 No. 43
V. Special Equipment			
Piling machine	10	82	C.3 No. 15
Construction elevator	1	66	C.4 No. 62
Diesel generator	2	74	C.4 No. 84
Water purification equipment	3	N/A	N/A
VI. Other Equipment			

Plant/Activity	Number of units	Lp @ 10m	Reference [1]
Steel processing equipment	6	N/A	N/A
Woodwork equipment	4	N/A	N/A
Electric slag pressure welding machine	6	73	C.3 No. 31
Flash butt-welding machine	4	73	C.3 No. 31
Electric welder	10	73	C.3 No. 31
Electric winch (a)	4	N/A	N/A
Electric winch (b)	4	N/A	N/A
Impact hammer	6	82	C.3 No. 15
Hand drill	10	76	CONCAWE CNP 064 [6]
Sand-wheel grinder	6	75	C.4 No. 94
Angle abrader	10	75	C.4 No. 94
Bench grinder	4	80	C.4 No. 93
Electrohydraulic pipe bender	2	N/A	N/A
Pneumatic drill(including hammer)	20	82	C.3 No. 15
Submerged pump	20	62	C.8 No. 23
Sewage pump	8	68	C.4 No.88
Vertical tamping machine	2	82	C.3 No. 15
Frog hammer	6	82	C.3 No. 15

Noise emissions from construction activities have been estimated for the 6 groupings (I to VI) of equipment items outlined in table 8-7 in accordance using the methodology presented in BS5228:2008: Noise and Vibration Control on Construction and Open Sites.

The IFC General EHS Guidelines state that the day time noise levels (LAeq 1-hour) at residential, institutional or educational type receptors should not exceed 55dB(A). Due to the temporary and transient nature of construction noise, a Project threshold value has been set at 10 dB higher than the IFC limit. Therefore 65 dB(A) has been applied for the assessment of construction noise impacts and those levels higher than 65dB(A) are highlighted in orange in Table 8-8.

Table 8-8: Construction noise levels (project in isolation)

Distance (m)	Construction Noise Level (dB(A))					
	I	II	III	IV	V	VI
10	81.7	81.5	81.8	73.0	82.7	89.5
20	75.7	75.5	75.8	67.0	76.7	83.5
30	72.2	72.0	72.3	63.5	73.2	80.0
40	69.7	69.5	69.8	61.0	70.7	77.5
50	62.7	62.6	62.9	54.0	63.8	70.6
75	59.2	59.0	59.3	50.5	60.2	67.0

Distance (m)	Construction Noise Level (dB(A))					
	I	II	III	IV	V	VI
100	56.7	56.5	56.8	48.0	57.7	64.5
150	53.2	53.0	53.3	44.5	54.2	61.0
200	50.7	50.5	50.8	42.0	51.7	58.5
300	47.2	47.0	47.3	38.5	48.2	55.0

From the above table, the construction noise limit of 65 dB(A) is expected to be exceeded for the six types of construction plant and equipment when the project is considered in isolation. It should be noted however, that in all cases, the exceedance of the limit is expected to be limited to within a radius of approximately 50 - 75 m from the edge of the construction site. Given below is the impact significance of the construction related noisy activities.

Table 8-9: Impact significance for noise related activities-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	National	Short	Moderate	Probable
	4	2	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should prioritize building the perimeter walls around the facility • The EPC contractor should endeavor to reduce operations or other noisy tasks through off-site fabrication whenever practicable • The EPC contractor should ensure minimum compliance with the environmental noise standards stipulated in L.N. 61: Noise and Excessive Vibration Pollution Regulations, 2009 and occupational noise limits stipulated in and L.N. 25: Noise Prevention and Control Rules, 2005 • The EPC contractor should maximize the offset distance between noisy equipment items and residential receptors; • Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors • The EPC contractor should ensure that all equipment and its mufflers is regularly serviced, and immediately serviced/replaced if damaged. • Acoustic covers on all machine engines that generate excessive noise levels are to remain closed at all times. • The EPC contractor should limit operation times of noisy equipment, vehicles and activities, where possible; • Community liaison would form a critical element in the management of the noise impacts. If provided with adequate warning, affected sensitive receptors are sometimes willing to accept excessive noise for a short period of time. Designation of a community liaison officer			

	who will be able to deal with the concerns of residents and establishment of a noise complaint response program can enable the identification and resolution of any noise related concerns at an early stage • The EPC contractor should conduct regular inspection and spot checks of all noise generating equipment.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	National	Short	Minor	Improbable
	4	2	2	2
	Result: (-16) Low negative			

8.3.2 Noise from operational phase activities

During the operational phase, the principal sources of noise in power plants include turbine generators and auxiliaries; boilers and auxiliaries, such as coal pulverizers; reciprocating engines; fans and ductwork; pumps; compressors; condensers; precipitators, including rappers and plate vibrators; piping and valves; motors; transformers; and circuit breakers.

In order to predict the operational noise levels from the above sources and their impacts on sensitive receptors, a noise modeling study was conducted using the internationally recognized SoundPLAN version 7.3 software.

The propagation methodology adopted within the SoundPLAN model was the International Organization for Standardization (ISO) 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors' (ISO, 1996).

In the absence of detailed design data, equipment has been integrated into the noise model as either a point, area or block source, depending on the size and function of the item of equipment. In the absence of vendor noise data, all equipment has been modelled at the occupational noise threshold sound pressure level (Lp) of 85 dB(A) at a distance of 1m from any equipment façade. The sound power level data has been estimated based on the sound pressure level data and approximate equipment sizes estimated from data provided by the project engineers or based on approximate dimensions illustrated on Project plot plans and facility layout drawings.

Under normal operating conditions, the modeled sound levels at the boundaries of the plot are shown in Table 8-10. The IFC General EHS Guidelines provide a maximum value of 70dB(A) at the fence line as community noise limits.

Table 8-10 : Predicted Project Site Boundary Noise Levels – Normal Operation

Boundary	Maximum Cumulative Boundary Noise Level under Normal Operating Conditions (dB(A))	Boundary Noise Limit: IFC Guidelines	
North	45.3	70	70
East	55.5	70	70
West	54.4	70	70
South	48.9	70	70

Noise emissions from normal and emergency operational activities have been estimated for the five existing NSRs. According to the IFC standards, the daytime and night time noise limits at the residential NSRs are 55 dB(A) during the day and 45 dB(A) at night respectively.

The noise levels at NSRs due to normal operation of the Project in isolation at the five sensitive receptors are detailed in table 8-11 and assessed against the IFC daytime and night time noise standards.

Table 8-11: Assessment of Noise Levels at Existing NSRs under Normal Operating Conditions

Receptor	Project noise contribution at receptor (dB(A))	Baseline Noise level at receptor (dB(A))	Cumulative noise level at Receptor (dB(A))	Change in noise level at receptor (dB(A))	Applicable IFC Noise Limit (dB(A))	
					Day	Night
NSR1	40.7	53.0	53.2	0.2	55	45
NSR2	44.3	47.3	49.1	1.8	55	45
NSR3	47.4	43.8	49.0	5.2	55	45
NSR4	40.7	49.4	49.9	0.5	55	45
NSR5	38.6	44.1	45.2	1.1	55	45

As shown in table 8-11, the cumulative noise levels (Project noise contribution with ambient noise) have been compared against the IFC noise limits for daytime and night time periods. The results indicate no exceedances of daytime noise limits for any of the NSRs, however all five NSRs are expected to experience exceedances of the night time limit of 45 dB(A).

It should be noted that it is arguable that the noise limits are conservative with regards to the existing ambient noise levels, as most ambient noise levels already exceed the applicable night time limit.

In terms of contextualizing background noise levels in excess of the standards, the IFC Guidelines states that the contribution of operational noise should not result in an increase of background noise levels by more than 3 dB(A). Based on this requirement, the cumulative noise level should not be 3 dB(A) greater than the ambient noise level. Under this consideration, NSR 3 is expected to experience a cumulative noise level which is more than 3 dB(A) above the existing ambient noise level.

It should be noted at this point that the Project contribution to this exceedance is below the daytime noise limit and only 2.5 dB(A) above the night time IFC limit.

The noise levels at NSRs due to normal operation of the Project in isolation at the five sensitive receptors are detailed in table 8-12 and assessed against the IFC daytime and night time noise standards.

Table 8-12: Assessment of Noise Levels at New NSRs under Normal Operating Conditions

Receptor	Project Noise Level at Receptor (dB(A))	Applicable IFC Noise Limit (dB(A))		Applicable IFC Noise Limit (dB(A))	
		Day	Night	Day	Night
NSR6	65.5	55	45	55	45

Receptor	Project Noise Level at Receptor (dB(A))	Applicable IFC Noise Limit (dB(A))		Applicable IFC Noise Limit (dB(A))	
		Day	Night	Day	Night
NSR7	64.1	55	45	55	45
NSR8	60.2	55	45	55	45
NSR9	52.1	55	45	55	45
NSR10	53.2	55	45	55	45

As shown in table 8-12, the Project noise levels have been compared against the IFC noise limits for daytime and night time periods. The results indicate exceedances of daytime noise limits for NSR 6, 7 and 8; while all five NSRs are expected to experience exceedances of the night time limit of 45 dB(A).

It should be noted that it is arguable that the noise limits are conservative with regards to the fact that the classification of the NSRs is technically an industrial area; however, given that these areas are designed to accommodate workers, it was considered more conservative to assess the noise levels at these locations against the residential standards.

The impact assessment table for noise during the operational phase is provided below.

Table 8-13: Impact significance for noise related activities-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	National	Short	Moderate	Probable
	4	2	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • According to Legal Notice 25: Noise Prevention and Control Regulations 2005 (under the OSHA 2007), the EPC contractor will ensure that continuous noise characteristics of all equipment do not exceed 85dB(A). • For the new NSRs 6 and 7, the EPC contractor's design for the worker's colony windows should include secondary glazing (4 mm single glazed window) as defined in the Building Research Establishment (BRE) Digest 379 (1993). For NSRs 8 – 10, the EPC contractor's design for the worker's colony windows should contain thermal glazing (Thermal 6-12-6 mm in a PVC-U frame) as defined in the Building Research Establishment (BRE) Digest 379 (1993). • The O&M Company shall always comply with the latest environmental and occupational noise regulations promulgated under the EMCA or OSHA and their respective subsidiary legislation. In the absence of Kenyan standards on noise, the developer will comply with the requirements of the latest IFC Noise Guidelines for similar types of power plants. • The O&M Company should endeavor to reduce operations or other noisy tasks through off-site fabrication whenever practicable.			

	• The O&M Company should ensure that all equipment and its mufflers is regularly serviced, and immediately serviced/replaced if damaged. • Acoustic covers on all machine engines that generate excessive noise levels are to remain closed at all times. • The O&M Company should limit operation times of noisy equipment such as vehicles and activities, where possible; • The O&M Company should conduct regular inspection and spot checks of all noise generating equipment.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	National	Short	Minor	Improbable
	4	2	4	2
	Result: (-20) Low negative			

8.4 Thermal effluent

8.4.1 Discharge of once-through cooling water

The proposed coal power plant will utilize a once-through cooling water system for the condenser. A once-through cooling system carries off waste heat from the power plant by means of water flowing through the condenser and discharges it to the natural water body. There, waste heat is transferred to the atmosphere which is the ultimate heat sink.

The Lamu coal power plant will require about 42,000m^3/hour of seawater to cool the combustion systems. Water for cooling the systems will be obtained directly from the sea, used for cooling then released back into the sea; at the discharge point, the temperature differential of the ambient and discharged water will be about 9°C. Without adequate mitigation measures, waters with such elevated temperature differentials can potentially be harmful to sensitive habitats such as coral species. For instance, the 1997–1998 El Niño weather phenomenon in East Africa resulted in a sea temperature rise of 1–2°C in March–April 1998, resulting in widespread coral bleaching and mortality in the region (Obura 2001).

According to the current World Bank Group (WBG) EHS Guidelines for Thermal Power Plants, thermal discharges should be designed to ensure that discharge water temperature does not result in exceeding relevant ambient water quality temperature standards outside a scientifically established mixing zone. Further, the WBG General EHS Guidelines state that the temperature of wastewater prior to discharge should not result in an increase greater than 3°C of ambient temperature at the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use and assimilative capacity among other considerations.

The effects of thermal discharges on the marine environment can be sub-divided into direct effects (those organisms directly affected by changes in the temperature regime) and secondary effects (those arising in the ecosystem as a result of the changes in the organisms directly affected).

Direct effects

The direct effects of thermal discharges on the marine environment include:

- Change to the temperature regime of the water column and perhaps the sediment of the receiving environment over a small area;
- Lethal and sub-lethal responses of marine organisms to the change in temperature regime;
- Stimulation in productivity in a range of organisms.
- Minor reduction in the dissolved oxygen saturation. Changes to dissolved oxygen saturation potentially arise as a result of the reduction in solubility of oxygen in sea water with increasing temperature and as a consequence of the increased productivity of microbial communities in particular

Indirect effects

The indirect effects of thermal discharges on the marine environment include:

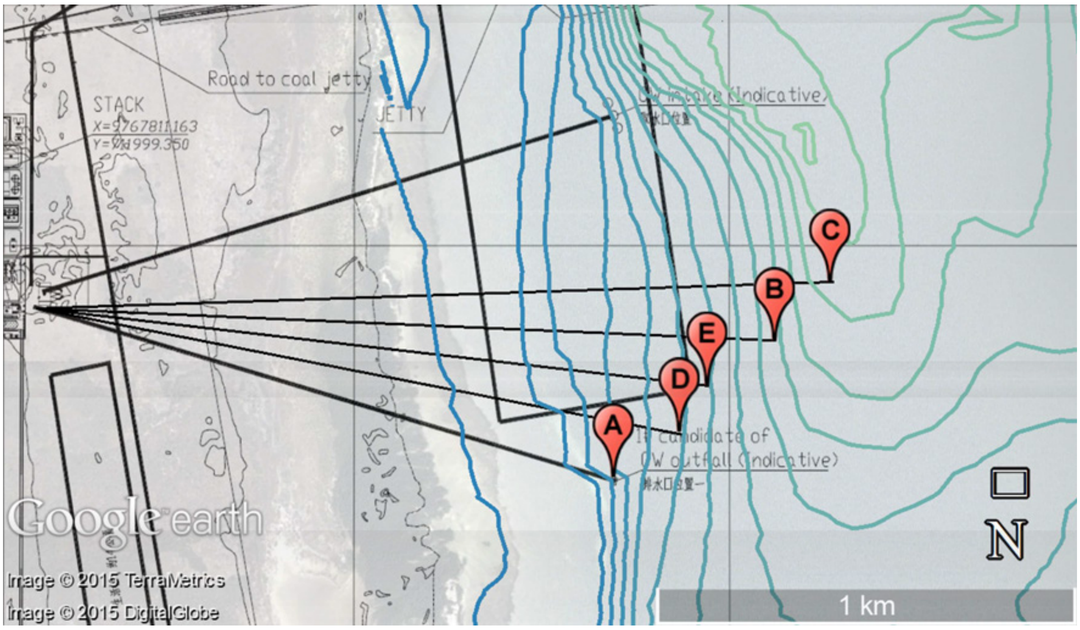
- Changes in the distribution and composition of communities of marine organisms comprising marine sites (particularly estuaries);
- Localized changes in bird distributions usually in response to increased macroinvertebrate or fish food supplies close to thermal discharges.

A thermal plume modeling study was undertaken using the US EPA endorsed Cornell Mixing Zone Expert Model (CORMIX) which is primarily used for the assessment of regulatory mixing zones resulting from continuous point source discharges.

Mixing behavior can be assessed from a range of discharge designs within bounded channels (e.g. rivers, estuaries or industrial discharge channels) and unbounded channels (e.g. coastline or lakes). The mixing behavior is modelled based on discharge characteristics and ambient conditions such as current speed, buoyancy of the effluent, stratification of the ambient fluid, effluent flow rate and port diameter/design. CORMIX is particularly effective at determining **near field** mixing characteristics based on outfall design and the ambient conditions at the point of discharge.

Figure 8-3 shows the screening locations for the circulating water discharge using CORMIX.

Figure 8-3: Circulating water discharge locations for screening purposes



Water depths and current speeds at each of the locations were determined by interrogating the modelling results of the 3D tidal simulations of the Lamu estuary. Tidal simulations were conducted for a 1-year period, and assessments within the near field were assessed at water heights and current velocities at mean high tide (MHT) and mean low tide (MLT).The ambient parameters at the locations are shown in Table 8-14 below.

Table 8-14: Ambient Parameters at Location Options

Ref.	Latitude	Longitude	Average Depth (m)	Depth at MHT (m)	Depth at MLT (m)	Current Speed at MHT (m/s)	Current Speed at MLT (m/s)
A	-2.105363	40.921075	3.5	4.56	2.44	0.12	0.07
B	-2.102450	40.924537	7	8.06	5.93	0.11	0.07
C	-2.101193	40.925731	10	11.06	8.93	0.09	0.07
D	-2.103403	40.923148	4	5.06	2.94	0.12	0.07
E	-2.104468	40.922537	5	6.06	3.94	0.12	0.07

Various types of diffuser designs were used to carry out the screening assessment as shown below.

Figure 8-4: Uni-directional Perpendicular Diffuser

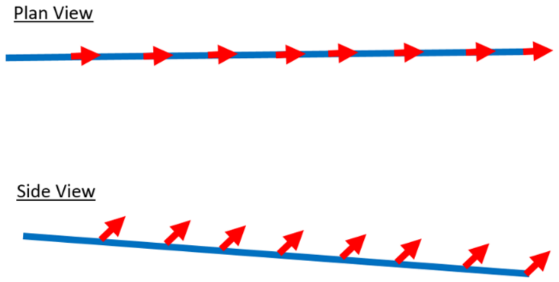


Figure 8-5: Staged Perpendicular Diffuser

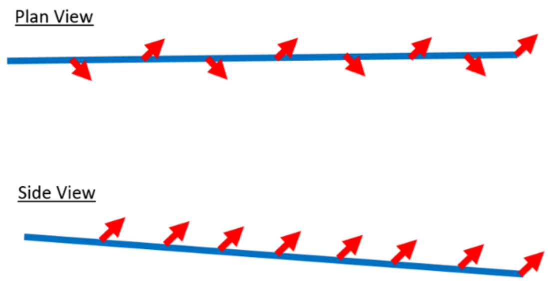


Figure 8-6: Uni-directional Parallel T Diffuser

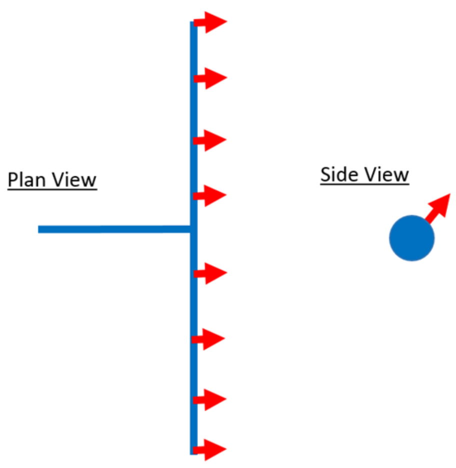
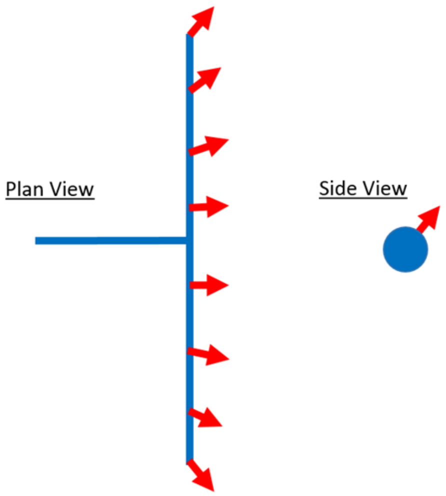


Figure 8-7: Fanned Parallel T Diffuser



All four outfall designs were assessed at locations A, B and C to determine mixing behavior at variable distances within the plume centerline, with the exception of the 'Staged Perpendicular Diffuser'. It was not possible to assess this design within the near-field due to the instability of the plume, and therefore unreliable nature of dilution predictions. This instability is likely caused by the forced separation of the plume by the variable discharge direction, results can only be reliably predicted once the multiple plumes are re-joined downstream into a single plume.

An additional two diffuser designs were assessed, based on the favorable results of the planned designs within the assessment, and in an attempt to introduce diffuser designs that may be more technically and financially feasible to the Client. The designs were variations to the 'Uni-directional perpendicular diffuser' design with reduced lengths and number of ports.

A summary of the designs assessed is provided within Table 8-15.

Table 8-15: Design Screening Options Parameters

Ref.	Description	Port Diameter (m)	Diffuser Length (m)	Port Number	Horizontal Discharge Angle (°)
a	Single Port	4	N/A	1	60
b	Uni-Directional Perpendicular Diffuser	0.44	100	35	45
c	Staged Perpendicular Diffuser	0.44	100	35	45
d	Parallel T Diffuser Uni-Directional	0.44	100	35	60
e	Parallel T Diffuser Fanned	0.44	100	35	60
f	Uni-Directional Perpendicular Diffuser	0.58	50	20	45
g	Uni-Directional Perpendicular Diffuser	0.82	25	10	45

The results of the screening assessment using CORMIX modeling software is given in tbale 8-16.

Table 8-16: CORMIX screening results for various thermal plume modeling scenarios and diffuser options

Scenario Ref.	Discharge Type	Diameter (m)	Port Number	Discharge Angle (°)	Tidal Conditions	Depth at Discharge (m)	Distance from Shore (m)	Current Velocity (m/s)	Temperature (Δ°C) at Distance (m)							Δ3°C within 100 m?	Δ3°C within near-field?
									1	2	5	10	20	50	100		
Db	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MHT	5.06	590	0.12	1.85	1.85	1.85	1.85	1.85	1.85	1.56	Yes	Yes
Db	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MLT	2.94	590	0.07	2.42	2.42	2.42	2.42	2.42	2.42	2.03	Yes	Yes
Df	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MHT	5.06	590	0.11	3.24	3.21	3.10	2.94	2.70	2.19	1.74	Yes	Yes
Df	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MLT	2.94	590	0.07	3.54	3.50	3.41	3.41	3.41	2.86	2.29	Yes	Yes
Dg	Uni-Directional Perpendicular Diffuser (g)	0.82	10	45	MHT	5.06	590	0.11	4.36	4.28	4.07	3.79	3.29	2.44	1.87	Yes	Yes
Dg	Uni-Directional Perpendicular Diffuser (g)	0.82	10	45	MLT	2.94	590	0.07	5.50	5.42	5.22	4.94	4.38	3.19	2.45	Yes	Yes
Eb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MHT	6.06	600	0.12	1.81	1.79	1.75	1.69	1.69	1.69	1.42	Yes	Yes
Eb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MLT	3.94	600	0.07	2.09	2.09	2.09	2.09	2.09	2.09	1.77	Yes	Yes
Ef	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MHT	6.06	600	0.11	2.99	2.95	2.85	2.70	2.47	2.01	1.59	Yes	Yes
Ef	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MLT	3.94	600	0.07	3.37	3.33	3.22	3.07	2.95	2.48	1.97	Yes	Yes
Eg	Uni-Directional Perpendicular Diffuser (g)	0.82	10	45	MHT	6.06	600	0.11	4.03	3.95	3.74	3.47	2.99	2.26	1.72	Yes	Yes
Eg	Uni-Directional Perpendicular Diffuser (g)	0.82	10	45	MLT	3.94	600	0.07	4.86	4.78	4.57	4.29	3.72	2.79	2.11	Yes	Yes
Ba	Single Port (a)	2.6	1	45	MHT	8.06	770	0.12	9.00	9.00	9.00	8.20	5.63	2.87	1.41	Yes	No
Ba	Single Port (a)	2.6	1	45	MLT	7.8	770	0.07	9.00	9.00	9.00	8.21	5.64	2.90	1.44	Yes	No

Scenario Ref.	Discharge Type	Diameter (m)	Port Number	Discharge Angle (°)	Tidal Conditions	Depth at Discharge (m)	Distance from Shore (m)	Current Velocity (m/s)	Temperature (Δ°C) at Distance (m)							Δ3°C within 100 m?	Δ3°C within near-field?
									1	2	5	10	20	50	100		
Bb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MHT	8.06	770	0.11	1.76	1.75	1.71	1.65	1.55	1.46	1.24	Yes	Yes
Bb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MLT	5.93	770	0.07	1.81	1.80	1.76	1.71	1.71	1.71	1.44	Yes	Yes
Bc	Staged Perpendicular Diffuser (c)	0.44	35	45	MHT	8.06	770	0.11	-	-	-	-	-	-	-	?	?
Bc	Staged Perpendicular Diffuser (c)	0.44	35	45	MLT	5.93	770	0.07	-	-	-	-	-	-	-	?	?
Bd	Parallel T Diffuser Uni-Directional (d)	0.44	35	60	MHT	8.06	770	0.11	5.50	4.73	3.71	2.98	2.34	1.63	1.50	Yes	Yes
Bd	Parallel T Diffuser Uni-Directional (d)	0.44	35	60	MLT	5.93	770	0.07	5.69	4.93	3.91	3.17	2.50	1.76	1.60	Yes	Yes
Be	Parallel T Diffuser Fanned (e)	0.44	35	60	MHT	8.06	770	0.11	5.20	4.43	3.42	2.72	2.11	1.46	1.13	Yes	Yes
Be	Parallel T Diffuser Fanned (e)	0.44	35	60	MLT	5.93	770	0.07	5.44	4.67	3.65	2.93	2.29	1.60	1.45	Yes	Yes
Bf	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MHT	8.06	770	0.12	2.63	2.59	2.49	2.36	2.15	1.74	1.39	Yes	Yes
Bf	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MLT	5.93	770	0.07	3.02	2.98	2.88	2.73	2.50	2.03	1.61	Yes	Yes
Ca	Single Port (a)	2.6	1	45	MHT	11.06	930	0.12	9.00	9.00	9.00	6.66	3.40	2.04	1.49	Yes	No
Ca	Single Port (a)	2.6	1	45	MLT	8.93	930	0.07	9.00	9.00	9.00	8.22	5.64	2.90	1.37	Yes	No
Cb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MHT	11.06	930	0.09	1.66	1.64	1.61	1.55	1.45	1.25	1.06	Yes	Yes
Cb	Uni-Directional Perpendicular Diffuser (b)	0.44	35	45	MLT	8.93	930	0.07	1.75	1.74	1.70	1.64	1.54	1.39	1.17	Yes	Yes

Scenario Ref.	Discharge Type	Diameter (m)	Port Number	Discharge Angle (°)	Tidal Conditions	Depth at Discharge (m)	Distance from Shore (m)	Current Velocity (m/s)	Temperature (Δ°C) at Distance (m)							Δ3°C within 100 m?	Δ3°C within near-field?
									1	2	5	10	20	50	100		
Cc	Staged Perpendicular Diffuser (c)	0.44	35	45	MHT	11.06	930	0.09	-	-	-	-	-	-	-	?	?
Cc	Staged Perpendicular Diffuser (c)	0.44	35	45	MLT	8.93	930	0.07	-	-	-	-	-	-	-	?	?
Cd	Parallel T Diffuser Uni-Directional (d)	0.44	35	60	MHT	11.06	930	0.09	5.02	4.24	3.25	2.57	1.98	1.36	1.25	Yes	Yes
Cd	Parallel T Diffuser Uni-Directional (d)	0.44	35	60	MLT	8.93	930	0.07	5.19	4.41	3.41	2.71	2.10	1.45	1.33	Yes	Yes
Ce	Parallel T Diffuser Fanned (e)	0.44	35	60	MHT	11.06	930	0.09	4.77	3.99	3.02	2.37	1.81	1.24	0.95	Yes	Yes
Ce	Parallel T Diffuser Fanned (e)	0.44	35	60	MLT	8.93	930	0.07	4.94	4.16	3.17	2.50	1.92	1.32	1.21	Yes	Yes
Cf	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MHT	11.06	930	0.09	2.27	2.24	2.15	2.03	1.84	1.48	1.19	Yes	Yes
Cf	Uni-Directional Perpendicular Diffuser (f)	0.58	20	45	MLT	8.93	930	0.07	2.50	2.47	2.38	2.25	2.04	1.65	1.32	Yes	Yes

The results of the screening assessments indicate that the diffuser designs at all locations meet the project requirement of Δ3°C within the near-field mixing zone (or area of initial dilution). As all designs meet the project requirements within the near field mixing zone, cconsideration of direct impacts of outfall construction will be considered within the assessment (i.e. longer outfall pipes are likely to cause greater direct destruction of habitat and generation of turbidity plumes during construction).

The preferred design option was further modelled for the 'far-field' behavior of the thermal plume using a 3D Plume Discharge Model (PLUME3D). PLUME3D modeled the cooling water dispersion over a full year period to statistically determine the temperature rise within the receiving environment. The results of PLUME3D are spatially and temporally accurate and will be utilized to determine potential impacts on environmentally sensitive habitats within the estuary. The results of the PLUME 3D modeling indicated that the selected discharge design, a uni-directional perpendicular diffuser, is anticipated to meet IFC requirements within the near-field mixing zone, and therefore a significant increase in temperature of greater than 3°C is not anticipated to extend beyond the effluent jet issuing from the diffuser openings. Therefore, the selected outfall design and location are anticipated to comply with the strictest definition of IFC requirements.

Given below is the impact assessment of thermal discharge of once through cooling water.

Table 8-17: Impact significance for thermal discharge of cooling water into the estuary-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Very high	Highly probable
	2	4	10	4
	Result: (-64) High negative			
Mitigation measures	**Comments/Mitigation:** • A cost benefit analysis should be undertaken to determine the optimal design of the submerged diffuser design. Consideration should be given to utilize the shortest length of the diffuser and CW discharge in order to minimize construction related impacts on the marine ecology. • The Proponent should consider installation of CW intake technologies such as seasonal barrier nets or mesh/wire screens to reduce impingement and entrainment of fish, jellyfish, etc. The reduced intake flow rate also reduces the potential for entrainment of marine species. • During the initial testing at the plant and cooling water systems commissioning, it should be ensured the initial effluent and cooling water discharges fully comply with the AfDB and/or IFC standards on thermal discharge. • Over-chlorination of the condensed water will be prevented and should be achieved through process monitoring • Water quality monitoring should be provided on all lines feeding the outfall. If process standards are accidentally exceeded, there should be an option of diverting the stream into a holding pond;			

	• The O&M company should periodically monitor flow and quality on the main outfall using alarms if standards are exceeded; • The O&M Company should conduct reef inspection and water quality monitoring at specified locations (in collaboration with an NMK marine ecologist) and at appropriate time intervals according to the environmental monitoring plan and report reef status and water quality data after each survey.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

8.5 Climate change

As part of the ESIA Study, a desktop climate change impact assessment was undertaken for the proposed 1,050MW coal fired power plant comprising two distinct parts namely:

- A climate risk assessment (CRA); and
- A greenhouse gas (GHG) assessment.

This Climate Change Specialist Study was undertaken with the following objectives:

- Undertake a high level assessment of the physical risks facing the development, such as high temperatures, floods, strong winds, monsoons etc. and identify adaptation measures that could reduce the risk or take advantage of opportunities; and
- Estimate the operational carbon footprint of the proposed 1,050MW Coal Fired Power Plant, Lamu County, identify high level opportunities for minimizing the carbon footprint, and understand exposure to applicable regulation.

The climate change impact assessment was also undertaken in accordance with the requirements of the African Development Bank's integrated safeguard system which requires an assessment of climate change for coal fired power plants. Additionally, the IFC Performance Standards require that all new projects undertaken after January 1, 2012, need to undertake an assessment of climate change impacts associated with a project.

There are a number of key drivers for conducting a CRA and GHG assessment alongside an ESIA for a new development and include:

- Climate change impacts (as identified through the CRA) may have implications on the environmental performance of the project; for example, if changes in extreme weather events result in damage to facilities that lead to environmental impacts (e.g. from leaks or damage to equipment and storage facilities).
- Integrating CRA into ESIA's can help to improve the climate resilience of projects and can help to avoid the maladaptation of projects to climate change. Projects failing to consider climate change risks at the planning stages could face severe financial, safety and operational impacts in the future if climate change impacts bring about the damage or disruption to operations, assets, infrastructure and energy supply.

- Projects conducting a CRA and GHG assessment as part of the ESIA process are likely to be identified by stakeholders as being forward looking and responsible, bringing about reputational benefits.

Please note that this impact assessment for climate risk does not follow the standard format used in the rest of the Impact Assessment Chapter. This is owing to uncertainties that exist with regard to the accuracy of simulated climate change predictions, specifically due to the early stage of project design and that (in many cases) available information was insufficient to determine significant change to the baseline risk profile. As such, a conservative approach has been adopted and estimated values are considered to reflect worst-case scenarios.

The CRA was conducted by reviewing historic data on climate and weather events in the project region and surrounding towns, and overlaying the findings with peer-reviewed scientific projections of climate change in order to assess and identify future climate risk and opportunities for the project. Key interactions between project components and climate risk sources were subsequently analyzed and prioritized.

8.5.1 Climate change induced-risks on the project

In terms of the climate change impact assessment, the project area is envisaged to have the following characteristics:

- The climate around the project area is typically hot & dry with low precipitation throughout the year;
- Extreme weather events are not characteristic of the region and the project site in particular and those that have taken place do not appear to have had a significant impact apart from droughts impacting fresh water supply;
- Temperatures across Africa are projected to increase over the 21st Century (across all seasons) and the warming is anticipated to exceed the global mean annual temperature increase, which is projected to be approximately 3.4°C by 2100. In Kenya, warming is expected to be greater over the Northern and Central parts and lower along the coast (within which the project area falls);
- Overall, it is envisaged that the project area is likely to get hotter and drier with increasingly variable precipitation as a result of climate change. Additionally, storm surges along the coast may become more common given projected increases in severe weather events specially the El Niño Southern Oscillation (ENSO), La Niña and Inter-Tropical Convergence Zone (ITCZ).

Based on the experience of the climate change specialist, given below are the potential climate change impacts on the proposed project.

Table 8-18 : Potential climate change risks and consequences to the project

Weather variable	Risk to project	Potential consequence
High Temperature (air/oceans)	• Health risk to workforce and community • Equipment efficiency • Sea temperature increase	• Reduce workforce efficiency • Potential community unrest • Downtime and delays due to reduced productivity and problems with equipment • Downtime in ability to cool due to marine life damage

Weather variable	Risk to project	Potential consequence
Flooding	• Very low with only some localized pooling	• No major consequences
Drought	• Reduced water availability (e.g. water restrictions as water prioritized for community) • Increased need of water for dust suppression (during construction) • Evaporation of ponds/dams/water supply • Evaporation causing vegetation loss and erosion • Drying up of natural local fresh water supply in sand dunes	• Reduced production • Delays • Community stress and unrest • Livestock loses • Shut downs due to cooling discharge water heating marine area and impacting marine life beyond best practice levels.
Sea Level Rise	• Limited due to site elevation of between 6 & 12 m above sea level. • Storm surges could have some impact on the lower areas of the project site	• Disruption to the generation plant will be limited but flood defense barriers to be considered.

Those impacts that emerged as being of moderate significance to the project under future predicted climate change conditions were:

High Temperature

- Affecting staff health and potentially productivity;
- Physically affecting nearby communities, which may lead to community unrest;
- Reducing access to water and affecting subsistence agriculture in nearby community, which may lead to community unrest;
- Reducing the efficiency of equipment, which may compromise productivity;
- Low rainfall comporting water availability within region, which may result in reduced productivity;
- Increased sea water temperature which could lead to productivity issues, as cooling system may need to be stopped due to discharge water into sea increasing beyond best practise levels, which could damage marine life; and
- Increase risk of more severe stores over the warmer seas.

Rainfall and Flooding

- Flooding will be minor and limited to surface water build up with severe weather events, but run off to the ocean will limit this impact;
- Maintenance could be impacted if parts are shipped in or trucked in from areas within the flood prone zones within Kenya. Delays could have a minor impact on operation efficiencies;

- Construction could be impacted by high temperatures causing worker fatigue and equipment in-efficiencies and failure due to excessive heat;
- Wetting the coal supplier in storage rendering it un usable till dried; and
- Access of supplier from areas within the high flood risk zone in Kenya.

Sea Level Increase

- Damage from storm surges to plant, infrastructure and erosion,
- Sea water egress into plant and damaging equipment, and
- Port access for supplies of coal could be delayed due to severe storm events.

Based on the more significant types of impacts, it is advisable that the project developer invests in a mitigation measures that will act to reduce the influences of hotter temperatures on the plant, it's staff and the nearby communities as well as appropriate flood and sea level control measures.

8.5.2 Adaptation measures for climate change

Based on the potential climate change risks on the proposed project, it is recommended that the adaptation measures listed in the table below be implemented.

Table 8-19: Proposed adaptation measures for coal power plant

Climate Variable/ Event	Potential Impact on Power Generation and Associated Activities	Phase of Power Plant Affected	Project Component Impacted	Possible Adaptation Measure(s)
Change in disease distribution	Increase incidence of dengue, diarrhea, bartonellosia, malaria and other vector-borne diseases (given increased high temperatures) will impact the health of workforce and surrounding community putting strain on health facilities	Construction & Operational	Health	Rollout community health programs as part of community based adaptation Establish a health support program for staff including training on the avoidance of diseases and infections as well as distribution of prevention materials (i.e. mosquito nets etc.) Clear unwanted water bodies to prevent breeding grounds for Mosquitos
Cyclone/High Winds	Increase dust, blow the Fly ash being blown around	Construction & Operational	Community Support and Health/ Safety	Improve dust suppression mechanisms under high wind conditions
Human adaptation/mitigation and increased competition for land	Changes in climate impacting agricultural (subsistence) and food security could lead to	Construction & Operational	Community Support	Roll out community-based adaptation program considering improving food security under climate change conditions.

Climate Variable/ Event	Potential Impact on Power Generation and Associated Activities	Phase of Power Plant Affected	Project Component Impacted	Possible Adaptation Measure(s)
	conflict with local communities			
Pluvial/Fluvial flooding	Disrupted access to facility due to flooding leading to interruption to supply of inputs such as diesel, materials. Diesel in particular during construction phase, material supply throughout life of project.	Operational	Supply Chain	Implement appropriate flood control measures Implement appropriate stock control system
Storm Events	Increased delay to construction, docking of coal ships, as well as increased maintenance costs and possible business delays during operations Storm surges.	Construction & Operational	Power Plant and Harbour Infrastructure and facilities	Undertake more regular maintenance of infrastructure Implement flood control measures and controls
Temperature	Power Plant staff may experience health impacts as a result of temperature e.g. heat stress, which may result in delays	Construction & Operational	Health	Prevent working under very hot temperatures Ensure availability of cool drinking water for all on-site staff Change working hours to avoided hot working parts of the day
Temperature	Reducing efficiency of equipment due to hotter operating temperatures resulting in increased operational costs (trips/premature failures etc.)	Operational	Power Plant infrastructure and facilities	Review and adjust if possible the operational temperatures for equipment Increase maintenance schedule to prevent slow/shut downs

8.5.3 Impact of Project GHG Emissions on Kenya's National Emissions

This section provides an assessment of the potential impacts associated with the Project's contribution to climate change through 'greenhouse gas' (GHG) emissions. To determine this, the operational phase carbon footprint of the Project has been estimated in a Climate Change Specialist Study.

The Amu Power Company carbon footprint has been estimated in accordance with the *GHG Protocol: Corporate Accounting & Reporting Standard* developed by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The *GHG Protocol* provides comprehensive guidance on accounting and reporting corporate GHG emissions. It is the most widely used standard for mandatory and voluntary GHG programmes and makes use of the Intergovernmental Panel on Climate Change (IPCC) GHG Inventory guidelines for specific heating values, carbon content, densities and emission factors. In the absence of data available from the project developer, the following sources of information were used to calculate the GHG emissions:

- Intergovernmental Panel on Climate Change (IPCC) 2006 GHG Inventory guidelines and 2013 supplement where and when applicable;
- Department for Environmental, Food and Rural Affairs (Defra) 2014 GHG Conversion Factors for Company Reporting Guidelines;
- Kenya's intended National Determination Contribution (INDC) (23 July 2015);
- National Climate Response Strategy (NCCRS 2010);
- National Climate Change Action Plan (NCCAP 2013); and
- National Adaptation Plan.

The greenhouse effect occurs on a global basis and the point source of emissions is irrelevant when considering the future impact on the climate. It is not possible to link emissions from a single source – such as the Lamu Power Plant facility - to particular impacts in the broader study area.

Subsequently, this specialist study does not consider the physical impacts of climate change resulting from increasing GHG emissions, but rather the impact of the project on Kenya's National GHG Inventory and the implications of this.

The impact of the estimated operational emissions for the Lamu Coal Power Plant has been compared with a national emissions trajectory of Kenya from 2016 to 2040 which has been determined based on historic and projected economic growth and development pathways. The last official GHG emissions inventory for Kenya was completed for the year 1994 and used in the First National Communication, in 2002. Since then Kenya's GHG emissions from 2000 to 2010 have historically been calculated using the Intergovernmental Panel on Climate Change (IPCC) 2006 guidelines for GHG emissions inventories.

For a detailed overview of the methodology and approach used in calculating the Projects carbon footprint please refer to the Climate Change Specialist report. The table below summarises the key emission sources occurring on site and indicates those which are included in the carbon footprint.

Table 8-20: Summary of key emission sources (all Scope 1)

Emission Scope	Emission Source
Mobile combustion	Fuel used in freight carriers
	Fuel used in terrestrial vehicles including cars, utility vehicles, buses etc.
	Fuel used in airplanes for business travel
Stationary combustion	Diesel used for power generation (black start and during construction phase)
Waste emissions	Coal fired boiler
	Methane emissions from waste water (sewage) treatment
Refrigerants	Leakage/use of refrigerant gases in air conditioning units in vehicles and offices/accommodation
Fugitives	Methane escaping from coal storage yards
Lubricants	Use of lubricant oils and greases in machinery
Land clearance	Clearance of vegetated land (at the start of the project)

Kenya's national emissions were estimated to be 73 million tCO_2e in 2010[1] and the vast majority of these arose from land use, land use change and forestry and agriculture (75%). The energy sector accounted for 11.37% of emissions in 2010.

Based on the calculations in the climate change specialist study, the operational phase carbon footprint for the proposed project, is estimated to be approximately ~8.8 million tons CO_2e per year from 2020 onwards when all three boiler unit become fully operational. This calculation is based on the design parameters of the equipment to be employed, the estimated annual coal quality and feed rate.

Emissions from transport related activities account for approximately 284.22tCO_2e (0.00003%) of the total operational emissions from Lamu Power Plant's activities in the area.

Emissions from waste water (sewage) treatment estimated to account for 3 290tCO2e per annum (<0.04%) of the operational carbon footprint. However, due to the significantly higher number of people on site during construction (up to 3 000), waste water treatment contributes a higher proportion of emissions during the initial stages (construction) of the project.

During the construction phase of the project, electricity will be provided by diesel generators until the Lamu Coal Power Plant is up and running. Based on similar types of activities and the climate change specialist's experiences elsewhere, it is estimated that approximately 20MW of electricity would be needed to power the camps and construction of the facility. Based on a diesel consumption of 15.8 million litres per year, the emissions associated with the diesel combusted are 42,873tCO_2e.

The greenhouse effect occurs on a global basis and the point source of emissions is irrelevant when considering the future impact on the climate. It is not possible to link emissions from a single source – such as the Lamu Power Plant – to particular impacts in the broader study area. This specialist study, therefore, looks at the impact of the project on Kenya's National GHG Inventory and the implications of this rather than the physical impacts of climate change.

[1] Kenya's Intended National Determination Contribution – 23 July 2015

An indirect impact of Lamu Power Plant's activities in Kenya is the effect on global greenhouse gas emissions. In 2013, global emissions of greenhouse gases from anthropogenic activities excluding land use change and deforestation came to 36 Giga tons (Gt) CO_2e[2], this is 61% higher than 1990 (the Kyoto Protocol reference year) and 2.3% higher than 2012.

Current generation from the Lamu Power Plant Facility is anticipated to be approximately 1,050 MW of electricity per year (~8.8 GWh) using 3 600 000 tonnes of coal per annum. It must be noted that all but the parasitic load[3] will be distributed via national grid to local electricity demand. Excluding the emissions from transport of coal, transmission losses and downstream combustion of this electricity will result in the emission of approximately ~ 8.8MtCO_2e per year – a 0.024% increase in global emissions (World Total: 36 131 MtCO_2).

Given the growth in national emissions over time, by 2030 (143MtCO_2e)[4], Lamu Power Plant could account for around 6 – 10% of the Kenyan national emissions. The emission projection is based on GDP growth and projected emissions by 2030 which assumes a ~3.4% increase in emissions annually[5]. This is based on the emissions growing from the 2010 level of 73MtCO_2e to 143MtCO_2e in 2030. Since there is no actual data upon which to base this assumption, it is not possible to assess whether this figure is an over or under estimate of future emissions. Assuming that emissions will increase by 6% per year, the addition of the Lamu Power Plant facility will increase Kenya's emissions by an equivalent amount during the first few years of operation, reducing each year as national emissions rise.

Based on above assessment that the impact magnitude of the proposed project on Kenya's national emissions during the operational phase could be medium to high and the definite likelihood of the impact occurring, the significance is rated as major. It must be noted that the impact is based on the effect the operation will have on the national GHG emissions level which are low on a global context and therefore the impact on that basis is considered major.

Given its global nature, mitigation of the impact of climate change takes the form of reducing the concentration of greenhouse gases in the atmosphere. Subsequently, the developer should consider the following mitigation measures:

- Consider options for implementing waste heat recovery in order to improve the thermal efficiency of the plant;
- Consider the development of a man-made mangrove for the treatment of sewerage in order to sequester carbon[6];
- Optimise transport logistics;
- Incorporate 'green building' features in the design of offices and accommodation; and
- Explore options for providing local communities with electricity to offset deforestation.

[2] From http://co2now.org/Current-CO2/CO2-Now/global-carbon-emissions.html
[3] Represents the power consumed when the power plant is not generating electricity for the grid and/or self-generated load required to provide generation to grid i.e. it operational power.
[4] Kenya's Intended Nationally Determined Contribution (INDC) 23 July 2015
[5] Based on the Intended National Determined Contibution (INDC) 23 July 2015
[6] Asia-Pacific Conference on Science and Management of Coastal Environment (1997-01-01) 123: 49-59, January 01, 1997 By Wong, Y. S.; Tam, N. F. Y.; Lan, C. Y.

8.6 Waste management

The proposed power plant project is expected to generate a variety of wastes during the construction and operational phases of the project respectively. Given in Table 8-21 are the estimated quantities of wastes that may be generated by the proposed power plant during the construction and operational phases of the project.

Waste steam	Origin/Source	Estimated Quantities		Preferred treatment/ disposal options
		Construction (tons)	Operation (tons/year)	
Waste water	Concrete placing	1,500		Re-used after sediment removal
Construction waste	Building/ Architecture construction	400		Carted away for disposal by NEMA licensed transporter
Wood/iron sheets	Equipment package	500		Reused, and a little unusable waste will be carted away for disposal
Concentrate water	Concentrated water from water treatment equipment	110,000		Discharged into Manda Bay
Cooling water	Once-through cooling water system		9.42×10^8	Discharged into Manda Bay
Fly ash	coal burning		2.5×10^5	Stored in ash yard
Bottom ash	coal burning		2.7×10^4	Stored in ash yard
Gypsum	Wet Flue Gas Desulfurization		6.9×10^4	Stored in ash yard
Sanitary sewage	Colony		1.4×10^4	Treated through effluent treatment plant and used for dust suppression
Household refuse	Temporary colony and Colony	600	150	Carted away for disposal by NEMA licensed transporter

8.6.1 Construction phase waste assessment

Raw material waste from the construction of buildings and plant infrastructure may require offsite disposal. Some of the waste streams are likely to be generated during the excavations for building foundations and the construction of the building frame, internal fittings, electrical installations and external works and include the following waste streams:

- Hazardous wastes such as solvents, thinners, cleaners, cutting oils, paints, contaminated rags, packaging and containers, adhesives, light bulbs and batteries;

- Non-hazardous wastes such as food and canteen waste, scrap metal waste, waste paper, wood, cardboard packaging; and,
- Other wastes such as glass, uncontaminated soil and rubble, plastics and rubber.

The improper management of the above wastes may have potential adverse impacts on the environment in the absence of appropriate mitigation measures given that there are minimal waste disposal facilities within Lamu County.

Table 8-21 : Impact significance for waste-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Low	Highly probable
	2	2	4	4
	Result: (-32) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should endeavor to design out waste through the initial project planning phase, consider the types of materials used, the methods of transportation and how the materials are handled, stored and disposed of in-situ, particularly any excavated material from building foundations and retention of excavated materials on site. • In alignment with the IFC principles of waste avoidance and utilization, the EPC contractor should encourage their suppliers to minimize waste generation. This may involve suppliers committing to reduce surplus packaging associated with and construction raw materials such as plastics, cardboard and wooden pallets • The EPC contractor should construct a salvage yard which includes areas for segregating general and hazardous wastes. The waste storage facilities must include linings, bunds and roofing. • A hazardous chemical and waste storage facility should include a low permeability surface, preferably concrete, that is protected from the ingress of storm water from surrounding areas to ensure that accidental spillage does not pollute local soil or water resources. • All storage areas must also be properly demarcated and, if the material is hazardous, there should be adequate labelling and security at the facility. • A facility must be provided for separate storage of incompatible chemicals or wastes, e.g. acids and bases, flammable materials, etc. • The EPC contractor should emphasize the minimization and reuse aspect during the construction process through awareness among construction workers of waste minimization and recycling initiatives. Wastes should be segregated at source and kept in segregated stockpiles. • The EPC contractor should provide clearly labeled skips for separation of specific types of wastes such as metals, wood, card board. The skips should be located in a centralized area on an impermeable hardstanding surface.			

	• All waste oils and chemicals should be stored in drums or tanks in a bunded compound situated on an impermeable surface in order to prevent potential spillage.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Duration	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

8.6.2 Construction phase off-site waste management

The potential impact from the offsite disposal of waste to an appropriate waste disposal site may result in increased traffic movements from the site. This could be a significant impact as Lamu County lacks any dump sites or engineered landfills. If no minimization issues are implemented at the site this is likely to result in the increase of offsite waste truck movements (noise and dust generation) and the amount of waste disposed of to landfill sites resulting in a potential negative impact.

Table 8-22: Impact significance for off-site disposal of waste-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Short	Low	Highly probable
	3	2	4	4
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The Construction Environment Management Plan (CEMP) should identify appropriate approved waste disposal facilities in Lamu, Kilifi, Kwale or Mombasa Counties respectively for off-site disposal of construction wastes. • In order to reduce the off-site disposal of waste, it is recommended that the EPC contractor carry out an on-site waste audit at each stage of the construction process and implement appropriate on-site waste targets and program of monitoring at the site such as: ✓ Quantifying raw material storage; ✓ Quantifying the generation of each waste stream; ✓ Any improvements in current working practices; ✓ Methods of handling and storage of waste streams; and ✓ Quantifying the material disposed off-site. • The EPC contractor will ensure that the waste disposal transporter selected to dispose of any residual waste streams off site is registered with NEMA and will have a duty to ensure that waste is disposed of in a safe and correct manner			

	• The EPC contractor will ensure that all records of paperwork relating to the disposal of both hazardous and non–hazardous waste streams are retained as part of the CEMP and monitoring maybe required to ensure that the movement of waste off site is undertaken in accordance with the Kenyan Waste Management Regulations 2006 (L.N. 121)			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Short	Minor	Improbable
	3	2	2	2
	Result: (-14) Low negative			

8.6.3 Operational phase waste management

Without any beneficial use, fly ash, bottom ash and wet FGD gypsum are classified as wastes. According to the Technical Proposal submitted during the tender submission in April 2014, the annual ash and gypsum reject load for each unit is ~592,900m^3. Over a period of 15 years the total ash and gypsum volume is envisaged to be about 26,740,000m^3. Fly ash, bottom ash and wet FGD gypsum will be disposed of in the on-site ash yard. The lack of a properly designed ash yard could potentially lead to sub-surface and groundwater contamination. A further potential impact associated with generation of fly ash, concerns the release of fly ash material into the environment. Due to its low density and fine particulate size, it has the potential to travel relatively large distances.

Table 8-23: Impact significance for operational waste management

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Medium	Moderate	Probable
	3	3	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • An ash yard will be designed and constructed in accordance with the Chinese Standard GB 18599-2001: Standards for pollution control on the storage and disposal site for general industrial solid wastes. GB 18599-2001 states that if the coefficient of permeability is greater than 1.0×10^{-7}cm/s, there should be natural or artificial material to build an impermeable layer the thickness of which should produce an anti-seepage capacity which is equal to that of the clay layer of 1.0×10^{-7}cm/s permeability coefficient and of 1.5m thickness. • Based on the above standard, the proposed power plant ash yard design should incorporate at least three layers of protection namely (i) a 1.5m thick in-situ compacted layer of clay, (ii) an appropriately designed HDPE layer around the ash yard whose permeability coefficient is less than 1.0×10^{-7}cm/s, (iii) a 200mm thick layer of sand on top of the HDPE layer for protection, and (iv) a network of perforated pipes to collect leachate for subsequent treatement.			

	• The HDPE liner should be inspected for uniformity, damage and imperfections during construction and installation. • A leachate collection system should be incorporated in the ash yard design and provided at the lowest point(s) of the ash yard. The leachate and runoff should be collected from the coal ash pile and diverted it into a leachate storage or treatment system. • A groundwater monitoring system made up of wells should be installed and operated around the ash yard capable of verifying whether coal ash or leachate has penetrated the pad or HDPE liner. • Stormwater canals will be constructed along the perimeter of the ash dump. The leachate from the canals will be collected and treated in the ash treatment pool with the treated water used in the ash yard through a sprinkler system for dust suppression • A 7m wide road should be constructed around the perimeter of the ash yard complete with drains for access purposes • The O&M Company will develop and implement a waste management plan for the operational phase of the project • Based on the specific situation(s) at the time, the O&M Company should take suitable measures to prevent erosion of the ash pile during the monsoon season in Lamu or a failure of part of the ash pile • Employees should be trained in the proper handling and disposal of the fly ash, bottom ash and wet FGD gypsum to minimize their risk of exposure in accordance with the O&M Company's operational health and safety procedures. Employees should be provided with appropriate personal protective equipment (PPE) for handling the ash. Proper handling and disposal by employees would minimize exposure or health-related issues to the public.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long term	Minor	Improbable
	2	3	2	2
	Result: (-14) Low negative			

8.7 Water resources

Impacts associated with water resources include stormwater events and sanitary waste generated by construction activities at the project site. As the freshwater in Lamu is scarce, a desalination plant will be incorporated into the project. The desalination plant will provide fresh water for firefighting, service water, demineralized water and potable water for the colony. The impacts associated with water resources mainly include those associated with the sanitary waste as described below.

8.7.1 Improper management of wastewater-construction phase

During construction, the primary wastewater issues relate to storm water events and sanitary wastewater generated by construction activities on site.

Storm water has the potential to run off into areas containing hazardous materials and either leach these into the soil or carry these off the site, potentially contaminating other areas, groundwater, or coastal waters. Storm events can potentially have adverse impacts on water resources resulting in large amounts of silt laden run-off.

For the sanitary sewage, it is anticipated that about 3000 workers will be on site during the peak period of construction. At an average water use by one person of $0.1m^3$/day, it is estimated that $300m^3$/day of sanitary wastewater will be generated for treatment and disposal. This is a significant amount of sanitary wastewater that without proper treatment and disposal methods, could be discharged off-site with detrimental impacts on the environment.

Table 8-24: Impact significance for contaminated stormwater run-off into the estuary-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor will avoid silt laden run-off into the estuary throughout the construction phase by limiting the amount of exposed soil stockpiles left unprotected • The EPC contractor should store all hazardous materials and wastes on site in bunded areas lined with impermeable surfaces such as reinforced concrete • Any spills that occur from hazardous substances should be cleaned up immediately to prevent them being carried into the stormwater runoff			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Very short	Minor	Improbable
	2	1	2	2
	Result: (-10) Low negative			

Table 8-25: Impact significance for improper management of sanitary waste-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Moderate	Probable
	2	2	6	3

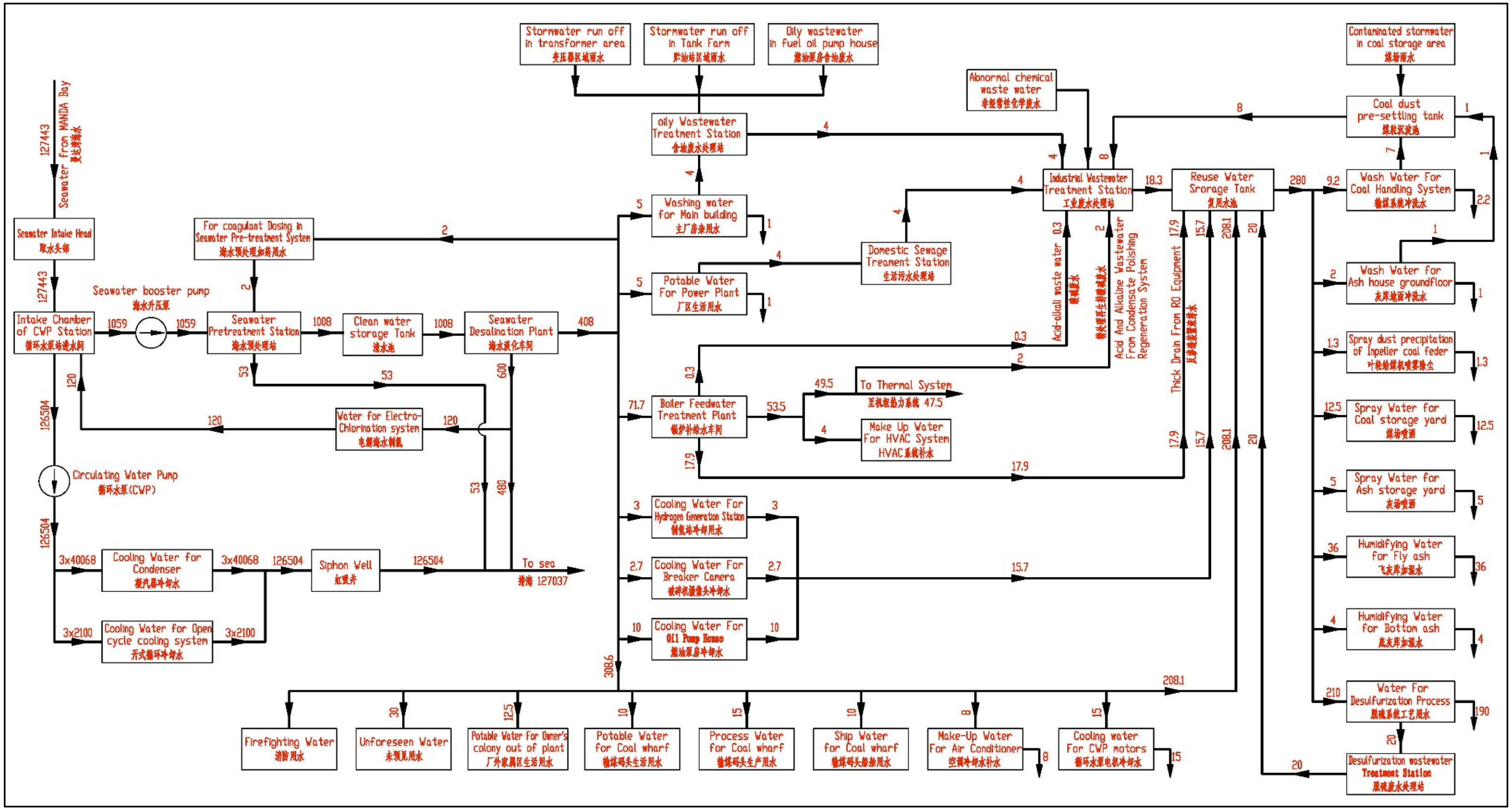
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC Contractor will design and build an appropriately sized Effluent Treatment Plant (ETP) for managing sanitary sewage that will be generated during the construction phase. The design of the ETP must include biodigesters for solid sewage and ensure that it will be able to meet as a minimum, the effluent discharge standards stipulated under Kenya's L.N. 120: Environment Management and Coordination (Water Quality) Regulations, 2006. Treated wastewater will be reused for ablution water in the cisterns or for landscaping or dust suppression purposes. • If septic tanks are constructed, the EPC Contractor will procure a new honeysucker vacuum truck for exhausting the septic tanks/latrines • Sludge generated from the sewage treatment plant that cannot be used as compost will be disposed off-site by a NEMA licensed transporter. The EPC Contractor to keep records of all sludges generated and disposed off-site • The EPC contractor to undertake weekly site inspections to ensure that all wastewater generated is managed properly and no leakages or spills occur within the site area • The EPC contractor will train their employees including sub-contractors at the site to minimize water consumption for ablutions and to ensure an understanding of wastewater issues • The EPC contractor shall develop procedures for the demobilization of the sewage treatment plant once the site construction phase ended to ensure that appropriate procedures/methods would be employed and no contamination to the site area occurs during this demobilization period.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Very short	Minor	Improbable
	2	1	2	2
	Result: (-10) Low negative			

8.7.2 Improper management of wastewater-operational phase

The main issues related to wastewater during the operational phase of the proposed coal power plant include domestic (including sanitary) wastewater, oil-contaminated and/or chemical containing wastewater and storm water run-off. The potential impacts that may result from these is described below.

The EPC Contractor has prepared a Water Balance diagram as shown in Figure 8-8.

Figure 8-8 : Water Balance DIagram for water management-Operational phase



Unit of water flow = m^3/h means consumption Volumes shown are for 3x350MW

Water consumption for daily activity used in the administration office and the colony (accommodations for workers onsite) during plant operation is pegged at approximately $0.2m^3$ per person per day. If approximately 500 workers are present on site, this will generate a daily sewage effluent volume of about $100m^3$ for treatment. Improper design of the sewage treatment plant and/or noncompliance with the water quality regulations of 2006 could have detrimental effects on surface water quality.

The industrial process of the power plant facilities will generate wastewater from various streams e.g. workshops, process areas and vehicle parking yards. Some of these streams may contain hazardous components such as oily water and/or wastewater containing chemicals. If managed improperly, such wastewaters can potentially cause pollution of the estuary.

Table 8-26: Impact significance for contaminated wastewater discharge-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The Operations and Maintenance (O&M) company should ensure that all hazardous materials and wastes on site are properly stored in closed systems in bunded areas • Process wastewater (e.g. oil-contaminated wastewater) will be treated separately from non-process run-off. Oil separator(s) will be utilized to provide primary treatment of the oily wastewater. Used oil removed from the wastewater will be stored in 210 liter drums and transported to a NEMA licensed waste disposal facility in Malindi or Mombasa by a NEMA licensed specialist operator. • Wastewater containing chemicals resulting from various streams (e.g. chemical storage, boiler blow-down water, chemical cleaning effluents) will be pre-treated by neutralization and/or detoxification prior to being collected and treated at the wastewater treatment plant on site. This will ensure the treatment process will function properly and the effluent discharges comply with the discharge limits stipulated under Legal Notice 120 titled Environment Management and Coordination (Water Quality) Regulations, 2006 (LN 120). • All wastewater is envisaged to be treated in the wastewater collection systems/treatment facilities will when in compliance with effluent discharge parameters, be re-used in the coal ash yard for dust suppression purposes. • If any wastewater is envisaged to be discharged into the environment or aquatic environment, the O&M company will acquire an Effluent Discharge License (EDL) from NEMA.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
	Study area	Very short	Minor	Improbable

With mitigation	2	1	2	2
	Result: (-10) Low negative			

Table 8-27: Impact significance for improper management of sanitary waste-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Domestic and sanitary wastewater will be collected and treated in a sewage treatment plant which will be provided by the EPC contractor for the proposed coal power plant. The discharge limits stipulated under Legal Notice 120 titled Environment Management and Coordination (Water Quality) Regulations, 2006 (LN 120) shall always be complied with for water quality discharge limits. The O&M Company will acquire an EDL for the sewage disposed off-site from NEMA.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Very short	Minor	Improbable
	2	1	2	2
	Result: (-10) Low negative			

8.7.3 Contamination of groundwater

During the operational phase, the proposed coal power plant will discharge fly ash, bottom ash and wet gypsum in an ash yard which is located about 200m from the intertidal zone on the eastern boundary. If the design of the ash yard does not include impermeable layers of protection, leachate from the ash yard could percolate into the sub-surface and potentially contaminate the groundwater. The inferred groundwater flow is eastwards towards the Manda Bay and any leachate in the groundwater would have adverse impacts on the hydrology.

A geophysical survey was undertaken in which 28 vertical electrical soundings (VES) of the project area were carried out at a grid size of 500m x 1000m to determine the surficial geology characteristics found in the project area. The results of these soundings indicate that the subsurface geological formations are permeable and the sedimentary formations are intercalated with weathered coral zones, clays and shales. These zones are likely to be old land surfaces (OLS) which formed in between different episodes of depositional history.

These zones are likely to be old land surfaces (OLS) which formed in between different episodes of depositional history. The curves have similar shape except VES_6 and VES_22. This implies that the project area is homogenous and comprises of Sand dunes, Raised Coral reef and Marine sands & clays of the Magarini sands in that stratigraphic succession.

The interpreted geophysical data indicates that the general area in which the coal power project is going to be constructed has the following characteristics:

- The subsurface geological formations are highly weathered and most of the layers have true resistivity of less than 980 Ohm-metre.
- There are shallow aquifers of between 3 and 5 metres below ground level and deeper aquifers of between 10 and 35 metres below ground level.
- The upper sub-surface geology is vulnerable to the infiltration of pollutants from coal ash yard and hydro-carbon pollutants in the event of leakage of petroleum hydrocarbons from heavy vehicles operating in the project area during construction which could lead to the local aquifer systems potentially being contaminated.
- The formation strength is composed of unconsolidated sands, clays and coral limestone weathering, sands and shales.

Based on the above, the impact significance for contamination of ground water during the construction and operational phases is given below.

Table 8-28 : Impact significance for for groundwater contamination-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	International	Long term	Moderate	Probable
	5	4	6	3
	Result: (-45) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The design of the coal stock yard and ash yard should include a sufficient number of groundwater monitoring wells. These groundwater monitoring wells should be checked regularly by sampling and analyzing water from them for compliance with Kenya's L.N. 120: Environment Management and Coordination (Water Quality) Regulations, 2006. • The discharge limits stipulated under Legal Notice 120 titled Environment Management and Coordination (Water Quality) Regulations, 2006 (LN 120) shall always be complied with for water quality discharge limits. The O&M Company will acquire an EDL for the sewage disposed off-site from NEMA.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Very short	Minor	Improbable
	2	1	2	2
	Result: (-10) Low negative			

8.8 Soils and geology

The project area is overlain by relatively shallow mainly black cotton soils which in some areas grade into more grayish colored loamy soils. The soils of the Kwasasi sub-location in Lamu area are classified as below. (Speck, 1978, Sombroek et al, 1982).

At several locations within the project footprint area, the surface soil samples were excavated up to a depth of 1.5m in order to determine the soil texture and observe the colors of the various horizons. The results of the soil survey are given below and it gives the baseline soil conditions within the project area.

Reddish-brown to gray fine loose sandy or clayey sandy soils vary from 5 to over 10m and are overlain by fine loose and/or compact sandy soils that are relatively deep and vary in depth between 0.3 and 1.5 metres in most places. The soils are mainly a product of the weathering and deposition of sand dunes, coral limestones, hence giving them the light color and high quartz content. Loamy and dark clayey soils are also widespread in the area.

The geological data based on secondary literature reviews indicates that the area in which the Lamu Coal Power Plant will be built, has the following characteristics:

- The first 4m of the ground contain fine loose soil at the top and compact sandy soil of low fertility but is useful for agricultural practice and farming activities.
- The lithology up to 10m is generally permeable and therefore in the event of construction of coal power facilities, care should be taken to construct strong foundations, hard standing and proper underground supporting systems.
- Highly weathered coral limestones are encountered after 3-8 metres below which saline water is encountered.
- The upper sub-surface geology is vulnerable to the infiltration in the event of the spillage of contaminants and that in the event of leakage and of seepage; the surface and groundwater is likely to be contaminated.

8.8.1 Soil erosion impacts

During the construction phase, the project footprint areas will be stripped of the topsoil and excavation done to receive reinforced concrete foundations for the power plant infrastructure.

There is the potential for the loss of soil and other excavated material through erosion caused by run off during rainy weather or from wind during the dry period in the construction phase of the proposed development. This is considered a negative and minor impact in the absence of suitable mitigation measures. The nature of the construction activities will involve the stripping and stockpiling of soil and other excavated material until it is reinstated, when required.

The continuous use of heavy machinery and other vehicles on unsealed areas of ground has the potential to adversely impact the soil structure, which is considered a direct impact. This is considered a negative and moderate impact in the absence of suitable mitigation measures.

Table 8-29: Impact significance for soil erosion-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Low	Probable
	2	2	4	3
	Result: (-24) Low negative			
Mitigation measures	**Comments/Mitigation:** • The site Engineer will ensure that silt control measures are implemented such as silt fences and silt traps to check occasional runoff. • The site Engineer will ensure that stockpiles of excavated materials stored appropriately in designated areas and at a minimum distance of 30m from any nearby watercourses or drains. Measures should also be taken to avoid direct rainfall on stockpile materials or exposed areas of ground that may result in slippage and washout of sediments into nearby drainage channels. • The site Engineer will ensure that long term stockpiles will be sealed at a suitable gradient and grass planted as part of rehabilitation plan. • The site Engineer will ensure that the stripped topsoil and tailings from the screening process will be used to progressively backfill the dugout trenches immediately behind the abandoned quarry site.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

Table 8-30: Impact significance of soil structure destruction by heavy vehicles-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Short	Moderate	Probable
	3	2	6	3
	Result: (-33) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The site Engineer will ensure that vehicles and other heavy equipment use approved tracks as access routes. • The site Engineer will ensure that well paved tracks (stone and laterite/murram) are used as access tracks to protect underlying soil. This should be well compacted in order to carry the weight of the expected heavy vehicles. The tracks should be constructed in such a way as to allow for easy drainage of surface run-off on either side of the track. In sloped areas the drainage channels on the sides of the tracks should have concrete barriers at intervals of 30 to 50 metres			

	(depending on the slope) to check erosion and cutting into the drainage channel.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Short	Low	Improbable
	3	2	4	2
	Result: (-18) Low negative			

8.9 Marine ecological impacts

8.9.1 Impacts due to dredging

While the present assessment does not take in consideration a specific design of intake and discharge structures at the site, potential marine environment impacts from the proposed coal power plant include:

(1) Impacts of construction activities of marine structures; and

(2) Impacts during operation

- (a) Impingement and entrainment of organisms due to the intake of large quantities of seawater;
- (b) Localized rise of sea water temperature due to cooling water discharge; and
- (c) Impacts on water quality.

Construction of intake and discharge structures at the coal power plant site may include offshore dredging (by floating equipment) and onshore dredging/excavation (by land equipment).

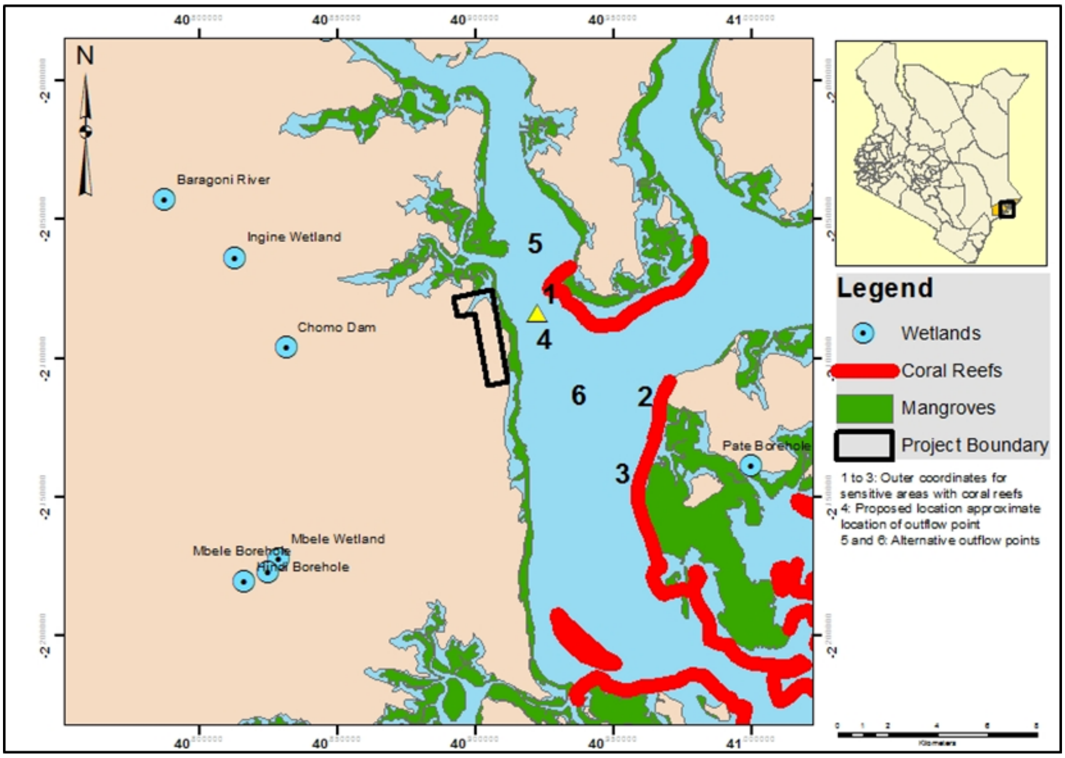
The project site is situated on the landward side of a shallow (water depths typically less than 10m) coastal estuary, which is fringed by a coral reef (Figure 8-9). Beside a small section of the coral reef itself, other materials to be dredged may include sand, silt and eventually clay. The total volume of material to be dredged may be on the order of several hundred thousand m^3. The main receptors for impacts during dredging are coral reef ecosystem comprising corals, flora and fauna, and benthic communities.

The recovery of the disturbed habitats following dredging ultimately depends upon the nature of the new sediment at the dredge site, sources and types of re-colonizing animals, and the extent of the disturbance. Recovery periods depend on habitat types and are in the order of few months to several years. Since the habitat type in this project is mostly sandy, it is anticipated that a full recovery of the benthic community will be established within 1 -2 years after dredging.

Reduced water quality and increase in turbidity and oxygen depletion due to suspension of sediments is a major negative impact, especially as the fine fraction plume can travel over significant distances. Settlement of these suspended sediments can result in the smothering or blanketing of sub-tidal communities and/or adjacent intertidal communities.

During project construction activities, there is a possibility of re-suspension of sediments increasing the turbidity and reduced dissolved oxygen in stormwater runoff. Wilkinson (2004) noted that activities associated with human disturbances such as increased coastal development, poor land-use and watershed management and sewage discharges lead to sedimentation, nutrient loading and eutrophication in marine habitats. These environmental problems adversely affect mangroves, sea grasses and coral reefs, more so their delicate and complex ecological interactions that makes them areas of high biodiversity. Specifically, coral reefs are sensitive and vulnerable to sedimentation; persistent sedimentation initially causes bleaching of corals followed by death (Obura et al. 2004). As such impacts associated with increased pollution and turbidity in the marine systems are regarded as significant.

Figure 8-9: Sensitivity map showing areas prone to degradation



Change of concentration and availability of nutrients during dredging can affect the marine life and is considered an impact of moderate significance.

Dispersion of contaminants during dredging and disposal affects marine life. This is a moderate impact of major negative significance.

Significant areas of Manda Bay are under mangroves, sea grass beds and coral reefs; depending on the location of the power plant infrastructure, some of these resources may be permanently lost while other will die due to impacts associated with dredging. For instance, during construction of Mokowe jetty in Lamu, about 100ha of mangrove forest was killed by sediment deposited from dredging activities (Abuodha & Kairo, 2001). Dredging activities during the construction phase are projected to cause significant and serious damage to the neighboring mangroves, sea grasses and coral reefs habitats.

The noise impacts (surface/underwater) from equipment used for dredging in the marine habitat can be considered minor. Similar minor impact is expected due to over-spill from the barge that handles dredged material.

Noise impact on construction workers during dredging is a typical workplace noise hazard. Workers will have access to personal protective equipment hence, sensitivity is assessed as minor.

Oil or fuel spillages from marine equipment, while unlikely, would have serious consequences for local marine life depending on the size of spill. The delivery of fuels, oils and chemicals should be avoided by sea route and instead delivered by road and stored away from the shoreline in a secure compound.

Since there are no designated marine protected areas next to the site, it is considered that there will be no impact on marine protected species of the Manda Bay such as dugongs and sea turtles; at least so far, these species have not been sighted anywhere near the coal power plant site area.

During the operational phase, the coal power plant may generate storm water during heavy downpour that is likely to flow directly into the sea. Other accompanying developments such as residential areas, schools, hospitals and other amenities are projected to add more contaminated waste water into the sea without adequate mitigation measures. Domestic effluents and storm water are sources of water pollutants in the form of sediments and nutrients. Nutrient enrichment leads to eutrophic systems that favor algae blooms, trigger incidents of anoxic conditions in the water column and subsequently degradation and loss of habitats and, elimination of vulnerable species. Fabricius (2005) and (Veron et al. 2009) reported that coral reefs and coral communities are highly sensitive to water quality changes, that are largely a product of sediment loads (which affects light penetration), nutrients and environmental contaminants. Terrestrial runoff from urban development, agriculture and deforestation are the principal causes of diminished water quality. Indeed runoff impacts have become such a worldwide phenomenon, that only reefs well removed from highly populated landmasses have escaped degradation of some sort. The analysis results of a sample of water collected in the bay adjacent to Lamu Town during the marine ecological assessment study showed elevated levels of total nitrogen and coliform bacteria counts.

The Lamu coal power plant is major development initiative and without adequate mitigation, might add wastes into the sea capable of causing significant adverse effects if they reach vulnerable environments. Therefore environmental impacts associated with waste discharges into the sea are rated as significant.

8.9.2 Impingement and entrainment of organisms

During the operational phase, there may be impacts associated with the cooling water system associated with the seawater intake and outfall locations.

A potential impact associated with the sea water intake is impingement and entrainment of organisms. Impingement occurs when marine organisms are trapped against intake screens by the velocity and force of water flowing through them. The fate of impinged organisms differs between intake designs and among marine life species, age, and water conditions. Some hardy species may be able to survive impingement and be returned to the sea, but the 24-hour survival rate of less robust species and/or juvenile fish may be less than 15%.

Entrainment occurs when smaller organisms pass through an intake screen and into the process equipment. Organisms entrained into process equipment are generally considered to have a mortality rate of 100%.

The number of affected organisms will vary considerably with the volume and velocity of feed water and the use of mitigation measures developed to minimize their impact. If intake velocities are sufficiently low, fish may be able swim away to avoid impingement or entrainment. The swimming performance for different species of fish can predict the types and ages most vulnerable, however, even large fish are frequently caught on intake screens, indicating that swimming ability is not the only factor in impingement. Cold temperatures or seasonal variations in age-selective migrations or growth are also factors.

Table 8-31: Impact significance of dredging for circulating water intake and discharge structures-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	High	Definite
	2	2	8	5
	Result: (-60) Medium negative			
Mitigation measures	**Comments/Mitigation:** • As part of the detailed design, the EPC contractor should reduce the loss of coral reef habitat (say by at least 10%) and the provision of outer wall structures which will facilitate the re-colonization of corals in the future • The EPC contractor should consider the timing of the dredging and disposal operations in order to avoid and reduce adverse impacts on marine sensitive habitats. This can be done based on knowledge of the local hydrodynamics to minimize sediment dispersion and the marine ecology around the power plant site location to avoid sensitive periods • Dredging should be undertaken at the most favorable points in the tidal cycle in order to reduce the movement of suspended sediment from the dredged area. • The EPC contractor should identify an access route for the dredger and barges to avoid physical damage to adjacent coral reef communities, particularly at low tide. • In order to avoid carryover of silt plume from the dredging and disposal operation, the EPC contractor should use silt curtains to minimize spreading of silt plume, and limit the volume of offshore disposal. Any spreading of dredged materials on adjacent coral reefs must be avoided. • The EPC contractor should load dredged material onto barges and dispose at sites away from the coral reef in deeper waters (say 50m). • The EPC contractor should reduce the impact of turbidity on water quality by avoiding sensitive areas, use of silt curtain, proper planning and scheduling of the dredging and disposal to avoid strong wind, current and tides that will further add to widen the effect of spreading of sediments, testing and analyzing the water column at upstream and downstream from dredging activities • To prevent noise impacts, the EPC contractor should apply a high standard for maintenance of equipment, installation of noise			

	suppressors in all equipment, provision of silencer and muffler, limiting the hours of operation. • There should be no refueling of the dredger or barge while working on site. All land based fuels should be stored away from the shoreline on hard standing to avoid accidental spillage. Spill kits and oil booms should be available for immediate use in the unlikely event of an accident.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Low	Improbable
	2	2	4	2
	Result: (-16) Low negative			

8.9.2.1 Impacts on sea water quality

Beside cooling water, the process waste water streams listed below may potentially impact groundwater or sea water, if not handled correctly or discharged accidentally. Given the hydraulic connection between groundwater and sea water in the coastal area, any accidental spill into groundwater onshore can be transferred to the sea water and may affect the marine environment in the same manner as effluents directly discharged to the sea.

Water treatment plant effluent

The plant will include a desalination plant for provision of service waters. The water discharged by the plant will have increased salinity and will be returned via the circulating water discharge pipe. The higher salinity of this water will have minimal impact once this water is mixed with the returning cooling water.

Boiler blow-down

During operation, small quantities of boiler water (boiler blow-down) will be discharged to avoid the build-up of impurities. This effluent will be virtually pure water, containing very small quantities of various chemicals that are used to prevent corrosion and scaling in the boiler.

The water discharged from the cycle must therefore be replaced with make-up water, which must be of high purity. Water from the desalination plant will therefore have additional treatment in a demineralized water treatment plant.

Miscellaneous minor process effluents

During commissioning and at infrequent intervals during the life of the plant, it will be necessary to chemically clean the water side of the boiler tubes. All solid effluents will be disposed offsite by a NEMA licensed contractor for treatment and disposal at an appropriately licensed disposal facility.

During maintenance it may be necessary to drain down the boiler, the closed circuit cooling water system or parts of these systems. All such wastes will be discharged to the sea water outfall after treatment. The boiler water will be identical to boiler blow-down and will be high purity water containing traces of ammonia, phosphate and suspended solids. The closed circuit cooling water will be high purity water containing small amounts of corrosion inhibitor.

During the detailed engineering of the plant, consideration will be given to the storage, recovery and re-use of these effluents.

Table 8-32: impact significance of incorrectly handled or discharged process waste water steams-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Moderate	Highly probable
	2	4	6	4
	Result: (-48) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor will provide a performance guarantee of the effluent treatment plant equipment which should include compliance with physicochemical parameters, pollutants, microbiological and mixing zone standards • The Operations and Maintenance (O&M) company should ensure that all process systems are controlled to ensure that the effluent quality standards in Kenya are met as a minimum. • The O&M Company will comply with all requirements of Kenya's L.N. 120: Environment Management and Coordination (Water Quality) Regulations, 2006 on Effluent Discharge License (EDL) requirements • The O&M company should have an adequate supply of oil booms and similar equipment on site to deal with accidental oil spills offshore • The O&M Company should not over-chlorinate the cooling water; • Water quality monitoring should be provided on all lines feeding the circulating water discharge. If process standards are accidentally exceeded, there should be an option of diverting the stream into a holding pond; • The O&M company should undertake continuous flow and quality monitoring on the main outfall with alarms if standards are exceeded; • The O&M Company should conduct reef inspection and water quality monitoring at specified locations and at appropriate time intervals according to the environmental monitoring plan and report reef status and water quality data after each survey.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

8.10 Terrestrial ecological impacts

This sub-section analyzes the potential ecological impacts on terrestrial ecology. The analysis has been conducted for:

- Loss of ecosystem services;
- Impacts on plants;
- Impacts on birds;
- Impacts on herpetofauna;
- Impacts on invertebrate fauna; and
- Impacts on mammals.

8.10.1 Loss of Ecosystem Services

Currently, the local community benefits from a wide range of provisioning, regulating and supporting ecosystem services such as fishing, abstraction of water for various purposes, medicinal plants, etc. some of which are key sources of income. With the construction and operation of the proposed coal power plant, some of these services may be eliminated or reduced.

Table 8-33: Impact significance of ecosystems services from the construction and operation of the power plant-construction and operational phases

Mitigation Status	Extent	Duration	Magnitude	Probability
Without Mitigation	Regional	Permanent	High	Probable
Scores	3	5	8	3
	Results: (-48) Medium negative			
Mitigation Measures	**Comments/Mitigation** • The O&M Company should consider supporting capacity building initiatives to create alternative sources of livelihoods for the communities within and around the project area, e.g., alternative sources of building materials and medicine (promote agro forestry), protein (bee-keeping for honey, empower fishermen to start fishing in deep waters, practice fish farming), etc. • The County Government of Lamu and other Central Government lead agencies should enforce fishery laws to control overexploitation, disallowing fishing in non-designated/protected areas using destructive fishing methods.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With Mitigation	Regional	Permanent	Minor	Improbable
Scores	3	5	2	2

	Results: (-20) Low negative

8.10.2 Impacts on Plants

8.10.2.1 Loss of biodiversity

As the construction activities involve vegetation clearance, terrain shaping and soil excavation, several plant species may be lost in the process among them being threatened species such as *Dalbergia melanoxylon*, *Dialium orientale*, and *Haplocoelum inopleum*, as well as mangroves. Although most of the other species likely to be lost might not be threatened, their destruction will reduce the vegetation cover for area. The community may also lose the ecosystem services such as herbal medicine, wood fuel and aesthetics value.

8.10.2.2 Habitat loss/size reduction, modification or fragmentation

Some habitats such as aquatic ecosystems are more critical to species' survival than others. Microhabitats within the project site are likely to be lost to pave way for construction activities. Small water pans, ponds, wetlands or dams may be reclaimed or reduced especially where access roads and perimeter walls are built across them or other construction work occupies part of these habitats. Increased demand for fresh water by the surging human population may further affect the diversity of aquatic vegetation.

This alteration of habitats may affect plant pollination and seed dispersal patterns especially where the mechanisms involves insects and animals.

8.10.2.3 Soil erosion and contamination

Soils play a fundamental role in biodiversity conservation thus changes to the structure and chemical composition can have subsequent effects on vegetation structure and composition as well as altering water courses.

Specific activities that will have a negative impact to soils which can be directly relevant to the functional capacity, sensitivity, vulnerability and general condition of soils include excavation activities, fuel tanks, waste management facilities, and waste treatment facilities. The impacts of these activities on soil properties and processes can include: erosion, pollution, e.g. from oil spills, heavy metals, organic compounds, industrial wastes, pesticides, changes in pH, loss of organic matter, compaction, structural deterioration, physical and chemical changes associated with topsoil stripping, storage changes associated with land restoration, decline in fertility, changes to soil water regime and removal or alteration of parent material. Clearing of vegetation may lead to changes in surface runoff flow direction and quantity in the area. This will potentially cause wind and water erosion. Solid wastes, oil leakage and waste oils will emanate from the project's activities due to the high influx of personnel and activities in the area. Solid waste materials expected include cans, wrappings, paper, and plastics waste, among others. Petroleum, oil leakage and waste oils may spill on the ground and ultimately into the soil or water systems and degrade the ecosystem.

8.10.2.4 Dust and other air pollutants

Destruction of ecosystems can also be caused indirectly if emissions from a coal-power plant reduce productivity of vegetation. Dust for instance will affect plants growth by interrupting physiological processes like transpiration when lodged on leaf surfaces thereby blocking their stomata. Stack emissions such as Sulphur dioxide, nitrogen oxides, carbon monoxide and heavy metals (such as mercury) may contribute to acid rain, which in turn pollute and affect plants growth by corrosion of their surfaces and causes acidification of aquatic ecosystems.

8.10.2.5 Increased anthropogenic activities

Human activities are responsible for most of the loss in biodiversity throughout the world and with the proposed coal power plant, activities such as construction of access roads and an upwelling of human population is expected in the area as project staff, suppliers, opportunistic job-seekers and new settlements due to opening up of the area. This may impact negatively on the biodiversity of the area due to increased pressure on ecosystem services. Of particular concern is the unsustainable harvesting of *D. melanoxylon* which is targeted for its hardwood timber and in the carving industry. Overexploitation of medicinal plants and wild fruit trees such as *Dialium orientale, Tamarindus indica* and *Adansonia digitata* may also occur. Clearing of vegetation for settlements and expansion of farmlands will further lead to loss of important plant species.

Elevated demand for fresh water for domestic use may affect the aquatic flora and convert the permanent swamps into seasonal ones. Excessive collection of fuelwood by workers during construction or operation can also lead to deforestation as well as increased charcoal burning.

Increased domestic waste production, sewage and non-biodegradable material may cause environmental pollution. Using chemical fertilizers, insecticides and herbicides to increase food production may lead to emission of toxic chemicals in the air, soil and water.

8.10.2.6 Invasive species

With the expected habitat disturbance during the implementation of the coal power plant, invasive species may take advantage of the situation and increase in the area. Clearing of natural vegetation opens up gaps that are immediately occupied by opportunist invasive and weedy species when conditions become favorable. Movement of trucks and soil from one point to another might spread seeds of these species along the communication and travel paths that under persistence disturbances. Exotic species might also be introduced in the area either passively as people dispose of fruit seeds in the environment or by design during landscaping activities.

Table 8-34: Impact significance for Biodiversity loss-Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Long term	Moderate	Highly probable
	2	4	6	4
	Result: (-48) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should undertake a pre-excavation identification of land within the project site for relocation and			

	conservation of threatened species that may be destroyed by the construction footprint. • The EPC contractor with the assistance of a National Museums of Kenya (NMK) botanist should where possible, relocate any endangered species to less disturbed environs within the project site or community lands • The EPC contractor should consider undertaking a reference voucher specimen collection within the project footprint for storage at the East African Herbarium (the national/regional repository for botanical collections) should be done for future scientific research as representative collections from the area • A wet season survey and collection of annual plants missed during the dry season should be done to avoid loss of the ephemeral species. • The EPC contractor should avoid clearing vegetation where it is not necessary to do so.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short	Low	Improbable
	2	2	4	2
	Result: (-16) Medium negative			

Table 8-35: Impact significance for soil erosion and contamination- Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Medium term	Low	Probable
	2	3	4	3
	Result: (-33) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Topsoil should be removed and stored for use in restoration and rehabilitation • Roadside trenches should not be channeled on bare soils without existing vegetation, especially where water flow would be expected to be high such as in culverts exits. • Where possible, earth-moving activities should not be done in days with heavy rainfall • Grass should be planted on bare areas to help stabilize the soil. • Any spillages (e.g. of oils and greases) should be cleaned immediately before spreading to other areas by runoff water			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Medium Term	Minor	Probable
	2	3	2	3
	Result: (-21) Low negative			

Table 8-36: Impact significance for dust and air pollutants-Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short term	Low	Definite
	2	2	4	5
	Result: (-40) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should restrict excavation to the project footprint areas • The EPC contractor should use site traffic control measures with well labelled low speed limit signs • Equipment, machines and vehicles should be in good condition to minimize smoke emissions • The EPC contractor should undertake wetting/sprinkling to avoid nuisance dust emissions • The EPC contractor should plant vegetation as part of the rehabilitation plan			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short term	Minor	Improbable
	2	2	2	3
	Result: (-18) Low negative			

Table 8-37: Impact significance for alien invasive plant species-Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long term	High	Probable
	3	4	8	3
	Result: (-45) Medium negative			
Mitigation measures	**Comments/Mitigation:** • All earthmoving and excavation equipment and transport vehicles should be inspected and cleaned of any extraneous soil and debris that may harbor invasive species propagules. This should be done in designated areas using preferably high-pressure washing machines • Construction materials such as sand and gravel should be obtained from weed-free sites • Only seed collected from indigenous plants in the vicinity of the project should be used for re-vegetation programs. Exotic species should be avoided			

	• Cultivated fruit seeds should be properly disposed to avoid finding their way into natural vegetation areas. • Minimize unnecessary soil and vegetation disturbance • Monitoring of the invasive species coverage to be done			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long term	Low	Improbable
	3	4	4	2
	Result: (-22) Low negative			

Table 8-38: Impact significance for biodiversity loss-Operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Long term	Low	Probable
	2	4	4	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The O&M Company should implement an afforestation programme to include the threatened species in areas such as near the power plant, the buffer zone, adjacent community lands and unused site land. This should involve stakeholders working with community groups to establish plant nurseries for the programme • A wet season survey and collection of annual plants missed during the dry season should be done to avoid loss of the ephemeral species. • The O&M company should create awareness on importance of conservation for their staff members			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Long term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

Table 8-39: impact significance for increased anthropogenic activities-Construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Short term	Low	Highly probable
	1	2	4	4
	Result: (-28) Low negative			

<table>
<tr><td>Mitigation measures</td><td colspan="4">Comments/Mitigation:
• The EPC contractor and O&M company should develop and implement awareness programs on the importance of conservation of provisioning services and other natural resources
• The EPC contractor and O&M company should encourage their staff members in raising plant nurseries and subsequent tree planting activities
• The EPC contractor and O&M company should practice waste reduction initiatives in order to relieve the pressure on the ecosystem</td></tr>
<tr><th>Mitigation Status</th><th>Extent</th><th>Duration</th><th>Magnitude</th><th>Probability</th></tr>
<tr><td rowspan="3">With mitigation</td><td>Study Area</td><td>Short Term</td><td>Minor</td><td>Improbable</td></tr>
<tr><td>1</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td colspan="4">Result: (-10) Low negative</td></tr>
</table>

8.10.3 Impacts on Birds

8.10.3.1 Nature of impacts

Birds are highly mobile and therefore are likely to move out of the area once developed. However due to the presence of species of conservation concern (IUCN red list species and migratory species), the cumulative impact on conservation obligations is present.

Recent advances in technology mean that modern coal power plants are cleaner and more efficient, with up to efficiencies of up to 50% achievable. The Lamu coal power plant will use supercritical coal power plant technology with a state of the art 210m tall smoke stack. The smoke stack will use a three stage treatment system ensuring that approximately 95% of exhaust gases and particulates are removed including sulphur dioxide, carbon dioxide, and mercury and nitrogen oxides. Emissions will be largely water vapour.

Noise and vibration may be an issue during the construction phase. The contractor has not given levels of noise and vibration of the machines they will use during the construction phase. During the operation phase the plant will produce less than the permitted levels of noise recommended by NEMA (table 6.32) and vibrations of no more than the recommended 0.5cm/s at 30m from a source.

[7]Table 8-40: Maximum permissible noise levels for constructions sites

Type of receptor	Day L_{eq} (dB(A))	Night L_{eq} (dB(A))
a) Health facilities, educational institutions, homes for disabled, etc.	60	35
b) Residential	60	35
c) Areas other than those prescribed in (i) and (ii)	75	65

[7] Source: L.N.61 of 2009: Environment Management and Coordination (Noise Pollution and Excessive Vibration Control) Regulations

8.10.3.2 Construction phase

During this phase, the project is expected to attract a large workforce (c2000) on the site. Access roads will be built, traffic to the site will increase and associated waste disposal challenges. Impacts on the avifauna are likely to be:

i). **Loss of habitat and displacement-** the current habitat on the site will be cleared to give way to construction of the site. Avifauna on the site will be displaced. Opportunistic species, e.g. scavenging birds will replace them. Already during the recent visit there was evidence of people clearing and burning the habitat (Figure 8-10) in anticipation of compensation by the project. Species of conservation concern such as Coastal Black Boubou and Eurasian Curlew, are likely to be displaced and their numbers reduced.

Figure 8-10: Ongoing habitat clearance at the project site

ii). **Invasive species-** the increase in human population and associated activities e.g. waste disposal is likely to attract and increase populations of scavenging and invasive birds species e.g. Marabou Storks and Indian House Crows. This will have direct effect on populations of indigenous species through mainly predation as well as risk to public health

iii). **Waste and sewage disposal-** There may be up to 2000 people at the site during construction. This will likely create waste and sewage disposal problems.

iv). **Noise and Vibration**-The Lamu coal power plant proposes a 24-hour construction schedule. A NEMA permit may be required for infrequent high noise level activities which may exceed the permissible levels.

8.10.3.3 Operation phase

i). **Loss of ecosystem services provided by birds**- Birds serve several roles in the ecosystem including seed dispersal, weed and pest control, pollination and waste disposal service (scavenging)**.** With displacement, these functions will be lost. They also have an aesthetic value.

Figure 8-11: Flock of shorebirds/waders feeding on a mudflat near the project site

ii). **Loss of feeding habitat-** The Lamu coal power plant is next to sandy beaches and mud flats used regularly by shorebirds and waders for feeding (Figure 6-2). These beaches and mudflats are likely to be destroyed and/or polluted by activities of the PLCPP.

iii). **Heavy metal poisoning**- Residue ash may contain heavy metals including mercury, arsenic and lead (e.g. see *http://www.sourcewatch.org/index.php/TVA_Kingston_Fossil_Plant_coal_ash_spill*). Entry of the heavy metals in the food chain impacts on avifauna through lesser egg production and survival rates and mortality of adult birds (Fry 1995). Birds at the top of the food chain are usually the most severely affected via bioaccumulation and bio-magnifications of the toxicants discharged. Though the Lamu coal power plant will use modern technology and a three stage emission treatment system, the residue ash and the planned ash dumpsite still pose a threat of seepage and ash spill contaminating the environment. It is noted that the ash dumpsite will be located in a tidal zone. The amount of residues will depend on geological origin of the coal, combustion conditions and efficiency of particulate removal.

iv). **Collision risks-** There is a risk that low flying birds will collide with the smoke stack at the coal power plant. For migrating birds, a combination of bad weather and operation lights will attract them to the site. This is more of a factor especially during bad weather and at night for flocks of migrating birds.

v). **Cumulative impacts on Kenya's conservation obligations-**Kenya is signatory to several international conservation treaties. Most relevant for the Lamu coal power plant is the Convention on the conservation of Migratory Species of Wild Animals. Lack of adherence to the applicable requirements of this convention will be a negative impact.

Table 8-41: Impact significance on loss of habitat and displacement on avifauna-construction and operation phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Medium term	Low	Probable
	2	3	4	3
	Result: (-27) Low negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should excavate those areas where the project footprint will be constructed. Further the EPC contractor should undertake restoration and rehabilitation of disturbed areas to as near original conditions as possible • Amu Power should undertake a re-afforestation program to compensate areas destroyed by the construction activities			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Medium Term	Minor	Improbable
	2	3	2	2
	Result: (-14) Low negative			

Table 8-42: Impact significance of invasive species on avifauna abundance and diversity-construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Medium term	Low	Probable
	2	3	4	4
	Result: (-36) Low negative			
Mitigation measures	**Comments/Mitigation:** • All earthmoving and excavation equipment and transport vehicles should be inspected and cleaned of any extraneous soil and debris that may harbor invasive species propagules. This should be done in designated areas using preferably high-pressure washing machines • Construction materials such as sand and gravel should be obtained from weed-free sites • Only seed collected from indigenous plants in the vicinity of the project should be used for re-vegetation programs. Exotic species should be avoided • Cultivated fruit seeds should be properly disposed to avoid finding their way into natural vegetation areas. • Minimize unnecessary soil and vegetation disturbance • Monitoring of the invasive species coverage to be done			

Mitigation Status	Extent	Duration	Magnitude	Probability
With mitigation	Study Area	Medium Term	Minor	Probable
	2	3	2	2
	Result: (-14) Low negative			

Table 8-43: Impact significance for noise and vibration on avifauna abundance and density-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Low	Probable
	2	4	4	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should install equipment that meets the environmental noise limits stipulated by Kenyan environmental noise regulations. • The installed equipment should comply with the requirements of the occupational noise limits specified in the occupational noise regulations			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long Term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

Table 8-44: Impact significance of heavy metal poisoning on the avifauna abundance and density-operation phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Moderate	Probable
	2	4	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The ash yard should be designed and constructed in accordance with international standards to prevent leaching into the subsurface. • In order to prevent leakage from the ash yard, an impermeable liner should be placed before receiving fly ash from the boiler. The ash yard must have a properly designed and impermeable bund wall around the ash yard.			

Mitigation Status	Extent	Duration	Magnitude	Probability
With mitigation	Study area	Long Term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

Table 8-45: Impact significance for loss of feeding habitat on the avifaunal abundance and density-operation phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Moderate	Probable
	2	4	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The O&M company should limit cutting down trees and grass areas to the construction footprint areas • The O&M company should develop and implement a tree planting program for the lifetime of the project			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long Term	Low	Improbable
	2	4	4	2
	Result: (-20) Low negative			

Table 8-46: Impact significance for conservation obligations on cumulative impacts-operation phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	National	Long term	Minor	Probable
	4	4	2	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • APCL should adhere to the applicable requirements of the Convention on Migratory Species (CMS) and specifically resolution 7.5			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	National	Long Term	Minor	Probable
	4	4	2	2
	Result: (-20) low negative			

8.10.4 Impacts on Herpetofauna

8.10.4.1 Herpetofauna loss due to habitat modification and alteration

Herpetofauna loss is likely to occur during the site preparation and construction. There will be three activities involved in this i.e. construction of the plant, construction and improvement of the access road and the transmission line. This process will lead to:

a) *Loss of habitat*: This will happen during the initial clearing to remove vegetation. This will clear all the herpetofauna habitats on the ground like trees, dead tree trunks, grasses which are home to amphibians and reptiles. It will also remove the source of food which are insects which are eaten by lizards who are in turn eaten by snakes thereby interfering with the food chain.

b) *Excavation and landscaping*: Construction phase will involve landscaping which will involve excavation, compacting flattening of some areas. Wells, loose top soils and burrows will be covered or removed. This will take away the breeding site, which are mostly the soft and loose top soil. Amphibians congregate on wetlands which in the actual plant building location will be the water wells dug by the community for drinking water that during excavation and landscaping might be destroyed.

c) *Exposure of herpetofauna to predation and road deaths*

Cleared vegetation will expose herpetofauna to their predators when closing the roads and in open spaces created to accommodate transmission line. The animals will be prone to being crushed on the road by vehicles. This is especially during the wet season when the animals have more movement in search of mates for breeding. Reptile forms a diet for the local people with clearance of their habitats the reptiles will be more exposed

Figure 8-12: A Nile monitor Lizard (Varanus niloticus)

8.10.4.2 Invasive species and human-wildlife conflict

During the clearing of the project site, animals such as snakes and lizards may move to other areas. However, due to the sudden change of environment, there is likely aggression from animals such as agitated snakes trying to escape. Further, snakes will move to other sites that are near the area. The concentration of snakes and lizards like Nile monitor lizards may rise thus leading to competition for available resources near homes and feeding on domesticated animals. Increased snake bites and snake encounters may occur to workers and the surrounding general population. A construction camp is going to be established holding about 2000 workers. Waste and new habitats formed will attract lizards and rodents which in turn attract snakes this might cause human-wildlife conflicts as well as wildlife-wildlife conflicts.

8.10.4.3 Spillages of chemicals and oils

Oils and fuels from machines, generators and vehicles plus other chemicals used during construction and in the operation may accidentally spill on the site. These include chemicals used in the cleaning, treating and reducing the toxic gases in the operations of the plant. This spillages if collected by rain water will eventually accumulate and if not well disposed on the land will end-up in the ocean or in other habitats. This will contaminate water and soils and affect especially amphibians more because they rely on their skin for respiration. This will lead to death and low reproduction due to the eggs and larval stages not getting enough air thus leading to population changes (Mahaney, 1994, Akani et al. 2004). This can also have adverse effects if it lands in the ocean where turtles live, feed and bask.

8.10.4.4 Trace elements from the fly ash

The fly ash from coal combustion may contain residual trace elements such as arsenic, selenium, cadmium, chromium and mercury which are heavy metals. These chemicals are known to modify hormonal responses of amphibians and reptiles thereby affecting breeding. In turtles, these chemicals accumulate in embryos leading to deformations of the young (Hopkins et al. 2013). This trace elements accumulation in tissues also affects other reptiles and amphibians leading to poor and stunted growth. For instance in amphibians, the swimming ability of tadpoles is impaired if the trace elements are in water (Metts *et al*. 2013, Todd *et. al*. 2012, Wanda *et al*. 2011). This is because they cause deformation on juveniles that affects their activities such as breeding, avoiding predators and feeding.

8.10.4.5 Dust and exhaust particles pollution

During construction there will be exhaust fumes from vehicles and also dust during excavation which may affect breathing systems of herpetofauna. Amphibians which breathe through their skin and need to keep their skins moist for this purpose will be mostly affected. This will also include dust from the fly ash dump as it dries relatively fast and so can be blown by wind.

8.10.4.6 Alteration of marine environment

Cooling water for the power plant will be obtained from the Manda Bay. This will pose the danger to marine turtles which may get entrained in the moving screens, thus leading to death in the process. Another area of concern is the release of thermal water from the plant with elevated higher temperatures that may affect turtles, which are dependent on their environments temperature as they cannot thermo-regulate. The green turtle is endangered because its eggs and mature individual are harvested by humans for food. The green turtle prefer nesting areas on clean sandy beaches where it lays its eggs which might be destroyed by clearing mangroves and dredging activities with pollution and sedimentation. Also spillages of oils and chemicals, raw sewerage, fly ash trace elements can lead to decline in their food sources which are mainly sea weed, algae and sea grass (IUCN 2010, Spawls *et al*. 2004).

Table 8-47: Impact significance for herpetofauna loss due to habitat modification and alteration- construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Long Term	High	Highly probable
	2	4	8	4
	Result: (-56) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Before the onset of the construction, a reforestation program should be initiated in conjunction with the local community • The excavation should start on one end preferably from the ocean side heading inland to allow animals to escape • Areas that will not be put to immediate use to be left intact. • If possible, avoid excavation during the rainy (wet) season when animals are breeding • Top soil to be kept aside for use in replanting and landscaping • Together with experts, relocate animals found in the site that move slowly during clearing and excavation • Re-establish original habitat patterns to improve surface water runoffs			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short	Low	Improbable
	2	2	4	2
	Result: (-16) Low negative			

Table 8-48: Impact significance for invasive species and human-wildlife conflict-Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Medium Term	Moderate	Probable
	2	3	6	3
	Result: (-33) Medium negative			
Mitigation measures	**Comments/Mitigation:** • All workers be equipped with appropriate personal protective equipment which must be worn during working hours			

	• Educate local people of dangers from snake bites and how to prevent them • Equip local hospitals with anti-venom readily available from centres such as Bio-ken situated in Malindi. • Train doctors to identify types of bites and how to treat them • Dispose all solid waste according to Kenya's waste management Regulations 2006 as a minimum • Trap and rid the site of any rodents or vermin which attract snakes			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short	Low	Improbable
	2	2	4	2
	Result: (-16) Low negative			

Table 8-49: Impact significance for spillage of chemicals and oils-Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • A log of all dangerous chemicals be kept, how to be used, transported stored and disposed • Keep all dangerous chemicals, oils, greases, solvents, and residues in a well secured receptacles. • Have a standard operating procedure on how to deal with chemical spills if they occur and how to prevent them • Have a spill response team readily available to respond to such incidents • Train workers on spill preparedness and response • Have a containment and disposal plan for all hazardous materials • All used oils and hazardous wastes should be disposed of according to NEMA waste management regulations 2006			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Very short	Minor	Improbable
	2	1	2	2
	Result: (-10) Low negative			

Table 8-50: Impact significance for alteration of marine environment-operational phase

<table>
<tr><th>Mitigation Status</th><th>Extent</th><th>Duration</th><th>Magnitude</th><th>Probability</th></tr>
<tr><td rowspan="3">Without mitigation</td><td>Study Area</td><td>Long Term</td><td>High</td><td>Highly probable</td></tr>
<tr><td>2</td><td>4</td><td>8</td><td>4</td></tr>
<tr><td colspan="4">Result: (-56) Medium negative</td></tr>
<tr><td>Mitigation measures</td><td colspan="4">Comments/Mitigation:
• Recycle water used in the plant to minimize uptakes
• Use barrier nets around the intake area to prevent entrainment of animals
• Use the IFC recommended uptake velocities of 0.5ft/s
• Use multiport diffusers when releasing water into the sea
• Treat all waste water and runoff water before coming to contact with the ocean
• All used oils, hazardous wastes and effluent to be disposed of according to NEMA waste management regulations 2006</td></tr>
<tr><th>Mitigation Status</th><th>Extent</th><th>Duration</th><th>Magnitude</th><th>Probability</th></tr>
<tr><td rowspan="3">With mitigation</td><td>Study Area</td><td>Long term</td><td>Low</td><td>Improbable</td></tr>
<tr><td>2</td><td>4</td><td>4</td><td>2</td></tr>
<tr><td colspan="4">Result: (-20) Low negative</td></tr>
</table>

Table 8-51: Impact significance for invasive species and human-wildlife conflict-operational phase

<table>
<tr><th>Mitigation Status</th><th>Extent</th><th>Duration</th><th>Magnitude</th><th>Probability</th></tr>
<tr><td rowspan="3">Without mitigation</td><td>Study Area</td><td>Long Term</td><td>Low</td><td>Probable</td></tr>
<tr><td>2</td><td>4</td><td>4</td><td>3</td></tr>
<tr><td colspan="4">Result: (-30) Medium negative</td></tr>
<tr><td>Mitigation measures</td><td colspan="4">Comments/Mitigation:
• The project on-site medical center should be equipped to provide anti-venom if a trained doctor will be available full-time
• Equip local hospitals with anti-venom readily available in Bio-ken Malindi.
• Train doctors to identify types of bites and how to treat
• Dispose all solid waste according to NEMA waste management regulations 2006 and EMCA act 1999
• Trap and rid-off the site of any rodents which attract snakes</td></tr>
</table>

Mitigation Status	Extent	Duration	Magnitude	Probability
With mitigation	Study Area	Long Term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

Table 8-52: Impact significance for spillage of chemicals and oils and release of trace heavy metals from ash yard-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short	Moderate	Probable
	2	2	4	3
	Result: (-24) Low negative			
Mitigation measures	**Comments/Mitigation:** • A log of all dangerous chemicals be kept, how to be used, transported stored and disposed • Keep all dangerous chemicals, oils, greases, solvents, and residues in a secure room. • Have a standard operating procedure on how to deal with spills • Have a spill response team readily available to respond • Train worker on spills and how to deal with them • Have a containment and disposal plan for all hazardous material (where to dispose) • Collect and separate all water from rain from different areas like roof and ground surface run-off then store and treat separately • All oils and hazardous materials to be disposed of according to NEMA waste management regulations 2006 and EMCA act 1999			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

Table 8-53: Impact significance for dust and exhaust particles pollution-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Low	Probable
	2	2	4	3
	Result: (-24) Low negative			

Mitigation measures	**Comments/Mitigation:** • Water sprinklers should be used to reduce dust where activities will generate it • Vehicle speed should be set at 30 to 40 KPH to reduce dust emissions • It is recommended that low sulphur diesel is used for construction plant and equipment			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short	Low	Improbable
	2	2	4	2
	Result: (-16) Low negative			

8.10.5 Impacts on Invertebrate fauna

8.10.5.1 Destruction and loss of habitat

The excavation of land for construction of the coal plant, ash yards, coal stock pile areas, housing estate and access roads will lead to loss of habitats especially for the ground dwelling species. Natural vegetation will be cleared affecting the species that depend on it for food and shelter. There will therefore be loss of breeding and nesting areas. This loss is not projected to be significant for invertebrates since only a fraction of the larger area will be excavated and the study did not identify a species that has a very restricted habitat that was within the areas to be cleared.

8.10.5.2 Possible effects of gaseous emissions and dust

Air contaminants accumulate in insects tissues by ingestion, respiration or penetration through the cuticle. There are known interactions between sulfur compounds from coal plants and insects which show changes in population dynamics induced by sulfur compound pollution stress (Eric and Robert, 1977). Sulfur and nitrogenous gases emitted from the combustion of fossil fuels contributes to the formation of acidic rains that may lead to the following:

- Interference with phytophagous (plant feeding) invertebrates: The loss of vegetation cover due to acidic rains together with the covering of vegetation with soot which might contain heavy metals will in turn affect a variety of leaf feeding invertebrates such as grasshoppers and leaf beetles;
- Decline of pollinators: Contamination with various pollutants emanating from a coal power plant has been shown to affect the abundance social bees such as the African honey bee even at very low concentrations (Gary and Orie, 1980). Decline of these major pollinators will result in reduced pollination which in turn will affect the agricultural productivity of the farming communities bordering the project area;
- Decline of natural predators and parasitoids: Parasitic wasps have been shown to suffer from coal plant emissions (Gary and Orie, 1980). Decline of these predators and parasitic groups have been shown to lead to a rapid increase of several plant feeding insects (Gary and Orie, 1980);
- Effects on ground beetles (Carabidae): A number of insect groups with a strong sensory system such as predacious beetles e.g. ground beetles have been shown to reduce in

abundance due to pollutants emanating from coal (Gary and Orie, 1980). These beetles live in very close association with the soils and detritus.

8.10.5.3 Effects of increased vehicular activities on invertebrates

There is likely to be increased emissions and dust from vehicles to and from the construction site which will no doubt soil the leaves of plants adjacent to the access roads used for the project. These are likely to affect the vegetation which in turn will have some effects on invertebrates that depend on them. This may however not be widespread but localized in the immediate areas next to the access road.

8.10.5.4 Potential effects of ash yards

Different ground dwelling invertebrate groups require different pH conditions of the soil. The dispersal of ash from the ash yard to neighboring locations is likely to increase the pH of the soils in the surrounding areas. This will have an effect on those species that require neutral or acidic soil conditions for survival.

8.10.5.5 Likely effects of desalination on marine invertebrates

The project will have a desalination plant to provide water for various uses. Desalination of sea or ocean water is a widespread technology used in many countries in the world to solve the problem of water quality. It is quite common in the North Africa, Middle East, (Pantell, 1993) and fast growing in United States of America (Jenkins and Wasyl, 2005). If not well mitigated, desalination might have potential effects on marine invertebrates both during the uptake and release of the resultant brine back into the sea. These impacts of sea water desalination can be attributed to operational aspects below.

- Impingement where large marine invertebrates such as crabs and lobsters are trapped on the intake screen, resulting in their injury or death;
- High concentration of brine: It has been estimated that salinity levels of the discharge brine is approximately double that of the intake sea water which equals to 64-70 ppt (part per thousands) (Rashad, 2007). The average salinity of the sea water is approximately 30-37 ppt (Millero and Sohn, 1992); in the Lamu area, the salinity is usually less than 34% (Kitheka, 1997);
- Increased alkalinity in the discharge water due to basic/alkaline chemicals used during desalination (calcium carbonate and calcium sulfate);

8.10.5.6 Light pollution from lighting during and post construction

A lot of artificial light is expected in the evenings all through the construction phase as well as from security lights in the housing estate during the operational phase. An expected effect this is that it will attract large amounts of both nocturnal and diurnal invertebrates mainly insects. Some of the groups highly attracted to light are moths, beetles, midges, crane flies, mayflies, ant lions, bush crickets, and the water bugs (Eisenbeis, & Hassel, 2000). Many types of marine invertebrates, such as late-stage crab larvae, are also attracted to artificial light (Porter et al, 2008) It is estimated that about a third of all insects attracted to street lighting die (Eisenbeis, 2006). In a study carried out in Finland, it was found that even light as little as that of a light trap can lead to extinction of some moth that have very small populations (Väisänen & Hublin, 1983). Most of these attracted invertebrates do not find their way into the natural habitats but rather rest on the ground where they are either trampled or predated on. Artificial lighting also repels some species that operate under the cover of darkness. These include earwigs, cockroaches, woodlice, earthworms and scorpion (Camp & Gaffin, 1999). This affects their feeding and breeding patterns and it is highly probable that it threatens their survival prospects.

8.10.5.7 Expected effects of developments such as housing estates

These developments are likely to cause a proliferation of undesirable species. The influx of many workers in the area and mushrooming of residential estates to accommodate them will result in the generation of tonnes of garbage and sewerage. This will in turn attract a few undesirable invertebrate species such as house flies (*Musca domestica*) and blow flies (*Chrysomya spp*). Production of sewage and forming of other organically enriched water pools from these residential estates will create conducive breeding habitat *Culex quinquefascitus* for mosquitoes. This is an urban mosquito that thrives in organically contaminated waters. Besides being a source of great biting nuisance, it is the main vector of elephantiasis in urban areas. This was found in large populations in Lamu Island and Mokowe during the study period. The housing estates together with the expected urban development will most certainly bring with it the two nuisance cockroach species *Blatella germanica* and *Periplaneta americana* and to a smaller extent the Psychodid moth flies.

8.10.5.8 Impacts of pooling of storm waters from paved areas and road construction

Run-off water from the paved area and roadside pool resulting from access road construction will create breeding grounds for *Anopheles gambiae* and *An. funestus* mosquitoes. These two are the principle vectors of malaria in Africa.

8.10.5.9 Impact of harvesting construction material locally

Locally sourced construction materials such as sand from nearby rivers will distort the ecosystems from which they are sourced. Sand harvesting from rivers particularly affects the dragonflies in the family *Gomphidae* that specifically breed in sandy substrates in rivers and streams.

Table 8-54: Impact significance for destruction and loss of habitat – Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short	Low	Definite
	2	2	4	5
	Result: (-40) Medium negative			
Mitigation measures	**Comments/Mitigation:** • If possible, creation of new access roads should be avoided. Improve and use existing roads to the site • No burning should be employed to clear vegetation. Employ alternative methods such as clearing by machines. This will allow as many species as possible in the affected areas to migrate to the non-affected areas.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
	Localized	Short	Minor	Improbable

With mitigation	1	2	2	2
	Result: (-10) Low negative			

Table 8-55: Impact significance for gaseous emissions and dust – Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Very short	Minor	Probable
	1	1	2	3
	Result: (-12) Low negative			
Mitigation measures	**Comments/Mitigation:** • Earth moving should be planned to coincide with rains or during the time of the day when it is calm with low invertebrate activity			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Very short	Small	Highly improbable
	1	1	0	1
	Result: (-2) Low negative			

Table 8-56: Impact significance for increased vehicular activities– Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short	Minor	Highly probable
	2	2	2	4
	Result: (-24) Low negative			
Mitigation measures	**Comments/Mitigation:** • If possible creation of new access roads should be avoided. Improve and use existing roads to the site • No burning should be employed to clear vegetation. Employ alternative methods such as clearing by machines. This will allow as many species as possible in the affected areas to migrate to the non-affected areas. • Use regular watering of access roads as a dust suppression technique			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Small	Improbable
	2	2	0	2

	Result: (-8) Low negative

Table 8-57: Impact significance for effects of ash yards –construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Short	Minor	Probable
	1	2	2	3
	Result: (-15) Low negative			
Mitigation measures	**Comments/Mitigation:** • Restrict the excavation area to only that demarcated for the ash yard • Ensure that the ash yard is properly bunded with an impermeable layer beneath it			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Short	Small	Improbable
	1	2	0	2
	Result: (-6) Low negative			

Table 8-58: Impact significance for pooling of storm waters from paved areas and road construction – Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Short term	Low	Probable
	1	2	4	3
	Result: (-21) Low negative			
Mitigation measures	**Comments/Mitigation:** • Proper drainage of storm waters should be taken into account right from the design phase of paved areas and access roads to avoid storm water retention.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Short term	Minor	Improbable
	1	2	2	2
	Result: (-10) Low negative			

Table 8-59: Impact significance for harvesting construction material locally – Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Short term	Moderate	Probable
	3	2	6	3
	Result: (-33) Medium negative			
Mitigation measures	**Comments/Mitigation:** • If possible, the EPC contractor should source all construction materials from existing borrow pits			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Short term	Low	Improbable
	3	2	2	2
	Result: (-14) Low negative			

Table 8-60: Impact significance associated with development of housing estates – Construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Short term	Minor	Improbable
	1	2	2	2
	Result: (-10) Low negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should institute proper garbage and sewerage management for the temporary workers' accommodation area to prevent garbage breeding flies such as house flies and filth flies.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Short	Small	Highly improbable
	1	2	0	1
	Result: (-3) Low negative			

Table 8-61: Impact significance for desalination water effects on marine life – operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
	Study area	Long term	Low	Probable

Without mitigation	2	4	4	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Locate the circulating water inlet and outlets in areas of the sea with lesser biodiversity or fewer sensitive species such as corals			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

Table 8-62: Impact significance for light pollution– operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Long term	Minor	Probable
	2	4	2	3
	Result: (-24) Low negative			
Mitigation measures	**Comments/Mitigation:** • Minimize the impacts of lighting by using the minimum number of bulbs. • The O&M Company should use low pressure sodium vapor lamps, also known as sodium oxide lamps. • Floodlights at the edges of the project site should be positioned to face away from the adjacent areas. • When not needed, the floodlights should be switched off			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long term	Small	Improbable
	2	4	0	2
	Result: (-12) Low negative			

Table 8-63: Effects of developments such as housing estates – Operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Long term	Minor	Improbable
	1	4	2	2
	Result: (-14) Low negative			

Mitigation measures	**Comments/Mitigation:** • The O&M Company should use proper garbage and sewerage management to keep garbage breeding flies such as house flies and filth flies in check. • All residential house should have screened windows			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Long term	Small	Highly Improbable
	1	4	0	1
	Result: (-5) Low negative			

8.10.6 Impacts on mammals

8.10.6.1 Habitat Alteration

Clearing of vegetation, soil excavation and construction of facilities may alter the habitat for mammals in the area. The population of trees and other plant species will also be reduced through clearing of vegetation to pave way for the power plant structures. It is expected that vegetation will be stripped in some of the areas leading to loss of ecological functional areas such as woodlands and bushes. As a result wildlife ranging, foraging and roosting areas may be adversely affected.

8.10.6.2 Displacement of mammals from project site

Spatial occupation of the area by project facilities and people will displace mammals that currently forage in the project area and could create a barrier effect, which may alter their dispersal patterns. Displacement may lead to human-wildlife conflict in other locations as animals could move to human-occupied areas in the vicinity of the project site looking for foraging grounds.

8.10.6.3 Alteration of mammal movements and behaviors

Mammals' species including bats are sensitive to human occupation. Disturbances include flood lights, vehicle lights and noise from machinery and vehicles. This will affect movement of mammal species across the landscape, and may result in occasional road kills. Occupation of the area by project facilities will render the site inaccessible to mammals. This will reduce faunal foraging options by barring the site as a foraging ground. Noise and vibrations from the heavy machinery may interfere with foraging, ranging, breeding and nesting behavior of mammals in the ecosystem within the project site and those in the larger ecosystem.

8.10.6.4 Collision impact on bats

Bats may collide with the emissions stack of the coal power plant. This is expected to be more intense during hours of heightened bat activity (typically 1800hrs to 2359hrs).

Table 8-64: Impact significance for habitat alteration for mammals-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short Term	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • As part of the rehabilitation plan, the O&M company should consider a re-afforestation program for mammals; • Areas devoid of human activities should be left intact or rehabilitated and allowed to regenerate.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Very short	Low	Improbable
	2	1	4	2
	Result: (-14) Low negative			

Table 8-65: Impact Significance on Mammal Displacement-Construction Phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study Area	Short term	Moderate	Probable
	2	2	6	3
	Result: (-30) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should engage the Kenya Wildlife Service (KWS) to translocate large mammals from the project area to the nearest conservation area. • The EPC contractor should engage the KWS during the construction period to monitor the movements of translocated mammals to ensure they remain within the conservation area			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study Area	Short term	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

Table 8-66: Impact significance for bat collision with emission stack-operation phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Low	Improbable
	2	4	4	2
	Result: (-20) Low negative			
Mitigation measures	**Comments/Mitigation:** • The O&M Company should consider using radar techniques to deter bats from venturing close to the stack.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Long Term	Minor	Probable
	2	4	2	2
	Result: (-16) Low negative			

8.11 Socio-economical-cultural environment

8.11.1 Increased affordability, reliability and stability of electricity supply

The proposed project is envisioned to inject about 981.5MW of electricity into the national grid, currently standing at 2173MW as at December 2014, as part of the Government of Kenya's Least Cost Development Plan for power generation to bring down the cost of power via a more stable, cheaper, reliable platform. Once complete, the Project will constitute approximately 36% of the new combined grid capacity as well as bring down the average cost of generation for Kenya Power and Light Company ("KPLC"). This is expected to:

a) Increase KPLC's outreach and connectivity with emphasis on rural electrification, educational institutions, health institutions and micro-enterprises;

b) Significantly reduce the cost of electricity;

c) Address the current power shedding outages experienced nationally and;

d) Address the current uncertainty of power generation from hydropower

Table 8-67: Impact significance for increased affordability, reliability and stability of electricity supply - Operational phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	National	Medium term	High	Definite
	4	3	4	4
	Result: (+44) Medium positive			

Enhancement measures	• The O&M Company should minimize, to the extent possible, operational cost that may subsequently result in an increase in consumer tariffs • O&M Company should employ appropriate technologies to increase efficiency and stability of power generation			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	National	Medium term	High	Definite
	4	3	8	5
	Result: (+75) High positive			

8.11.2 Creation of direct, indirect and induced employment

The proposed project is envisioned to generate direct and indirect employment opportunities for both skilled and unskilled workers. Direct employment includes jobs at the power plant during the construction and operational phases. Indirect employment will be realized through increased business opportunities and spurred economic growth both at the County and national levels. APCL is committed to build the capacity and capability of local people and businesses to benefit from the project.

Creation of employment opportunities was perceived to be the most important benefit of the project by the communities in Lamu. This was mainly expected to benefit the unemployed people living within and around the proposed project site. The unemployment levels are generally high in the region and expectations on job opportunities are high among the people of the area. APCL will also ensure gender balance during employment to help empower women in the community. APLC envisions building the capacity of 1000 local youth through the National Youth Service with an aim of absorbing them into the project during the construction phase.

During the construction phase, it is projected that the workforce will peak at approximately 2,978 personnel with 59% of these being Kenyan workers and 41% Chinese workers. These will mainly be semi-skilled and unskilled jobs. A large fraction of the construction-based jobs will be under civil works which will include but not limited to carpentry, steel-works, water-works, concrete-works and masonry. The operational phase of the project is anticipated to peak at approximately 320 workers at commissioning (with at least 50% of these being Kenyan personnel) with a projected growth to about 500 jobs. These will mainly be skilled positions.

It is anticipated that the proposed project will result in a marked increase in individual income nationally and specifically for the Lamu community. This will be attributed by the increased purchases from local and national businesses, employment generated by project activities, and a general spur of economic activities stimulated by the project.

The Energy (Local Content) Regulations (2014) provides guiding principles that will ensure the local communities and Kenyans benefit from the proposed project. The regulations place an obligation on APCL and its contactors to:

a) Ensure that local content is a component of their operational energy activities

b) Establish a local office, where procurement, project management and implementation decision making are to take place, to the satisfaction of the Commission.

c) Give Kenyan citizens the first consideration for employment and training in any operations executed in energy activities

d) Give first consideration to services provided from within Kenya, to goods manufactured in Kenya, to locally available goods and Kenyans citizens

e) Submit a Local Content plan to the Commission demonstrating compliance with the Kenyan Local Content requirements. The Local Content plan should detail how the proponent and its contractors shall ensure:

- First consideration to services provided within the country and goods manufactured in the country where the goods meet the specifications of the energy sector as established by-the Kenya Bureau of Standards or by other internationally acceptable standards
- Qualified Kenyans are given first consideration with respect to employment
- Adequate provision is made for the training of Kenyans on the job

While Part two of the first schedule on minimum local content in goods and services under the Local Content regulations will guide the specific local content to be achieved, part one provides a premise for the assumption that the proposed project will dedicate at least 30% - 40% of the total project budget to local content. Based on this assumption, at least KES 5.4 billon of the KES 18 billion project budget will be expended on local content resulting in a significant increase in individual income nationally.

Table 8-68: Impact significance on creation of direct, indirect and induced employment - construction phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Localized	Short term	Low	Probable
	1	2	4	3
	Result: (+21) Low positive			
Enhancement measures	• APCL and its contractors must endeavor to prioritize the local community in the allocation of job opportunities, prioritizing from the residents immediately neighboring and/or displaced by the project, to the larger Lamu County • APCL should also ensure opportunities for capacity building are afforded to the local communities to enable them to benefit from the available employment opportunities. This includes training in skills set required during the construction and operational phases of the project • Job advertisements should be made through mediums that are easily accessible to the local community such as Chief's noticeboards, CLO's, local radios, etc. • Where possible, expertise should be sourced locally then nationally before resorting to engagement of international experts • The recruitment selection process should seek to promote gender equality and the employment of women where possible. • Management and enhancement measures for local employment should be included in the company's labor and human resources plan.			

	• Where possible, Lamu County administration should be consulted when recruiting local workers • APCL should make a conscious effort to promote local businesspeople in the procurement of goods and services to assist in providing more economic and employment opportunities for the local community			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	Regional	Short term	Moderate	Definite
	3	2	8	5
	Result: (+65) High positive			

Table 8-69: Impact significance on creation of direct, indirect and induced employment - operational phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Localized	Short term	Low	Probable
	1	3	4	3
	Result: (+24) Low positive			
Enhancement measures	• APCL and its contractors must endeavor to provide the local community for any job opportunities, prioritizing from the residents immediately neighboring and/or displaced by the project, to the larger Lamu County • The O&M Company should ensure opportunities for capacity building is afforded to the local communities to enable them to benefit from the available employment opportunities. This includes training in skills set required during the construction and operational phases of the project • Expertise should be sourced locally then nationally before resorting to engagement of international experts • Job advertisements should be made through mediums that are easily accessible to the local community such as Chief's noticeboards, CLO's, local radios, etc. • The recruitment selection process should seek to promote gender equality and the employment of women where possible. • Management and enhancement measures for local employment should be included in the company's labor and human resources plan. • Where feasible, Lamu County administration should be consulted when recruiting local workers • Promotion and prioritization of employment opportunities for the local community • APCL should make a conscious effort to promote local businesspeople in the procurement of goods and services to assist			

	in providing more economic and employment opportunities for the local community			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	National	Short term	High	Definite
	4	3	6	5
	Result: (+65) High positive			

8.11.3 Economic growth

The proposed 1,050MW coal power project is of such a magnitude that will impact the economy of the whole country and by extension the East Africa region. Implementation of the proposed project is anticipated to stimulate economic growth through:

- Elevation of Lamu County's profile with subsequent infrastructural development, increased revenue and investment in the county
- Access to affordable and reliable power by industries and micro-enterprises nationally. This will promote the emergence of new enterprises and boost business and economic opportunities both in the informal and informal sectors. This is also expected to increase productivity of all sectors through mechanization of sectors such as agriculture, enhanced industrialization and adoption of ICT.
- Enhanced availability of markets for local products. Both goods and services such as food supplies, catering services and construction materials will be required during construction as well as operations. As rightly perceived by the local communities, this will lead to secondary employment and creation of small supporting businesses.
- Increased tax revenue through VAT, withholding tax on imported services and PAYE on project employee salaries

Table 8-70: Impact significance of economic growth - construction phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Regional	Short term	Low	Probable
	3	2	4	3
	Result: (+27) Low positive			

Enhancement measures	• The Government, in partnership with APCL, should provide financial literacy training to individuals compensated during the RAP to ensure prudent investment and utilization of the funds • Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities • Communication and information programs should be used to manage expectations and target local service providers • APCL and its contractors should, to the extent possible, make deliberate efforts to source for all required supplies from local providers, prioritizing from Lamu County to the rest of the Country, before resorting to importation • Tender documents should include guidelines for the involvement of local entrepreneurs, businesses and SMEs from the local sector			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	National	Short term	High	High
	4	2	8	4
	Result: (+56) Medium positive			

Table 8-71: Impact significance of economic growth - operational phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Regional	Short term	Low	Probable
	3	2	4	3
	Result: (+27) Low positive			
Enhancement measures	• Ensure that economic opportunities are available or are created for the local community and that proper capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities • Communication and information programs should be used to manage expectations and target local service providers • The O&M Company should, to the extent possible, make deliberate efforts to source for all required supplies from local providers, prioritizing from Lamu County to the rest of the Country, before resorting to importation • Tender documents should include guidelines for the involvement of local entrepreneurs, businesses and SMEs from the local sector • APCL, through its CSR programme, should promote and support economic empowerment initiatives for the local community • APCL should endeavor to minimize, to the extent possible, production costs, subsequently lowering electricity cost nationwide			

	• APCL should remit all applicable taxes to the local and national Government, as per legal provisions			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	International	Medium term	High	Definite
	5	3	8	5
	Result: (+80) High positive			

8.11.4 Infrastructure development

Lamu County generally suffers from poor underdeveloped infrastructure. It is anticipated that the implementation of the proposed project will stimulate the enhancement of the following infrastructures:

- Transportation Infrastructure: improvement of existing roads, creation of new roads and associated structures such as bridges; Improvement of existing jetties and creation of new ones.
- Public Health Infrastructure: improvement of health facilities; desalination and provision of potable water supplies; wastewater treatment and management; solid and hazardous waste management and treatment
- Communications Infrastructure: enhanced telephone services (fixed lines and mobile) and associated transmission facilities
- Energy Infrastructure: improvement of electrical power supply

Table 8-72: Impact significance on infrastructure development - construction phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Localized	Short term	Minor	Probable
	1	2	2	3
	Result: (+15) Low positive			
Enhancement measures	• APCL should collaborate with the relevant Government ministries to enhance infrastructural development, with emphasis on infrastructure that may experience immediate and adverse strain directly from project activities, and of which existing provisions are inadequate to handle project-related strain without compromising access by the local communities such as public health, education, transport and housing			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	Regional	Long term	Very high	High
	3	4	10	4
	Result: (+68) High positive			

Table 8-73: Impact significance on infrastructure development - operational phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Localized	Medium term	Minor	Probable
	1	3	2	3
	Result: (+18) Low positive			
Enhancement measures	• The County and national Government should leverage on the anticipated economic growth and support infrastructural development to meet the growing demands, both within Lamu County as well as Nationally • APCL should collaborate with the relevant Government ministries to enhance infrastructural development, with emphasis on infrastructure that may experience immediate and adverse strain directly from project activities, and of which existing provisions are inadequate to handle project-related strain without compromising access by the local communities such as public health, education, transport and housing • The County and national Government should endeavor to prioritize the development of crucial infrastructure for the County			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	National	Permanent	Very high	High
	4	5	10	4
	Result: (+76) High positive			

8.11.5 Capacity building

APCL aims at building capacity of the local communities to enable them to benefit from the immediate project opportunities such as employment during the construction phase, as well as for sustainability throughout the project lifecycle. APCL envisions imparting practical skills to 1000 local youth through the National Youth Service with an aim of absorbing them into the project during the construction phase. These skills will be retained in the local community even after the decommissioning of the power plant and will increase the residents' employability as they secure jobs in other developments that may arise in the area. Additionally, APCL will also increase the competency levels of its workers through continued capacity building and exposure.

Being the first project of its nature and magnitude, the proposed 1,050 megawatt power plant will employ various international experts who will work along local employees. Through this, there will be a transfer of technology and skills to the local community, creating a pool of highly skilled professionals with specialized knowledge that will be utilized in the continued implementation of the power plant as well as in implementing future projects of a similar nature. APCL will institute deliberate structures to promote and enhance this knowledge transfer. Throughout the construction and commissioning phases of the project, APCL and its contractors will maintain a workforce composition of at least 50% Kenyan personnel to work and learn alongside Chinese expatriates. Under the Energy (Local Content) Regulations (2014), APCL and its contractors are obligated to develop an employment and training plan and succession plan with respect to all energy activities. The succession plan will make provisions for and require Kenyans to understudy the requirements of the position held by a non-Kenyan for a period determined by the Commission on a case-by-case basis after which the position occupied by the non-Kenyan will be assumed by the Kenyan to ensure that the minimum local content levels are met.

Education empowers a person to participate in the development process. It inculcates knowledge and skills needed to improve the income earning potential and in turn the quality of life. Lamu County suffers from inadequate education infrastructure and consistent poor performance in education as ranked nationally. Through its CSR program, APCL envisions to collaborate with the County Government and other development actors to support the improvement of education standards in the County.

Table 8-74: Impact significance on knowledge transfer and capacity building - construction phase

Enhancement Status	Extent	Duration	Magnitude	Probability
Without enhancement	Localized	Short term	Small	High
	1	2	0	4
	Result: (+12) Low positive			
Enhancement measures	• The EPC contractor should institute an elaborate structure to promote and enhance knowledge transfer between international experts employed by the project and the local employees. This should be a set requirement for all international firms contracted by APCL • The EPC contractor should ensure effective capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities. This includes training for the skills required during the construction and operational phases of the project • The EPC contractor should effectively communicate the skill requirements to the local community well in advance of the construction and operational phases. This should be done through mediums that are easily accessible to the local community such as CLOs, community noticeboards, local radio, etc.			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	Regionally	Short term	High	Very high
	3	2	8	5
	Result: (+65) High positive			

Table 8-75: Impact significance on knowledge transfer and capacity building - operational phase

Enhancement Status	Extent	Duration	Magnitude	Probability
	Study area	Medium term	Small	High

Without enhancement	2	3	0	4
	Result: (+20) Low positive			
Mitigation measures	• The O&M Company should institute an elaborate structure to promote and enhance knowledge transfer between international experts employed by the project and the local employees. This should be a set requirement for all international firms contracted by the O&M Company • The O&M Company should ensure effective capacity building is afforded to the local communities to enable them to benefit from the available economic opportunities. This includes training for the skills required during the construction and operational phases of the project • As part of its CSR, APCL should consider support of tertiary education specifically to the Lamu community. The beneficiaries should then be absorbed by APCL and its contractors in gainful employment or provision of business opportunities • Additionally, in collaboration with the County Government and other non-state development agencies, APCL should consider supporting infrastructural development for local primary and secondary schools • The O&M Company should effectively communicate the skill requirements to the local community well in advance of the construction and operational phases. This should be done through mediums that are easily accessible to the local community such as CLOs, community noticeboards, local radio, etc.			
Enhancement Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With enhancement	Nationally	Medium term	High	High
	4	3	8	5
	Result: (+75) High positive			

8.11.6 Land acquisition and involuntary resettlement

The 1,050MW power plant will require approximately ~394.9 hectares (~975.4 acres) of land. This will necessitate the acquisition of the land and subsequent relocation of all legitimate project affected persons (PAPs) within the delineated project site including those who live on, have assets on, and or engage in commercial activities on the required land through a Resettlement Action Plan (RAP).

The Request for Proposal (RFP) for the proposed project stated that the Ministry of Energy and Petroleum (MoEP) would provide the developer with land free of encumbrances for constructing and operating the power plant. Subsequently, the RAP process is being led by the MoEP. The land tenure for the project site is defined as "Community Land" which according to the Constitution of Kenya 2010 is held in trust by the County Government of Lamu.

The RAP will be conducted in accordance with the requirements of the African Development Bank's Operational Safeguard 2 titled Involuntary Resettlement and the International Finance Corporation's Performance Standard 5 titled Land Acquisition and Involuntary Resettlement.

In order to satisfy the legal and lender requirements of the RAP, two committees were set up namely a Steering Committee and a Technical Committee. The steering committee is the higher level committee that provides leadership on the resettlement management framework while the technical committee provides technical advice on how resettlement and land acquisition issues for the proposed project should be handled. The membership of the two committees comprises the County Government of Lamu, The County Commissioner of Lamu (representing the national government), the National Lands Commission (NLC), the LAPPSET Corridor Development Authority (LCDA), Kenya Ports Authority (KPA), the community committees and the project developer.

The County Government Act, 2012 requires that any project of national significance must be presented to the County Assembly for consideration. The project developer satisfied this required in mid-2015 when the County Assembly of Lamu unanimously approved the development of the project. This paved the way for the County Government of Lamu to allocate the land to the project developer.

According to the Lands Act 2012, the implementing agency for acquiring community land is the National Lands Commission (NLC). The NLC will implement the recommendations of the RAP which is currently being undertaken by the MoEP.

Implementation of the RAP in accordance with the requirements of national legislation and lender requirements is a significant issue in the pre-construction phase of the project. The PAPs expressed this as an important milestone during the stakeholder engagement process. Some of the potential socio-economic concerns associated with land acquisition and involuntary resettlement include:

- Relocation of the PAPs to areas with fewer resources compared to the project site. This may include loss of farmland due to relocation to smaller parcels of land, absence of forests, fishing grounds, grazing grounds, etc.;
- Relocation of individuals to areas where their productivity skills are less applicable;
- Disruption of social networks and community organization;
- Loss of cultural identity and ancestral heritage through disruption of traditional authority, culturally significant sites and rituals, and dispersion of kin groups; and
- During consultations with the local women, they expressed concerns that since the men hold ownership rights to land and property, and given the high poverty and low financial literacy within the local communities, the women feared that the men would misappropriate resources provided as compensation for land and assets during the project-related land take, leaving the women and children poor and landless.

Table 8-76: Impact significance of land acquisition and involuntary resettlement – pre-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long-term	High	Highly-probable
	3	4	8	4
	Result: (-60) High negative			

Mitigation measures	• The MoEP and NLC should implement a RAP that complies with Kenyan legislation and lender requirements of the African Development Bank's Operational Safeguard 2. The RAP should also comply with the requirements of Performance Standard 5 of the International Finance Corporation on Land Acquisition and Involuntary Resettlement • The National Land Commission (NLC) should ensure full disclosure, consultation and meaningful engagement of the PAPs throughout the resettlement process (including the host communities) • The NLC should develop and implement a compensation plan for displaced and relocated people commensurate to the lost socio-economic value. • The NLC should ensure that new locations are culturally and commercially compatible with the proposed project site • The NLC should provide counseling services for the PAPs to assist them in adaptation of the new surroundings • The NLC should provide financial literacy training for PAPs for sustainable management of the funds			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long-term	Low	Improbable
	3	4	4	2
	Result: (-22) Low negative			

8.11.7 Disruption and loss of livelihoods

Disruption and loss of livelihoods is defined as the loss of assets or access to assets that result in a loss of income or means of livelihood. This type of economic resettlement can have greater effects than physical resettlement.

The land required for the proposed project (~360 hectares) is defined as community land (which is held in trust by the County Government of Lamu). Subsequently, none of the users of the affected land have formal land title.

The communities in the project area are primarily dependent on land cultivation for income and livelihood, supplemented by fishing and livestock husbandry. About 75% of the communities cultivating the land in the project area come from Pate Island.

The potential acquisition of land currently utilized for agriculture poses a risk in the loss of livelihoods from crop production. Those who conduct farming activities within the proposed project site include residents of Bargoni, Hindi and Pate Island. Nearly all of these do not reside within the proposed project site. Additionally, a section of the proposed project site covers land currently utilized for livestock grazing. These grazing lands are utilized by local farmers and nomadic pastoralists traveling from Garissa County in search of pasture.

There may also be limited tourism-related livelihoods at risk due to the negative visual/aesthetic impacts associated with the proposed power plant infrastructure. This is a perceptive risk based on one's visual sensitivity to the power plant.

According to the Statistical Abstract 2015 (produced by the KNBS), the quantity of fish landed in Lamu County in 2014 was 2,428 metric tons valued at KShs 277,945,000 which represents ~27% of the total fish landed in the coastal strip of Kenya. Of the 2,428 metric tons, marine fish accounted for 2,198 metric tons (valued at KShs 176,187,000), crustaceans accounted for 174 metric tons (valued at KShs 90,210,000) and other marine fish accounted for 56 metric tons (valued at KShs 11,548,000).

Given the above, disruption and loss of livelihoods related to the fishing industry was a concern expressed by the local community during stakeholder engagement meetings. The community's perception is that the proposed project may adversely impact fish landing sites and poisoning of fish through hazardous discharges into the sea by the power plant.

Even though ~75% of communities in Lamu depend directly or indirectly on fishing, the sector remains inadequately developed. Majority of the fishermen employ traditional techniques which have limited their capacity to fish in deep seas. An expressed concern was that project activities will destroy current fishing sights located adjacent to the islands, and result in migration of fish to the deep sea.

The extent of the impact associated with disruption of livelihoods will extend to the Bajuni community from Pate Island that cultivate in the Kwasasi area and is considered to be local. The loss of land in the project area and therefore impacts on livelihood and income generation will be permanent in duration for those cultivating in the project area.

Table 8-77: Impact significance on disruption and loss of livelihoods - construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long-term	Moderate	Highly probable
	2	4	6	4
	Result: (-48) Medium negative			

Mitigation measures	• The EPC contractor should avoid contamination of and destruction of fish landing sites while construction of the power plant and associated infrastructure;
	• The EPC contractor should have develop and implement a transparent recruitment plan for employment and business opportunities for the local community;
	• The EPC contractor should implement a capacity building program for the local communities to enable them to benefit from the available economic opportunities;
	• The MoEP should develop and implement an IFC compliant Resettlement Action Plan (RAP) for project affected persons. The NLC should implement the RAP developed by the MoEP
	• To mitigate loss of tourism-related livelihoods, the design of the power plant facilities should be done in a way that:
	  ○ Minimizes loss of existing aesthetic and visual quality
	  ○ Reduces the impact or disruption of activities at tourism and recreational areas / facilities			

Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**

With mitigation	Study area	Long term	Low	Improbable
	2	4	4	2
	Result: (-20) Low negative			

8.11.8 Impacts to demographic profile

Lamu town is an important religious center for Islam in East Africa. It is also a dominant cultural center reputed for its historic past and socio-cultural traditions that have been upheld to date.

It is envisaged that with the construction of the project, a substantial amount of money will be spent in the project area and its environs for sourcing construction materials. The local content could potentially amount to about 10% – 20% of the envisaged US$2 billion project cost which would amount to a significant amount of money that can be injected into the economy of Lamu County and the country as a whole. While there are positive aspects associated with such local content injection into the local economy, there may also be adverse impacts that could potentially result from access to disposable income which hitherto are not there.

Over the construction period of about 42 months, the peak workforce is expected to be approximately 2,978 persons; 50% of these are expected to be Chinese while the other 50% are expected to be Kenyan.

A temporary construction camp is will be constructed within the southern section of the project site. The EPC contractor will design and build the accommodation, cooking and sanitary facilities for the construction workers, laydown areas and parking areas. The entire project site (~394.9 hectares) will be fenced off; the construction camp which will be located within the project site will be fenced off too and access will be controlled and restricted to employees. The EPC contractor will develop and implement specific policies for the management of the camp and construction workforce.

The project is expected to impact the social fabric in the project area in the following ways:

- Broken family bonds from migration of workers to the project area;
- Rise in prevalence of sexually transmitted infections; and
- Increase in crime.

The extent of the impacts to demographics will largely be contained within the project-affected communities and subsequently, will be local in scale. The duration of impacts associated with the construction phase will largely be short-term, lasting about 42 months.

In some cases, impacts will be of shorter duration, particularly if opportunistic job seekers who are unable to secure work leave the area. The probability of impacts, however, is highly likely, based on past experience in the region and current conditions.

The communities living in the project area are ethnically homogenous as the vast majority of people in and around the project site belong to the Bajun tribe; subsequently any influx of "foreigners" whether Chinese or those from other parts of Kenya, will be keenly felt.

It is important to take cognizance of the existing tensions between the Bajun and other ethnic minorities from the rest of Kenya who may be perceived to take over jobs meant for the local communities living within Lamu County. Adding large numbers of people from other parts of Kenya seeking employment opportunities may further exacerbate such tensions.

The operational phase of the project is expected to begin in September 2019 and continue for approximately 25 years. The operational phase is estimated to require about 500 directly employed workers to operate the power station and its auxiliaries; about 50% will be Chinese and the other 50% will be Kenyan. The Operations and Maintenance (O&M) company will source these jobs locally within Lamu County if the skills base exists. Employment opportunities that will be made available and the stakeholder expectations in this regard must be managed appropriately.

The majority of the local and regional recruitment will be for semi-skilled and unskilled positions (such as kitchen staff, security guards and cleaners).

The skilled workers that will be sourced by the O&M Company will overshadow their Chinese counterparts with the view of taking over such positions over a period of time. The power plant will be operated on a 24-hour, seven day basis. The control room operators, general operators and watch keepers will work on rotating shifts and a number of them will be accommodated at the permanent worker colony.

The impacts of the project on demographic profile during the operational phase are expected to be similar to those of the construction phase and include:

- Population increase due to influx of opportunistic job seekers and operation workforce; and
- Change to the ethnic structure of the local area, created by non-local workforce.

The extent of impacts to demographics will remain largely contained within the project affected communities and will therefore be local in nature. The duration of impacts associated with the operations phase will be long term, continuing for the life of the Project and ceasing when the Project stops operating.

The small and ethnically homogenous nature of the affected communities increases their sensitivity to the arrival of newcomers, particularly foreigners (Chinese and those from other parts of Kenya). This sensitivity of the changing demographics during the operational phase could raise tensions in the project area.

Table 8-78: Impact significance on changes to demographic profile – construction and operational phases

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long-term	Moderate	Probable
	3	4	6	3
	Result: (-39) Medium negative			
Mitigation measures	• The EPC contractor should develop and implement a transparent recruitment process and communicate the same through the area Chiefs' offices to manage expectations and opportunistic influxes • Priority for employment and other economic opportunities should be given to the local community to minimize in-migration • The EPC contractor should develop and implement camp and workforce management protocols which are clearly communicated to the workforce and enforcement measures implemented • The EPC contractor should customize the grievance mechanism developed in this ESIA Study and implement it for the construction phase of the project.			

	• The EPC Contractor and Developer should facilitate small land medium enterprise (SME) development in the local communities and surrounding region. • The EPC Contractor and Developer should invest in infrastructure development that can provide long-term benefit to the communities • The Developer should identify and facilitate training opportunities with vocational training institutions such as the Lamu Polytechnic for the local workforce to participate in other job sectors • The Developer should support sustainable development and implementation of new technologies in local agricultural production and fishing			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long term	Low	Improbable
	3	4	4	2
	Result: (-22) Low negative			

8.11.9 Impacts on infrastructure and social amenities

With the commencement of the construction phase of the project, there will be an influx of workers in the project area. During the peak construction period, it is expected that there will be about 3,500 workers on site; the construction period is expected to be about 42 months.

The proposed project lies in the Lamu West constituency whose population according to the 2009 Housing and Population Statistics was 82,698 people and has a population density of 21 persons per square kilometer.

The existing infrastructure in the project area is poor. The communities in and around the project area do not have access to piped clean drinking water, toilet sanitation facilities and solid waste disposal. Residents rely on community shallow wells for water (the water is generally saline) and dump household waste in improvised landfills.

The communities in the Kwa Sasi area and generally in Hindi sub-county do not have access to electricity. During the public stakeholder consultations, the communities expressed a hope that the developer will supply the project affected communities with cheap electricity.

The enrollment for pre-primary, primary and secondary schools is adequate, however the challenge is performance of the students in national examinations. The County's youth economic empowerment lies in tertiary education; there are 4 youth polytechnics in the County, all in a deplorable state.

Lamu County has a total of 688.5km of roads of which only 6km is tarmacked. There are two main roads namely the Mokowe-Garsen road (C112) which connects the county to the rest of the coast counties and the county, and Mokowe –Kiunga Road (D568 and E865) which connects the county to Somalia border. These roads are unpaved and become difficult to use during the rainy season.

The existing roads will be used to transport about 30% of the construction materials, plant and equipment required for the project while 70% of the materials will be transported via sea to the project area. Parts of the C112 road from Garsen to Mokowe will need to be upgraded in order to allow some of the construction materials to be transported to the project site.

On improvements to the infrastructure, the project developer has already commenced a program of corporate social responsibility for assisting the project affected communities. For example, the developer has undertaken the following improvements to the infrastructure among several other initiatives that they have commenced:

- Development of early childhood development classes at Bobo Primary School;
- Construction of the computer laboratory at Bargoni Primary School;
- Provision of water tanks at several locations in Kwasasi and its environs including weekly supply of potable water free of charge;
- Provision of solar lights to members of the project affected communities;
- Supply and installation of a cold storage facility at Mokowe for sea food for the fishermen;
- Provision of solar street lights and interlocking concrete block paving in Lamu town.

The main negative impacts to infrastructure associated with the 42-month construction phase of the project include:

- Deterioration of the C112 road from Garsen to Mokowe especially during the rainy season resulting from transportation of goods by heavy commercial vehicles. At the time of the ESIA Study, it was unclear how many truck trips will be required for transporting goods on the C112;
- Disruption to road access from project vehicles;
- Influx of opportunistic job seekers into the communities, adding pressure to the overburdened infrastructure services (roads, schools, health facilities, etc.);
- Increased household wastes and the inability to dispose of the same in an environmentally safe manner; and
- Contamination of water resources used by local communities.

The positive impacts to infrastructure associated with the construction phase include:

- Upgrading sections of the C112 road between Garsen and Mokowe especially near the project site by keeping it in a motorable state;
- Developing an effluent treatment plant appropriately sized for the construction phase of the project;
- Supporting the Lamu County Government to develop an appropriately designed and sized land fill for solid waste management;
- CSR projects related to infrastructure which will be undertaken by the developer and EPC contractor over the 42-month construction period; and
- Developing and/or upgrading health and educational facilities within Hindi sub-county.

Some of the key operational phase impacts include:

- Inadequate electrical supply to the community;
- Limited piped water;
- Poor toilet sanitation and solid waste disposal;

- Poor health facilities; and
- Inadequate road systems.

The proposed project will provide a net 981.5MW of electrical power to the national grid at the National Control Center in Nairobi via a 520km long 400kV overhead transmission line. This will increase the total available electricity in the country by 981.5MW (a figure representing more than 45% of the country's total on-grid generating capacity as at December 2014).

The Project will make use of public roads for Project-related transport and the frequency of vehicle movements will be significantly lower than that experienced during the construction phase. During the operational phase, the developer may develop a tarmac section of the road from the project site to Mokowe.

There will be a permanent worker colony for about 350 persons built within the project area. This facility will be self-sufficient from a resource and waste management perspective. There will be a desalination plant constructed as part of the project; the water will be used as process water in the power plant, potable water in the worker colony and a flanged connection for potable water will be provided to the community at no cost at the project boundary. There will also be a permanent effluent treatment plant constructed for the workers at the power station.

The impacts to infrastructure during the operational phase are similar to those characterized for the construction phase namely:

- Influx of opportunistic job seekers into the communities, adding pressure to the overburdened infrastructure services (roads, schools, health facilities, etc.);
- Contamination of water resources used by local communities;
- Project use of the C112 road could reduce their capacity; and
- Increased power supply for the national grid.

Table 8-79: Impact significance for existing infrastructure and social amenities - construction and operational phases

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long term	Moderate	Probable
	3	4	6	3
	Result: (-39) Medium negative			
Mitigation measures	• The EPC contractor and project developer should consult with relevant agencies (local and national Government and non-governmental organizations) on the current and future infrastructural development plans for the County and supplement their implementation; • The EPC contractor should consider providing housing facilities for all construction workers. If this is not possible, the EPC contractor should make plans to transport workers daily to and from Mokowe and Hindi to the project site using buses; • The EPC contractor should provide adequate infrastructure for water supply, waste management, health facilities, schools, etc. so as not to strain the existing County resources; • The EPC contractor should develop and implement a traffic management plan which should be strictly enforced. Among other			

	things, the construction vehicle traffic should be limited to roads indicated specifically for the project and avoid use of roads that would adversely disrupt effective functioning of local communities; • The EPC contractor should develop and implement adequate communication infrastructure for improving connectivity between the project site, regionally and nationally.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long-term	Low	Improbable
	3	4	4	2
	Result: (-22) Low negative			

8.11.10 Impacts on public health

Public health is the combination of sciences, skills, and beliefs that are directed to the maintenance and improvement of the health of all people. Therefore, the potential impacts of a major infrastructure project to public health can be substantial in both an adverse and a beneficial manner. Historically, there has not been a set of generally accepted standard guidelines or checklists to direct the public health impacts evaluation of large infrastructure projects, particularly in developing countries. Typically, public health evaluations have primarily focused on morbidity, mortality, and disability. Both the impacts and potential mitigation measures have generally been viewed through a health sector or disease specific perspective (e.g., malaria control programs) and have not necessarily considered the overall potential available to the infrastructure sector to positively impact and improve the quality of life and affect disease rates. Since the project is a major infrastructure effort, it is equally appropriate to evaluate its potential impacts in a broader perspective than traditional evaluation of disease morbidity, mortality and disability.

The analysis of potential health impacts for an infrastructure project should be conducted in a manner that is philosophically consistent with the shift from pure disease specific morbidity, mortality, and disability towards a broader consideration of the linkages between the proposed project and environmental health. In this setting, environmental health is the prevention of disease through the control of biological, chemical, or physical agents in air, water, and food, and the control of environmental factors that may have an impact on the well-being of people.

In general, increased personal disposable income as a direct result of project employment, business opportunities and associated effects would result in an increase in spending on preventive and curative health services. It is expected that the following sub-sectors of environmental health will improve as a result of the proposed project:

- Respiratory diseases where (i) new project workers would receive sanitation/hygiene training which should positively impact home environments and (ii) diseases discovered during the project worker screening process would be identified for possible treatment;
- Vector-related diseases in which (i) local contractors/entrepreneurs would obtain design measures for vector control which should beneficially affect other local projects, (ii) existing roads needed for the project will be improved, particularly drainage and the minimization of standing pools of water that provide vector habitats, and (iii) vector-related diseases which are discovered during new project worker screening would be identified for possible treatment;

- Sexual behavior in the local communities may positively change as new project workers would receive sexually transmitted diseases (STD)/HIV information, education and communication during orientation;
- Water and food-borne diseases in which (i) the EPC contractor would provide a potable water supply source to the local community as part of their CSR initiative and (ii) camp solutions providers would obtain guidelines in the areas of water and food sanitation which should have a positive impact on future local projects;
- Accidents and injuries which include (i) driver safety training that would be provided to all project drivers thus positively impacting overall road safety and, (ii) site-specific safety training received during new project worker orientation should positively influence safe work practices at other local projects;
- Chemical exposure-environmental disease through programs which would target potential chemical exposures and the prevention of environmentally related diseases, thereby positively impacting local health education.

The potential adverse impacts to public health as a result of the proposed project include the following:

- Temporary housing impacts including increased incidence of vector-borne diseases, respiratory illnesses, food supply and quality issues, injuries, and solid/liquid waste disposal problems for sanitary and non-sanitary wastes. Vector-borne diseases are represented by malaria, filariasis, yellow and dengue fever which are spread by mosquitos. The above diseases associated with temporary housing could emanate from (a) construction activities (temporary and permanent housing), (b) inadequate drainage within the project's camp area and external to the project (worker housing areas constructed locally), (c) clogged storm drains, (d) improper trash collection and disposal both within the project facilities and external to the project and (e) increased activity at public facilities due to influx of workers/worker families;
- Transportation which includes air emissions from project related construction activities and STIs associated with truck drivers. The role of truckers in spreading STIs is widely acknowledged to be a major contributor to the spread of HIV and other STIs. Accidents and injuries associated with increases in vehicular traffic, workers, and pedestrians on existing and proposed project related roads and road hazards created by construction equipment can enhance the risk of injuries;
- Water and sanitation impacts include spread of vector-borne diseases, storm drainage-related problems and water utilization and availability problems.

The impacts of the project on public health are expected to be local in nature and limited to the study area and its environs.

Table 8-80 : Impact significance on public health - construction and operational phases

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Low	Highly probable
	2	4	4	4
	Result: (-40) Medium negative			
Mitigation measures	• The EPC contractor should provide sanitation guidelines in the contracts for companies who are responsible for the construction			

	and operation of temporary housing and mobile construction camps; • Sanitation guidelines should address toilet facilities, potable water, sewage disposal facilities, laundry, hand washing and bathing facilities; • Sanitation and hygiene training should be incorporated by the EPC contractor into new employee orientation programs. • The O&M company should implement the above programs for the operational phase of the project; • Initial medical screening programs provided through the occupational health program would preclude workers with active respiratory diseases such as tuberculosis from working at the site. • The EPC contractor should undertake health screenings and malaria surveillance programs throughout the project occupational health program; • The O&M company should develop and implement a medical surveillance program for their employees during the operational phase of the project; • The EPC contractor should implement measures that prevent water pooling along construction routes, near water sources, drains, sewers, housing areas, and waste management areas; • The EPC contractor should develop and implement an HIV/AIDS peer educator program throughout the construction phase. The O&M Company should implement the same program during the operational phase.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long-term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

8.11.11 Occupational health and safety

It is anticipated that during the construction phase of the proposed project, there will be about 2978 workers; during the operational phase, there may be up to 500 workers. The occupational health and safety concerns likely to arise include: accidents related to 'working at heights' and operation of machinery, trenches collapse, scaffold collapse, electric shock and arc flash/arc blast, failure to use proper personal protective equipment and repetitive motion injuries, working in confined spaces, occupational illness due to exposure to dust and other hazardous substances such as solvents and petroleum products, fire outbreaks due to electrical faults and mishandling of flammable substances; and fall injuries related to excavated pits electric shocks, being struck by falling or moving objects, vehicle related accidents, accidents associated with lifting equipment,.

Without adequate controls, there will be potential adverse impacts on workers arising from inconsistent management of occupational safety and health.

There may also be industrial hygiene hazards that workers could potentially be exposed to such as chemical handling without the use of proper personal protective equipment or studying the Safety Data Sheet (SDS) for the chemical on safe handling.

The above hazards and risks associated with the construction phase may arise from the lack of a comprehensive written S&H Plan drawn up by the EPC Contractor for the construction phase of the project.

Additionally, the S&H regulator – DOSHS, lacks sufficient resources to regulate workplaces in Lamu County and there is currently no DOSHS office in Lamu. This is a significant S&H related weakness for the proposed coal fired power plant and could potentially lead to the lack of compliance with S&H related laws and regulations by the EPC Contractor during the construction phase which in turn could lead to accidents and incidents that do not get reported.

Table 8-81: Impact assessment and significance: Occupational health and safety concerns - construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Localized	Long term	Very High	Definite
	1	4	10	5
	Result: (-75) High negative			
Mitigation measures	• The EPC Contractor should develop and implement an Occupational Safety and Health (OSH) Management System (that is in line with the occupational Health And Safety Act of 2007 and its subsidiary regulations), OHSAS 18001 and the IFC General EHS Guidelines and will outline OSH procedures including: ✓ Provision of occupational safety and health orientation training to all employees; ✓ Periodic safety inspections; ✓ Employment of health and safety personnel; ✓ Development of a worker safety programme; ✓ Development and implementation of safe systems of work. • The EPC contractor shall comply with all applicable legislative requirements of the OSHA and its subsidiary legislation throughout the construction phase of the project. • The EPC Contractor shall conduct an occupational safety and health risk assessment for construction phase activities in accordance with Section 6(3) of the Occupational Safety and Health Act, 2007 (OSHA) and ISO 31000 and submit the report to the DOSHS for consideration • The EPC Contractor should ensure there is an effective and efficient firefighting system together with an adequately trained Emergency Response Team			

	• The EPC Contractor shall develop and implement a S&H training program for all workers that they employ during the construction phase of the project. The S&H training program will be based on a training needs analysis carried out of the workforce. Internal and external S&H trainers will be engaged for provision of project and site specific S&H training courses in order to prevent accidents and injuries.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Very short	Minor	Probable
	1	1	2	3
	Result: (-12) Low negative			

Table 8-82: Impact assessment and significance: Occupational health and safety concerns - operational phase

Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
Without mitigation	Localized	Long term	Very High	Definite
	1	4	10	5
	Result: (-75) High negative			
Mitigation measures	• The O&M Company shall always ensure full compliance with the OSHA and its subsidiary legislation throughout the lifetime of the project. • The O&M Company shall conduct annual occupational safety and health risk assessment for the operational phase of the project in accordance with Section 6(3) of the OSHA. • Based on the S&H risk assessment findings, the O&M Company shall develop and implement a formal Occupational Health and Safety Management System compliant with the applicable requirements of the Occupational Safety and Health Act, 2007 (OSHA) and its subsidiary legislation, IFC General EHS Guidelines and OHSAS 18001 • The O&M Company will develop and rollout a S&H training program for all employees during the operational phase of the project. The S&H training program will be based on a training needs analysis undertaken for the workers in the power plant. • The O&M Company will enter into mutual aid agreements with first responders in Lamu in the event that emergency assistance is required; • APCL and its contractors should ensure there is an effective and efficient firefighting system together with an adequately trained Emergency Response Team			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Localized	Very short	Low	Improbable

	1	1	4	2
	Result: (-12) Low negative			

8.11.12 Increase in traffic and related incidents

The influx of construction workers will entail an increase in the traffic to and from the project site. Construction activities will potentially increase traffic in the Lamu main land as construction vehicles will have to go to the construction site to deliver construction materials and equipment. The increase in the number of road users is not an impact, but merely a change process. However, the number of construction vehicles, increased public transport vehicles and project-related traffic may change the movement patterns of other road users in such a way that their movement patterns are disrupted, and their safety levels are impacted on.

During the operational phase of the project, increased traffic levels will be caused by public transport vehicles used by workers as well as service contractor vehicles leaving and entering the power plant. Also, better roads graded by APCL will result in an increase in number of motorcycles in the area which record high levels of accidents.

Table 8-83: Impact assessment and significance: Increase in traffic and related incidents - construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Short term	High	Definite
	3	2	8	5
	Result: (-65) High negative			
Mitigation measures	▪ APCL and its contractors should undertake a risk management appraisal of their road transport carriers. This appraisal should be used to select those road transport carriers that can demonstrate compliance with set standards ▪ The EPC Contractor should develop a Traffic management plan for both the construction and operational phase ▪ The EPC Contractor will regularly inspect the access roads conditions and, whenever necessary, repair damages related to construction traffic ▪ Abnormal loads should be timed to avoid times of the year when traffic volumes are likely to be higher e.g. start and end of school holidays, long weekends, etc. ▪ Dust suppression measures must be implemented for heavy vehicles such as wetting of murram roads on a regular basis ▪ Prepare detailed plan for signage around the Construction Areas to facilitate traffic movement, provide directions to various components of the Works, and provide safety advice and warnings. Details regarding maximum permissible vehicular speed on each section of road. All signs shall be in both English and Swahili language				

	▪ APCL and its contractors should advance public awareness programs to identify areas of particular risk and approaches to reduce risk. This is expected to include awareness programs along roads leading to the site to frequent users on traffic dangers. Traffic calming and speed control measures should be instigated in consultation with the relevant authorities			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short term	Low	Probable
	2	2	4	3
	Result: (-24) Low negative			

Table 8-84: Impact assessment and significance: Increase in traffic and related incidents - operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Regional	Long term	High	Definite
	3	4	8	5
	Result: (-75) High negative			
Mitigation measures	▪ APCL and its contractors should undertake a risk management appraisal of their road transport carriers. This appraisal should be used to select those road transport carriers that can demonstrate compliance with set standards ▪ Develop a Traffic management plan for both the construction and operational phase ▪ Abnormal loads should be timed to avoid times of the year when traffic volumes are likely to be higher e.g. start and end of school holidays, long weekends, etc. ▪ Dust suppression measures must be implemented for heavy vehicles such as wetting of murram roads on a regular basis ▪ Prepare detailed plan for signage around the power plant to facilitate traffic movement, provide directions and provide safety advice and warnings. Details regarding maximum permissible vehicular speed on each section of road. All signs should be in both English and Swahili language ▪ APCL and its contractors should advance public awareness programs to identify areas of particular risk and approaches to reduce risk. This is expected to include awareness programs along roads leading to the site to frequent users on traffic dangers. Traffic calming and speed control measures should be instigated in consultation with the relevant authorities			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Regional	Long term	Low	Probable

	3	4	4	3
	Result: (-33) Medium negative			

8.11.13 Security related impacts

The developer has engaged the services of a specialist consultancy for the security impact assessment of the proposed project. Due to its nature, it cannot be disclosed as part of the ESIA. Subsequently, the potential impacts discussed below are associated with the general security to be provided as part of the project.

Not only do health issues impact on communities, but the physical safety of communities can also be endangered as a result of the influx of job seekers and construction workers (e.g. potential increase in crime). There is perception that crime increases in an area the moment that construction workers arrive on site. Because of this perception, occurrences of crime during the time of the project are likely to be ascribed to the construction workers. This has a mental health impact, such as fear. However, it should be noted that in most instances it is not the actual construction workers who engage in criminal activities but more likely job seekers who loiter at the site in search of employment.

Table 8-85: Impact significance on security-construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	National	Long-term	Moderate	Probable
	4	4	6	3
	Result: (-42) Medium-negative			
Mitigation measures	**Comments/Mitigation:** • Construction workers should be clearly identifiable. Overalls should have the logo of the EPC contractor on it and/or construction workers should wear identification cards; • The construction site and construction camp should be fenced and access should be controlled by means of a security access point • Loitering of outsiders at either the construction site or at the construction village should not be allowed. Loiterers at the site or the camp should be removed in cooperation with the local National Police Service; • Unsocial activities such as consumption or illegal selling of alcohol, drug utilization or selling and prostitution on site should be prohibited			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	National	Long-term	Low	Improbable
	4	4	4	2
	Result: (-24) Low negative			

8.12 Impacts on archaeological artefacts

The surface soil of Kwasasi and its environs is clay mixed with beach sands. The vegetation cover is thick bush land and woodland. The whole of this project area was searched for any archaeological remains which would include pottery, archaeological bones, graves, stone and iron objects.

Although the above factors hampered the possibility of finding any in situ or surface archaeological materials, the Kwasasi residents reported having found potsherds below the surface when they were constructing their houses. The residents of Kwasasi led the specialists to an archaeological site which they referred to as a shrine at Ngini area which is a walking distance from the project site. The shrine had been in use by the residents until recently. On the archaeological site stands a *mwongo* tree which makes the residents to believe that their ancestors were buried here. The site contained a large collection of both local and imported pottery ware which had been dated elsewhere to between 7th and 16th Centuries AD.

The pottery includes archaeological Tana ware pottery which is known to occur all along the East African Coast. On the Kenyan coast, Tana ware is found along the Tana River up to Garissa area. The major Kenyan coastal sites, which have contributed Tana ware, are Shanga and Manda on the Lamu archipelago and Ungwana on the lower Tana River basin.

On a well site west of the project location, parts of a collapsed well were found still intact protruding from the edge of a cliff. More than half of it had already collapsed. The residents claimed out that the well was inside a mosque whose remains were still visible on the sea shore after several years of erosion.

About 3 meters away from the collapsed well, pottery could be seen eroding from a nearby ashy level. The composition of the pottery scatter included both local and imported wares.

Given that there have been moveable archaeological finds during the filed surveys, there is a potential that there could be other sites either within the project site or its environs.

Table 8-86: Impact significance for destruction of archaeological movable materials-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Permanent	Very high	Probable
	2	5	10	3
	Result: (-51) Medium-negative			
Mitigation measures	**Comments/Mitigation:** • Amu Power should develop and implement a chance finds procedure which must be complied with by all contractors engaged at the coal power plant site; • Amu Power must incorporate a chance finds procedure into their contract documents with their EPC contractor; • In the event of archaeological materials appearing during any construction related activities, work should stop immediately and a qualified National Museums of Kenya (NMK) scientist engaged to advise on the way forward;			

	• Due to the sensitivity of this region, Amu Power should engage an archaeologist(s) and cultural heritage expert(s) to offer watching brief throughout the construction phase.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Permanent	Minor	Improbable
	2	5	2	2
	Result: (-18) Low negative			

Table 8-87: Impact significance for destruction of archaeological built in heritage-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Permanent	Very high	Definite
	2	5	10	3
	Result: (-51) Medium negative			
Mitigation measures	**Comments/Mitigation:** • A watching brief must be put in place to cover all excavation activities. An archaeologist should be present at all times since the probability of finding buried ruins is high. • Amu Power should develop and implement a chance finds procedure which must be complied with by all their contractors; • Amu Power's must incorporate the chance finds procedure into their contract documents with their nominated contractors who will undertake construction works in Kwasasi; • In the event of archaeological materials appearing during any construction related activities, work should stop immediately and a qualified NMK scientist engaged to advise on the way forward;			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Permanent	Low	Improbable
	2	5	4	2
	Result: (-22) Low negative			

8.13 Landscape and visual impacts

During the construction period, the activities on site have the potential to impact upon the general character of the local area, which is currently undeveloped land. During the construction stage, when foundation work and excavation works commence, the area will undergo changes as trucks, drilling rigs and other machinery are transported to the site.

Stockpiles and storage yards, if not adequately managed, can be considered to be a detriment to the visual impact during the proposed construction period. Given the relative isolation and nature of the site, however, this is considered to be of minor negative importance.

If domestic and construction waste is not adequately managed and stored properly on the site, this has the potential to be of minor to moderate negative significance to the visual impact of the site and adjacent areas.

During the construction of the marine works, machinery such as dredgers, cranes etc. will be required for the intake/outfall structures. This is likely to obstruct views towards Pate Island.

Considering the absence of major sensitive receptors in the proximity of the site, impacts of a minor significance are expected.

The movement of soil around the site and general vehicle movements together with ground preparation works may result in a localized increase in visible pollution, comprising vehicle/generator exhausts and/or dust. This can be considered to be a visual impact of minor to moderate negative significance.

The plant design calls for the construction and operation of a stack and buildings, which will reach up to a maximum height of 210m. These will be visible from several kilometers away from the site. As required by Kenya Civil Aviation Authority (KCAA) laws and regulations, the stack will be colored in accordance with their approved color scheme and have flashing lights operating at all times.

Table 8-88: Impact significance for poor aesthetics-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Moderate	Highly probable
	2	4	6	4
	Result: (-48) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The EPC contractor should consider proper and efficient sequencing of construction to minimize vehicle movements and time of deployment • All vehicles, generators and machinery on site, will be required to be regularly maintained by the EPC contractor and any other sub-contractors on site, with records of the work undertaken and scheduled. Any vehicles, which come to site, will be inspected prior to entry to the site to ensure that visible emissions are not excessive. • Daily inspections will be required to determine if any vehicles, generators or equipment are emitting excessive smoke, with any non-complying machinery being taken out of commission to be repaired. • During periods of high wind activity, excavation works and ground moving equipment will be required to be minimized by the EPC as far as possible. Stockpiles of materials may also need to be sprayed with water in order to minimize the airborne particles and which should also be included within the dust suppression strategy followed during the construction period.			

	• During the construction period, the EPC contractor will be required to ensure that the site has proper housekeeping practices, in order for stockpiles and storage yards to be as well maintained as possible. • Waste generated on site, as well as being disposed of within designated areas on site, will be required to be transported by NEMA licensed transporters offsite and to registered landfills or equivalent. Records and receipts of such waste will also be required to be kept by all subcontractors and the EPC contractor. • The temporary worker accommodation and site facilities will be required to be adequately designed in accordance with the **IFC/EBRD Worker Accommodation Standards** in order to blend in with the surrounding environment, with landscaping features where appropriate also incorporated within the design. In addition, sanitary facilities should be efficiently designed for appropriate storage capacity and collection in addition to preventing any onsite contamination.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Long term	Low	Improbable
	2	4	4	2
	Result: (-20) Low negative			

Table 8-89: Impact significance for landscape and visual-operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Long term	Moderate	Probable
	2	4	6	3
	Result: (-36) Medium negative			
Mitigation measures	**Comments/Mitigation:** • The permanent worker accommodation and site facilities will be required to be adequately designed in accordance with good architectural practices in order to blend in with the surrounding environment, with landscaping features where appropriate also incorporated within the design. • No mitigation measures are available to reduce the visual impact of the stack proposed for the plant, especially given the regulatory requirement of lights and coloration • In order to provide a pleasant working environment on the site, natural vegetation on the site will be allowed to grow. Areas along the fence-line are likely to be kept clear for security purposes. • The plant and grounds should be well maintained at all times. • All buildings should be painted in a color appropriate to the surrounding area.			

Mitigation Status	Extent	Duration	Magnitude	Probability
With mitigation	Study area	Long term	Minor	Improbable
	2	4	2	2
	Result: (-16) Low negative			

8.14 Cultural Heritage

8.14.1 Impacts on graves

The behavior of planting *mwongo* trees on graves is customary to the Boni people. The tree therefore serves as a clear indicator of a grave; there are a few *mwongo* trees sighted within the project area and beyond. The Boni people who are hunter gatherers used the land in Kwasasi long before the farming activities began. As such, they may have buried their dead here although they could not point to the graves since they currently live about 1 hour drive from the project area having been pushed there by the farmers who come from Pate island and elsewhere.

There are no shrines within the project area as confirmed by the local guides and field surveys. Given below is the significance for destruction of graves on the project site.

Table 8-90: Impact significance for destruction of graves-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Permanent	Very high	Improbable
	2	5	10	2
	Result: (-34) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Amu Power and its service contractors should undertake construction works carefully especially around the areas with *mwongo* trees for any visible signs of human bones. • Where bones appear in the course of any construction works on site, work should stop and a qualified scientist from the NMK should be engaged to identify and advise the contractor on the way forward • In the event of such an occurrence, the EPC contractor must engage the Kwasasi Elders to undertake the necessary rituals to relocate the human bones and accord a proper burial at a new location.			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Permanent	Low	Highly improbable
	2	5	4	1
	Result: (-11) Low negative			

8.14.2 Impacts on cultural landscape

Table 8-91: Impact significance for loss of cultural landscape and sense of place-construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Permanent	High	Probable
	2	5	8	3
	Result: (-45) Medium negative			
Mitigation measures	Comments/Mitigation: • The design of the power plant should consider the height and density of the planed buildings to harmonize the visual impact on cultural landscape • Amu power and its service contractors should ensure that buildings are designed in such a way that the architecture resembles Swahili houses and painted a similar colour in order to blend in with the surroundings • Amu Power and its service contractors should build vegetation buffer zones, including planting of trees within and in-between various service contractors work areas • Amu Power and its service contractors should only cut down vegetation and trees where their respective footprints are planned			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Low	Improbable
	2	5	4	2
	Result: (-22) Low negative			

8.14.3 Loss of plants of cultural value

Table 8-92: Impact significance for loss of medicinal and wild foods plants-construction phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Permanent	Low	Probable
	2	5	4	3
	Result: (-33) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Wherever medicinal trees and wild fruit plants are to be cut down within the project area, the EPC contractor should offset such trees and plants outside the project area.			

	• Amu power should support the existing health facilities and strive to empower the residents to visit for medical solutions			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	1
	Result: (-6) Low negative			

8.14.4 Impacts associated with WHS OUV

Table 8-93: Impact significance for increased population density and pressure on the infrastructure at the WHS-construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Low	Highly probable
	2	2	4	4
	Result: (-32) Medium negative			
Mitigation measures	**Comments/Mitigation:** • Amu Power to implement their drug and alcohol policy at the coal power plant • Amu Power should support activities in Lamu County that promote cultural heritage such as the Maulidi festival, Lamu Cultural Festival, etc. • Amu Power should sponsor competitions in calligraphy and exhibitions organized by the NMK and civil society groups			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			

Table 8-94: Impact significance for changes in population character on the WHS-construction and operational phase

Mitigation Status	Extent	Duration	Magnitude	Probability
Without mitigation	Study area	Short	Low	Probable
	2	2	4	3
	Result: (-24) Low negative			
Mitigation measures	**Comments/Mitigation:**			

	• Amu Power should build a flexible program that allows time for its workers to participate in the cultural festivals • Amu Power should allow time for Muslim faithful to attend prayers and other religious activities as required by Islamic faith in order to maintain the religious component of the UOV • Amu Power should encourage preparation and serving of local traditional dishes within its restaurants • Amu Power should have an induction program that introduces its workers to the traditional cultures of Lamu and where necessary promote the Swahili learning institutions within the Island • Amu power should impose a dress code to its workers (outside the PPE) and people doing businesses around the coal plant to maintain the cultural values and, which is not offensive to Lamu residents			
Mitigation Status	**Extent**	**Duration**	**Magnitude**	**Probability**
With mitigation	Study area	Short	Minor	Improbable
	2	2	2	2
	Result: (-12) Low negative			