ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF 300 MW GAS POWER PLANT AT KISIWA VILLAGE, NAUMBU WARD IN MTWARA DISTRICT, MTWARA REGION

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Submission Date:	**31 March 2020**

EXECUTIVE SUMMARY

Title and Location of the Project

300MW Combined Cycle Gas Turbine (CCGT) power plant at Kisiwa Village, Naumbu Ward, Mtwara District, Mtwara Region in Tanzania

Project Proponent

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Introduction

Tanzania's economic growth triggered by changes in economic policies has prompted the demand for commercial energy in the country in particular electricity power. In order to meet increasing energy demand and maximize recently discovered offshore gas resources in the country, the Government of Tanzania through the Tanzania Electric Supply Company Ltd (TANESCO) is planning to install a 300MW Combined Cycle Gas Turbine (CCGT) power plant (the "Project") in Kisiwa village in Mtwara District, Mtwara Region in Tanzania. The project is expected to increase availability and reliability of electricity supply through the addition of new power generation to the national grid. The Project will be funded by the Japan International Cooperation Agency (JICA) and will be owned and operated by TANESCO.

The ESIA study has been undertaken in accordance with the requirements of the Environmental Management Act, Cap 191 of 2004 and the Environmental Impact Assessment and Audit Regulations of 2005, which requires mandatory EIA to all energy development projects. This Environmental and Social Impact Assessment (ESIA) report presents an assessment of the potential environmental and social impacts associated with the proposed Project. This report has been prepared for TANESCO and presents the objectives, methodology and outcomes of the ESIA study.

Project Description

The Project is located in Kisiwa Village in Mtwara District in Mtwara Region, 400km south of Dar es Salam, Tanzania. It will be located a part of the shore terrace of the Mambi River and in front of Kisiwa Bay (Sudi Creek). The Project Site will have an area of approximately 160 ha, which will be developed into a power complex. The proposed Mtwara power plant site will cover approximately 37ha, which is a quarter of the Project Site. The area is allocated for power plant development according to the Mtwara Master Plan.

The proposed configuration of the power plant is a Combined Cycle Gas Turbines (CCGT) Power Plant with 300 MW generation capacity. The plant configuration consist of one or two power blocks each consisting of two gas turbine generators (GTG x 2), two heat recovery steam generators (HRSG x 2) and one steam turbine generator (STG x1). The assumed capacity factor is 85.9%. The power plant is expected to have a plant service life time of 25 years is planned to be operated for 24 hours a day throughout a year.

The operation of gas turbines generates power and steam which is collected by heat recovery system. The steam produced in heat recovery steam generators is led to a steam turbine which generate additional power. The power generated from gas turbine generators and steam turbine generators will be stepped up from the around 11 KV to 400kV by generator main transformers and connected to an adjacent 400kV substation, located within the Project site.

The power plant will use natural gas as fuel. This will be supplied by the Tanzania Petroleum Development Corporation (TPDC) through a gas pipeline that connects to a gas valve station of the natural gas pipeline from Mnazi Bay to Dar es Salaam. The 16km gas pipeline that would connect to the Project will be developed exclusively for the Project. TPDC will be responsible for the new gas pipeline construction, management, operation and maintenance.

The Project would require approximately 300m^3/day of water supply. The proposed process water supply will be provided by the Mtwara Urban Water Supply and Sewerage Authority (MTUWASA). MTUWASA confirms that the current and planned wells in the area will be more than sufficient to supply Project requirements and water demand in Kisiwa village. Cooling water will be drawn from sea through a water intake facility. The power plant will have an onsite wastewater treatment facility. Treated wastewater will be discharged to Sudi Creek.

Existing roads and tracks will be used for material transport. Besides upgrading and widening of existing roads for this purpose by Tanzania Rural and Urban Roads Agency (TARURA), a new access road, (approximately 700m) that connects the Project Site to the Kisiwa/Mgao Road, needs to be constructed.

Environmental and Social Baseline Condition

The Project Site is located beside Sudi Creek. It extends to the seashore, with a small area facing the seashore line (the “nose”). The nose area is currently being utilized as a mooring point of fishing boats. The open area behind the nose area has a combination of flat lowland and some highlands (up to 30m in elevation). In lowland areas, pastures, salt fields, and limited houses can be observed.

Terrestrial vegetation in the Project Site consists mainly of coastal thickets and mangrove vegetation. Although these are in degraded state, two species are classified as vulnerable under IUCN Red List. Mangrove forests along the shore, are protected under Tanzanian law. The Project Site is not located within or close to protected areas and ecologically sensitive areas such nesting site for turtles or bird important areas.

The marine environment within Sudi Creek and outside it (mouth portion) vary significantly. Fishes are found within Sudi Creek but the sea bottom is generally devoid of visible living fauna/flora (e.g. live corals, seaweeds), probably due to low dissolved oxygen levels and high turbidity of the water in the area. The sea bottom is dominated by very coarse sand, enriched with pebbles and shell fragments. On the contrary, a thriving marine environment with occasional sightings of some marine mammals, have been observed outside the mouth of Sudi Creek.

The villages close to the Project Site are Kisiwa Village and Namgogoli Village, which are located at approximately 2-4km away. Majority of the villagers are involved in multiple economic activities, with agriculture as the primary economic activity. Although fishing is a common activity along the coast, few villagers are engaged in such activities.

A family graveyard, consisting of over 50 graves, is located in between the nose and the Project Site. The relatives desire not to relocate the family graveyard. Also, certain parts of the Project Site used to be an archaeological excavation and study site, where Rich Iron Age pottery have been discovered. However, this area is not designated as a cultural heritage site under the Antiquities Act of 1979.

Project stakeholders and their involvement in the EIA process

At the beginning of the ESIA process, stakeholder identification was conducted to determine exactly who the stakeholders are and understand their priorities and objectives in relation to the proposed project. Stakeholders identified include relevant government agencies (central, regional and local levels), community groups and organizations, non-governmental organizations (NGOs) and academic institutions, and international financing agencies.

Consultation activities were undertaken by approaching the different levels of government down to villages. Meetings with relevant government agencies (e.g. Tanzania Forest Service, Marine Parks, Mtwara Port Authority), academic institutions (e.g. University of Dar es Salaam), and NGOs (e.g. Volunteer for Youth in Health and Development, Mtwara Society Against Poverty) were also conducted. Aside from these, focus group discussions were also conducted, targeting village elders and women's group. The main objectives of stakeholder engagement activities include introducing the project and its potential impacts, and gathering concerns of the different stakeholder groups.

To initiate the consultation process, prior information about the Project were shared through letters to the Regional Administrative offices of Mtwara region. The Regional Administrative Secretary allowed the consultants to proceed with consultation in Mtwara District Council. From Mtwara district, letters were prepared and sent to the wards and village leaders in Kisiwa and Namgogoli villages. Wards Executive officer in collaboration with village leaders informed the villagers to be prepared and attend the consultation meetings with the consultants.

The first phase of consultations were undertaken during the full ESIA study in March 2018, during the scoping stage. The second phase of consultation was conducted during the full ESIA study from 8th – 17th August, 2018.

As a result of several engagement and consultation activities, it has been identified that there is overall support for the Project from various stakeholders. Different groups, particularly local communities, expressed expectations such as employment opportunities, access to stable electricity supply, and potential improvement in social services. However, a number of issues and concerns were raised. In general, stakeholders highlighted the need for the project developer to properly implement compensation for land acquisition, pollution control and mitigation measures and to support communities that will be affected by the Project. The main concerns raised from stakeholders include following:

- Natural disasters
- Environmental pollution
- Thermal discharge
- Impact on biodiversity
- Land acquisition and compensation
- Livelihood loss
- Migration and influx of workers

Project Alternatives

The main factors considered in the selection of alternatives include economic constraints, location, environmental and social impacts, and sensitivity of area.

“No Project” Alternative

The proposed project is intended to generate 300MW that will be injected into the nation grid to provide electricity throughout Tanzania. Implementation of the no project alternative will deny this amount of power to the National grid which is required to supply the expanding power demand as forecasted by the Power system Master plan 2016. Therefore, this alternative is not viable and will not be considered since the country need power to supply emerging industries as the country aims to transition to a middle income country by 2030.

Location alternative

In terms of power plant location, two alternative sites for the proposed the Mtwara power plant, have been studied. These are the Mikindani site and the Project Site. Kisiwa site is more advantageous in terms of land use allocation, wider available area, less resettlement and distance from settlements (air and noise sensitive receptors).

Technology alternative

In terms of cooling technology alternatives, seawater cooling (once-through cooling) and air cooled condenser (ACC) were considered. Seawater cooling is preferred due to higher process efficiency, less fuel requirements, and less emissions.

Impact Assessment

Potential environmental and social impacts that will be caused by the Project during pre-construction, construction and operation phases, have been identified and assessed based on impact nature, type, duration, extent, scale, frequency, magnitude, and receptor sensitivity. A summary of the potential project impacts and the corresponding significance rating is listed in the Table below.

The environmental and social concerns related to the proposed Mtwara Power Plant have been identified based on the JICA environmental and social consideration guidelines (April 2010), relevant environmental legislation in Tanzania, and other applicable environmental and social conditions.

For each impact item, potential impacts in each stage of development (in planning and construction, and in the operation phase) are divided into negative impacts (−) and positive impacts (+), and the degree of impacts is classified as shown below.

A (+/ -): Major positive / negative impacts are projected
B (+/ -): A certain degree of positive / negative impacts is projected
C: Impacts are unclear (further investigation is needed. Impacts may become apparent as the survey progresses)
D: No impacts are projected

As can be observed, impacts during construction phase are expected to be more significant compared to during operation phase. During construction, potential impacts on water resources, marine ecology, wastes, community health and safety, and land acquisition are considered significant. During operation phase, wastes, impact on marine species (due to wastewater discharge) and greenhouse gas emissions are the key considerations. A summary of the potential project impacts and the corresponding significance rating is listed in the Table below.

Summary of Potential Project Impacts

Environmental/Social Item	Construction	Operation
Air Quality	Negligible	Negligible
Noise	Negligible	Negligible
Soil	Minor	Minor
Water Resources	Minor-Moderate	Minor
Terrestrial Ecology	Moderate	Negligible
Marine Ecology	Minor	Minor
Wastes	Minor	Minor
GHG Emission		Moderate
Employment & economy	Positive	Positive
Community Health, Security and Safety	Minor	Negligible
Occupational Health and Safety	Moderate	Minor

Environmental/Social Item	Construction	Operation
Community Infrastructure & Public Services	Moderate	Minor
Cultural Heritage	Negligible	-
Land acquisition & resettlement	Moderate	-

Environmental and Social Management Plan

The Environmental and Social Management Plan (ESMP) for the Project aims to avoid, reduce, mitigate, or compensate for adverse environmental and social impacts/risks and to propose enhancement measures. Potential impacts may be eliminated or reduced through implementation of appropriate mitigation measures. The primary role and responsibility for the implementation of the ESMP lies on TANESCO and its contractors, in collaboration with various stakeholders.

Mitigation planning involves undertaking activities during the design, implementation and operation phases of a project. Funds need to be set aside to ensure implementation of planned actions. Suggested mitigation actions include (but are not limited to) the following:

- Ensure compliance with air emissions, noise, vibration, and effluent standards set by the government
- Implement measures to reduce dust generation (e.g. watering, covering of materials)
- Install an onsite wastewater treatment facility
- Ensure mechanisms in place to address accidental spills/leakages
- Develop emergency response procedures
- Conduct trainings for employees regarding health and safety, emergency response, waste management, chemical handling/storage, etc.
- Maintain equipment and vehicles regularly
- Develop Waste Management Plan, Emergency Management Plan
- Implement proper waste management (segregation, storage, and disposal)
- Provide appropriate amenities at workers' camp and power plant site
- Establish a grievance redress mechanism
- Limit mangrove and vegetation clearing to designated areas
- Implement landscaping and revegetation after completion of construction
- Develop a corporate social responsibility plan (social investment)
- Explore opportunities to work with local stakeholders
- Install a continuous emission monitoring system (CEMS) to monitor NOx concentration
- Conduct annual pollutant release inventory to monitor GHG emissions.
- Develop and implement a Resettlement Policy Framework that is compliant with laws related to land acquisition and resettlement
- Provide an income restoration program for affected population
- Obtain permits prior to clearing of mangrove areas.

Environmental and Social Monitoring Plan

In order to ensure proper implementation of the ESMP, it is necessary to monitor relevant biophysical and social environmental components of items identified in the ESMP. An environmental and social monitoring plan identifying biophysical and social indicators/metrics to be monitored, location, frequency, responsible entity and fund source, has been developed.

During construction, items that will be monitored include:

- General compliance
- Dust generation
- Noise
- Storm/rainwater runoff
- Waste management
- Soil erosion
- Loss of mangrove areas
- Resettlement issues
- Complaints
- Accidents/incidents

During operation, items that will be monitored include:

- General compliance
- Seawater quality (at discharge point)
- Stack emissions
- Waste management
- Complaints
- Accidents/incidents

Cost and Benefit Analysis

The implementation of the project will involve large amount of financial resources. However, in the absence of the project, the current power shortage and supply problem are expected to continue and this can significantly affect economic performance of industries, individuals, and the country in general.

The project will generate electricity to the national grid for distribution to industries, companies and households in the country. This power source will assist TANESCO to meet current and future electricity demands in the country. Moreover, the project is expected to benefit the people of Tanzania through reduced airborne pollution and greenhouse gas (GHG) emissions, compared to the alternative power generation options.

Therefore, the benefits to be realized from the proposed Mtwara power plant project are expected to outweigh environmental and social costs.

Decommissioning

Activities to be done during decommissioning include, demolition of power plant and hauling rubble and waste materials from the demolition. Several impacts (negative and positive) are likely to occur as result of the decommissioning.

TANESCO will prepare a detailed decommissioning plan to ensure that environmental and social impacts are minimized in order to comply with environmental legislations and policy requirements. In decommissioning phase a team of experts with a representative from the relevant national, regional and local government bodies will be formed to monitor the implementation of the decommissioning plan.

Potential impacts which need to be considered during decommissioning include the following:

- Soil erosion
- Storm water runoff and seawater quality
- Noise and vibration
- Waste generation
- Loss of electricity generation
- Loss of employment

Conclusion

Potential environmental and social impacts that will be caused by the Project during pre-construction, construction and operation phases, have been identified and assessed. With the proper implementation of the Environmental and Social Management and Monitoring Plan, together with some embedded control measures in the Project design, it can be ascertained that the Project is unlikely to cause any significant environmental and social impacts since many of the impacts are localised, short-term and/or temporary in nature.

Overall, the benefits to be realized from the proposed Mtwara power plant project are expected to outweigh environmental and social costs. The Project presents opportunities for employment and improvement of the local economy. More importantly, it would contribute to increased improved stability of the national power supply and distribution.

SIGNED DECLARATION OF EXPERTS

We hereby certify that the particulars given to this report are correct and true to the best of our knowledge.

S/N	Name	Title	Roles in the EIA team Area of expertise	Signature
1	Hussein Sosovele	Professor, IRA	Team Leader	
2	Raphael Mwalyosi	Professor, IRA	Ecologist Expert	
3	Florian Silangwa	PhD, IRA	Socio-economics Resettlement Expert	
4	George Sangu	PhD, Department of Botany	Plant Ecologist	
5	Edwinus Lyaya	PhD, Department of Archaeology and History	Archaeologist	
6	Alex Chambi	BSc, EARG	Land Use	
7	Anselm Silayo	MSc, EARG	Natural Resource Management	

ACKNOWLEDGEMENTS

TANESCO would like to thank all key players for review and revise the EIA and for all other continuous supports throughout the entire process to complete EIA.

We also would like to thank the EIA team for their cooperation and contribution to complete this report. Moreover, the greatest contribution was made by the local stakeholders including local authorities, leaders and people living around the proposed project site, who provided prompt assistance, shared their concerns and expectations and actively participated in the public consultations.

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LIST OF ACRONYMS AND ABBREVIATIONS

A/C	Air conditioning
AC	Alternating Current
AIDS	Acquired Immune Deficiency Syndrome
ASR	Air Sensitive Receptor
BDL	Below detection limit
BH	Borehole
BMU	Beach Management Unit
BOD	Biological Oxygen Demand
Bscf	Billion standard cubic feet
CBD	Convention on Biological Diversity
CBO	Community-based Organization
CEMS	Continuous Emissions Monitoring System
CI	Chief Inspector
CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora
COD	Chemical Oxygen Demand
CWP	Cooling Water Pump
DADP	District Agricultural Development Plan
dB	Decibel
DC	Direct Current
DO	Dissolved oxygen
EDG	Emergency Diesel Generator
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMDC	Environmental Management Divisional Standards Committee
EMP	Environmental Management Plan
EPC	Engineering, Procurement, and Construction
ESI	Electricity Supply Industry
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWURA	Energy and Water Utilities Regulatory Authority
FGD	Focus Group Discussion
FHH	Female Headed Households
GCP	Ground Control Points
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIS	Geographic Information System
GLC	Ground Level Concentration
GTCC	Gas Turbine Combined Cycle
GTG	Gas Turbine Generator
GTW	Gas Turbine World
H	Height
HH	Household
HIV	Human Immunodeficiency Virus

HRSG	Heat Recovery Steam Generator
HSE	Health, Safety, and Environmental
Hz	Hertz
IBA	Important Bird Area
IFC	International Finance Corporation
ILFS	Integrated Labour Force Survey
INDCs	Intended Nationally Determined Contributions
IPD	In patient Department
IUCN	International Union for the Conservation of Nature
JICA	Japan International Cooperation Agency
KBA	Key Biodiversity Area
kPa	kilopascal
kV	kilovolt
MALFD	Ministry of Agriculture, Livestock, and Fisheries Development
MBREMP	Mnazi Bay Ruvuma Estuary Marine Park
MJ	Megajoule
MMscf	Million standard cubic feet
MNRT	Ministry of Natural Resources and Tourism
MoE	Ministry of Energy
MRD	Mtwara Rural District
MSOAPO	Mtwara Society Against Poverty
MTUWASA	Mtwara Urban Water Supply and Sewerage Authority
MW	Megawatt
NEMC	National Environment Management Council
NESC	National Environmental Standards Compendium
NFPA	National Fire Protection Association
NGO	Non-Governmental Organization
NLUPC	National Land Use Planning Commission
NOx	Nitrogen Oxides
NSGRP	National Strategy for Growth and Reduction of Poverty
NSR	Noise Sensitive Receptor
OCHA	Office for the Coordination of Humanitarian Affairs
OP	Operational Policy
OPD	Outpatient Department
OSHA	Occupation Health and Safety Act
PAP	Project-Affected Person
PM	Particulate matter
PME	Powered Mechanical Equipment
PPE	Personal protective equipment
ppm	Parts per million
RAS	Regional Secretary
RSCB	Ruvuma and Southern Coast Basin
SDGs	Sustainable Development Goals
SIDP	Sustainable Industrial Development Policy
SME	Small and Medium Enterprise
SMEDP	Small and Medium Enterprises Development Policy
SOP	Standard Operation Procedure
SPMT	Self-Propelled Modular Transporter

SPT	Standard Penetration Test
STD	Sexually Transmitted Disease
STG	Steam Turbine Generator
SWL	Seawater Level
TANESCO	Tanzania Electric Supply Company Ltd
TANROADS	Tanzania National Roads Agency
TARURA	Tanzania Rural and Urban Road Agency
TFS	Tanzania Forest Service Agency
TMA	Tanzania Meteorological Agency
TPA	Tanzania Ports Authority
TPDC	Tanzania Petroleum Development Corporation
TSS	Total Suspended Solid
TWA	Time Weighted Average
TZS	Tanzanian Standards
UPS	Uninterruptible Power System
URT	United Republic of Tanzania
VLFR	Village Land Forest Reserve
VOYOHEDE	Volunteer for Youth in Health and Development
W	Width
WHO	World Health Organization
ZECO	Zanzibar Electricity Corporation

1 INTRODUCTION

1.1 PURPOSE OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

This Environmental and Social Impact Assessment (ESIA) report presents an assessment of the potential environmental and social impacts associated with the proposed 300MW thermal power plant at Kisiwa village in Mtwara District in Mtwara Region in Tanzania. This report has been prepared for Tanzania Electric Supply Company Limited (hereinafter referred to as "TANESCO") and presents the objectives, methodology and outcomes of the ESIA study.

Environmental Impact Assessment (EIA) is a formal process for predicting consequences of proposed development projects. The consequences may relate to bio-physical; biological/ecological; socio-economic and landscape/aesthetic environment. EIA concentrates on problems, conflicts and natural resource constraints that could affect the viability of a proposed project. It also examines how the project might cause harm to people, their property or their livelihoods. The EIA identifies measures to minimize the problems and outlines ways to improve the project's suitability.
The aim of an EIA is therefore to ensure that potential problems are foreseen and addressed at an early stage in the project's planning and design stage. In summary, an ESIA:

- Predicts and evaluates the likely environmental, socio-economic and cultural impacts of projects,
- Finds ways to reduce unacceptable impacts and shape the project so that it is socially acceptable, economically viable and suits the local environment

1.2 BACKGROUND AND OVERVIEW

Tanzania has been experiencing rapid economic growth in the recent years. The country's average annual GDP growth rate between 2000 and 2015 was 6.6% and this is projected to increase (up to 8%) in the coming 10 years. To achieve this expected economic growth, the government plans to industrialize the economy and compliment other sectors of growth in order to transition to a middle income country by 2025. To fulfil this plan and vision, a reliable power source is imperative.

The Ministry of Energy (MoE) estimates that electricity accounts for approximately 1.2% of the primary energy used (URT, 2015). Lack of reliable electricity is currently a major production cost component as any slight increase of tariff has been a subject to soaring of prices of goods and services up. This electricity unreliability needs to be addressed promptly in order to meet the anticipated demand triggered by industrialization policy of the current government.

According to the Five Year Development Plan-II (2016/17 to 2020/21) prepared by the Government of Tanzania, power system development is one of the top priorities of the government. At present, Tanzania lacks reliable energy source. The country's current installed capacity (1,468MW, September 2017) relies on hydro power plants (39%) and thermal power plants (61%). Blackouts are commonly experienced during peak period particularly in dry season, when hydropower outputs are reduced. With the increase of population and deteriorating generation plants and transmission lines, power outages are expected to increase unless the generation is increased.

Gas-fired power plants are positioned as major new power sources. It is estimated that approximately 45 billion cubic meters of proven natural gas reserves can be found in Tanzania. Recent major offshore gas discoveries in Tanzania have generated high expectations about the opportunities that might open up both for the domestic economy and for supply to international markets.

To capitalize natural gas resources and increase thermal power generation in the country, the Government of Tanzania through the TANESCO is planning to install a 300MW gas-fired thermal plant at Kisiwa village in Mtwara. Electricity generated by the power plant will be distributed via an electricity transmission system composed of two substations and 400kV transmission line that would connect to the national grid at the Somanga substation. The proposed power plant and transmission system (the "Project") are expected to assist TANESCO in meeting current and future electricity demands in the country. The Project will be funded by the Japan International Cooperation Agency (JICA).

The proposed project will be owned and operated by TANESCO, which is a public limited company under the Ministry of Energy. TANESCO owns most of the electricity generating, transmitting and distributing facilities in Tanzania Mainland. It holds licences for electricity generation, supply, transmission, distribution, and cross border trading.

1.3 PROJECT JUSTIFICATION

Augment power supply in Tanzania

The current power generation in Tanzania is about 1,537MW (MEM, 2017). At the expected current trend in average annual GDP growth of between 6 and 8 percent for the coming 10 years, the expected national demand cannot be achieved. To meet the growing demand for electricity anticipated from industrialization efforts and development of massive infrastructures like standard gauge railway that require high energy inputs, the Government is planning to increase Tanzania's generation capacity to 5,000MW by 2020 and 10,000 MW in 2025. To achieve this generation goal, the Government of Tanzania has embarked on reforming the Electricity Supply Industry (ESI) mainly by attracting private capital in the industry and seeking supports from international communities to develop power generation plants from natural gas hydro, coal and wind.

Increase energy security and grid connectivity

As of now, Mtwara and Lindi region are the isolated grids from the national grid, hence the current capacity of power is insufficient to supply for the future development projected in these regions. This Mtwara GTCC and the transmission line project can provide sufficient power supply and stabilize the national electricity.

Stimulate local economic development

The development of Mtwara GTCC power plant may have the potential to stimulate economic development in the Southern region by providing reliable electricity supply to industries such as agriculture and mining in Lindi and Mtwara regions.

Improve local electrification

The average of percentage of electrification in the entire Mtwara region is less than 50%. As for Lindi region, the total average of electrification in the entire Lindi region is over 50%. The main power source in Lindi and Mtwara is solar power. The coverage percentage of electrification in Lindi and Mtwara region is projected to increase with the implementation of the Mtwara GTCC project.

Contribute to Climate Change Mitigation

According to Tanzania's Intended Nationally Determined Contributions (INDCs), the country will reduce greenhouse gas emissions economy wide between 10-20% by 2030. One of the intended actions in the energy sector is "expanding the use of natural gas for power production, cooking, transport and thermal services through improvement of natural gas supply systems throughout the country." Thus, this project is in line with this action plan.

1.4 SCOPE AND OBJECTIVES OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

According to the Environmental Impact Assessment (EIA) and Audit Regulations of 2005, all energy development projects require a mandatory EIA. It is on this basis that the National Environment Management Council (NEMC) directed TANESCO to carry out a full EIA study after screening the detailed project brief.

Aside from fulfilling the requirements of the EIA and Audit Regulations (2005), this ESIA is also aimed at meeting requirements set by the Japan International Cooperation Agency (JICA), in particular the JICA Guidelines for environmental and social considerations (JICA Guidelines). The Project will ensure that potential negative and positive impacts of the project on social, economic and environment within the project area and beyond are mitigated and managed in accordance with these regulations and requirements.

This ESIA for the proposed Mtwara power plant in Kisiwa Village, Mtawara District is intended to provide decision-makers with sufficient background information to: (i) assess the socio-economic, biophysical and ecological conditions of the proposed project area; (ii) predict significant impacts that could be caused by the project; (iii) consider the project alternatives, mitigation measures and prepare environmental management and monitoring plan. The specific objectives of this ESIA are:

- To provide detailed description of the proposed 300MW gas-fired power plant activities at Kisiwa village in Mtwara District, Mtwara Region in Tanzania.
- To establish an environmental and socio-economic baseline analysis in the study area and Mtwara District and identify issues of significant bio-physical, ecological/biological and socio-economic impacts that is likely to be affected by the proposed project.
- To provide an understanding of the policy, legal and institutional framework for the project including a forum and opportunity for public and stakeholder involvement.
- To identify, predict and evaluate environmental, social and economic impacts associated with the proposed project activities and provide the required alternatives for mitigation.
- To develop appropriate environmental and socio-economic management plan for implementing, monitoring, and reporting of the mitigation measures.

1.5 METHODOLOGIES IN THE EIA STUDY

The following ESIA approaches and methods were used.

1.5.1 Approach for Environmental Issues

Data on environmental issues were obtained through literature review and assessment of existing environmental databases (e.g. vegetation, cultural and archaeological sites, characteristics of land, geomorphology, water resources and water quality, existing waste practices. To complement the preliminary review of available information, field visits in Mtawara District where the project will be located was made. Site visit was undertaken to assess project location and layout in relation to the proposed development activities; assess the physical characteristics of the project area including the geography, water, vegetation and wildlife resources, economic activities, human population settlement and distribution in order to gauge the kind of issues and impacts that are likely to be due to the implementation of this project. In all the areas various pertinent issues related to the proposed development were identified.

1.5.2 Assessment of Land Use Issues

A preliminary understanding of the current use of the land in the proposed project area was collected through filed observation and discussion with local communities occupying and using the areas. The field observation and discussions focused on the main current uses of the land; the significance attached to their lands; the possible impact of disturbance to economic activities and wildlife during implementation.

1.5.3 *Approaches for Socio-economic Issues*

Literature review, public consultations and extensive stakeholder involvement constituted the main approach for collecting socio-economic data and issues. On the basis of this approach, existing social - economic databases such as regional and local population indicators such as demographics, migration patterns, employment, economic activities, income levels, land use, NGO's, social organizations, education, health and development programs at regional, district and village levels were undertaken. In order to collect socio-economic issues in ESIA, the following methods and tools were used:

Literature Review

To address the identified objectives, a preliminary review of the available information on the proposed development and related literature was undertaken. This included national policies, laws and regulations governing the power generation in Tanzania as well information and other types of data describing the project area.

Household Survey

In order to understand the socio-economic condition of communities around the proposed development, a district socio-economic profile was reviewed and supplemented by a household survey. In conducting a detailed household's survey, the following tools were used:

- **Household questionnaire:** A household questionnaire was prepared and used for collecting basic information from all possible affected people. In addition, the questionnaire collected household demographic information, type of residential houses, level education, economic activities, and average household's income and land related issues from the household's heads in the proposed development.

- **Checklist:** A checklist was prepared and used for collecting qualitative data on social services that are obtained in the village, main economic activities, village land use, and views of the villagers regarding the proposed project.

Meetings and Stakeholders consultations

The literature review was followed by a series of meetings with the project stakeholders. First the meeting, which was conducted via teleconference, involved ERM experts, TANESCO representatives and the consultants. The meeting was intended to broaden the Consultancy Team's understanding by seeking clarification on various issues which were incorporated in the terms of reference and the execution of the assignment. Other meetings were undertaken in Mtwara region and Mtwara District Council in Mtwara. Two public meetings were also undertaken at Kisiwa village. The first meeting, was undertaken during the scoping exercise, involved all the member of the village to briefly discuss the project, likely impacts and the fate of those who will be affected. The second meeting was undertaken during the full ESIA study and it involved members of the village and details of the matters related to compensation, benefits related to project and other social economic issues were discussed. The purpose of the meeting was to raise awareness to all villagers about the proposed project.

Stakeholder's consultation was one of the methods used in the ESIA exercise. Consultations were made with identified stakeholders including the local communities in the proposed project area. Stakeholders' consulted were identified based on the nature of the ESIA but in some occasions the Consultancy Team was connected to some of the stakeholders either through key informants or stakeholders themselves. As pointed out earlier the Consultancy Team also had a discussion with the representatives the Regional Administrative Secretaries in Coast and Mtwara regions. In Mtwara District Councils, the district technical staffs such as land officer, community development, planning, and natural resource and agriculture officers were consulted for their views and concerns regarding the proposed development.

Beyond the project site, the Consultancy Team consulted the Ministry of Energy, Ministry of Industries, Trade and Marketing in Dar es Salaam, Tanzania Port Authority, Ministry of Natural Resource and Tourism (MNTR) and Ministry of Agriculture, Livestock and Fisheries Development (MALFD). These consultations aimed to get clarifications on some issues related to policies and laws as well as agronomic and pricing issues related to sugarcane industry.

1.5.4 Archaeological and Cultural Heritage Issues

Methods employed to obtain such information included ethnographic inquiries and random archaeological surface surveys. The consultant interviewed the Village Chairman and local people and conducted focused group discussion at district and village to gather information concerning cultural and heritage sites.

1.5.5 Site visit

To complement the preliminary review of available information, a field visit to the project area carry out measurements for air quality, noise and vibration, conduct ecological assessment of the site, water, and geography, economic activities, human settlement and distribution in order to gauge the kind and the magnitude of resettlement anticipated from the project area. Site visits were also undertaken to assess project location and layout in relation to the proposed development activities to gauge the impacts that are likely to be of interest in the EIA process.

1.5.6 Ecological assessment

Both systematic and opportunistic survey were done within the project area to characterize vegetation, habitat and existing flora and fauna species in the area. Similarly characterization of the marine habitat was done in order to determine suitable monitoring site.

1.5.7 *Impact Assessment*

This section presents the methodology used to conduct the ESIA. The ESIA has been undertaken a systematic process that evaluates the potential impacts the project could have on aspects of the physical, biological, social/ socio-economic and cultural environment; identifies preliminary measures that the Project will take to avoid, minimise/reduce, mitigate, offset or compensate for potential adverse impacts; and identifies measures to enhance potential positive impacts where practicable.

Screening

At the initial stage of the ESIA, the preliminary information was complied into the Project registration form and Project Brief to be submitted to NEMC. It was provided to determine what EIA requirements apply to the Project. This step was conducted utilising a high level description of the Project.

Scoping study

Scoping study was undertaken to delineate the potential Area of Influence for the Project, and to identify potential interactions between the Project and resources/receptors in the Area of Influence. The Scoping study was undertook as a means to ensure that there is a focus on the issues that are important for Project planning, decision-making and stakeholder interests. During the scoping study, potential interactions between the Project, environmental and human resources/receptors were identified.

Project Description

In order to set out the scope of the Project features and activities, with particular reference to the aspects which have the potential to impact the environment, a Project Description has been prepared. Details of the Project facilities' characteristics are provided in Chapter 2 of this ESIA Report.

Baseline Conditions

To provide a context within which the impacts of the Project can be assessed, a description of physical, biological, social/socio-economic and cultural conditions is presented. The baseline characterization is reported in Chapter 4 of this Report.

Stakeholder Engagement

An effective ESIA Process requires engagement with relevant stakeholders throughout the key stages. This assists in understanding stakeholder views on the Project and in identifying issues that should be taken into account in the prediction and evaluation of impacts.

Impact Assessment

The impacts of the proposed development were identified drawing from the scoping report and updating the checklist accordingly. The initial baseline condition prior to project implementation provided the basis for forecasting the future scenario with or without the project and compares the changes with existing established standards, relevant national and sectoral laws and regulations while taking cognizance of stakeholder views and concerns. The approach to impact prediction was to give ratings for each identified potential impact and producing a correlation matrix. Impact prediction or estimation of the magnitude, extent or duration of the impacts was done in comparison with the situation without the project. Details are described in Chapter 6.

1.6 STRUCTURE OF THIS REPORT

An outline of the ESIA report is provided in ***Table 1-1***.

Table 1-1 ESIA Report Structure

Chapte	Title	Description
	Executive Summary	Summary of entire ESIA report
1	Introduction	This Chapter outlines the development and structure of the ESIA report including the Project background, objectives, Impact Assessment scope and the report structure.
2	Project Description	This Chapter provides a concise description of the Project and its geographical and temporal context. It will include a site description, an overview of the Project Facility design and details of Project inputs and outputs.
3	Administrative Framework	The policy, legal and institutional framework in which the ESIA study has been conducted will be discussed in this Chapter. National regulations are summarized along with relevant international agreements, as well as applicable international best practice guidelines and standards.
4	Existing Biophysical and Social Environment (Baseline)	This Chapter summarizes the available baseline data on the biological resources, physical environment, socio-economic conditions and receptors within the Project Study Area. It will be based on both primary and secondary data sources and will consider changes in the baseline condition without the development in place.
5	Stakeholder engagement	This Chapter summarizes comments and concerns received from stakeholders and how these comments have been addressed.
6	Impact Assessment Alternatives Analysis	This Chapter summarizes the predicted impacts of the Project, proposed mitigation measures, and analysis of alternatives.
7	Mitigation Measures	This Chapter presents proposed mitigation measure to address identified impacts
8	Environmental and Social Management Plan (ESMP)	The ESMP draws together the possible mitigation measures; define the specific actions required, institutional roles and responsibilities for implementation;
9	Environmental and Social Monitoring Plan	This Chapter presents a monitoring program and estimate the costs of the measures.
10	Cost Benefit Analysis of the Project	This Chapter describes the cost-benefit analysis to determine whether a project will deliver net economic benefits to society.
11	Decommissioning	This Chapter describes potential environmental and social impacts that need to be considered during the decommissioning phase
12	Summary and Conclusion	This Chapter will summarizes conclusions that are made based on the assessment as well as outline any further recommendations.
	References	
	Appendix	

2 PROJECT DESCRIPTION

2.1 INTRODUCTION

The Project is expected to improve electricity service and coverage through the addition of new power generation, transmission and distribution capacity, as well as through much needed reinforcement of the existing network. The project is also aimed at increasing investment and economic activity to businesses and communities by improving the reliability and quality of electric power. This is aligned to the Government of Tanzania's National Energy Policy (2013) and TANESCO's mission.

The power plant will generate electricity and connect to the national grid for distribution to industries, companies and households in the country. This power source will assist TANESCO to meet current and future electricity demands in the country.

The objective of the project is to improve the power supply in Tanzania. The project also intends to reduce the duration and frequency of power interruptions to the coastal regions, improve voltage conditions at consumer's premises, reduce power system losses, increase customers, and improve the power line capabilities for smooth power transfer to the coastal regions and beyond.

2.2 LOCATION

The proposed Project Site is located in Kisiwa Village, Naumbu Ward, Mtwara District, Mtwara Region, Tanzania. It is approximately 400km south of Dar es Salam. In particular, the 300MW GTCC Power Plant, the New Mtwara Substation and its related facilities and utilities will be located in the north east part of the Kisiwa Region, a part of the shore terrace of the Mambi River and in front of Kisiwa Bay (Sudi Creek). The overview of the project site location is shown in ***Figure* 2-1**, while the zoomed satellite image of the project site and the surrounding towns is shown in ***Figure* 2-2Error! Reference source not found.**. The coordinates of the proposed power plant area are listed in ***Table* 2-1**.

Table 2-1 Coordinates of the Power Plant Boundaries

Points	S	E
A: Northwest boundary	10°10′53.70″	39°59′21.10″
B: Northeast boundary	10°10′51.41″	39°59′23.74″
C: Southwest boundary	10°10′57.83″	39°59′24.93″
D: Southeast boundary	10°10′56.03″	39°59′27.11″

Note: Refer to Points A-D in **Error! Reference source not found.**. Coordinates were taken via Google Earth.
Source: JICA Study Team, 2018

Figure 2-1 Overview of the Project Site Location

Source: IRA

Figure 2-2 Location of the Project Site

Source: JICA Study Team, 2018 (using Google Earth)

The Project Site will have an area of approximately 160 ha to give way to the power plant complex, which is composed of the power plant and planned future developments. The proposed Mtwara power plant site will cover approximately 37ha, which is a quarter of the Project Site. Areas for future development will serve as buffer zone for the impacts from the proposed power plant.

The boundaries of the Project Site, owned by TANESCO, is indicated by the red perimeter in ***Figure 2-3***. These boundaries have been mutually agreed upon by TANESCO and Mtwara Regional Secretary (RAS). The boundary along the seashore is defined by the setback distance (60 meters) from high tide level. The boundary on the hill side is defined by boundary beacons and it is for the construction of boundary ring road of 30 meters width in the future. TANESCO has plans to develop the Project Site as a Power Complex in the future.

The northern part of the Project Site belongs to the Tanzania Ports Authority (TPA), and it has mangrove forests and abdicated salt fields.

The Project Site can be accessed through unpaved roads, which are used by local residents and are used for transporting cashew nut, and the National Road (B-2) which branches near the Dangote cement factory. Then, the narrow road, which diverges from the cashew nut collector road and which is being used by local fishermen, reaches the Project Site through the deserted salt fields spread across a long distance of 700 meters approximately.

Figure 2-3 Surroundings of Project Site

Source: JICA Study Team, 2018

The site location is a plot space with dimensions of approximately 1km x 2km, the site will be able to accommodate several other plants of various capacities in the future (refer to ***Figure 2-4***). The proposed power plant site will be located within Area 1 and it is near to the potential terminal point (GIS compact substation) of the 400kV transmission line to be constructed in this plot. Proposed routes of the fuel and water supply lines, new access road and transmission line are also shown in ***Figure 2-4***.

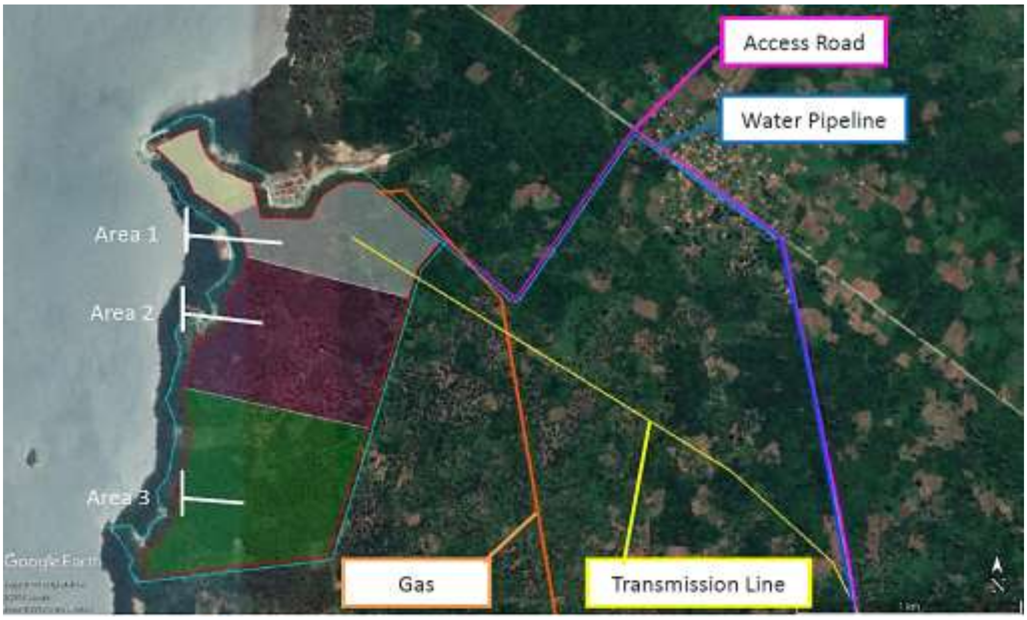


Figure 2-4 Boundaries of the Project Site and Future Developments

Source: JICA Study Team, 2018

2.3 *PROJECT COMPONENTS*

2.3.1 *Power Plant*

The proposed configuration of the power plant is a Gas Turbine Combined Cycle (GTCC) Power Plant with 300 MW generation capacity. The plant configuration consist of one or two power blocks each consisting of two gas turbine generators (GTG x 2), two heat recovery steam generators (HRSG x 2) and one steam turbine generator (STG x1). The plant is expected to have a plant service life time of 25 years. The layout of the proposed power plant is presented in ***Figure 2-5***.

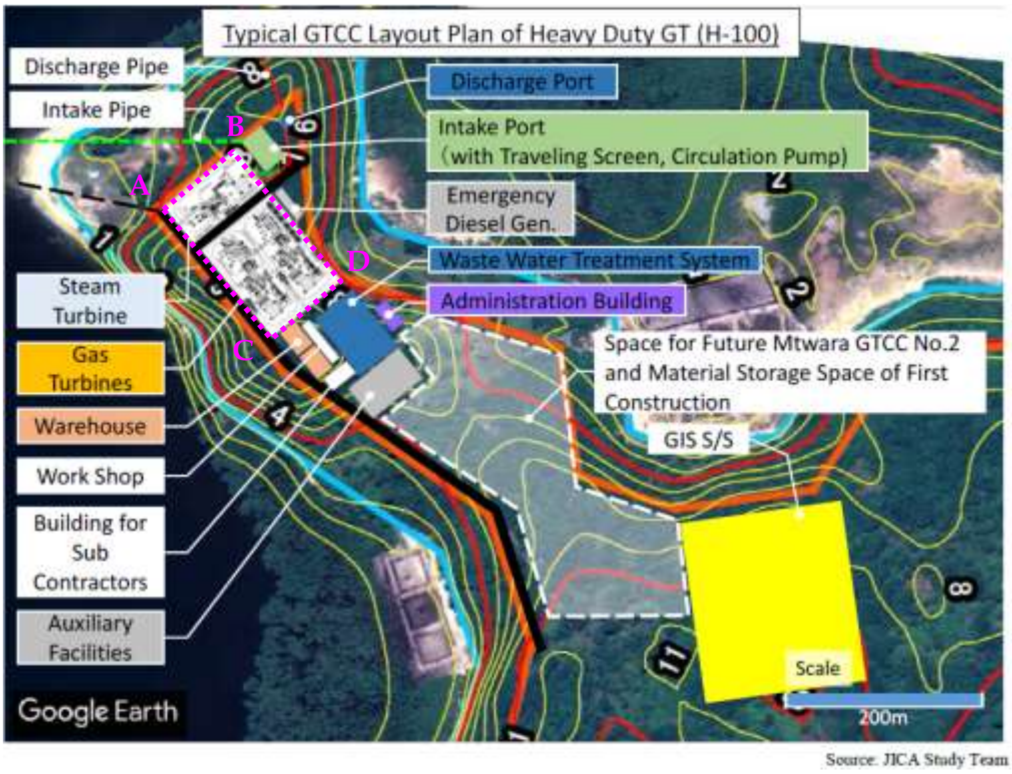


Figure 2-5 Layout of Project Components

Source: JICA Study Team, 2018

The main components of a GTCC include gas turbine, heat recovery steam generator and steam turbine. The operation of gas turbines generates power and steam which is collected by heat recovery system. The steam produced in heat recovery steam generators is led to a steam turbine which generate additional power. The assumed capacity factor (assumed dispatch of available capacity) is 85.9% based on the followings.

The load factors (LF) will be fluctuated between 90.2 ~ 99.7%, therefore, mean value of the past LF is (90.2 + 99.7)/2 = 94.95.
94% is selected as round-off value on the safe side.

Capacity Factor (CF) is as follows:
CF ≈ Availability Factor (91.4%) × Load Factor (94%) = 85.9%

The expected CF of Mtwara GTCC in operation phase will change as shown in table below.

Year	COD	2nd year	3rd year	4th year	5th year	6th year
Stop by machine trouble	5%	5%	5%	5%	5%	5%
Stop by miss operation	0%	0%	0%	0%	0%	0%
Stop by planed inspection	0 hour 0%	(312 hours) (3.6%)	480 hours 5.5%	0 hour 0%	(312 hours) (3.6%)	768 hours 8.8%
Availability Factor (AF)	95%	91.4%	89.5%	95%	91.4%	86.2%
Load Factor (LF)	94%	94%	94%	94%	94%	94%
Capacity Factor (CF)	89.3%	85.9%	84.1%	89.3%	85.9%	81.0%

The power generated from gas turbine generators and steam turbine generators will be stepped up from the around 11 KV to 400kV by generator main transformers and connected to 400kV substation.
A typical CCGT power plant layout for a Heavy Duty GT with Seawater Cooling System (H-100) is presented in ***Figure 2-6***.

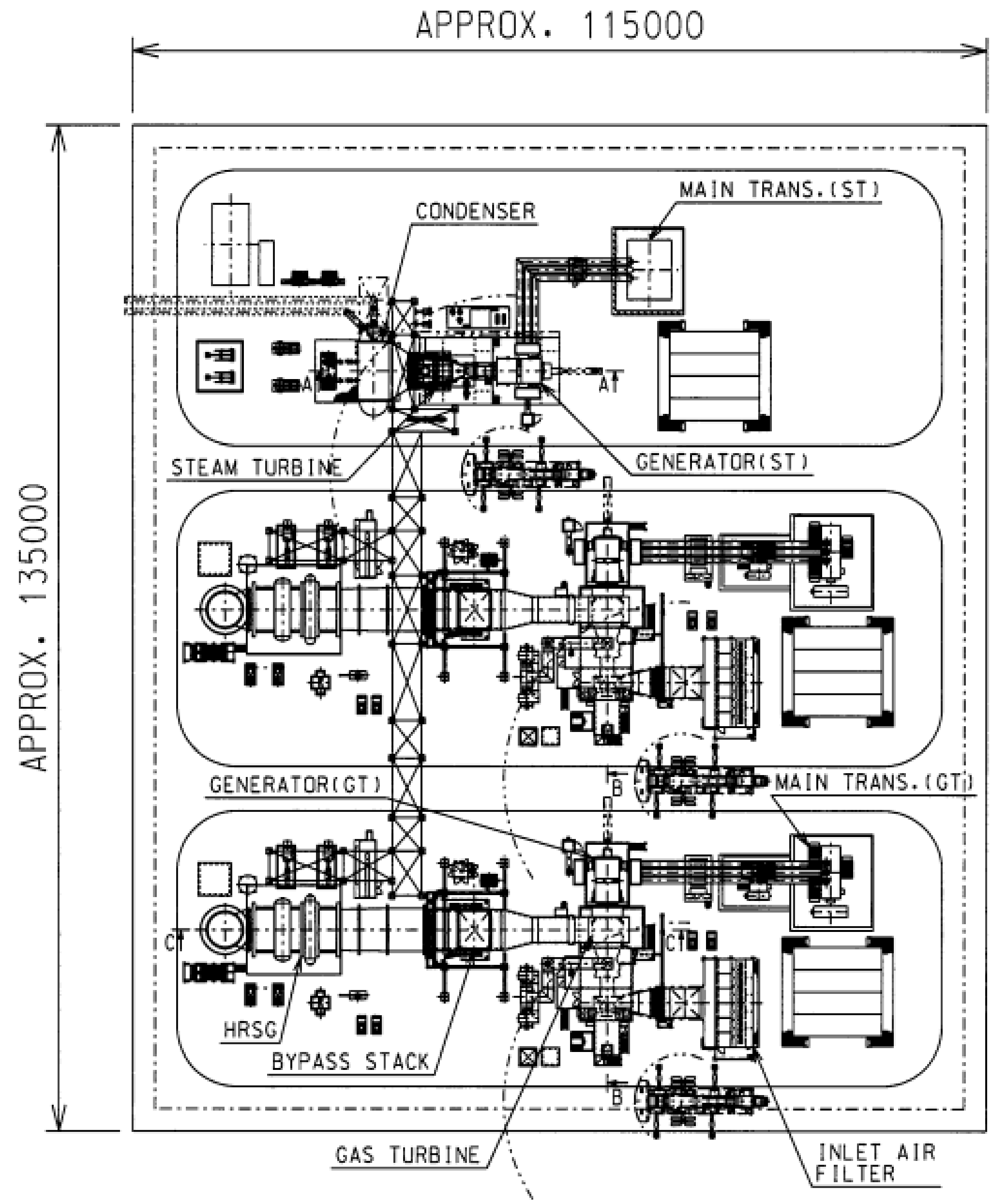


Figure 2-6 Typical GTCC Layout of Heavy Duty GT with Seawater Cooling System

Source: JICA Study Team, 2018

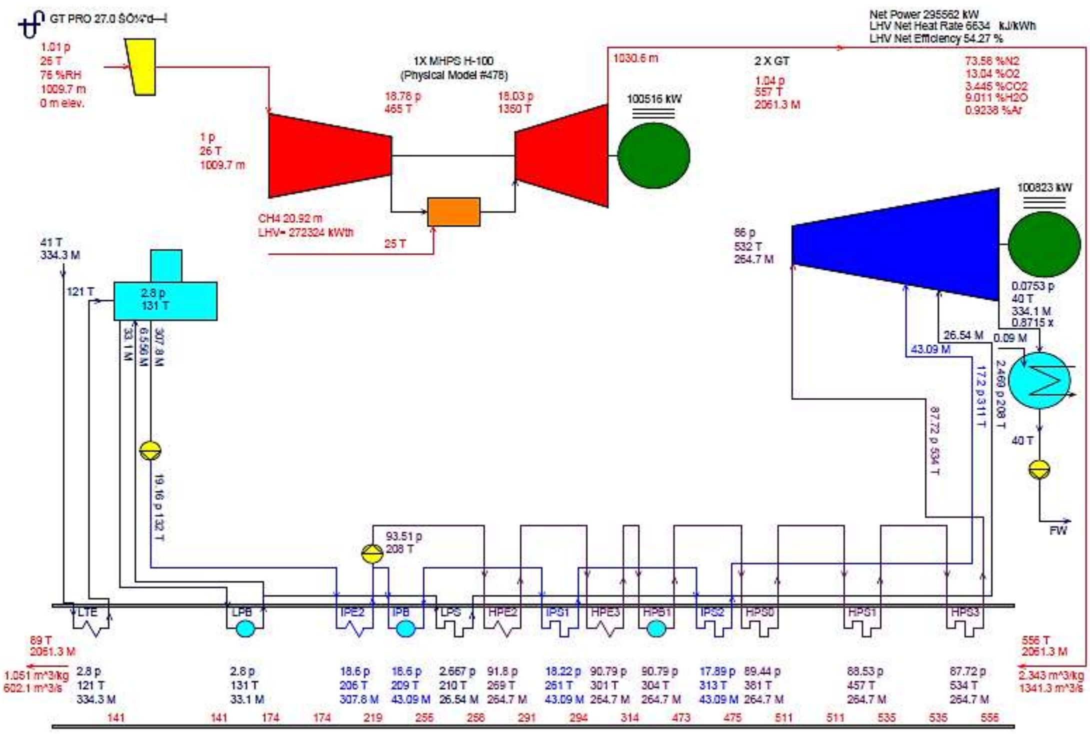


Figure 2-7 Heat Balance Diagram of Heavy Duty GT

Source: JICA Study Team, 2018

Gas Turbine

The GT will be an open cycle heavy duty and will be equipped with the exhaust gas bypass system. In order to select a GT that satisfies this requirement of 2-on-1 GTCCs with an output of 300 MW as described in the "2018 GTW Handbook", two models are chosen as candidate GTs for this project (see ***Table 2-2***).

Table 2-2 Comparison of GTCC of Each Supplier

Supplier		MHPS	Siemens
Model		H-100 × 2 units × 1 block	SGT-800 × 2 units × 2 blocks
Launch		2013	2010
Feature	Type	Heavy Duty	Heavy Duty
	Characteristics of ambient temperature	Base	Base
Spec based on GTW *	Output [MW] (ISO base)	344.5 (Gross)	326.2 (Net)
	Net Efficiency [%] (ISO base)	56.7	58.6
	GTW USD/kW (Standard bare bone price)	726	891**
	Number of GT	2	4

* Sources: Official website of MHPS / GE, 2018 GTW Handbook GTW (Gas Turbine World) Handbook 2018

** This is the price of a different model with lower spec. Actual price seems to be higher than this price.

The GT type will be finalized during detailed design. It will be designed based on the quality of natural gas feed. Its design will have a minimum number of bearings, and will be located on a steel frame or on adequate steel structures and concrete foundation, sized for the transient maximum transmittal torque imposed on the shaft in case of any short circuit of the generator or out-of-phase synchronization, based on whichever is larger. The power output shall be taken out at the cold end of the shaft.

The GT will include a low NOx burner to meet the NOx emission requirement for the operation of specified natural gas. There will be two exhaust stacks – 40m in height and 5m in diameter.

Heat Recovery Steam Generator

Heat Recovery Steam Generator (HRSG) is the facility that supplies steam to the steam turbine, which is generated by recovering the residual heat of the exhaust gas of the gas turbine. HRSG is classified into several categories depending on the flow direction of gas turbine exhaust gas in HRSG, the method of circulating the internal fluid of the evaporator of HRSG, and whether the steam turbine exhaust is reheated or not. The type of HRSG is selected according to plant design conditions, gas turbine specifications, steam turbine, site space, placement conditions, etc. In addition, denitration facility is generally incorporated as an environmental countermeasure.

For the project, the natural circulation type HRSG is preferred. With regard to the flue gas flow direction, horizontal or vertical gas flow types are both acceptable for this project. There are also various types of reheating system and pressure type. These details will be decided based on the manufacturer’s recommendation, and the layout will be proposed during the contract stage. Also, the HRSG will not be furnished with duct burners. Bypass stacks will have the following dimensions - 40m in height and 5m in diameter.

Steam Turbine

The steam turbine will be of condensing type, directly connected to the generator. Steam shall be downward or axially exhausted to the surface condenser, which is cooled by the fresh circulating water or seawater.

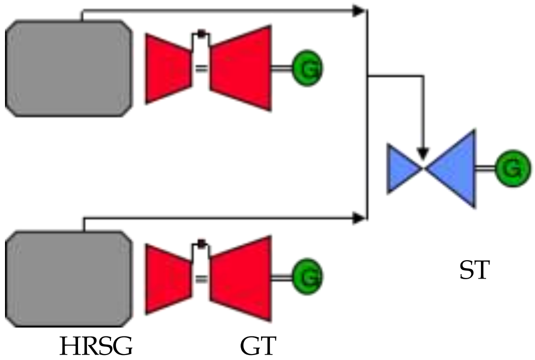
The steam turbine and auxiliary systems shall be designed to run continuously under all specified operating conditions for the specified lifetime of the plant. The steam turbine’s maximum capability shall satisfy the conditions of steam pressure, temperature, and flow as developed by the HRSG when the GT is operated on maximum capability ambient conditions. In case the HRSG is supplementary fired, the steam turbine shall be sized to cope with the maximized capability of the HRSG in consideration of the supplementary firing of the specified ambient conditions.

The steam turbine will be provided with the necessary number of bore scope ports for easy inspection of the operating conditions of the blades and rotor, at periodical intervals, if applicable.

Power Block Configuration

A multi-shaft 2-on-1 GTCC is recommended for the Project because its advantages in terms of output, efficiency, construction cost, and simple operation of the GT, in accordance with TANESCO’s requirement. The system consists of two gas turbines, two HRSG, one steam turbine, and 3 generators. The schematic diagram of this type of system is presented in ***Figure 2-8***.

2-on-1 ×1 unit



Each GT and ST is installed separately and each GT and ST has a Generator.

Figure 2-8 Schematic Diagrams of multi-shaft 2-on-1 GTCC

Source: JICA Study Team, 2018

Cooling System

Seawater cooling system will be adopted considering the conditions of the Project Site. The characteristics and schematic diagram of seawater cooling system are presented in below.

Table 2-3 Characteristics of Condenser Cooling Type

Type	Seawater cooling
Installation cost	Base
Efficiency of GTCC	Base
Fresh water consumption	Base (100 %)
Space of land	Base
Constituent equipment	• Intake/discharge channel • Intake/discharge pipe • circulating water system • bar-screen system • rotary-screen system
Note	• It is necessary to avoid hot water recirculation and heat accumulation. • Equipment needs to be installed on the coast line.

Note : Model GTCC: H-100 (300MW class), ISO conditions (101.33 kPa, 15℃ 60% RH)

Source: JICA Study Team, 2018

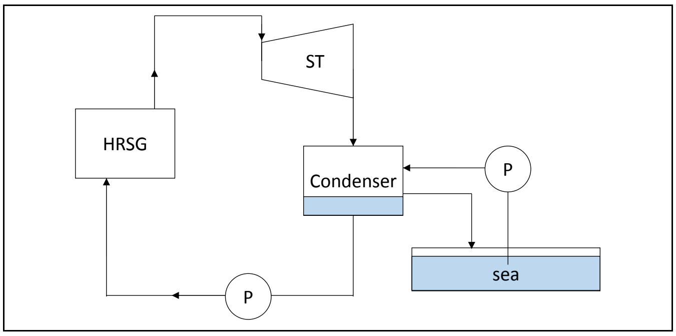


Figure 2-9 Schematic System Diagrams of ST Cooling Type

Source: JICA Study Team, 2018

2.3.2 *Other Facilities*

The proposed plant will also include the plant equipment necessary for operations of equipment such as cooling water system, water treatment system, fire protection and fighting system, ventilation and air conditioning system, electrical distribution system, battery system, lighting system, and plant control system.

Water Supply Treatment System

The Project requires approximately 300 m3 of industrial water per day, which is the amount of water used when the 300 MW class GTCC power plant operates at 100% load.

The current water supply capacity of the Mtwara Urban Water Supply and Sanitation Authority (MTUWASA) in the Kisiwa and Mikindani area is about 1,200 m3/day with the deep wells located near Mbuo River, and it will increase up to approximately 1,850 m3/day. The water source is located about 8 km from Kisiwa site. Currently, the water demand for the deep wells located near Mbuo River is approximately 400m3/day.

From the above information, it is considered that the amount of water required for the Mtwara power plant would be secured by water supply from MTUWASA.

Figure 2-10 shows the terminal point of the water pipeline schematic at the boundary of Kisiwa site. The arrow indicates ownership of water supply facilities after the construction. Ownership of water supply facilities is as shown below.

- Outside the terminal point: MTUWASA
- Inside the terminal point: TANESCO

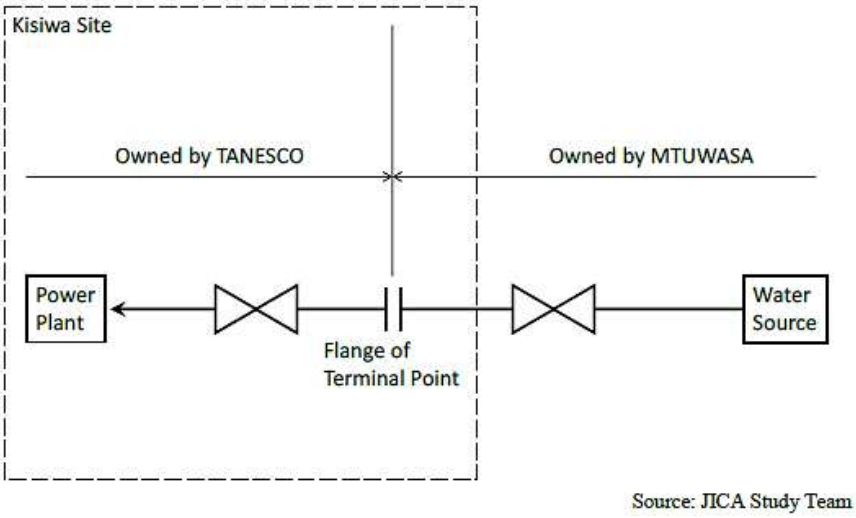
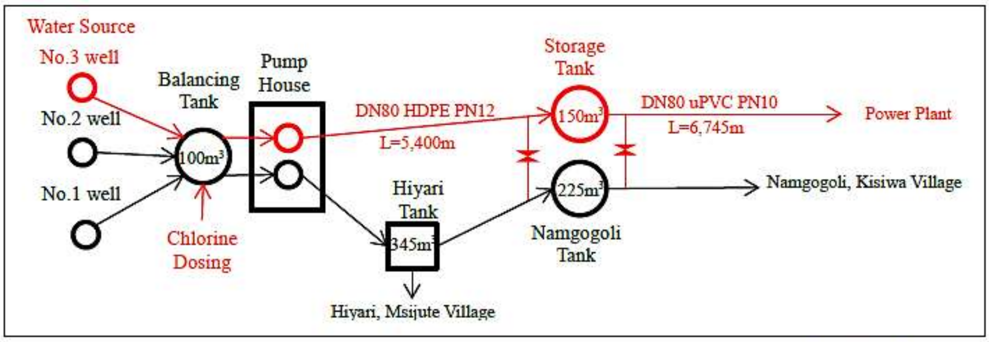


Figure 2-10 Water Pipeline Terminal Point

The new water pipeline to Kisiwa site will be constructed exclusively for Kisiwa site. According to the EIA report of the water pipeline, ***Figure 2-12*** shows the route plan of water pipeline from the wells to Kisiwa site. Length of this pipeline is approximately 12 km.

Outline of the proposed water supply system is shown below in ***Figure 2-11***.



Source: JICA Study Team

Figure 2-11 Proposed Water Supply System for the Mtwara GTCC Power Plant (black: existing, red: proposed)

As per agreement between both parties (TANESCO and MTUWASA), TANESCO facilitated the EIA exercise for the construction of the above mentioned water supply system from the borehole located in Mbuo village to a proposed Gas power plant to be constructed in Kisiwa village in Mtwara District in Mtwara Region, implemented by MTUWASA as project developer. The EIA study was separately conducted apart from this EIA for the Mtwara power plant, and the EIA report for the water pipeline has been developed. TANESCO has engaged Environmental Experts to carry out the EIA study for the aforementioned project that will be carried out by MTUWASA as project developer, aiming at identifying, investigating and foreseeing the future negative impacts emanating from the proposed project as well as providing mitigation measures of those impacts.

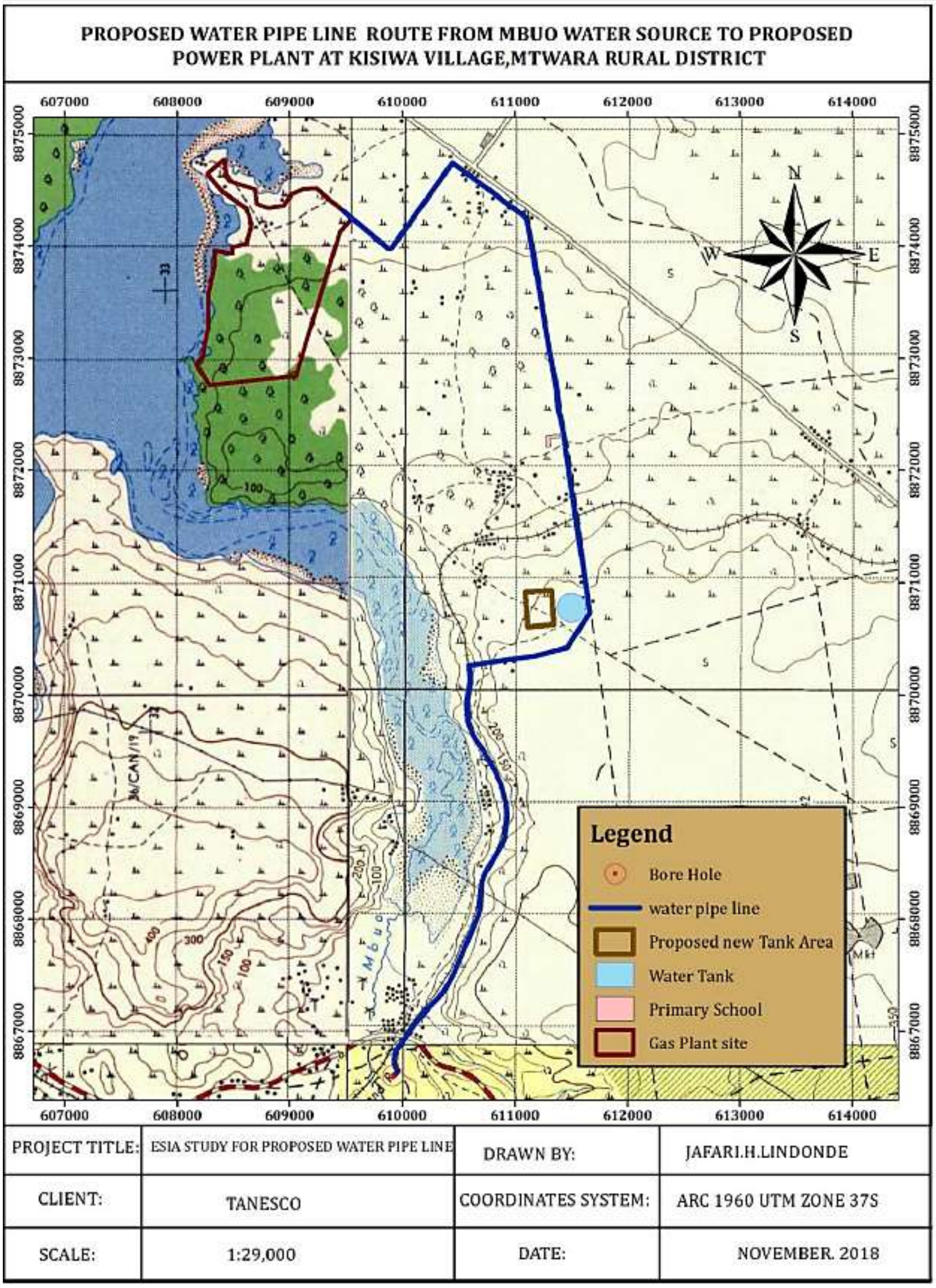


Figure 2-12 Location Map of the Water Supply Facilities

Source: EIA Report for the Proposed Construction of Water Supply Pipeline from Mbuo village to a Proposed Gas Power Plant (11.1km) Located at Kisiwa Village in Mtwara District, Mtwara Region

In order to achieve industrial water specifications, it is necessary to install a water treatment facility (e.g. pretreatment facility and demineralized water facility). ***Figure 2-13*** shows an example of a typical water treatment system.

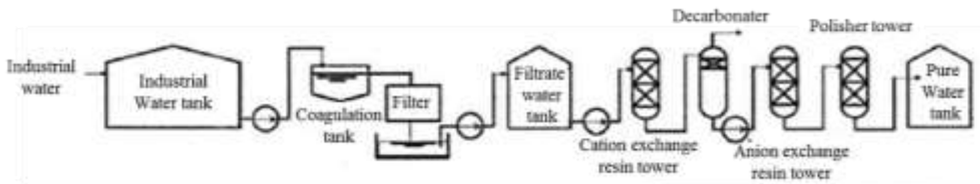


Figure 2-13 Outline of Water Treatment System

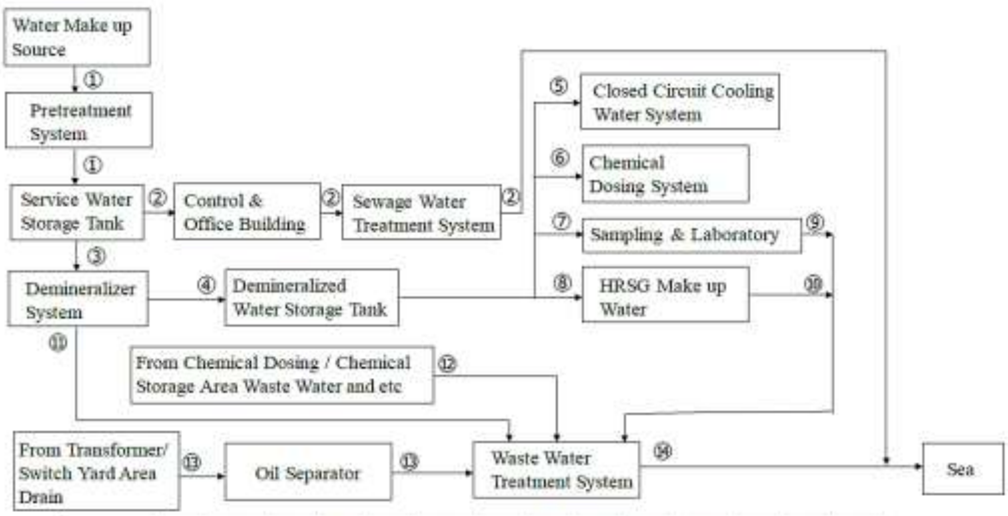
Sources: Mitsubishi Heavy Industries technical report Vol.50 No.3 (2013)

Wastewater Treatment Facility

Wastewater consists of drain from demineralized water treatment facility, blow down water from the HRSG, floor drains from the GT and steam turbine buildings, and surface drainage of transformer area. The water balance for the power plant is presented in ***Figure 2-14***. With 300m^3/day of water supply, it is estimated that approximately 230m^3/day of treated wastewater will be released to the ocean (via Sudi Creek). Since the location of the power plant is more than 5km away from the mouth of the Sudi Creek, it is not realistic to construct the discharge pipe or structure to the Ocean, therefore, it is released to the Sudi Creek.

Chemical drains such as demineralized water treatment facility and HRSG blow down water are sent to the wastewater treatment facility. Floor drains from the GT and steam turbine buildings, and surface drainage of transformer area that may contain oil are treated in an oil separation system before being sent to the wastewater treatment facility. The wastewater facility consists of retention units and neutralization system of effluent streams. The pH of collected water is adjusted to comply with applicable standards. Treated wastewater is discharged to Sudi Creek. Wastewater will be discharged mixed with the thermal wastewater and it is planned to discharge meeting the IFC and Tanzanian national standards.

Sewage and toilet drainage are treated by septic tanks. Chemical drains are treated in a wastewater treatment system after the neutralization treatment. Drains that may contain oil is treated in a wastewater treatment system after being treated with an oil separation system.



Stream No.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭
Flow (m^3/day)	300	80	220	160	45	5	30	80	30	80	60	15	45	230

Figure 2-14 Water Treatment Flow (Water Balance)

Source: JICA Study Team, 2018

Water Intake and Discharge Facility

Tower-type seawater intake and offshore discharge will be adopted by the project. The intake and discharge structures consist of water intake tower, intake pipe, intake port, circulating water pipe, discharge port, discharge pipe, among others. The basic layout of the intake and discharge structures are shown in ***Figure 2-15***.

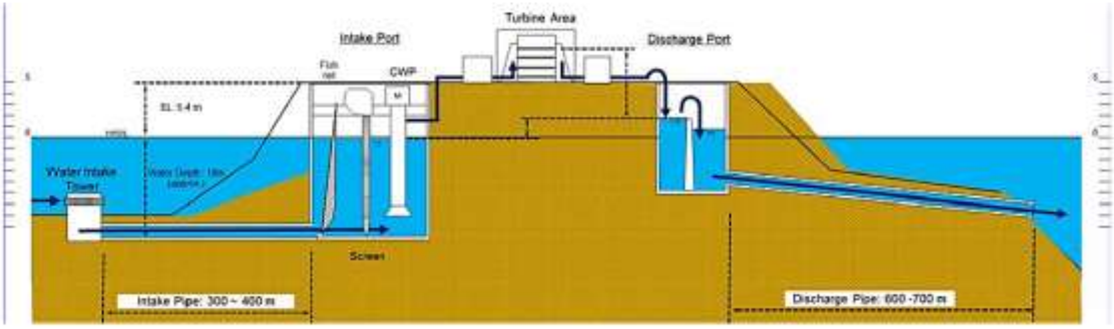


Figure 2-15 Cross-section of Intake and Discharge Structures

Source: JICA Survey Team, 2018

Water intake tower is located at a distance of 150 m away from the coastline and the point of water discharge is located approximately 600 m away from the coastline. Water intake port, which consists of fish prevention screen, bar screen and sea water intake pump, is installed at the depth of 15 - 20 m, with a width of 10 m, and a length of 20 m approximately.

The discharge port is 10 m deep and the discharge pipe extends for about 600 - 700 m (refer to ***Figure 2-16***).

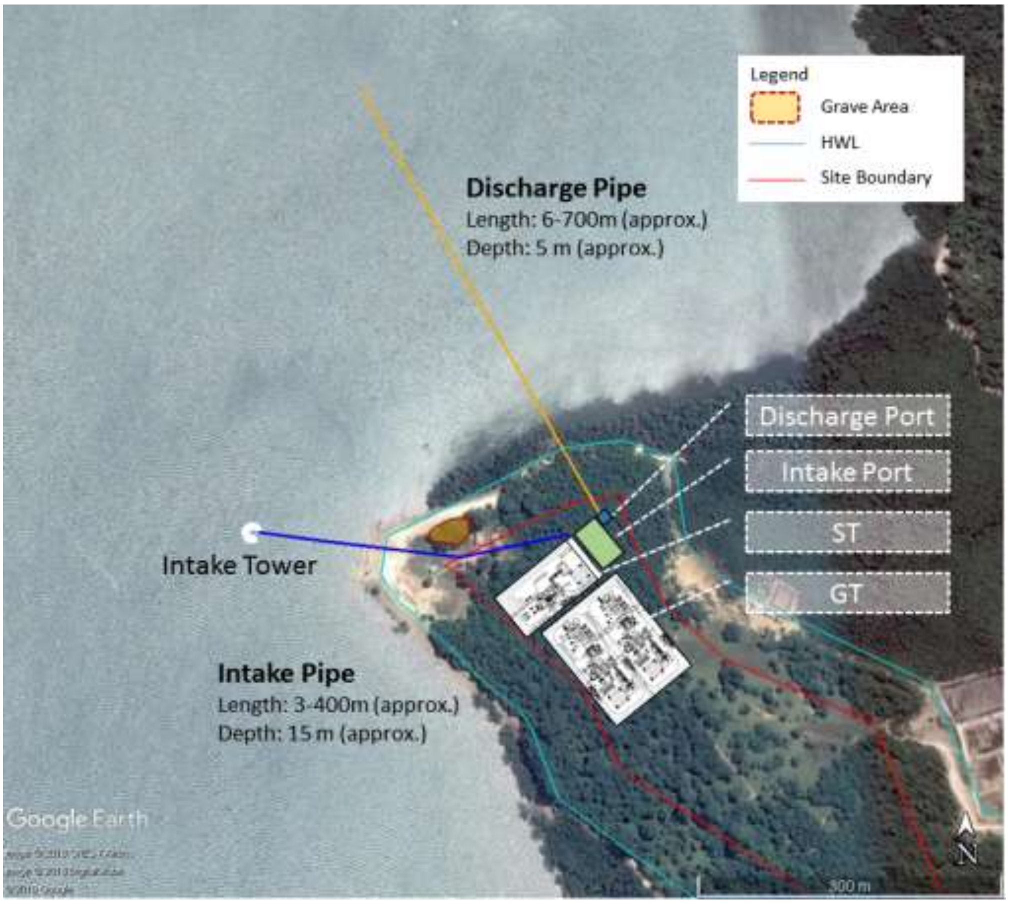


Figure 2-16 Conceptual Layout of Intake and Discharge Streams

Source: JICA Study Team, 2018

The water intake port which consist of fish prevention screen, bar screen and sea water intake pump (for cooling water), is installed at the depth of 15 - 20 m, with a width of 10 m, and a length of 20 m approximately. The bar screen is a facility to remove large objects such as marine litter. The rotary screen facility can remove small objects such as marine creatures that passed through the bar screen. On the other hand, the Discharge port is 10 m deep and the discharge pipe is designed to be extending for about 600 -700 m and most of it part is located in the offshore section. Material of pump (pipe) is basically steel and the type of foundation is basically concrete.

Rainwater Drainage System

Based on the conditions presented below, the total runoff volume from the plant site is estimated at 3.5 m^3/s. With this assumption, there is a need to install seven (7) drainage outlets within the Project Site in order to drain out rainwater safely.

Design rainfall intensity:	168 mm
Plant area (Phase-I):	7.5 ha
Volume of runoff:	3.5 m^3/s
Drainage Channel bed slope:	1%
Capacity of channel:	0.52m^3/s (W: 40 cm, H: 40 cm)

The draft plan of the rainwater drainage system is shown in **Error! Reference s ource not found.**, and the draft design of roadside ditches is shown in **Error! Reference source not found.** as a design of road cross-section.

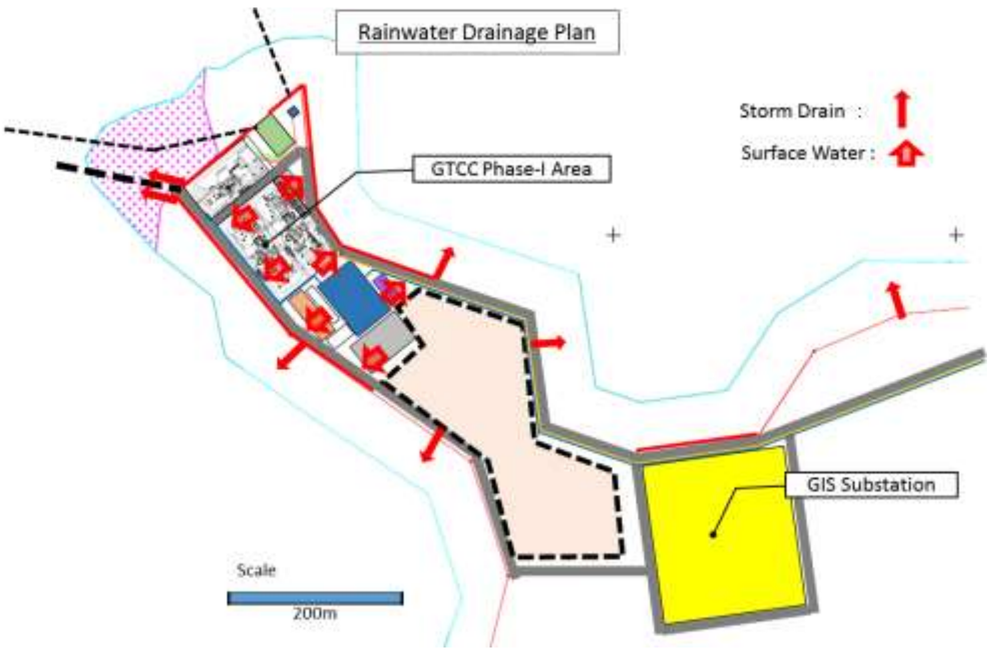


Figure 2-17 Draft Plan of Rainwater Drainage System

Source: JICA Study Team, 2018

Access Roads

In order to facilitate the implementation of the power plant project, access road is one of the important facilities which is required before construction begins. The existing rough road at Hiyari village near Dangote Cement factory at the junction of Mtwara to Dar es Salaam highway road need to be improved in order to allow heavy trucks to transport construction materials and equipment with up to capacities of 56 tonnes to the power plant at Kisiwa.

The proposed unpaved single-lane road is under the management of Tanzania Rural and Urban Road Agency (TARURA), shown in ***Figure 2-20***. According to the road classifications it is defined as collector road which requires 20m from the centre line to each side. Since there are tight curves and culvert structures along the route, road improvement and widening, compliant with National Road standards, will be necessary to allow the passage of construction vehicles such as large and long trucks.

As per the first schedule of the Environmental Impact Assessment and Audit Regulations 2005, the EIA study for the access road was conducted **separately from this EIA** for the Mtwara power plant, and TANESCO has engaged Environmental Experts to carry out the EIA study for the aforementioned project that will be carried out by TARURA as project developer.

ROW of the road will be 40 meters. Although width of carriageway can be set as 6.0m according to the Road Geometric Design Manual, it is set as 6.5m in order to allow the safe and smooth passage of heavy construction vehicles. Taking into account the requirements of two-lane road to secure drainage, safety etc., the following standard cross-section is planned (***Figure 2-18***).

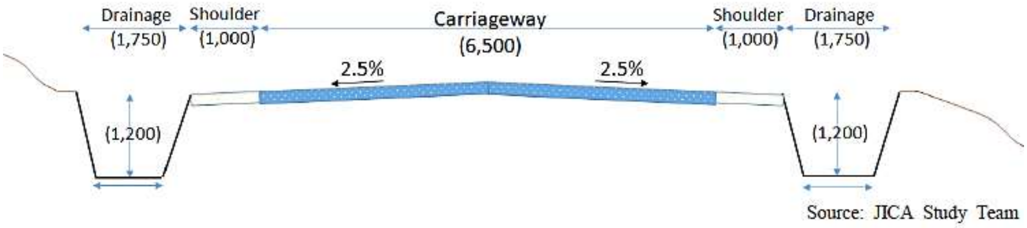


Figure 2-18 Planned Standard Road Cross-section

38 culverts are expected to be installed in the targeted section of the road and planned design is as shown in ***Figure 2-19***.

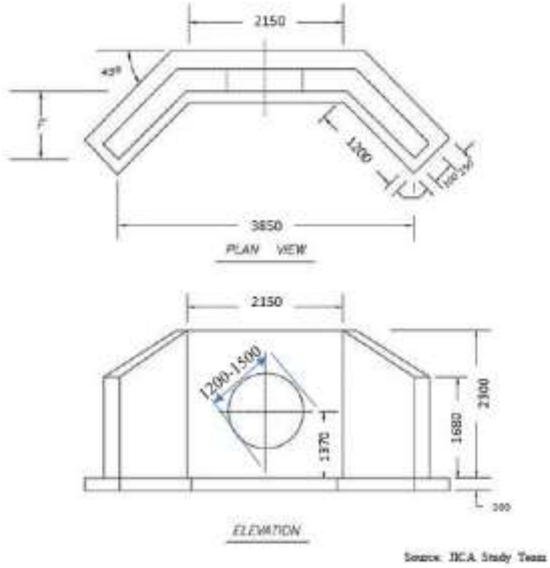


Figure 2-19 Planned Culvert Design *Source: JICA study team, 2018*

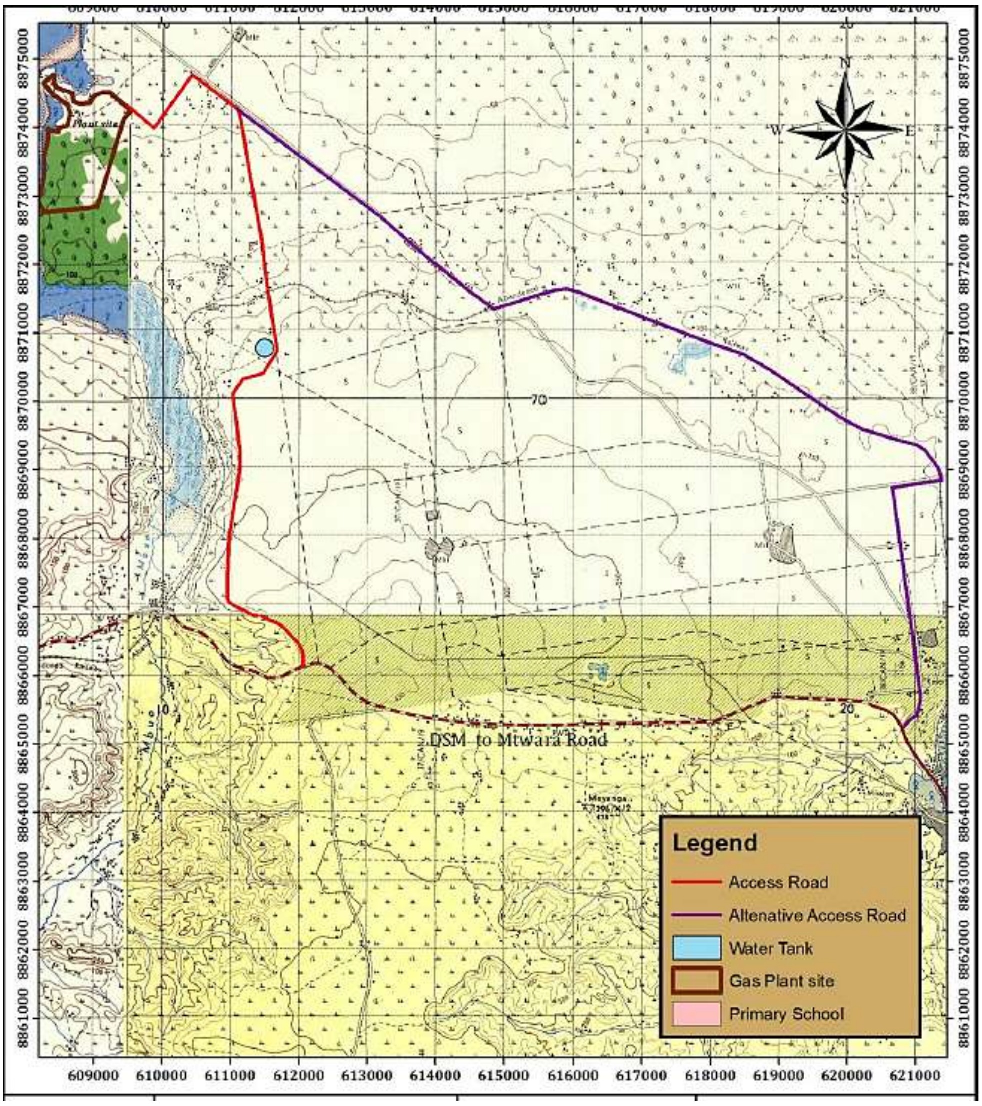


Figure 2-20 Map showing location of the proposed road and alternative road to the proposed Kisiwa Power Plant

Source: Environmental and Social Impact Assessment for the Proposed construction of Access Road to the Proposed 300MW Mtwara combined cycle gas turbines (CCGT) Power Plant to be located at Kisiwa village in Mtwara District Council, 2019

From the existing road to the Project Site, a new access road, approximately 700m, needs to be constructed as shown in ***Figure 2-21*** (refer to pink line). This road will be developed exclusively by TANESCO for the Mtwara power plant.

Figure 2-21 Access and Boundary Roads

Source: JICA Study Team, 2018

As for the site boundary road shown in ***Figure 2-21***, according to the Regional Administrative Secretary (RAS), TANESCO is responsible for the road development for 15 meters width from the center line of the road and the adjacent developer is responsible for the other half. The site, owned by the Tanzania Ports Authority (TPA), is adjacent to the northern area of Kisiwa site, and it has mangrove forests and abdicated salt fields.

Administration roads with a standard width of 10 meters will be constructed within the Project Site to allow construction works, transportation and maintenance works. The proposed routes for administrative roads are presented in ***Figure 2-22.*** The standard design shown in ***Figure 2-23*** will be adopted.

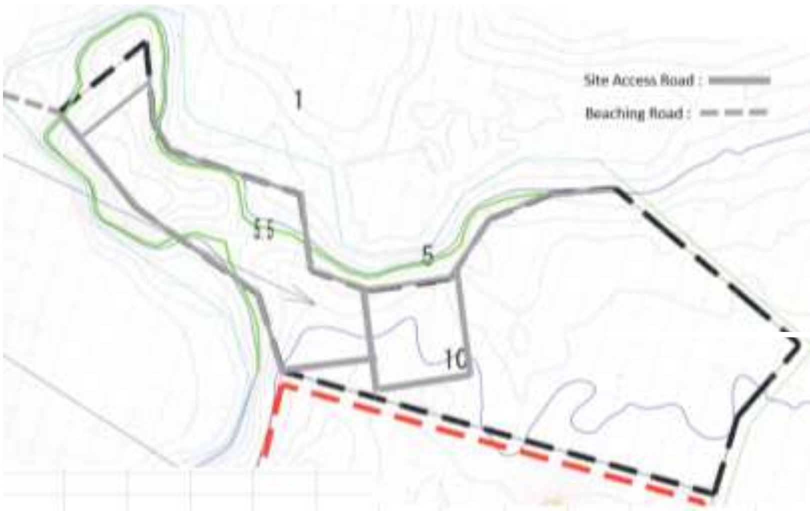


Figure 2-22 Draft Plan of Administrative Road

Source: JICA Study Team, 2018

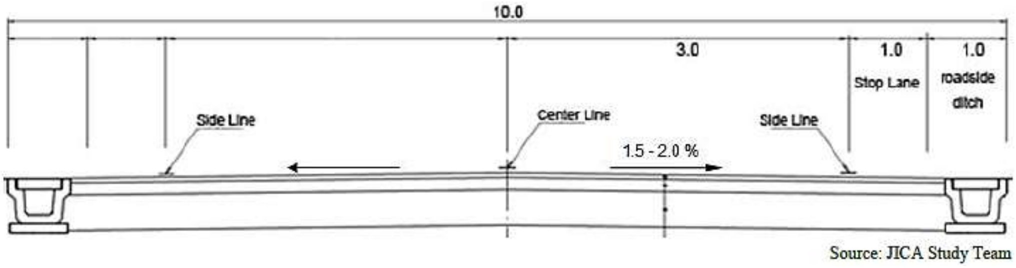


Figure 2-23 Proposed draft design of Roads with Roadside Ditch

Buildings

There will be four main buildings in the Project Site. This include ST building, administrative building, and warehouse. The specifications required for each building for the Project are summarized in ***Table 2-4***. The location of these buildings are shown in ***Figure 2-5***.

Table 2-4 Proposed Specifications of Project Buildings

	Name of building	Specification
Project Site	Steam Turbine Building	- Steel frame structure equipped with overhead cranes - Side walls: corrugated plates and steel plates - Roof structure: steel truss - Windows: purpose of ventilation - Lifetime: 20 – 30 years - Area needed for the building: 20m x 45m - The building accommodates steam turbine
	Administration Building	- Frame structure: reinforced concrete and three (3) floors - Side walls: bricks and mortar with appropriate number of windows - Facilities: A/C system, internet, gas, electricity, portable water - Area needed for the building: 15m x 32m - The building accommodates control room etc.
	Warehouse	- Steel frame structure with overhead cranes and one (1) floor - Area needed for the building: about 20m x 40m - The building is for storage etc.

Source: JICA Study Team, 2018

Firefighting system

In order to protect employees and facilities in the plant from fire, fire protection shall be considered, such as securing separation distance between facilities, adopting fire-retardant or fireproof facilities, selecting appropriate firefighting system. Unless otherwise specified in Tanzania laws, National Fire Protection

Association (NFPA) 850[1] shall be applied as the standard for fire protection for the plant.

Fire area boundaries should be based in consideration of the following.

- Types, quantity, density, and locations of combustible material
- Location and configuration of plant equipment
- Consequence of losing plant equipment
- Location of fire detection and suppression system

Fire barriers for separating fire areas should be of a minimum 2 hour resistance rating.

Water supply for the permanent fire protection installation should be able to provide water for 2 hours, and the hose stream demand should not be less than 1,890 L/min. In case multiple fire pumps are required, the pumps should not be subject to common failure, and should be of sufficient capacity excluding the capacity of the largest pump. According to TANESCO's requirement, a fire station with fire engines is basically necessary because this project is the first plant of the power complex.

The general combination of facility and firefighting system are shown in ***Table 2-5***.

Table 2-5 General Combination of Facility and Fire Fighting System

Item	Facility	Firefighting System
1	Bearing for GT, ST and Generator	Carbon Dioxide Extinguisher
2	GT and ST Oil Tank	Carbon Dioxide Extinguisher
3	Generator Exciter room	Carbon Dioxide Extinguisher
4	Step up Transformer	Water Spray System
5	Office Building	Hydrant and Portable Extinguisher
6	Workshop and Storage	Hydrant and Portable Extinguisher
7	Cable Room	Carbon Dioxide Extinguisher or Water Splay System
8	Yard Area	Hydrant

Source: JICA Study Team, 2018

Emergency Power Supply System

One diesel generator shall be installed for each unit, as emergency generator. The emergency diesel generator (EDG) is installed for the following purposes.

- To shut down unit safely in case of system blackout;
- To prepare for immediate restart when power to start is received; and
- To secure disaster prevention security power.

[1] NFPA 850 refers to the Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.

A black start generator is installed in order to start the power station or the unit in case there is no power supply from the grid (e.g. blackout). One diesel generator shall be installed as black start generator for the power station.

Uninterruptible Power System (UPS) shall be installed in order to supply AC power continuously to important facilities which are not permitted to fluctuate due to voltage or loss of power supply. The UPS will consist of converter (AC to DC), inverter (DC to AC) and static switch to switch between UPS output and AC bypass. The specifications of the UPS are summarized in ***Table 2-6***.

Table 2-6 UPS Specifications

	Specifications
AC input	400V, 3 phase, 50Hz
DC input	same as the DC battery voltage
AC output	230V, single phase, 50Hz

Source: JICA Study Team, 2018

DC battery will installed for the following purposes.

- To supply power to facilities driven by DC voltage
- To shut down unit safely in case of system blackout until power from EDG is supplied
- To supply backup power when other emergency power supply fails

TANESCO has no standard for the voltage of DC battery, therefore the voltage depends on the manufacturer standard.

Duplicate digital protection devices will be installed for protection of generators and transformers. Protection devices to AC and DC power input to will also be installed. The input to the lockout relay shall be determined based on the "AND" condition of outputs from each duplicated protection devices.

2.4 *PROJECT LIFECYCLE OVERVIEW*

Project life cycle analysis identifies the key issues and concerns that are likely to evolve over the entire lifespan of a project. In the case of the proposed project, these issues may arise during the construction, operation and maintenance, and decommissioning. The following sub-sections identify the key activities to be completed and facilities to be constructed and operated over the lifetime of the project.

2.4.1 *Pre-Construction and Construction Phase*

Beach landing Operation

In order to prepare for the beach landing operation, there is a need to arrange barge's safe grounding at the sea bed, to place the sand bag, steel plates, and to conduct civil works to make the self-propelled modular transporter (SPMT)'s approaching angle shallow.

Prior to the arrival of heavy cargo ship at the Mtwara Port, the barge with self-propelled modular transporter (SPMT) needs to be on standby, close to the Mtwara Port. Once the heavy cargo ship arrives, the heavy cargo will be lifted from the cargo hold by the ship's own crane, and discharged to the SPMT on the barge. The heavy cargo, SPMT and the barge must be connected and secured by materials such as lashing chain.

The departure time from the Mtwara Port and the arrival time at the beach landing place need to be coordinated, to make the operation safe whilst considering tide conditions, water depth and a suitable horizontal angle approach of the SPMT from the barge to the beach. SPMT will be discharged when the approach angle is almost horizontal. The final angle adjustment will be done by sand bags, steel plates and wooden materials.

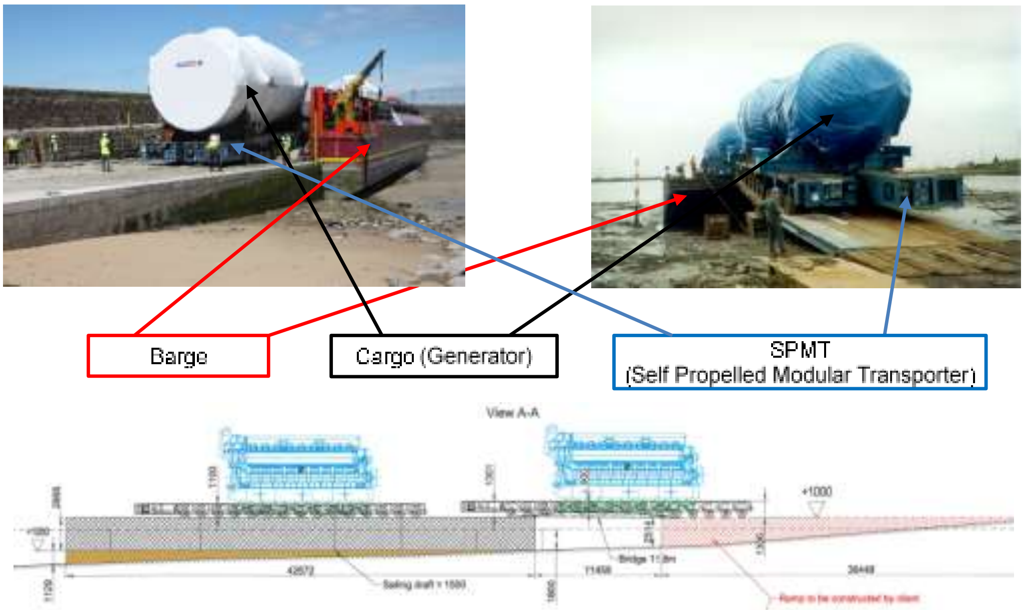


Figure 2-24 Beach Landing Sample Picture (Sample)

Source: JICA Study Team, 2018

Move from beach landing location to the final nominated place in site

After unloading the SPMT from the barge at the nearest beach from the power plant construction site, materials and equipment will be transported to the Project Site. The transportation route that will be used will be the route with the shortest distance, sufficient width, clear of obstacles, and has flat surface. This would allow shorter travel time and easier maneuvering.

The Project Site is approximately 40km away from Mtwara Port. The proposed transportation plan from the landing site to Project Site is shown in ***Figure 2-25***. With this route, there are approximately 10 bridges, 30 culverts and numerous cross roads, sharp curves that will be crossed.

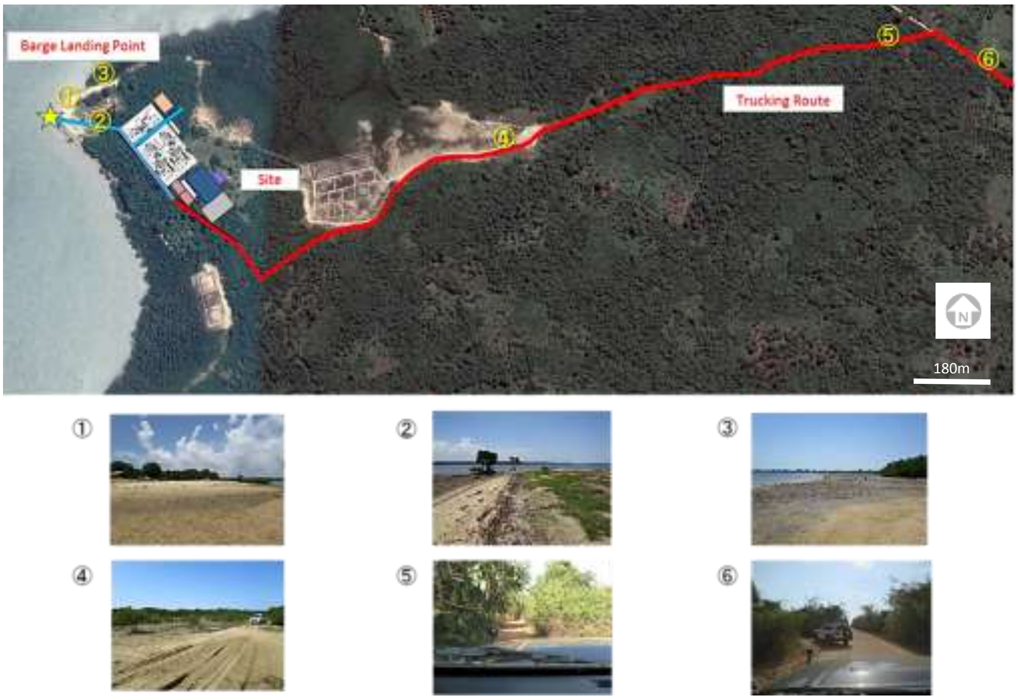


Figure 2-25 Inland Routing after Beach Landing

Source: JICA Study Team, 2018

Unloading at the construction site

In general unloading heavy cargo from SPMT is done by lifting materials using a crane arranged at the construction site. Another alternative is by fixing the height of the cargo with the support material installed under the heavy object, jacking down the SPMT, self-propel it and extracting it to complete the work.

When unloading from SPMT at the site, it is necessary to pay attention to the following points.

- Select a large crane that matches the weight and size of the major equipment (GT, ST, generator, etc.) and procure it.
- Secure the assembly space of the crane to be installed at the site.
- Crane's turning, securing outrigger overhang space.
- Cargo must be stored with enough space so that we can pull out necessary cargo and put in new cargo during the installation work.
- When removing storage equipment along with the equipment, ensure that there is sufficient storage space including sufficient passage and clearance so that the cargoes do not interfere with each other.
- Securing space to store all cargoes including equipment transported by land transport.

Site preparation

Before the contractor(s) set up the construction works, the following preparation works have to be completed.

- Upgrading works of the access road (ca. 700m) in addition to the upgradation of the village road (ca. 10km) which are necessary for the project.
- Site leveling works for 34ha.

After all these preparation works are finished, the contractor(s) will start the construction works.

2.4.2 *Construction Phase*

The construction phase will include construction of the following:

- power plant,
- civil and structural elements,
- administration and control building,
- access/approach road,
- guard house,
- water treatment facility,
- workshop and storage, and
- fuel supply system, etc.

It will also involve installation of mechanical equipment, electrical equipment, and plant control system. The construction phase is estimated to take around 32 months.

Foundation Works

The proposed design for the foundation of gas turbines (GT) and steam turbine (ST) is presented in ***Figure 2-26*** and ***Figure 2-27***. This basic layout is designed on the assumption that the building for ST is needed. Based on geological survey results, the mat foundation thickness of GT and ST is 2.0 meters with concrete piles which can to reach foundation rock (approx. 20 m).

The types of pile which will be used in the Project will be determined whilst considering the soil condition of the site, past experiences, market availability, and other factors. Precast concrete piles may be the most appropriate for the Project. However, application of cast-in-place piles will be reconsidered in the phase of detailed design. The Franki Piles method, one of the cast-in-place concrete piles, is adopted in the Kinyerezi II Project and those kinds of pile are available in Tanzania.

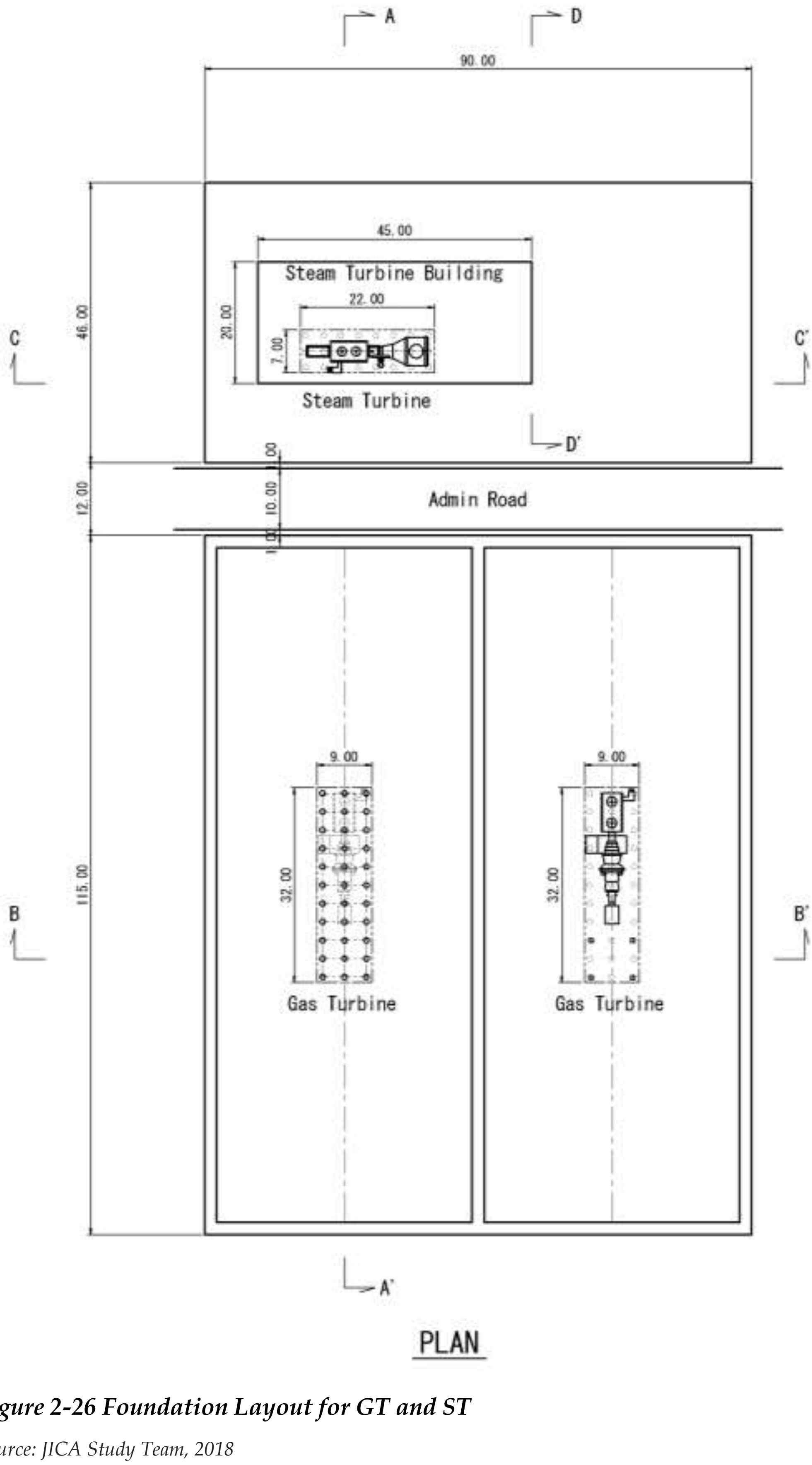


Figure 2-26 Foundation Layout for GT and ST

Source: JICA Study Team, 2018

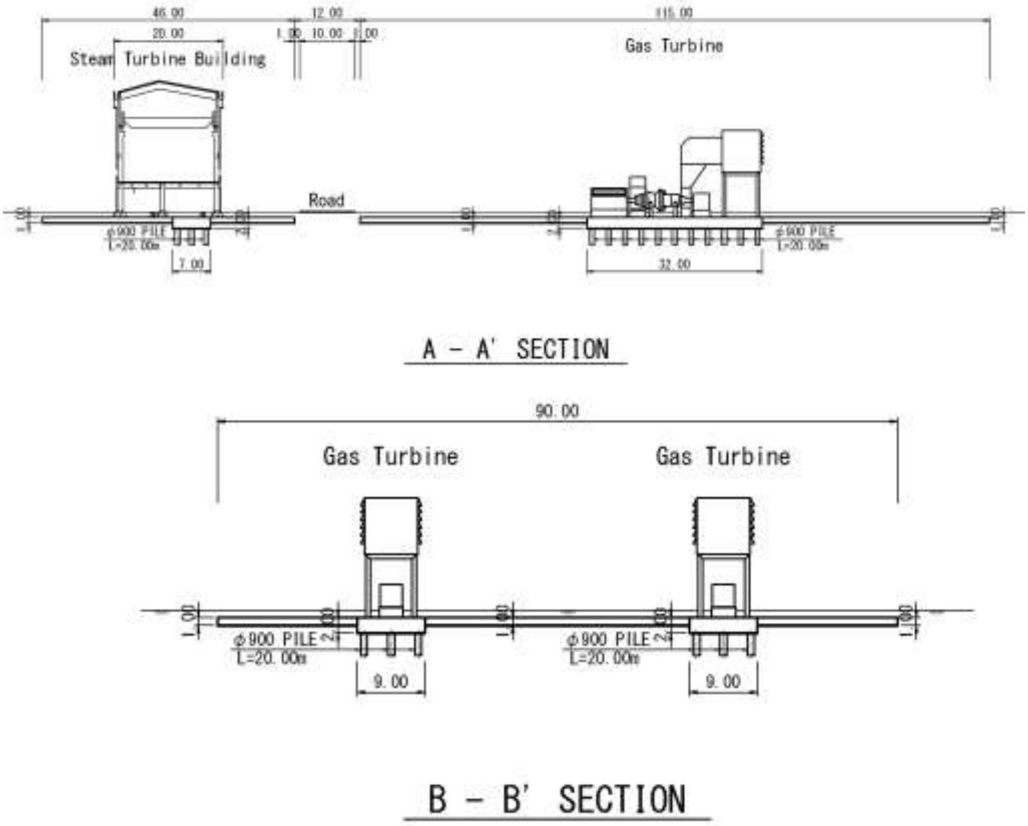


Figure 2-27 Draft Design of Foundation for GT and ST

Source: JICA Study Team, 2018

Construction of Intake and Discharge Structures

The construction of the intake pipe is divided into two sections: 220 meters onshore and 150 meters offshore.

In order to install intake pipe offshore and intake tower, Temporary Cofferdam Construction Method will applied to undertake foundation works underwater. Cofferdam is constructed in order to keep water out of the excavation area, and it consist of manufactured steel corrugated plates welded to each other. The bottom part of the cofferdam would be embedded up to one meter into the foundation rock layer. The overall height of the structure will be almost 20 meters.

Excavation inside the steel sheet piles is done using heavy equipment such as pile drivers, cranes with clamshell buckets and so on. Excavated soil from sea bed is placed in the vicinity temporarily and used as backfill soil. When crushed stone is necessary for installing the intake pipe, it needs to be transferred from the dump truck to the barge ship using the beaching road, as there is no unloading place around the site. Images of construction method are shown in ***Figure 2-28***.

Source: Japan Press-in Association
URL: http://www.atsunyu.gr.jp/

Source: Okamura Co., LTD

Figure 2-28 Sheet Pilling and Crane with Clamshell Bucket (Image)

Construction on the discharge structure is done in the order of water discharge port and water discharge pipe. Excavation / flattening of offshore section is done using clamshell buckets, and the excavated soil is temporarily placed in the vicinity and used as backfill. The construction method for the discharge pipe will be applied based on the condition of sea floor geology.

Working drawing of excavation on the onshore section including a part of intake and discharge port is shown in ***Figure 2-29***, and it is excavated with a slope of 1: 1 and a small step is made at every 5 m depth.

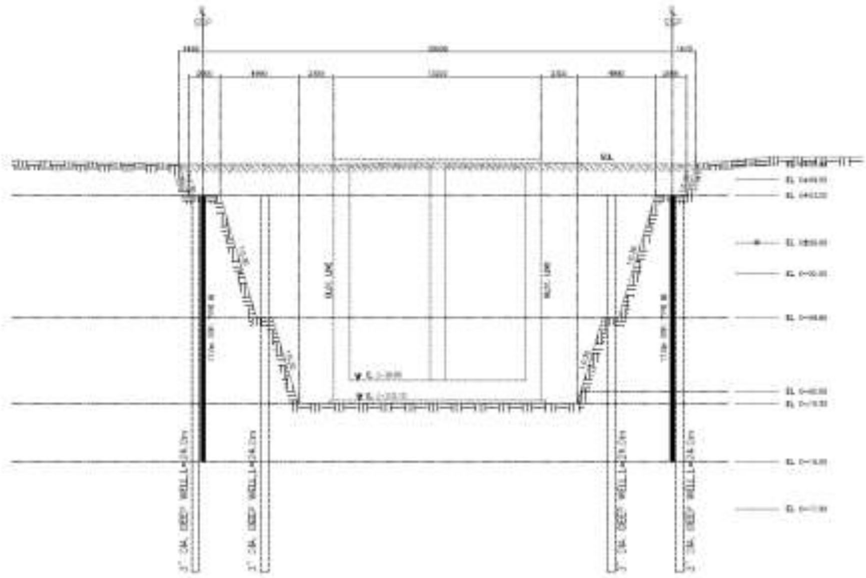


Figure 2-29 Working Drawing of Water Intake/ Discharge Port (draft)

Source: JICA Study Team, 2018

On Site Facilities

During construction, the following facilities will be installed at the laydown area:

- Concrete batching plant
- Waste incinerator
- Septic tank
- Wastewater treatment plant

General wastes such as paper, wood are expected to be incinerated during the construction phase.

Material Requirements

For the construction of the power plant and its associated facilities, an estimate of construction materials will be required and where these will be sourced are provided in ***Table 2-7***.

For the procurement of construction material, two quarry companies with necessary permits are identified near the project site. One is located about 30km to the west supplying low grade aggregate and the other one is located about 90km to the west supplying high grade aggregate.

Table 2-7 Construction Material Requirements

Material	Amount	Source
Concrete	26,000 m^3	Concrete plant near the construction site
Sand	9,360 m^3	Sourced within Tanzania
Aggregate	11,378 m^3	Sourced in Tanzania
Cement	3,380 m^3	Sourced in Tanzania
Water	4,862 ton	Sourced in Tanzania
Soil for construction	143,000 m^3	Excavated soil, soil brought in to the site
Reinforcing steel	3,120 ton	Sourced in Tanzania and from another country

Source: JICA Study Team, 2018

Manpower

It is estimated that a minimum construction workforce is estimated 50 to 100 workers, and the maximum construction workforce is estimated 400 to 1,100 workers.

To accommodate workers required during construction, temporary workers' camps will be built on the area allocated for GTCC No. 2 in the Project Site Layout (refer to ***Figure 2-5***).

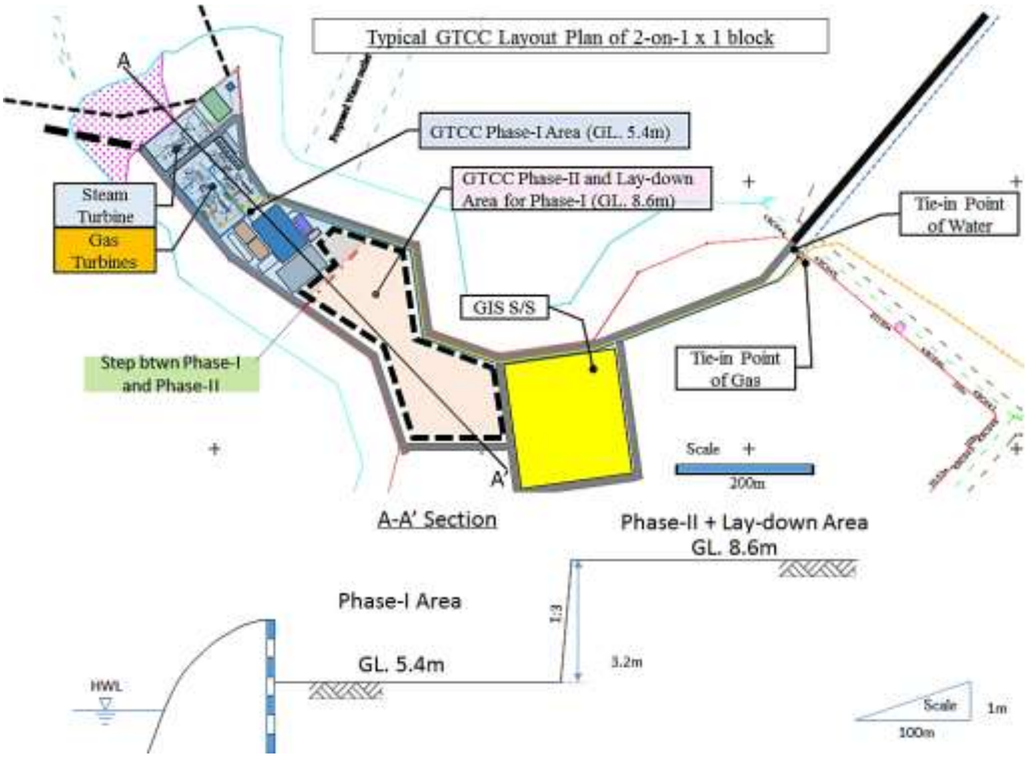


Figure 2-30 Layout and Sectional View of Project Phase I and Phase II Areas

Source: JICA Study Team, 2018

Waste

Solid and liquid waste will be generated from construction works mainly from site clearance and material leftovers such as unused concrete. During the land levelling activities, excavated soil amount of 340,000m^3 will be generated. All the excavated soil will be utilized for filling within the site.

In terms of wastewater, the approximate number of people onsite during the construction phase is expected to be approximately 1,100 people per day during peak period. Assuming 100 L/person/day of water consumption, and considering sanitary wastewater production to be 80% of water consumption per person (for non-continuous use), this equates to the production of 88,000 litres of sanitary wastewater daily. Septic tanks will be installed to store and treat septage. The type and design of the septic tank will be decided once the contractor has been decided.

The modern sanitary landfill with modern equipment at Mang'amba area in Mtwara Urban is being considered as a waste disposal site for the project.

Construction Schedule

The construction periods are effected by the transportation distance & easiness, the site conditions, etc. As the short time case, the construction period of GT is estimated to take 22 months, and that of GTCC is estimated to take 32 months.

2.4.3 *Operation phase*

Manpower

It is estimated that around 80 to 90 full-time workers will be employed during the operation of the power plant.

Fuel Supply

The power plant will use natural gas as fuel. The composition and properties of the gas which will be supplied to the Project Site from the Mnazi Bay gas field are presented in ***Table 2-8***. Assuming that this gas will be used at the Project Site, fuel feed rate will be approximately 1.7 MMscf per hour, 40.7 MMscfd and 14.8 Bscf per year will be needed.

Table 2-8 Gas Composition and Properties of Natural Gas Feed

No.	Parameter/Component Characteristic	Quality Standard Limits or Range
1.	Methane	87.0 - 99.0 mol.%
2.	Ethane	1.8 - 5.1 mol. %
3.	Propane	0.1 - 1.5 mol. %
4.	Inert gases	Max. 7.0 mol. %
5.	Carbon Dioxide	Max. 4.0 mol. %
6.	Oxygen	Max. 0.2 mol. %
7.	Nitrogen	Max. 5.6 mol. %
8.	Hydrogen Sulphide	Max. 5.7 mg/m^3
9.	Total Sulphur	Max. 10.0 mg/m^3
10.	Water	Max. 73.0 mg/m^3
11.	Hydrocarbon DewPoint	Max. 2.0°C at 3500 kPa
12.	High Heating Value	35.1 – 42.3 MJ/m^3
13.	Wobbe Index	41.0 - 52.0 MJ/m^3
14.	Specific Gravity	0.57 – 0.62
15.	Temperature limits	2.0 – 50°C
16.	Mercaptan Sulphur	Max. 5.0 mg/m^3

Source: TPDC, 2016

Natural gas will be supplied by the Tanzania Petroleum Development Corporation (TPDC) through a gas pipeline that connects to gas valve station No.1. (BVS 01) of the existing gas pipeline from Mnazi Bay to Dar es Salaam. The gas pipeline that would connect to the Project will be approximately 16 km in length. TPDC will take all responsibility for the new gas pipeline construction, operation and maintenance. The proposed pipeline route is presented in ***Figure 2-31***.

ESIA study for the gas pipeline was conducted separately by TPDC and EIA report has been developed.

The new gas pipeline for the Project Site will be constructed exclusively for the Project. Therefore, gas supply will not be available for the consumption of other neighbouring facilities and villages.

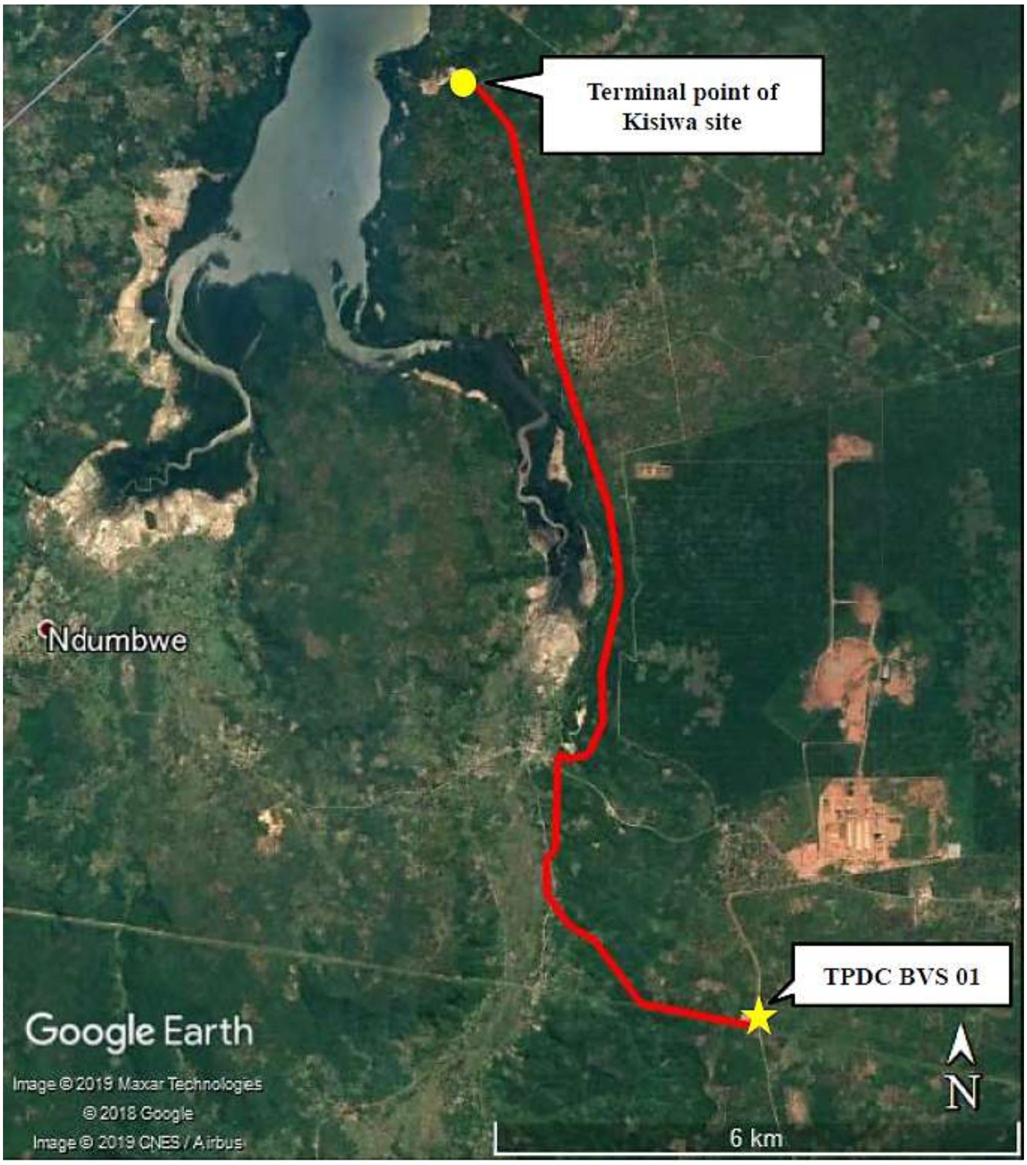


Figure 2-31 Proposed Gas Pipeline Route

Source: JICA Study Team, 2018

In order to adjust gas condition for firing in Gas turbine, the fuel gas supply system will have the following devices:

- Shut-off valves
- Flow meter
- Separators for removing foreign substance
- Gas compressor or gas pressure reducing facility (If necessary)
- Gas heaters (If necessary)
- Gas flow and pressure regulating systems
- Gas detectors
- Fire extinguish system
- Gas sampling systems (if required)

These devices will be installed in the northeast of the Project Site. The specifications of these equipment will depend on turbine requirements and gas specification. The flow diagram of the gas supply system is shown in ***Figure***

2-32. Quality of treated gas will be confirmed by the GT supplier during the tendering period.

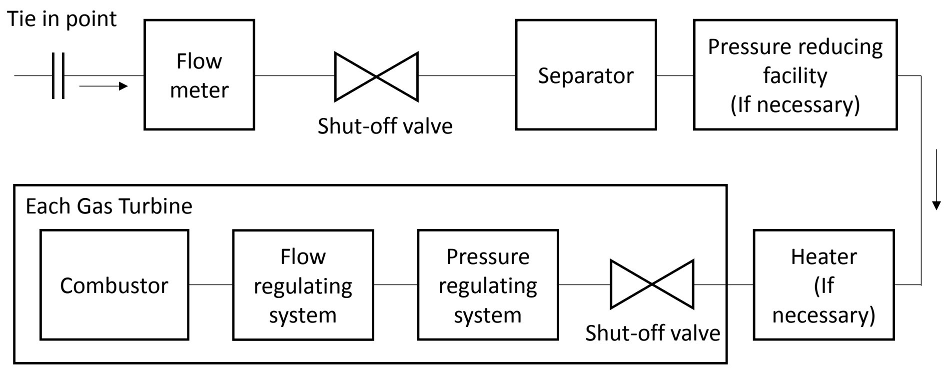


Figure 2-32 Preliminary Flow Diagram of Gas Supply System

Source: JICA Study Team, 2018

Water supply

The Project would require approximately 300m³/day of water supply, which will be used for boiler (demineralized water), cooling system, closed circuit and water washing, fire-fighting, among others. The proposed water supply will be provided by the Mtwara Urban Water Supply and Sewerage Authority (MTUWASA), which is implementing a development project for the wells located near Mbuo River. Three (3) wells will be developed in this project, and total water supply is expected at a rate of 1,850m³/day. MTUWASA has already developed two wells, and the present water supply volume is about 1,200m³/day. Currently, the water demand in Kisiwa village, etc. is about 400m³/day. The third well has been dug. It will be able to supply additional water upon installation of pump and pipes. Water supply volume of the third well is expected to be about 650m³/day.

TANESCO is fully responsible for the new pipeline construction, while MTUWASA will be in charge of its management, operation and maintenance. The route of the new pipeline to Project Site is still being finalized. ***Figure 2-33*** shows the proposed water pipeline route from the wells to the Project Site.

Figure 2-33 Proposed Water Supply Pipeline Route

Source: JICA Study Team, 2018

Wastes and Discharges

During operation phase, waste generation mainly associated with the planned warehouse packaging material and chemical residues etc. are expected as below.

Expected wastes that will be generated during the power plant operation include:

- Maintenance waste from construction
- Maintenance (paint residue, etc)
- Metal cut offs from machinery workshop, etc.
- Packaging materials (card board, wood and barrels)
- General wastes from offices (paper, used fluorescent lights), etc.
- Sanitary waste
- Oily sludge from oil filters for air intake
- Chemicals from warehouse

An overview of wastes that will be generated, its approximate amount, and waste disposal methods is provided in ***Table 2-9***.

Table 2-9 Potential wastes from the power plant during operation

Type of waste	Waste amount	Treatment	Final waste disposal
Waste oil	10 tons/yr	Store in drums and transport it to outside the site	Certified waste disposal contractor
Metal scraps	20 tons/yr	Collect at the site and transport by truck to outside the site	Handover to recycling centers
Glass/ceramic scraps	170 tons/yr		
Plastics	10 tons/yr		
General waste	7 tons/month		Certified waste disposal contractor
Sewage sludge	220 m^3/yr		Certified waste disposal contractor

Source: JICA Study Team, 2018

Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows:

Table 2-10 Amount of wastewater from the project

Type of waste water	Amount (m^3 per day)	Sent to/ Treatment method
Process wastewater (laboratory wastewater & HRSG make-up water)	110	Discharge to sea after treatment
Chemical Wastewater	15	
Wastewater from Demineralizer	60	
Domestic wastewater	80	Treat in septic tanks

Source: JICA Study Team, 2018

2.4.4 *Decommissioning phase*

During this phase the main issues will involve demolition of the facilities such as power plant facilities, staff quarters and storage facilities. When the power plant becomes unusable from reasons, decommissioning of the power plant may be carried out in the Environmental and social Management Plan to be made as a part of the Environmental Impact Assessment report. Therefore, dismantling of the unusable equipment will be carried out ready for removal from site and any other buildings and structures which can be used by others for other activities such as offices will be left behind and handed over to new users during the final years of the project. The main issues of concern will be removal and handling of cleared materials (rubbles). Others issues include noise and dust level due to demolition of structures and restoration of the area.

2.5 *PROJECT BOUNDARIES*

Determining the boundaries within which the ESIA will be undertaken is an important process in the ESIA since this determine the extent in which the impacts will be experienced. Designation of boundaries focuses and bound the impacts to where they are likely to be felt on the biophysical environment, social, legal and the local economy. Three types of boundaries were considered i.e. institutional, temporal and spatial boundaries as elaborated in the following paragraphs.

2.5.1 *Institutional boundaries*

These refer to institutions and sectors in which the project lies or interacts. They were determined in terms of political, legal, regulatory and/or institutional mandates and administrative structures. The proposed project development is about thermal power generation at Kisiwa village utilizing natural gas from Mnazi bay, Mtwara district in Mtwara region. This development touches the interests of national institutions such as TPDC, TANESCO, EWURA and TANROADS; administrative units (Mtwara Regional Secretariat, Mtwara District Council, Village Governments of Kisiwa Village, Namgogoli, Mgao, and Naumbu are likely to be of interest to this EIA.

Similarly sector ministries such as Ministry of Energy, Ministry Livestock and Fisheries, Ministry of Natural Resources and Tourism, Ministry of Water and Irrigation; Ministry of Labor, Employment and Youth Development and Ministry of Lands, Housing and Human Settlement Development. In addition to the sector ministries there international institution with interest to the proposed development. These institutions will be consulted to get their view on the proposed development.

2.5.2 *Temporal boundaries*

These refer to the lifespan of the project and reversibility of impacts associated with the proposed project development and operation. For example, the impacts may be either short-lived or long term, reversible or irreversible, with implications stretching far into the future. Consideration is also given to what happens when the project ends i.e. decommissioning and the cumulative effects associated with this and several other power projects within the locality and those activities that the power generation will feed into.

2.5.3 *Spatial boundaries*

The thermal power generation at Kisiwa Village will have implications that could be felt locally, regionally, nationally and internationally. For example, natural gas from Mnazi bay will be fed into the thermal plant to generate electricity that will be fed into national grid and utilized elsewhere within the country. The thermal power plant on the other hand, will require equipment and machines imported from outside Tanzania, thus creating benefits to the supplying countries as well. Similarly the technical assistance during construction and operation of the plant may come from outside the country to enhance knowledge transfer and training for sustainability of plant

However, in determining the spatial dimension of the ESIA, it is important to consider impacts in a form similar to a contour layout, starting with the core impact area. This is the area where the actual plant will be located and where the electricity will be generated and auxiliary infrastructure are actually located and, which would bear the most impacts than the rest. In this case, the core impact area will be the Kisiwa village where the thermal plant and all associated infrastructure, substation and water pipeline for uptake and discharging will be located. The gas pipeline connecting the proposed plant from the TPDC connection valve will be located in different village and traversing a number of villages including Namgogoli. Therefore this area will constitute the core project area and it is anticipated that major adverse impacts are likely to be higher on this sub village.

The gas pipeline connecting the proposed plant from the TPDC connection valve will be located in different village and traversing a number of villages including Namgogoli. Therefore this area will constitute the core project area and it is anticipated that major adverse impacts are likely to be higher on this sub village. This ESIA however, does not cover issues associcted with pipel line development. TPDC conducted a seprate ESIA for this component.

This core impact area is surrounded by an immediate impact area, an area that is outside the core area but plays an important role or bears relatively some of the impacts (positive or negative) felt in the core area. The immediate impact area in the case of the proposed thermal power generation project would include the villages around the plant where most of the labour force, food and goods are likely to come from. These villages include Mgao, Namgogoli, Naumbu, Mikindani, Mnazi mmoja, Mingoyo,Mtwara town and even Lindi town. Other such areas include towns like Dar es Salaam City. The latter areas will be linked with the proposed development project through power transmission, road transport, supply of goods and services as well as labour force.

The more outer spatial dimension for this proposed project is the area of influence that consists of centers of decision-making that can influence the development of the proposed thermal power generation project. These centers of decision – making include Dar es Salaam, the commercial city in Tanzania and Dodoma the capital City of Tanzania and headquarters for the relevant stakeholder ministries and other sector institutions; also included under area of influence is Mtwara town the regional headquarters

3 ADMINISTRATIVE FRAMEWORK: POLICY, LEGISLATION, INTERNATIONAL GUIDELINES

3.1 INTRODUCTION

The proposed power plant project and its associated support services will have both positive and negative impacts on the ecological, economic and social environment. As a result, there is need to ensure that throughout the life of the project, there is compliance with relevant national polices, legislations, administrative frameworks and standards on the management of the environment. Tanzania has also ratified several international agreements and conventions on environmental management, which demand interventions in, project planning, construction and operation. Also, others policies such as from the IFC and World Bank Policies and JICA guiding energy projects, need to be taken into account. Below is a review of the policies and laws that are relevant to the proposed development.

3.2 POLICIES RELATED TO THE PROJECT

The proposed Thermal Power Plant development in Mtwara will have implications to several policies. Below is a brief description of some of the relevant policies that the project will touch upon and which have to be adhered to for guidance.

National Energy Policy, 2015

The main objective of the National Energy Policy of 2015 is to provide a framework for the sustainable use of energy resources to ensure optimal benefits to Tanzanians and to contribute towards the transformation of the national economy. The Energy Policy of 2015 stipulates the promotion of energy development through the use of diverse energy sources. It also covers cross cutting issues related to governance, sustainability, economic tools, and social and environmental considerations.

The proposed Project will take into account the provisions of this Policy to ensure that its activities and its operation will be implemented in an environmentally and socially acceptable way.

The National Natural Gas Policy, 2013

The National Natural Gas Policy provides a comprehensive framework for promoting and enhancing natural gas development in the country. The Policy seeks to maximize benefits through optimization of value chain which includes mid and downstream activities. The Policy aims to ensure that natural gas development is conducted.

Objectives that are relevant to this project include:

- To ensure the reliability of natural gas supply;

- To promote linkages between the natural gas industry with other strategic sectors of the economy;
- To substantially improve Corporate Social Responsibility in communities neighboring natural gas facilities and operations;
- To promote rational use of natural gas in all sectors of the economy;
- To ensure compliance with Health, Safety and Environment standards in the natural gas value chain;
- To ensure that development of natural gas industry regionally and internationally benefits Tanzania;
- To support activities in the natural gas industry based on gender issues and addressing HIV/AIDS and other infectious diseases;
- To ensure maximization of benefits from the natural gas industry through PPP projects.

The proposed development will take into account some of the objectives of this policy.

Sustainable Industrial Development Policy – SIDP, 1996

Sustainable Industrial Development Policy-SIDP (1996- 2020) (URT, 1996) is a framework for Tanzania's industrialization process within the short, medium and long terms perspectives. The main objectives of the SIDP include human development and creation of employment opportunities; economic transformation for achieving sustainable economic growth; external balance of payments; environmental sustainability ad equitable development (URT, 1996).

The proposed power development at Kisiwa, Mtwara District will support the objectives of this policy, which also recognizes the need for EIA prior to implementation of the projects. (*ibid*: 39).

National Environmental Policy, 1997

The National Environmental Policy of 1997 outlines six major environmental problems that include loss of wildlife habitats and biodiversity, environmental pollution, land degradation and deforestation (URT, 1997). The Policy stipulates that an EIA shall be mandatory for all major projects to ensure that environmental concerns receive due and balanced consideration in reconciling urgent development needs with long-term environmental sustainability goals. The proposed project of thermal power generation will have to be developed taking into account the requirements of this policy, particularly issues related to air pollution.

National Land Policy, 1995

The overall aim of the National Land Policy (URT, 1995) is to address the various and ever-changing land use needs and "to promote and ensure a secure land tenure system, to encourage the optimal use of land resources and to facilitate broad-based social and economic development without endangering the ecological balance of the environment (ibid: 5). Specific objectives that are relevant to the project include:

- Ensure that existing rights in land especially customary rights of small holders (i.e. peasants and herdsmen who are the majority of the land users in the area are recognized, clarified, and secured in law;
- Ensure that land is put to its most productive use to promote rapid social and economic development of the country;
- Protect land resources from degradation for sustainable development.

The Project will require land, and therefore this policy will be relevant to this proposed development.

Small and Medium Enterprises Development Policy, 2003

The Small and Medium Enterprises Development Policy (SMEDP) (URT, 2003) harmonizes the role of informal sector that constitute the bulk of the SMEs in Tanzania. The main objective of the SMEDP is to foster job creation and income generation through promoting the creation of new SMEs and improving the performance and competitiveness of existing ones to increase their participation and contribution to the Tanzania economy" (URT, 2003: 16). The Policy defines SME as entities mainly based on non-farm economic activities in manufacturing, mining, commerce and services, employing between 5 - 99 people with capital investment of Tshs. 5 million to 800 million (*ibid*: 4).

The proposed thermal power development in Mtwara District is likely to stimulate growth and spread of SMEs, that may be engaged in a variety of activities, including service provision.

Community Development Policy, 1996

The Community Development Policy (URT, 1996) underscores the problems that communities in Tanzania are facing, including underdevelopment and notes that people must be enabled to develop their capacity to identify problems and develop ways of tackling them. The proposed development will have major implications on community development in terms of providing power that can stimulating growth in various sectors of the economy and improve human welfare and livelihoods.

Water Policy, 2002

The main objective of the National Water Policy of 2002 is to develop a comprehensive framework for sustainable development and management of the Nation's water resources and putting in place an effective legal and institutional framework for its implementation (URT, 2002).

The Policy recognizes the fundamental but intricate linkages between water and socio-economic development, including environmental services. The proposed development will put additional demand on water in an area where already, water is a very scarce resource. This EIA will examine water demand and supply issues for the proposed development in relation to available resources, other users and address the implications of water demand arising from the establishment of gas powered thermal plant at Kisiwa.

The Wildlife Policy of Tanzania, 2007

The Wildlife Policy of Tanzania promotes the sustainable conservation of wildlife and wetland resources (URT, 2007). The overall objectives of the Policy are (a) Protection and conservation of wildlife and wetlands (b) Sustainable utilization of wildlife and wetlands (c) Management and development of wildlife and wetland resources (d) Strengthen resource monitoring and research (e) Enhance communication, education and public awareness (f) Coordinate implementation of the policy and, (g) Foster regional and international cooperation (URT, 2007: 19 - 41). The policy recognizes the importance of EIA as a tool that can support wise use of the resource. The proposed site for the thermal plant does not have any large mammal remaining in the area, with the exception of small mammals and reptile, that too have to be taken into account when developing and implementing the project; therefore, the requirements of this policy will be taken into account.

The National Forestry Policy, 1998

The main objectives of the Policy includes sustainable supply of forest products and services by maintaining sufficient forest area under effective management; increased employment and foreign exchange earnings, ecosystem sustainability through forest conservation, enhanced national capacity to manage forest sector (URT, 1998:14).

The Forest Policy recognizes that investment projects in forest areas may cause adverse environmental impacts. EIA must be conducted in order to ensure damage to the environment is avoided and possible mitigation measures are provided. Although there are no forest with the conservation status in the proposed site, remnants of trees and shrubs are likely to be affected by this development and some of them may be of valuable nature and these will have to be taken into account.

The National Strategy for Growth and Reduction of Poverty (NSGRP II), 2010

Tanzania adopted the first National Strategy for Growth and Reduction of Poverty (NSGRP), in early February 2005. In 2010 it was reviewed and the current second version, was to be implemented from 2010/11 and 2014/15. The NSGRP II makes linkages with Vision 2025 and is committed to Sustainable Development Goals (SDGs) as internationally agreed targets for reducing poverty. The NSGRP II aims to reduce poverty through three broad outcomes: growth and reduction of income poverty; improved quality of life and social well being; and good governance and accountability.

The proposed development is responding to the NSGRP II by investing in an energy supply, which will contribute to fueling the economy. Issues such as availability of reliable and affordable power not just for the industrial areas but also to local people as well as other sectors will be fulfilled through this project and the contribution of this project to economic and social development will be explored in this EIA.

The National Employment Policy, 2008

The National Employment Policy (2008) aims to identify potential areas for employment and to lay down strategies of how to utilize such opportunities in promoting employment in the country. The proposed Project provides avenues for employment opportunity and thus supports the national employment policy. Employment opportunities arising from this Project should be extended to all people in terms of skills, numbers and groups (youths, women and others as per the Policy).

Other Relevant Policies

Other relevant policies include the following:
- Gender Policy, 2000;
- HIV and AIDS Policy, 2001;
- National Health Policy, 2001;
- Construction Policy, 2003; and
- Investment Policy, 1996.

By implementing the EMP based on the result of this EIA, the proposed project will be in line with the objectives of the above-mentioned policies.

3.3 APPLICABLE LAWS TO THE PROJECT

3.3.1 Environmental Laws

The Environmental Management Act, 2004

The Environmental Management Act No 20.of 2004 (Cap 191) (URT, 2004) provide comprehensive environmental framework that is intended to streamline management of the environment in Tanzania. Part VI of this Act and in particular Section 81- 103 provides the requirements for EIA and critical aspects that have to be adhered to when undertaking EIAs in Tanzania. The Act makes EIAs mandatory prior to the development of any project. The Act is directly relevant to the proposed development as it calls for full and detailed environmental assessments for such projects.

The Water Resources Management Act, 2009

The Water Resources Management Act, 2009 (URT, 2009) provides a framework for the management and utilization of water, taking into account domestic, social, industrial and environmental needs. The Act provides principles and objectives of Water Resources Management, which includes among others (a) meeting the basic human needs of present and future generation (b) promoting equitable access to water (c) promoting the efficient, sustainable and beneficial use of water in the public interest (e) protecting biodiversity, especially the aquatic ecosystem (f) providing a system for the management of the resources and implementation of international obligations.

The Act directs the need to apply and pay all required fees for water utilization permits. It also directs the adoption of integrated water resource management approaches and the application of principles such as (a) precautionary principle (b) polluter pays principle (c) the principle of ecosystem integrity, to mention some.

The proposed development will be located in areas that might result to polluting water bodies (underground or surface run off) and it will also require water for its operations and therefore, the provisions of this Act will be taken into account in order to safeguard this scarce resource.

The Forest Act, 2002

The Forest Act, (No.14), (URT, 2002) provides for the management of forests in order to enhance the contribution of the forest sector to the development of Tanzania and the conservation and management of natural resources. Also, the legislation fosters ecosystem stability through conservation of the forest biodiversity, water catchments and soil fertility. The site for the proposed development does not have a forest as such but, that development may trigger pressure on nearby forest areas leading to clearing of trees. The provision of this Act in terms of forest conservation will be addressed in this EIA.

The Electricity Act, 2008

The Electricity Act (URT, 2008) provides for the facilitation and regulation of generation, transmission, transformation, distribution, supply and use of electric energy and to support to broader trade in electricity and the planning and regulation of rural electrification and related matters (URT, 2008).

The Act provides requirements for obtaining licenses for (a) generation (b) transmission (c) distribution (d) supply, (e) physical and financial trade in electricity and electrical installation (URT, 2008). Any person intending to conduct any of the activities stipulated in Subsection 1 of Section 8 of this Act must apply for a license to the Energy and Water Utilization Regulatory Authority (EWURA).

The Wildlife Conservation Act, 2009

The Wildlife Conservation Act (URT, 2009) provides for the management and utilization of wildlife resources in Tanzania. Part 11, Section 5 (1) (a-m) of the WCA specifies the objectives of the Act, which include among others (a) To protect and conserve and administer areas with great biodiversity, including wetlands. (b) Protect and conserve wildlife resources and its habitats. It defines Wildlife Areas, which comprise of the following:

- Game reserves, wetland reserves, game controlled areas,
- Wildlife corridors, Dispersal Area, Buffer Zones, and Migratory Routes
- Species Management Area

The Act also stipulates provisions for Wildlife Management Areas, its management measures, restrictions, and penalties.

The Act stipulates various provisions including making it illegal for any off take of wildlife resources that is not regulated or authorized. It calls for the adoption of management tools such as management plans; environmental impact assessment, wildlife impact assessment and environmental auditing and monitoring in case development is taking place in wildlife resource areas. Wildlife in this Act includes large and small mammals, reptiles and the habitat in which these are found.

The Ministry of Natural Resources and Tourism is responsible for implementing this Act. The provisions of this Act will be addressed in this EIA.

3.3.2 Land-related Laws

The Land Act and Village Land Act, 1999

The Land Act 1999 (Act No 4 of 1999) and the Village Land Act 1999 (Act No 5 of 1999) (URT, 1999) provides the legal framework for the implementation of the Land Policy. The two Acts addresses various issues including defining the legal framework for land tenure system, and how land could be used for social and economic development. The Acts also defines issues of land acquisition and compensation to affected people. The Village Land Act addresses land tenure issues with specific reference to land within the village jurisdictions, defining tenure, access and use of such land as well as responsibility for management of the land. The proposed development will require land and therefore the provisions of this Act will be taken into account.

The Land Regulations, 2001

Five regulations are relevant to this project as follows:

- The Land (Compensation Claims) Regulations, 2001;
- The Land (Assessment of Value of Land for Compensation) Regulations, 2001;
- The Land (Allocation Committees) Regulations, 2001;
- The Land (Conditions of Right of Occupancy) Regulations, 2001; and
- The Land (Disposition of Right of Occupancy) Regulations, 2001.

The Project proponent will have to comply with these regulations during the assessment of any land value, relocation, resettlement and compensation processes.

The Land Acquisition Act, 1967

The Land Acquisition Act, (Act No. 47 of 1967) provide for compulsory acquisition of land for public interest and in connection with development aspects. Part II (b) of the Act refers to issues related to compensation and procedures that have to be followed when land is acquired. These procedures are also outlined in the Regulation for the Land Act and include issues of fair and prompt compensation to affected persons. The proposed development will need land for its development therefore; the provision of this Act will have to be taken into account in this EIA.

The National Land Use Planning Commission Act, 1984

The National Land Use Planning Commission Act, (No.3), 1984, established the National Land Use Planning Commission (NLUPC), as the principal advisory organ of the Government on all matters related to land use. The NLUPC is responsible for ensuring that land resources are used in sustainable manner taking into account the need for land use plans.

The proposed development might trigger land use conflicts resulting from increased pressure on land as a result of acquiring the land that is set aside for the power plant which is currently being sued by farmers and livestock keepers. Theses current and users will have to be reallocated to other lands and in the absence of a land use plan; conflicts might emerge and cause social and economic issues. The need for undertaking land use planning prior to acquiring the said land will be stressed in this EIA.

Town and Country Planning Ordinance (Cap 378 if 1958)

This ordinance establishes systems and procedures to control of development through planning areas and schemes. It stipulates requirements for land acquisition and compensation (including valuation of land and lodging of claims). The Project needs to acquire the area of the project site. It will abide by the provisions of this Ordinance.

3.3.3 Health and Safety Laws

The Occupation Health and Safety Act (OSHA Act)

The Occupation Health and Safety Act, (No. 5) (2003), deals with issues related to health and safety of workers in industrial areas. Under the Act, the Minister responsible for Labour shall appoint the Chief Inspector (CI) to perform the functions stipulated in the Act. Specific provisions of the OSHA Act – namely Section 21, 60, 61, 73-75 and 96 must be fully addressed in order to comply with this legal requirement.

The Act addresses issues of safe equipment, provision of personal protective equipment and a clean and safe work environment (e.g. provision of regular medical examination, air, drinking water, sanitary convenience, washing facilities, accommodation for clothing, first aid facilities: including safety training etc.).

The proposed development should operate within the requirements of this Act in additional to those of the Electricity Act and others as outlined in this section.

The HIV and AIDS (Prevention and Control) Act, 2008

This Act provides for: prevention, treatment, care, and control of HIV and AIDS; promotion of public health in relation to HIV and AIDS; appropriate treatment, care and support using available resources to those people living with or at the risk of HIV and AIDS; and related matters.

The Act also provides for the requirement of public education and programmes on HIV and AIDS. Section 8(1) of the Act states that the Ministry of Health and Social Welfare, health practitioners, workers in the public and private sectors and NGOs are required, for the purpose of providing HIV and AIDS education to the public, to disseminate information regarding HIV and AIDS to the public. Furthermore, Section 9 states that every employer, in consultation with the Ministry of Health and Social Welfare, shall establish and coordinate a workplace programme on HIV and AIDS for employees under his control and that such programmes shall include provision of gender-responsive HIV and AIDS education.

The provision of this Act should be followed during the various stages of the project development in view of its potential to create conditions where such HIV/AIDS transmissions are likely to occur.

The Employment and Labour Relations Act, 2004

This Act makes provision for: core labour rights to establish basic employment standards; a framework for collective bargaining: and the prevention and settlement of disputes and related matters. The Project proponent shall ensure that the employment standards as provided for by the Act are adhered to.

The Workers Compensation Act, 2015

This Act provides for compensation to workers for injuries suffered in the course of their employment, which result in disablement or death. Part II section 5 of the Act establish the Fund for administration and regulation of workers' compensation. This Act needs to be complied with as Project workers will be exposed to various dangerous and hazardous environments during project implementation.

The Public Health Act 2009

This Act is the overarching law that promotes the preservation and maintenance of public health. It stipulates requirements for waste management (solid, liquid, gas) including human wastes, hazardous wastes, sewerage and drainage in order to ensure the health and safety of workers and communities. It also covers the welfare and health of workers and stipulates monitoring and maintenance of workplaces and routine medical examinations.

This Act applies to the Project since project activities will generate impacts that may impact and pose risks to the health and safety of workers and neighboring communities. The Project proponent shall ensure that provision in this Act are adhered to.

The Water Supply and Sanitation Act 2009

This Act is aimed at providing sustainable, adequate and transparent water supply and sanitation services. It describes the functions and responsibilities of water supply and sanitation authorities (including Energy and Water Utilities Regulatory Authority) and stipulates requirements for national water supply and sanitation scheme. The Project will use water from MTUWASA-owned wells. TANESCO is fully responsible for the construction of the water pipeline that would connect to the project site, thus it has to comply with the provisions in this Act.

3.3.4 *Other related Laws*

The Energy and Water Utilities Regulatory Authority Act, 2003

The Energy and Water Utilities Regulatory Authority (EWURA) (Act # 11 of 2001 and # 8 of 2003 (URT, 2006) establishes a Regulatory Authority in relation to energy and water utilities and outlines its *modus –operandi.* The Authority is responsible for regulating energy development and water utilities in Tanzania and requires relevant developers to obtain permits and authorization from EWURA for any proposed development. The proposed development includes power generation, which requires permits. TANESCO as the main beneficiary has or is already allowed to establish and run such facilities in Tanzania and prior approval may not be necessary. In case, approval for this thermal plant is not available, due processes to obtain it must be started to ensure compliance with the requirements of this Act.

The Industrial and Consumers Chemicals (Management and Control) Act, 2003

The Industrial and Consumers Chemicals (Management and Control) Act No 3 of 2003 (URT, 2003) provides a legal framework for the management and control of industrial and consumer chemicals throughout their life cycle.

The law requires that all those persons who intends to produce, import, export, sale, deal in industrial and consumer chemicals must register with the Registrar of Industrial and Consumer Chemicals so that their capacities to manage chemicals can be assessed. The law also requires that facilities used in the production, storage disposal of chemicals and waste must be registered for the same reasons of ensuring that they are of sound designs and that are operated properly.

The proposed development will possibly be dealing with various chemicals that fall under this Act and the developer will thus be required to register with the Registrar of Industrial Chemicals and have the facilities inspected and regularly monitored as provided for under Part III and IV of the Act. The carrying out of this EIA in part meets the requirement of the Act.

The Antiquities Act 1974

This Act is aimed at preserving and protecting paleontological, archaeological, historical and naturally important sites and articles. It describes procedures and restrictions related to the discovery and protection of monuments, relics and protected objects. The Project may discover important relics or artifacts during the construction phase. In that case, the Project will follow procedures stipulated in this Act.

The Local Governments (District Authorities) Act, 1982

The Act requires the Registrar of Villages to register an area as a village and issue a Certificate of Incorporation to the village, which enables the Village Council to become a corporate body with a perpetual succession and official seal. In its corporate name, a village is capable of suing and being sued and is capable of holding, purchasing or acquiring in any other way any movable or immovable property.

The Mtwara District Council, which will be affected by this Project, have the mandate to intervene on any local issues that may be related to the project. These are issues such as access to water bodies for local use, settlement etc.

3.4 APPLICABLE REGULATIONS TO THE PROJECT

Environmental Impact Assessment and Audit Regulations, 2005

These Regulations were made in terms of Section 82 and 230 of the EMA (2004). The Regulations set procedures for carrying out EIAs and Environmental Audits (EAs). The Regulations are applicable to all projects contained in Third Schedule of the EMA (2004) and First Schedule of the Regulations. The Schedules list types of projects requiring EIA as well as those requiring project brief, project screening criteria, and steps for conducting EIA. *The steps enhanced further in the Environmental Management (Environmental Impact Assessment and Audit) (Subsidiary Legislation) Regulation, 2018 – GN 474.* The Regulations set out in detail the process to be followed in conducting an EIA, the form and content of EIAs, the review process, decision-making processes and appeals and also prescribes the stages and/or the EIA process, which are in principal managed by NEMC. The proposed power plant project falls under the projects requiring EIA i.e. as stated in paragraph 7 (a) and (b) paragraph of the Environmental Management (Environmental Impact Assessment and Audit) (Amendment) Regulation*, 2018*. It is thus a legally binding requirement to undertake the EIA of this Project. This EIA is responding to these EIA Regulations and highlight critical areas that require attention of the developer and other stakeholders.

The Environmental Management (Fee and Charges) (Amendment) Regulation, 2018

The Environmental Management (Fee and Charges) (Amendment) Regulations, 2018, which is read as one with the Environmental Management (Fee and Charges) Regulations, 2008, hereinafter referred to as the "principal Regulations" amended regulation 4 of the principal regulations specifically paragraph a, b, c and d. In addition the regulation stipulated plainly annual charges experts and developers need to abide. Thus this regulation is relevant to the project as both EIA experts and project developer need to abide. TANESCO shall need to abide among other things on Environmental Compliance Monitoring and Audit stipulated on regulation 3 which call for the project proponent to make sure pays Annual Charges for Environmental Monitoring and Audit. Furthermore the regulation particularly the annual charges for Energy Project as provided in item 7 of the Environmental Management (Fee and Charges) (Amendment) Regulation.

The Environmental Management (Control of Ozone Depleting Substances) Regulations, 2007

The Environmental Management (Control of Ozone Depleting Substances) Regulations, 2007 is applicable to

a) all persons dealing or otherwise handling or using controlled substances or products that contain, is made with or is dependent on, or designed to contain chemical substances that have the potential to destroy ozone molecules in the stratosphere and includes the products listed in the First Schedule to these Regulations;
b) every importer and distributor of ozone depleting substances
c) every importer of technology which uses ozone depleting substances
d) every company and individual who services refrigerators, air conditioners including mobile and other ozone depleting substances technologies
e) every company or an individual using or servicing fire extinguishers.

Part II of the regulation consider about prohibition and disposal of controlled substances or products. Specifically Regulation 5 require any person who manufactures, or imports or exports, sells, offers for sale or installs a controlled substance or product listed in the First and Second Schedules to these Regulations to have a license issued by the Director of Environment commits an offence. TANESCO should observe these regulations during importation of any ozone depleting substance or products.

According to regulation 34(1) it is an offence to imports or exports any controlled substance or product without a valid license issued under these Regulations. The Regulations is relevant to the proposed power transmission line and therefore TANESCO would need to abide to it.

Environmental (Registration of Environmental Experts) Regulations (2005)

It published in Government Notice No 348 of 2005, set out the objectives of the certification process, the establishment of the Environmental Experts Advisory Committee, the certification process for environmental experts, the registration process, the code of practice and disciplinary procedures. All certified environmental experts will be subject to the Code of Practice and Professional Ethics as prescribed in the Fifth Schedule of the applicable regulations. ESIA for the proposed Mtwara Power Plant is to be conducted by person or firm of experts registered and certified by the Registrar at NEMC.

3.4.1 The EIA Process in Tanzania

According to the First Schedule of the Environmental Impact Assessment and Audit Regulations of 2005, the following projects require EIA for the energy sector:

- Production and distribution of electricity, gas, steam, and geothermal energy
- Storage of natural gas
- Thermal power development
- Hydroelectric power
- Development of other large scale renewable and non-renewable sources of energy

An activity listed in the First Schedule of the EIA and Audit Regulations cannot proceed without obtaining the necessary license from the relevant licensing authority (line ministry). The licensing authority, however, will not issue a license without having first received an EIA Certificate from the NEMC. The Developer must commence with his/her authorized development within three years.

The EMA 2004 makes a provision of the EIA to be conducted at the national, sectoral or local government levels. Currently, all EIA projects are still being administrated at the national level. ***Figure 3-1*** shows an overview of the EIA process.

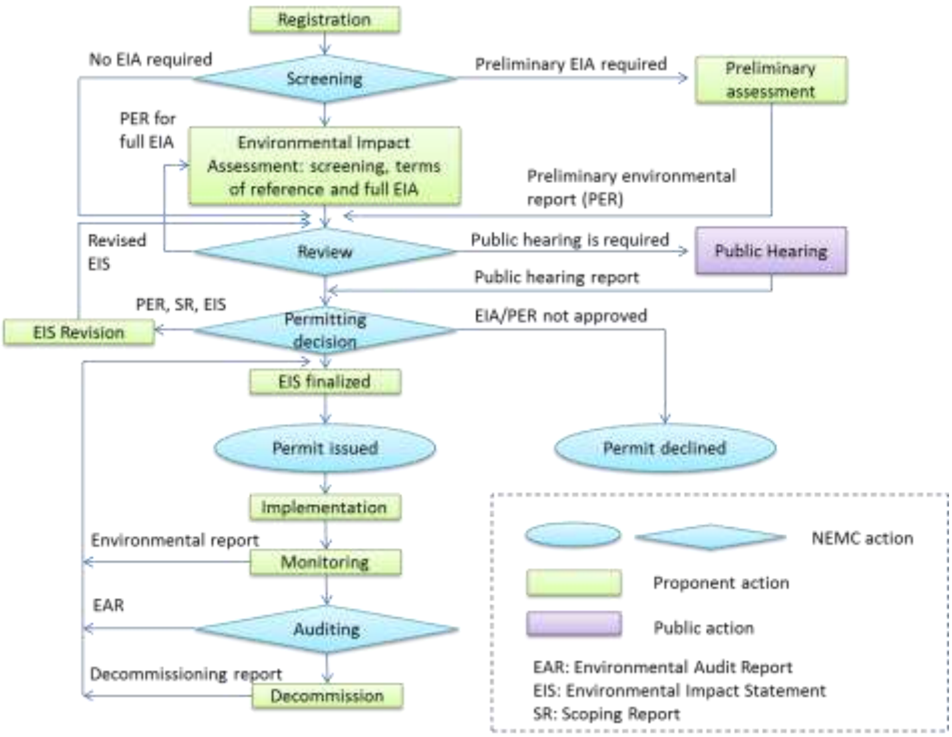


Figure 3-1 EIA Process Flow Diagram

Source: Energy Sector EIA guideline, MEM, 2012

Screening Phase

The proposed project must be registered with the National Environment Management Council (NEMC) to initiate the screening process. Registration is done by preparing and submitting to NEMC a project brief, that describes in brief the project, its scope and potential impacts and mitigation options, and filling in a project registration form. Screening is stage where NEMC determines the level of environmental assessment based on the screening criteria provided under Regulation 6 (1) of the EIA and Audit Regulations and its details provided under First Schedule of these Regulations. Level of environmental assessment is to determine if EIA is required for the project, or EIA is not required, or a preliminary environmental assessment is required.

Scoping Phase

This stage of the EIA process is intended to determine the scope of the study by defining the boundaries and the issues involved. The main objectives of this stage are:

- Development of appropriate study methods;
- Determination of spatial, temporal and institutional boundaries of the EIA study;
- Identification of relevant stakeholders;
- Identification and discussion of project alternatives and designs;
- Identification of the likely positive and negative impacts of the project;
- Identification of data requirements; and
- Development of Terms of References for undertaking a full EIA.

Detailed Impact Assessment

This stage will follow after NEMC has approved the Terms of Reference for this work that are submitted together with this scoping report. The Terms of reference provide details of the activities that have to be undertaken during detailed EIA.

Disclosure of the EIA Report

Disclosure of the project information helps affected people and other stakeholders understand the risks, impacts and opportunities associated with the project and is undertaken as part of the on-going stakeholder engagement. Thus, disclosure of the information will happen at different stages of the EIA process. For example, during the initial site visit, the scoping and detail EIA, access to relevant information will be provided to affected persons. More disclosure will happen when the draft EIA report will be submitted to NEMC and copies sent to various stakeholders for comments. This will provide opportunity to stakeholders to comment on the report and ensure their views are taken on board. The next disclosure will happen when the report is finalized and sent to Vice President's Office (VPO) for approval. At this stage the final report will be sent to various stakeholders including (in principle) the District Council that will have the information and understanding of the various issues addressed in the report. The copies will also have executive summaries in Kiswahili and English that will help stakeholders understand the issues contained in the report and mitigation measures.

NEMC or VPO does not as yet have a system of uploading EIA reports into their web sites, instead and according to the Environmental Management (Fee and Charges) (Amendment) Regulations, 2016, Government Notice #191 of 3rd June 2016, any person that want to access the EIA report for inspection and viewing will have to pay Tshs 15,000 and if they want to read they will pay Tshs 30,000.

3.4.2 *National Environmental Standards Compendium (NESC), 2009*

The National Environmental Standards Compendium (NESC) (URT, 2009) is a collection of various standards prepared at different times. The NESC consist of three parts. Part One comprises of standards that require compulsory compliance, which includes standards for industries with peculiar effect to the environment. Part Two consist of standards that may be implemented on voluntary basis. These include guidelines, codes of practice that can be enforced voluntarily by way of self – regulation. Part Three has the requisite test methods that should be followed when testing for compliance.

Although these are national standards, the NESC states that the standards "are to be reviewed independently to reflect sector specific needs as regulated by the National Environment Management Council". Most of the compulsory standards in the NESC are relevant to the proposed thermal power development project in Kilwa. These include standards such as:

(a) TZS 860 – 2005. Municipal and Industrial Wastewater – General Tolerance Limits for Municipal and Industrial Wastewater
(b) TZS 845 – 2005. Air Quality Specification
(c) EMDC 2 (1778). Air Quality – Vehicular Exhaust Emissions Limits
(d) EMDC (1777). Protection against ionizing radiation –Limits for Occupational Exposure
(e) EMDC 6 (1733) P2. Acoustics- General Tolerance Limits for Environmental Noise
(f) EMDC 5 (3453) - For hand arm and whole body vibration
(g) EMDC 5 (3454) – For vibration at sensitive site including residential areas (subsonic/air over) vibration.

This project will have to comply with those standards to safeguard the environment and the people.

3.4.3 *Applicable Environmental Standards*

Environmental Management Act (2004)-Related Regulations

The Project will be required to adhere to various provisions and standards stipulated in the regulations below in order to comply with Section 141 and Part IX of EMA (2004).

- Environmental Management (Air Quality Standards) Regulations, 2007;
- Environmental Management (Soil Quality Standards) Regulations, 2007;
- Environmental Management (Water Quality Standards) Regulations, 2007;
- Environmental Management (Solid Waste Management) Regulations, 2009; and
- Environmental Management (Hazardous Waste Control and Management) Regulations, 2009.
- The Environmental Management (Control of Ozone Depleting Substances) Regulations, 2007.

Air Quality Standards

Table 3-1 shows comparison of emission standards for thermal power stations and ***Table 3-2*** shows the comparison of ambient air quality standards between national and international ones. These will be applied to the Project.

Table 3-1 Comparison of emission standards for thermal power stations (mg/Nm³:O₂ 6% converted)

	Tanzanian regulation	IFC EHS GUIDELINES Natural Gas (all turbine types of Unit > 50MWth)
NOx	300 mg/Nm³	51 mg/Nm³ (25 ppm)

Source: Environmental Management (Air Quality Standards) Regulations, 2007, Tanzania
IFC, Environmental, Health, and Safety Guidelines (Thermal Power Plants) (December 2008)

Table 3-2 Comparison of ambient air quality standards

	Tanzanian regulation	IFC EHS GUIDELINES
NO_2	-	1-year: 40 (ug/m3) 1-hour:200(ug/m3)
NOx	24-hour: 150 (ug/Nm³) 8-hour:120 (ug/Nm³)	-

Source: Environmental Management (Air Quality Standards) Regulations, 2007, Tanzania
IFC, General Environmental, Health, and Safety Guidelines (2007)

Noise Standards

Table 3-3 shows the comparison of noise standards of Tanzanian regulation and IFC EHS guidelines. These will be applied to the Project

Table 3-3 Comparison of noise standards

	Tanzanian regulation (dB)		IFC EHS Guidelines (general) (dB)[1]	
	Industrial area	Residential building	Industrial area	Residential, institutional, educational
Daytime	70	50	70	55
Nighttime	60	35	70	45

Source: Environmental Management (Standards for the Control of Noise and Vibration Pollution) Regulations, 2015
IFC, Environmental, Health and Safety Guidelines (Thermal Power Plants) (December 2008)

Wastewater standards

Table 3-4 shows comparison of the wastewater quality standards of Tanzanian regulation and IFC EHS guidelines. These will be applied to the Project

[1] Daytime (7:00–22:00), Nighttime (22:00–7:00)

Table 3-4 Comparison of wastewater quality standards

	Tanzanian regulation PERMISSIBLE LIMITS FOR MUNICIPAL AND INDUSTRIAL EFFLUENTS	IFC EHS GUIDELINES
pH	6.5-8.5	6–9
Total suspended substances (SS)	100 mg/l	50
Oils	10	10
Total residual chlorine	-	0.2
Chrome (Cr)	1.0	0.5
Copper (Cu)	2.0	0.5
Iron (Fe)	5.0	1.0
Zinc (Zn)	5.0	1.0
Lead (Pb)	0.1	0.5
Cadmium (Cd)	0.1	0.1
Mercury (Hg)	0.005	0.005
Arsenic (As)	0.2	0.5
Temperature range	20 to 35	Temperature increase by thermal discharge from cooling system is to be Assessed in EIA

Source: Environmental Management (Water Quality Standards) Regulations, 2007, Tanzania
IFC, Environmental, Health, and Safety Guidelines (Thermal Power Plants) (December 2008)

Solid Waste Management

The Project will abide by the requirements of these Regulations, particularly

- Permit to transport solid waste
- Permit to dispose solid waste
- Duty to segregate waste at source
- Segregation and sorting of plastic wastes
- Storage of plastic waste safely before recycling or disposal
- Prohibition of litter

Hazardous Waste Control and Management Regulations 2008

The Project will abide by the requirements of these Regulations, particularly

- Labelling of wastes
- Handling and storing of hazardous wastes
- Transporting of hazardous wastes
- Reporting procedures

3.5 REQUIRED PERMITS AND APPROVALS

The following list presents indicative permits and approvals related to environmental and social considerations that will be required for the Project.

Table 3-5 List of required approvals and permits

Required Permit/Approval	Issuing Agency	Objective	Timing
Environmental Impact Assessment Certificate	National Environmental Management Council	To comply with the Environmental Management Act of Tanzania 2004	During project preparation (prior to construction)
Electricity License (for power generation project)	Energy and Water Utilities Regulatory Authority	To comply with the Electricity Ordinance 1957	During project preparation (prior to construction)
Building permits	City council	To comply with the City Council law	During project preparation (prior to construction)
Permit for felling trees (mangroves)	Ministry for Natural Resources and Tourism	To comply with the Forest Act 2002	During project preparation (prior to site preparation)
Wastewater discharge permit	Ministry of Water	To comply with the Environmental Management Act 2004	During project preparation (prior to construction)
Water use permit for wells	Ministry of Water	To comply with the Environmental Management Act 2004	During project preparation (prior to construction)
Permission from the Ministry of Infrastructure to transport heavy loads from the port of entry to the site.	Tanzania National Roads Agency	To comply with the Road Traffic Act (Maximum Weight of Vehicles Regulations 2001)	During project preparation (prior to construction)
Plan Safety Inspection Permit	Ministry of Labour, Youth Development and Sports	To comply with the Occupational Health and Safety Act No. 5 of 2003	During project preparation (prior to construction)
Working Permit(s) for employees of the suppliers and its permitted sub-contractors	Ministry of Labour Youth Development and Sports	To comply with the Tanzania Immigration Act 1995	During project preparation (prior to construction)

Source: JICA Study Team, 2018

3.6 INTERNATIONAL TREATIES AND CONVENTIONS

Tanzania is signatory to several international conventions, indicating the country's commitment in implementing stipulations in those treaties and conventions. This project will have to adhere to these commitments. Some of the conventions that may be applicable to the project, include the following:

International Convention on Biological Diversity

Tanzania is signatory to the Convention on Biological Diversity (CBD) since June 1992 and has taken steps to ensure conservation and use of these resources in judicious ways. Biological resources in Tanzania are facing a significant threat from unsustainable utilization, including increased poaching of wildlife.

While the proposed site for this development may not be very rich in terms of biodiversity of large mammals and plants, it is nonetheless equally important to ensure the basic tenets of this Convention are adhered to in all stages of the project development

UNESCO Convention for the Protection of the World Cultural and Natural Heritage (World Heritage Convention) 1972

This convention aims at encouraging the identification, protection, and preservation of earth's cultural and natural heritage. It recognizes that the nature and culture are complementary and that cultural identity is strongly related to the natural environment in which it develops.

The Convention provides for the protection of those cultural and natural 'properties' deemed to be of the greatest value to humanity. In the course of implementing this Project, cultural and heritage objects may be discovered. Recommendations will be made according to the Tanzanian legislation and policies and international best practices on how to handle these objects.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1979

This Convention seeks to control the trade in species of wild animals and plants that are, or may be, threatened with extinction as a result of international trade. Project sponsors must ensure that such trade is not happening in the project site during the construction of the project. During operation, such issues are under the jurisdiction of the Customs Department of the TRA and the Ministry of Natural Resources and Tourism (MNRT).

The African Convention on the Conservation of Nature and Natural Resources, 1968

This Convention requires contracting states to adopt measures necessary to ensure conservation, utilization and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of the people. Protected species should be accorded special protection, including the maintenance of habitats necessary for their survival. Although initially, the project site has been noted not to contain any significant number of biodiversity, detailed assessment of the status and characteristics of flora and fauna in the project site should be undertaken to ascertain the level of the threats the project may cause during the EIA.

The Paris Agreement

This Agreement brings together nations across the globe to commit themselves in addressing climate change through intended nationally determined contributions (INDCs). The Agreement presents several frameworks (e.g. financial, technology, capacity building, monitoring and evaluation) that would enable countries to achieve their ambitious targets in terms of emission reductions and enhance support to developing countries, particularly those vulnerable to the impacts of climate change. The Project is aligned with Tanzania's INDCs, which stipulated an emission reduction target between 10-

20% by 2030. It will expand the use of natural gas as an alternative source of energy, which is one of the intended action in the INDC's energy sector.

3.7 WORLD BANK SAFEGUARD POLICIES

This ESIA has also been prepared to fully comply with the World Bank Safeguard Policies and procedures, which have to be taken into account along with the Tanzanian legislations and policies during the implementation of the proposed Project. The World Bank Safeguard Policies include the Environmental Assessment: OP/BP 4.01, the Natural Habitats: OP/BP 4.04, the Forests: OP/BP 4.36, the Physical Cultural Resources: OP/BP 4.11, the Involuntary Resettlement: OP/BP 4.12, the Projects in International Waters: OP 7.50 and the Projects in Disputed Areas: OP 7.60.

Environmental Assessment: OP/BP 4.01

The objective of this Operational Policy (OP) is to ensure that environmental assessments is undertaken in those categories of projects that have or are likely to have potentially significant impacts on the environment.

Under this OP, projects are categorized as A, B, C and D according to their type, scale, location and anticipated significance of potential environmental impacts. The category indicates the scope and detail required for EIA. According to this OP, the proposed power plant project falls under Category A as this may have significant adverse environmental and social impacts that may be irreversible and diverse, therefore requiring full and comprehensive EIA.

Natural Habitats: OP/BP 4.04

This Operational Policy recognizes that conservation of natural habitats is essential to safeguard their unique biodiversity and to maintain environmental services and products for human society and for long-term sustainable development. During project financing, the World Bank considers if that project supports the protection, management and restoration of natural habitats, as well as policy dialogue and economic and sector work. The World Bank supports and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, coastal and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and most native species.

In complying with this requirement, the ESIA study has been done under the proposed project, as it has potential to cause significant conversion (loss) or degradation of natural habitats, directly (through construction) as well as indirectly (through human activities induced by the project).

Forests: OP/BP 4.36

The objective of this OP is to ensure forest resources are taken into account in any project design and implementation so as to ensure they are not affected.

This OP is relevant whenever any World Bank financed investment project has potential to cause impacts on the health and quality of forests or the rights and welfare of people and their level of dependence upon or interaction with forests or aims to bring about changes in the management, protection or utilization of natural forests or plantations.

The proposed project will have impacts on the health and the quality of natural trees and mangrove, e.g. where waste water would be disposed is directly linked with mangrove Therefore, the proposed Project will have to abide by the provisions of this OP in order to safeguard forest resources.

Physical Cultural Resources: OP/BP 4.11

OP 4.11 aims to assist countries to avoid or mitigate adverse impacts of development projects on physical cultural resources. For the purposes of this OP, 'physical cultural resources' are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The cultural interest may be at the local, provincial or national level, or within the international community.

This OP is relevant to Power plant project and therefore need to be abided.

Involuntary Resettlement: OP. 4.12

This OP acknowledges that development projects that displace people generally give rise to economic, social and environmental problems. Thus, the World Bank guidelines prescribe measures to minimize the negative impacts and ensure that the displaced community benefits from the project.

The objective of this OP is to:-
(a) Avoid or minimize involuntary resettlement where feasible, exploring all viable alternative project designs;
(b) Assist displaced persons in improving their former living standards, income earning capacity, and production levels, or at least in restoring them;
(c) Encourage community participation in planning and implementing resettlement; and
(d) Provide assistance to affected people regardless of the legality of land tenure.

This OP does not only cover physical relocation, but any loss of land or other assets resulting in:-
(a) Relocation or loss of shelter;

(b) Loss of assets or access to assets; and
(c) Loss of income sources or means of livelihood, whether or not the affected people must move to another location.

The proposed project is going to displace people; some displaced persons will lose their property and the work will involve acquisition of the land and compensation costs issues. Thus the provisions of this OP must be followed when dealing with affected persons.

3.8 JICA'S GUIDELINES FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

The objectives of the guidelines are to encourage Project proponents to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents in order to facilitate the achievement of these objectives.

While project proponents bear the ultimate responsibility for the environmental and social considerations of projects, JICA supports and examines appropriate environmental and social considerations undertaken by project proponents etc. to avoid or minimize development projects' impacts on the environment and local communities, and to prevent the occurrence of unacceptable adverse impacts.

JICA establishes "the Advisory Committee for Environmental and Social Considerations" as an independent council composed of external experts with the knowledge necessary to provide advice regarding support for and examinations of the environmental and social considerations of cooperation projects.

JICA confirms that projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries. JICA also confirms that projects do not deviate significantly from the World Bank's Safeguard Policies, and refers as a benchmark to the standards of international financial organizations; to internationally recognized standards, or international standards, treaties, and declarations.

There are some gaps between JICA guideline, World Bank Safeguard Policy and Tanzanian legislation on environmental and social consideration as below. Measures bridging the gaps are to be discussed with TANESCO.

Table 3-6 Gap Analysis between JICA Guidelines and National Laws

Response policy including JICA's guideline and the World Bank's Safeguard Policy	Relevant laws in Tanzania	Main gaps	Potential measures bridging the gap
・ Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests. ・ Whenever feasible, projects are sited on lands already converted (excluding any lands considered to have been converted in anticipation of the project). JICA does not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its siting, and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs. If the environmental assessment indicates that a project would significantly convert or degrade natural habitats, the project includes mitigation measures acceptable to JICA. Such mitigation measures include, as appropriate, minimizing habitat loss (e.g., strategic habitat retention and post-development restoration) and establishing and maintaining an ecologically similar protected area. JICA accepts other forms of mitigation measures only when they are technically justified.	・ The Environmental Management Act 2004 stipulates that the Minister responsible for Environmental Protected Areas by considering flora and fauna, special feature, the interests of the local communities and accordance with international society. (Article 47) ・ Under the National Policies for National Parks in Tanzania, 1994, although, the primary objectives are the protection and inheritance of natural resources (Article3.1), permission of all projects in National Parks is granted based on Environmental Impact Assessment, which clarify positive and negative impacts.	Under the domestic law in Tanzania, even within National Parks, project permission can be granted depending on the EIA result. It is not prescribed as for the necessity of analyzing if the economic benefits outweigh environmental costs.	・Avoid protected areas. ・Wherever feasible, project location is sited on lands already converted.

Response policy including JICA's guideline and the World Bank's Safeguard Policy	Relevant laws in Tanzania	Main gaps	Potential measures bridging the gap
· Confirm that projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities.	There is Environmental Impact Assessment System provided by EMA. Regulation on air quality, water, soil, waste management are established by the following regulation under the EMA. Environmental Management (Air Quality Standards) Regulations, 2007; Environmental Management (Soil Quality Standards) Regulations, 2007; Environmental Management (Water Quality Standards) Regulations, 2007; Environmental Management (Solid Waste Management) Regulations, 2009; and Environmental Management (Hazardous Waste Control and Management) Regulations, 2009.	In terms of the legal framework on environmental management, there is not a difference in particular. However, there is some gasp in the environmental standards between Tanzania and IFC EHS guidelines.	The project will comply with both Tanzanian environmental standards and IFC EHS guidelines.
· EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. For explanations, documents must be formulated in a language and manner, and that are understandable to the affected local people.	EISs (EIA reports) etc. should be formulated in languages understandable to stakeholders.	There is not a difference in particular.	-

Response policy including JICA's guideline and the World Bank's Safeguard Policy	Relevant laws in Tanzania	Main gaps	Potential measures bridging the gap
· In principle, host countries etc. disclose information about the environmental and social considerations of their projects. Assist project proponents etc.as needed. · Encourage host countries etc. to disclose and present information about environmental and social considerations to local stakeholders. · EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EISs are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted. · In principle, host countries etc. consult with local stakeholders to a reasonable extent. Assist host countries as needed.	· From screening step of project, participation opportunities are provided. During EIS review period, public consultation is held and EIS is made public and comments are received verbally and in writing. · Contents to be covered in EIA in Tanzania is stipulated in EIA and Audit Regulation, 2005. · Also, EIS is stored as official document by NEMC and available for perusal when needed.	There is not a difference in particular. Items to be covered in EIA is generally same.	-
· Confirm monitoring results through host countries etc. to verify environmental and social considerations are implemented surely. The information necessary for monitoring confirmation must be supplied by host countries etc. by appropriate means, including in writing. · Also, disclose the results of monitoring conducted by host countries etc. on its website to the extent that they are made public in host countries etc.	NEMC shall conduct environmental assessment. Project proponents should store monitoring data and formulate annual report and report actual result compared with original plan to NEMC. When negative impacts were occurred, appropriate mitigation measures shall be planned and implemented.	The gap is identified on monitoring. There is no regulation regarding monitoring result in Tanzanian regulation.	Monitoring information will be provided and the results will be disclosed.

Source: JICA Study Team, 2018

3.9 TANESCO'S HEALTH, SAFETY AND ENVIRONMENTAL (HSE) GUIDELINES

TANESCO has already prepared and approve the Health, Safety and Environmental guidelines that every undertaking covering consultants, contractors and subcontractor has to adhere to approved HSE guidelines to safe guard environment, community and for safety of worker and the environment.

The proposed construction of the power plant at Kisiwa will be guided by similar operation principles where environmental and social issues will have to be guided by the guidelines. In addition to having its own guidelines TANESCO are obliged to comply to other safe guard principles and guidelines issued by financier of a particular project. In this case safe guard principles and guidelines will be mandatory.

3.10 INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

Government Agencies Responsible for Environmental Issues

Sections 30 to 40 of the Environmental Management Act, 2004 provides for institutional arrangement covering Sector Ministries, Regional Secretariat, Township, Ward, Village, Mtaa and Kitongoji Environmental Management Officers. Thus the District environmental team, ward and village will have to be involved and if these are not in place as required by the law, efforts must be made to ensure they are installed and capacity is provided to them to effectively perform their duties.

In addition, beside the local institutional/administrative framework, the proposed project also falls under the Ministry of Energy, Ministry of Lands, Housing, Human Settlement Development and Ministry of Natural Resources and Tourism. These ministries, through their different units will have to be involved at various stages of the project development.

Other institutions whose administrative decisions will be relevant to the proposed development include the Ministry of Health, specifically OSHA that will be responsible for ensuring compliance to occupational health and safety standards as provided under OSHA. Details of how the various institutions should be involved and where necessary capacity development is provided will be addressed in the EIA.

Regional and District Administrative Structures

The proposed 300MW Thermal Power Plant development will take place in Kisiwa in Mtwara District, Mtwara Region; therefore, it falls under the jurisdictions of the Mtwara District Council and the Mtwara District Commissioner and Mtwara Regional Administration/Secretariat for administrative and implementation purposes. Thus, the Mtwara Regional Secretariat and Mtwara District Council in particular will support the implementation of this project. Critical areas such as implementation and enforcement of the mitigation measures including matters related to resettlement, provision of alternative land for affected persons and alternative social services such as water will be handled by the district authorities in collaboration with the developer, TANESCO.

Institutional arrangement of TANESCO

TANESCO has been vested with the overall responsibility for the coordination, planning and implementation of the project. TANESCO will form a Project Implementation Unit (PIU) to implement the project and ensure compensation to the affected people and implementation of the ESMP.

It shall:

- Provide information on the project with respect to design, environment and resettlement action plans.
- Be the focal points for implementation of the project.
- Liaise with the district administrations and village communities for preparation of valuation document.
- Provide trainings
- Disseminate information relating to accidents and safety/prevention measures and also material relating to HIV/AIDS
- Prepare internal monitoring reports for TANESCO management

The PIU shall be supported by other agencies such as District Administrations, Communication Department of TANESCO, Agency for spreading awareness on HIV/AIDS and also for income restoration assistance to PAP.

4.1 BIOPHYSICAL ENVIRONMENT

This chapter provides an overview of the environment-biophysical baseline conditions within the Project Study Area based on secondary data from published sources as well as primary data collected. This section of the ESIA report is organized by different biophysical parameters and also includes a discussion of the baseline conditions. The Project Study Area refers to the area that needs to be studied in order to adequately understand and describe the baseline conditions likely to be affected by the Project.

4.1.1 *Climate and Meteorology*

Temperature

The highest and lowest monthly mean temperatures in Mtwara are 27°C and 23.8°C in December and July respectively. The highest maximum temperatures are experienced in November and December and the lowest between June and September (***Figure 4-1***).

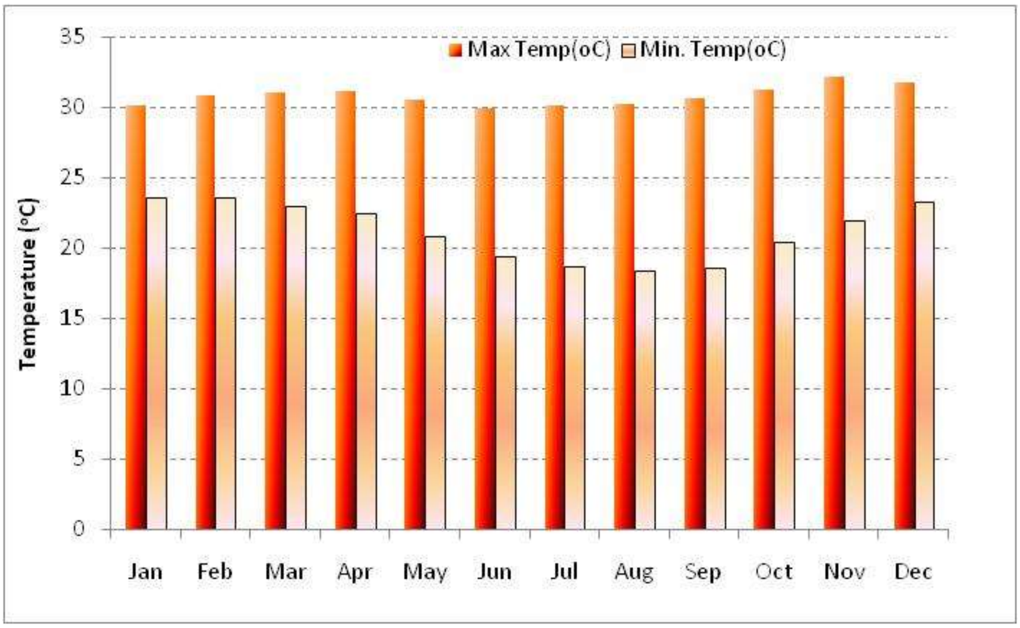


Figure 4-1 Mean Temperatures at Mtwara Meteorological Stn (2012-2016)

Source: Ruvuma and Southern Coast Basin Water Board (2016)

Rainfall

Rainfall distribution in the area is of unimodal pattern, commencing in November/ December and continues until April/May (***Figure 4-2***). The average annual rainfall is about 1000 mm.

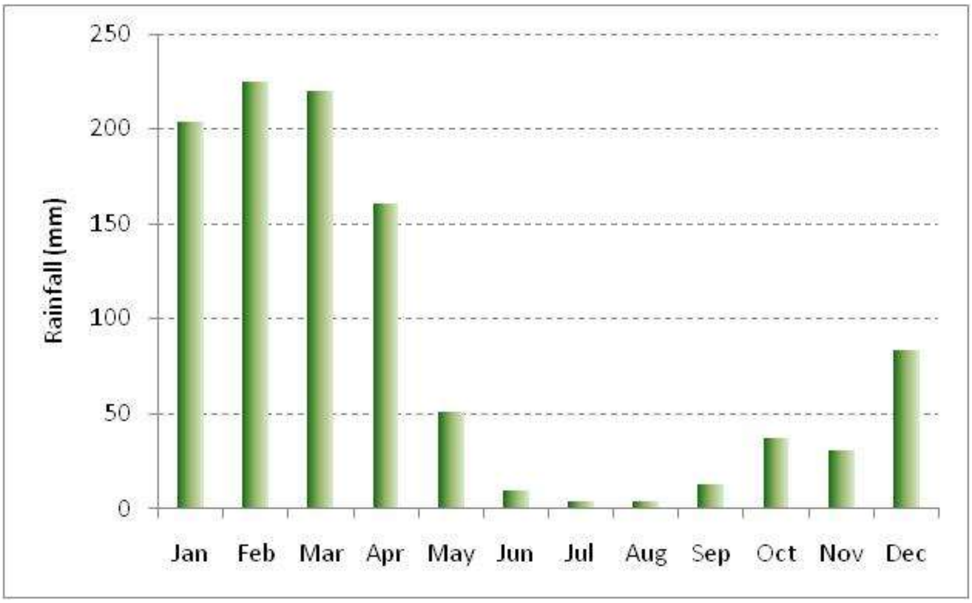


Figure 4-2 Mean Rainfall at Mtwara Meteorological Stn (2007-2016)

Source: Ruvuma and Southern Coast Basin Water Board, 2016

Wind

Survey Method

The measurements were conducted using a Thermal Anemometer Testo 425. The unit is a compact instrument for measuring flow velocities and temperature of flow by means of a permanently connected flow/temperature probe. Wind speed was measured at an interval of one hour starting from 07:00 to 18:00 each day for the period of seven days at a location within the Project Site. For each measurement, a multi-point and timed mean calculation of wind speed was used. The wind speed value recorded is the average of speed readings collected in a duration of one minute. Approximately 20 wind speed readings were captured and their average was automatically determined and recorded.

After determining the GPS location of the monitoring station, the north direction of monitoring station was determined using the GPS and the wind direction was established.

Analysis

The wind speed and wind direction data were analyzed using WRPlot view software. ***Figure 4-3*** presents the average wind speed in different wind class intervals and directions during site survey (March 23 – 29, 2018;).

Based on the results, the wind direction is distributed in 16 wind directions and 5 wind speed classes, including the calm (0 - 0.3 m/s).

The average wind speed is 2.56 m/s, whereas the calm wind frequency is 0.0%. The predominant average hourly wind direction at the plant site varied throughout the period of measurement.

As observed from ***Figure 4-3***, the most common wind is Northwest (observed between 11:00 and 18:00 Tanzania local time). From this direction, the wind comes approximately 22% of the time with the maximum wind speed is between 2.6 - 3.6 m/s. However, it has been observed that in between 07:00 and 11:00 Tanzania local time, the wind is often from South and Southwest between. From these directions, the wind comes approximately 13.2% and 11% with the maximum wind speed in the class interval 3.60 to 4.60 m/s, respectively.

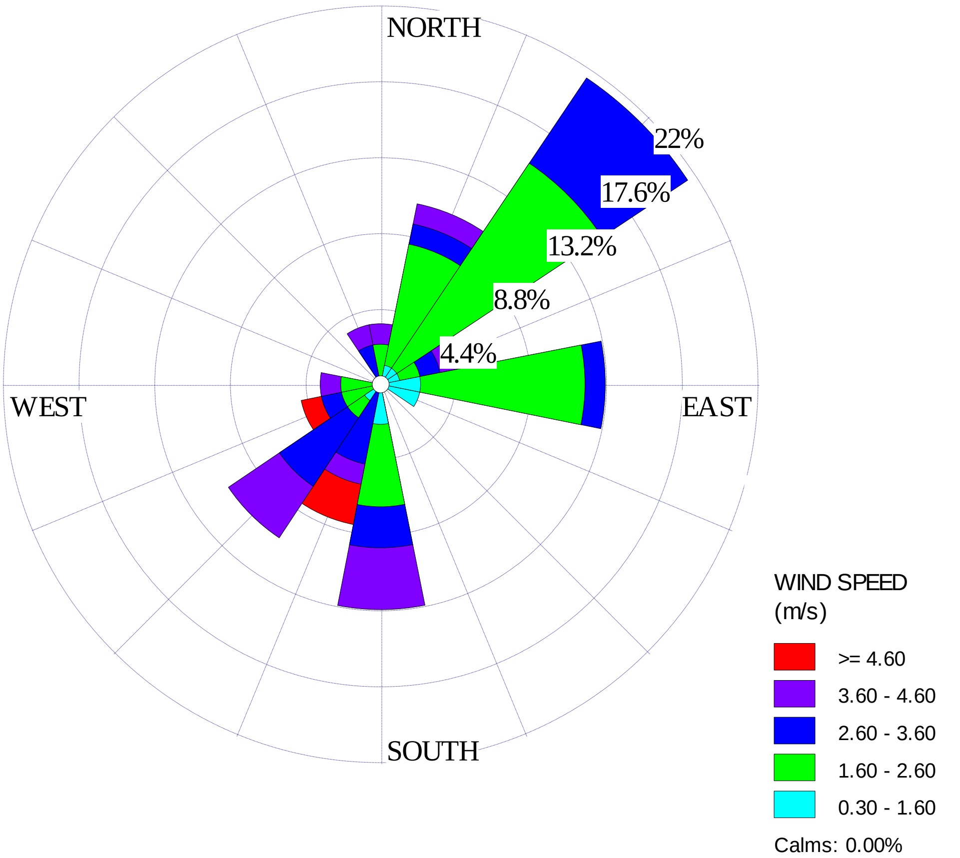


Figure 4-3 Rose Plot of Observed Wind Speed & Direction

Source: IRA, 2018

The average of hourly wind speeds over the period of measurement as a function of time 07:00 to 18:00 is plotted in ***Figure 4-4***. Based on the results, the maximum average wind speed is 4.5 m/s recorded at 08:00am, the time when the wind comes mostly from South-South-West and West-South-West directions. The minimum average wind speed is 1.4 m/s recorded at 18:00, the time when the wind mostly comes from South-East direction.

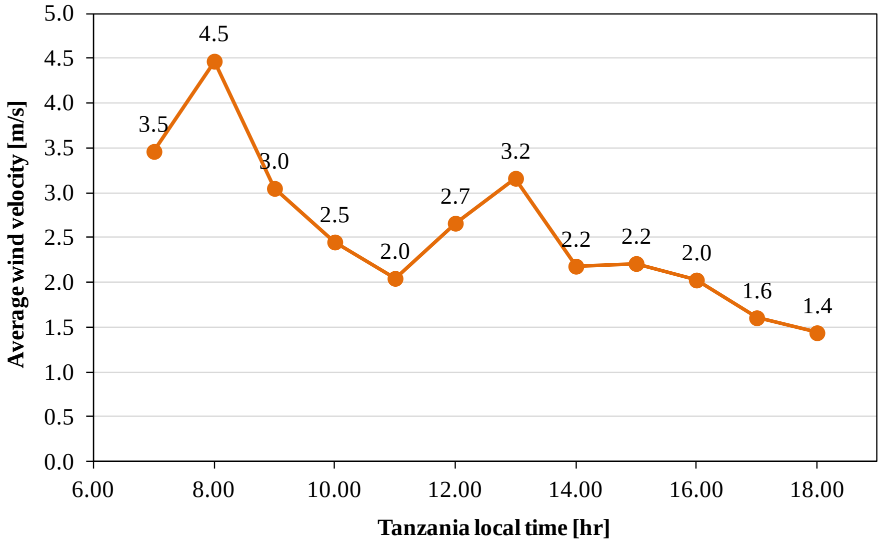


Figure 4-4 Average Wind Speed vs Time

Source: IRA, 2018

4.1.2 Land Use

The Master Plan of Mtwara RAS stipulates the proposed land use for Naumbu, Mtwara (refer to ***Figure 4-5***). The MP had got the government approval in March 2017 based on the Urban Planning Act No.8 of 2017 through a few years' process. Based on the land use map in the Master Plan, the Project Site is designated as a power plant development area. However, it is important to note that its surrounding areas are designated as residential and conservation areas.

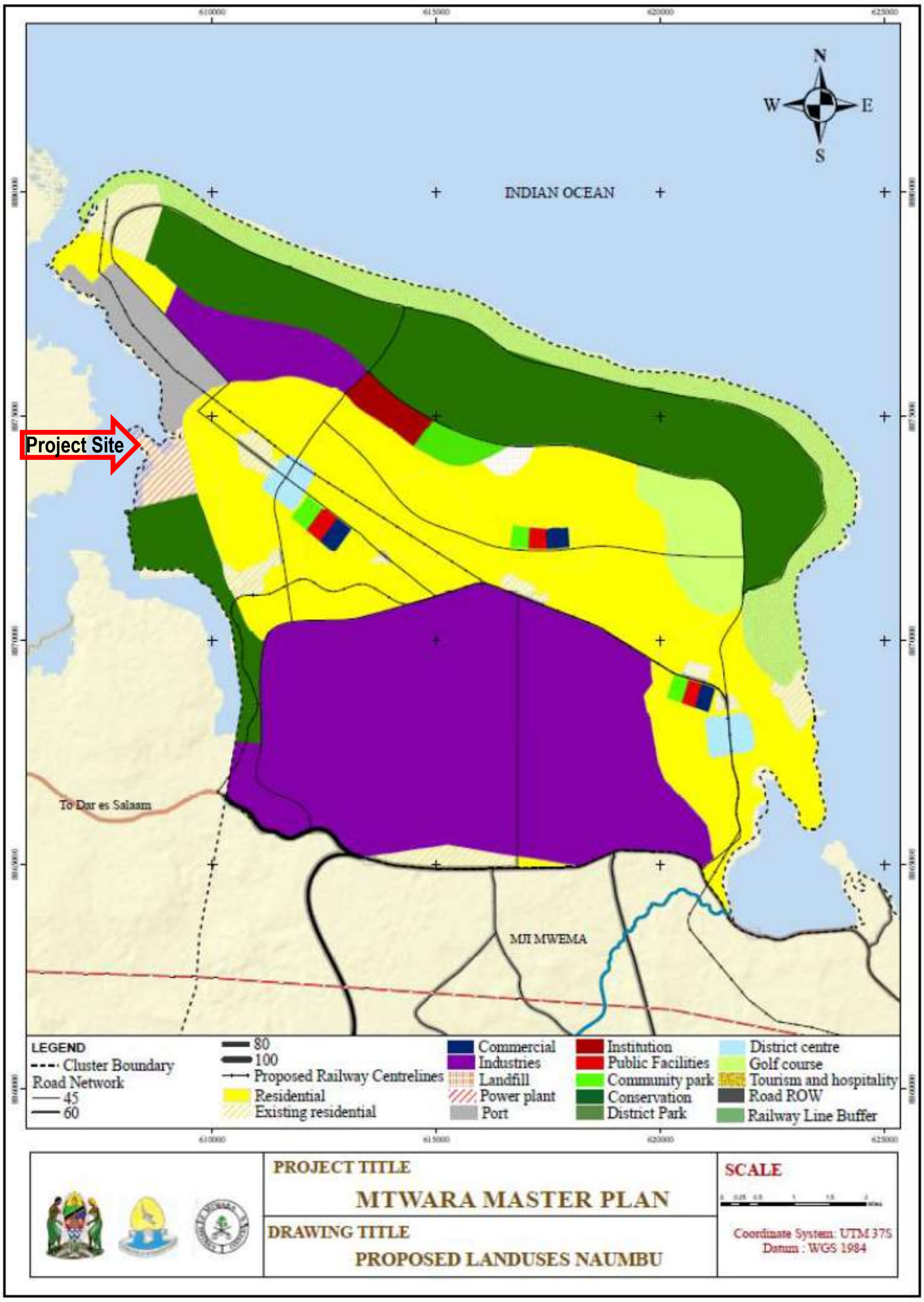


Figure 4-5 Land Use Map of Naumbu, Mtwara

Sources: Mtwara Regional Administrative Office, 2016

The Project Site extends to the seashore. Only a small area of the Project Site faces the seashore line (the "nose"). The nose area is covered by sand and the height of the nose area is almost 0m above sea level. At present, that area is being utilized as a mooring point of fishing boats.

The nose area is preferable for beaching and transportation of heavy equipment However, the area which covers 60m from the seashore line during high tide is designated as an environmental (coastal) buffer zone in Tanzania, and thus development activities cannot be implemented in this area. However, an officer of Mtwara RAS informed that temporary use of this area is acceptable during the construction of power station subject to reinstatement of original conditions after the construction.

The proposed Project Site (ca, 160 ha) covers the open area behind the nose area (flat lowland) and some highlands, necessary soil can be carried from the high land. Based on the site survey, the proposed Project Site is currently being used for pastures and salt fields. There are also observed limited number of houses and fishermen.

Open area behind the nose

Salt field in the low land;
Mangrove forest at the back

High land (sea in backyard)

Foot pass in the high land

Figure 4-6 Existing Land Uses in the Project Site

Source: IRA, 2018

4.1.3 Topography

The district topography is characterized by coastal zone of Indian Ocean with predominantly flat and undulating terrain. The most prominent features are Ruvuma River Valley, Kitere Plain and the Makonde plateau which dominate large part of the district. The raising undulating hills along the coastal areas has created unique features of the low laying area allowing the intrusion of the seawater to form bays surrounded by vegetated hills. The extensive beach is characteristic on the Msimbati area and part of the Mgao areas. The physical feature of the district has helped to shape the physical environment influencing not only the land through the geology and soils but also the weather, climate and hydrology of the region.

The topography of the study area is predominantly flat descending into Indian Ocean at Kisiwa bay. Much of the flat area receive sea water particularly during high tides. The elevation of this area is between 0 and 1,000 metres.

A topographic survey of approximately 3km^2 at the Project Site, shown in ***Figure 4-7***, was conducted. A topographic map (scale 1:2,500), which covers the Project Site, was developed based on the digital elevation models (DEMs) in which satellite images were obtained by World View-1 to 3 and Geo Eye-1. The specifications of topographic mapping is shown in ***Table 4-1***.

In order to improve the accuracy of the topographic map of the Project Site, some Ground Control Points (GCP) were set in the Project Site and a field topographic survey of those points were conducted on the coordinates and elevation. Additionally, in the case of peculiar terrain which cannot be read from the satellite image, the corrections were made based on the pictures that were taken at the site.

Figure 4-7 Area of Topographic Survey

Source: JICA Study Team, 2018

Table 4-1 Specification of Topographic Mapping of Project Site

Product	Purpose of Use	Details	Source
Ortho-rectified imagery	Base map to understand the current condition of the area	Seamless mosaic pan-sharpened; Resolution: 50cm; Band: 3 bands true color Captured area: 3km^2 Geographic coordinate system: WGS84	WorldView-2
Topographic Data (Digital Terrain Model)	To create contour line	Resolution: 1m	WorldView-1, WorldView-2, WorldView-3, GeoEye-1
Terrestrial objects	To integrate into topographic map	Extracted based on extraction criterion	Ortho-rectified imagery of Product #1
Topographic Map	To integrate all data and information into topographic map	Contour interval: 1m	Topographic Data

Source: JICA Study Team, 2018

The topographic map is shown in ***Figure 4-8***. The Project Site is characterized by a gentle slope land and is approximately 0 m to 30 m above sea level, north of the trunk road B2 near Kisiwa village center. The southeastern corner of the site is the highest elevation about 26 m and gradually decreases with a gentle gradient toward the northwest. The west side of the site faces the Kisiwa Bay and approximately 200 m along the coastline except the sandy beach at the northwest end has a slope of about 10% toward to the seashore.

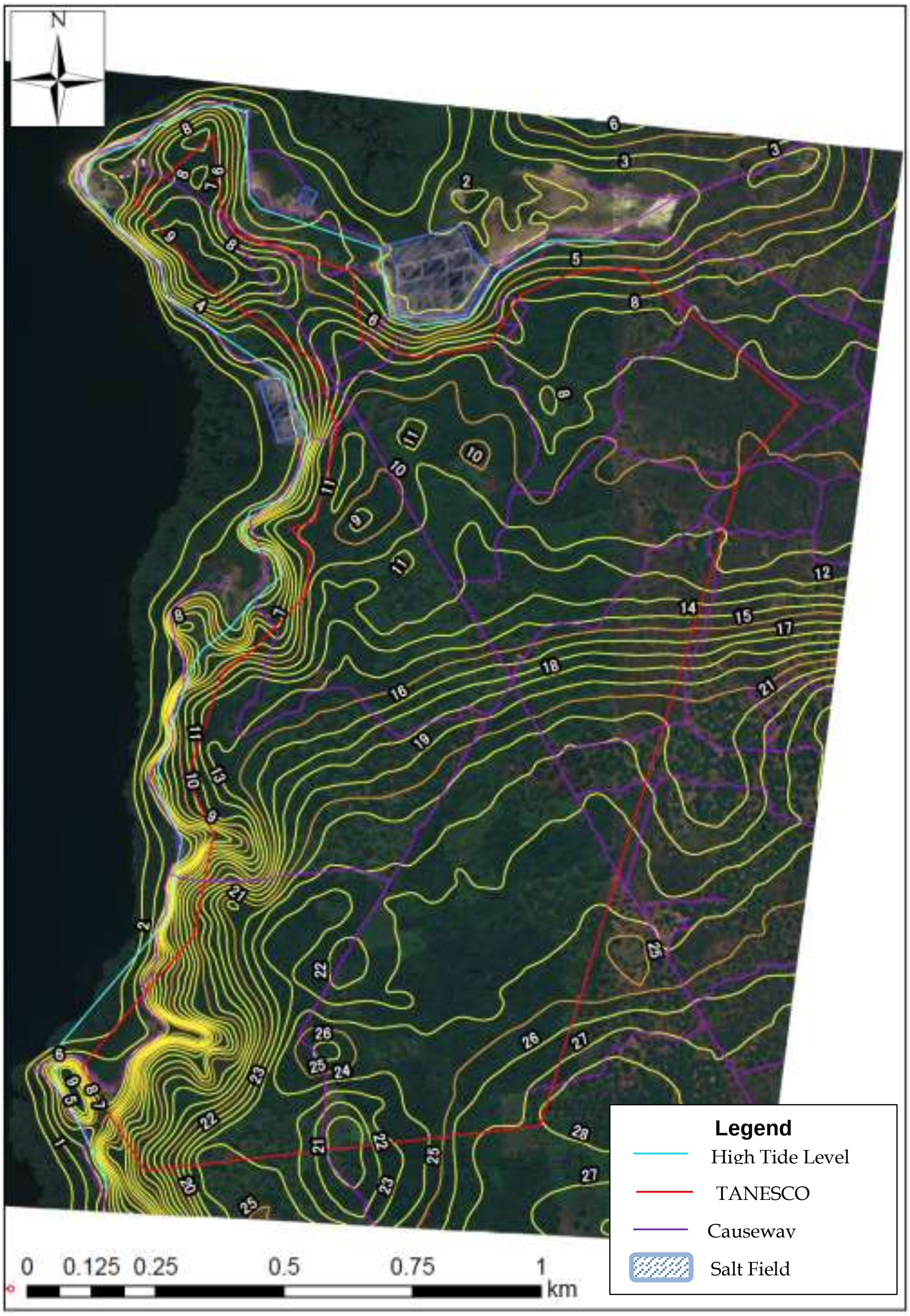


Figure 4-8 Topographic Map of Project Site

Source: JICA Study Team, 2018

4.1.4 *Geology and Soil*

Onshore Geology

Regional Geology

Terrain Features

The Project Site is located on the east shore of the Kisiwa Bay, where mangrove forest cover the marine shallows and the sand hills rise at EL.10 meters approximately. From the wide view, it can be noted that the terrain around the project site is almost a flat land, but a total of six marine terraces can be recognized, and dried-up gullies named 'wadi' incise these terraces deeply. When viewed from the highest elevation, it can be noted that the marine terraces form flat lands or have very gentle slopes at EL.270 – 300m, EL.210 – 240m, EL.150 - 170m, EL.60 – 120m, EL.20 - 40m and EL.10 - 13m in this region. These terraces seem to reflect the coastal benches or abrasion platforms which consisted of coral colonies in the distant past, and they showed up on the land surfaces due to the intermittent drop in sea water level during the glacial age. The general geo-structure around the project site is terrace benches with coral limestone and relatively thin sediments, which are derived from river or ocean currents which overlies the benches. Actually limestone outcrops are exposed on coastal cliffs or gully walls, and parts of them are exploited as quarry mainly for the cement material.

Geological Conditions around the Site

The Project Site includes four geological compositions, which include:

- the lowest land on the bay shore which is submerged constantly by ocean tides,
- the lowest terraces (Te1) at EL. 10-13m,
- the next terrace (Te2) at EL. 20 – 40m, and
- the coral limestone as basement.

As shown in ***Figure 4-9***, the underground conditions of the site confirms that Te1 consists of silty sand (S1), gravelly sand mixed with clay (SG). Soft clayey sand (Cl1) is present at the bottom and sediments stack up on a hard clay layer (Cl2) or coral limestone (Lm). There is an observed elevation difference of approx. 20m between the top surfaces of limestone of D-5 and D-6 (see ***Figure 4-9***). Therefore D-6 is identified to be located on higher terrace (Te2) than Te1. The coral platform of Te2 is thinly overlaid by loose sandy sediments.

According to the detailed contour map, the land surface gradually rises southward, beginning at EL.13m up to 30m, hence it seems that the ancient ocean cliff of limestones on Te2 is possibly buried under the sandy sediments along the contour line of EL.13m.

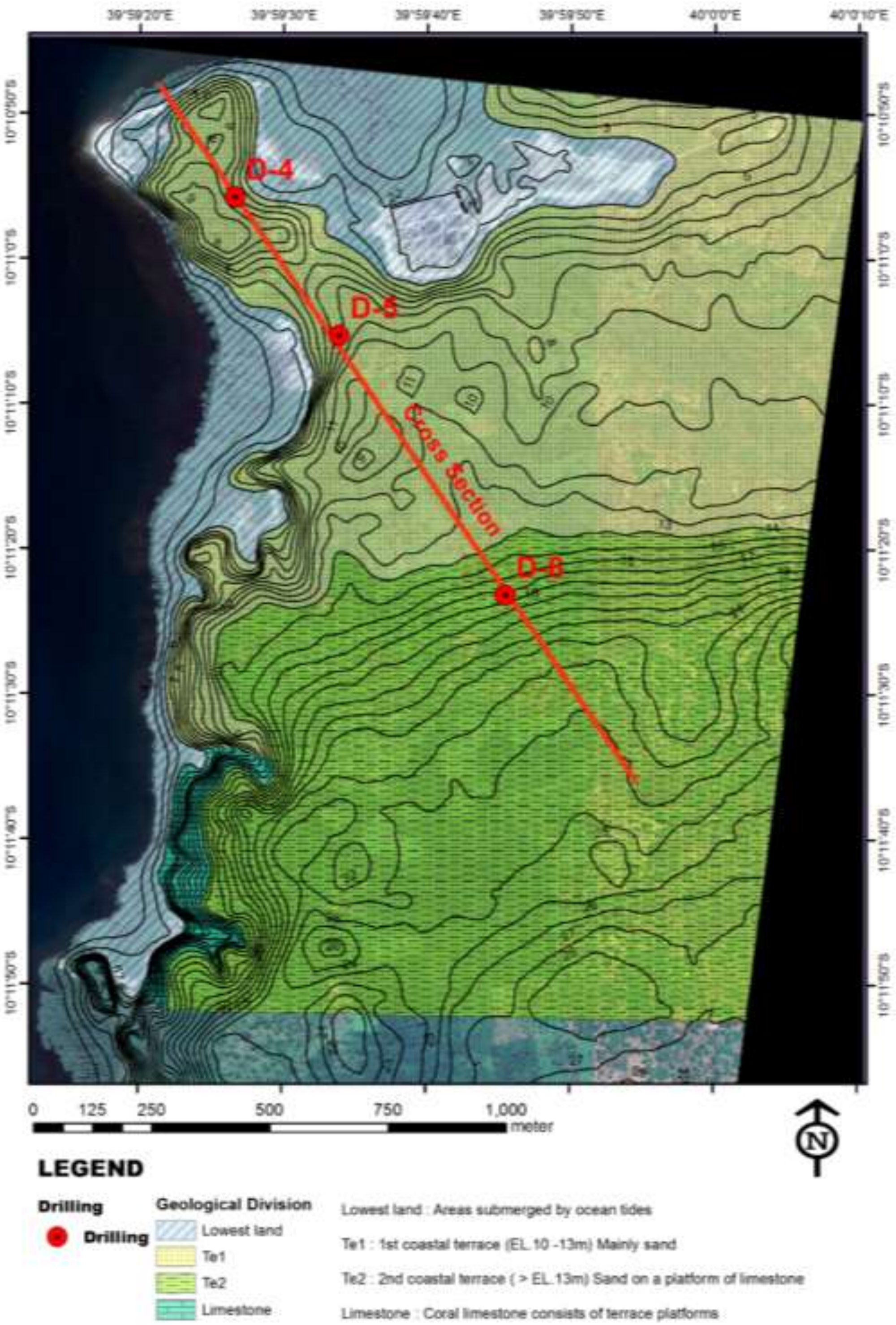


Figure 4-9 Geological Compositions around the Project Site

Source: JICA Study Team, 2018

Engineering Geology

Physical and Mechanical Properties of Foundation

Field drilling works in the project site carried out the standard penetration test (SPT) at 1.5m intervals for all boreholes, and disturbed soils were collected by SPT were subjected to laboratory tests. Soil compositions and the range of N-Values in each soil/rock layer of the site are summarized in ***Table 4-2*** below.

Table 4-2 Soil and Rock Layers of the Project Site

[Layer]	[Thickness]	[Composition]	[N-Values]
S1	5 – 10 m	Silty sand	< 10
SG	Approx.10 m	Gravelly sand mixed with clay	20 - 30
Cl1	Approx.5 m	Clayey sand mixed with gravel	< 10
Cl2	Approx.5 m	Hard clay with gravel	> 50
Lm	> 35m	Coral limestone thinly intercalated with compacted clay, sand and gravel	> 50 (Basically not penetrated)

Source: JICA Study Team, 2018

Geotechnical Consideration

Coral limestone which is composed in the platforms of terraces (Te1 and Te2) tolerates loading weight of any structures in the project. Basically piles have to reach up to the depth of limestone. It seems that the hard clay layer (Cl2) was formed at the same geological age as the limestone at the bottom floor of Te1, and it has been compacted sufficiently, therefore, the Cl2 layer is capable enough to receive the load of thermal power plant facilities. The Cl1 layer is not thick and is buried under sea level. It mainly consists of soft clay, thus it should be avoided as the pile foundation of any facility.

The SG layer is below sea level and it is entirely submerged by groundwater. If the open excavation reaches the layer, a large amount of seepage should be taken into consideration. Most of facilities can be directly placed on the SG layer, but, specifically, the foundation of crucial facilities such as gas turbines and steam turbine requires a more reliable layer than the SG layer. The top of layers namely the S1, may be capable of bearing directly the foundation of light facilities. As necessary, Standard Penetration Test (SPT) with borehole drilling should be carried out to check geotechnical condition at the place of each building in the project implementation stage.

Generally, the Project Site where power plant and other heavy equipment will be installed, is relatively favorable geological condition according to the result of geological survey.

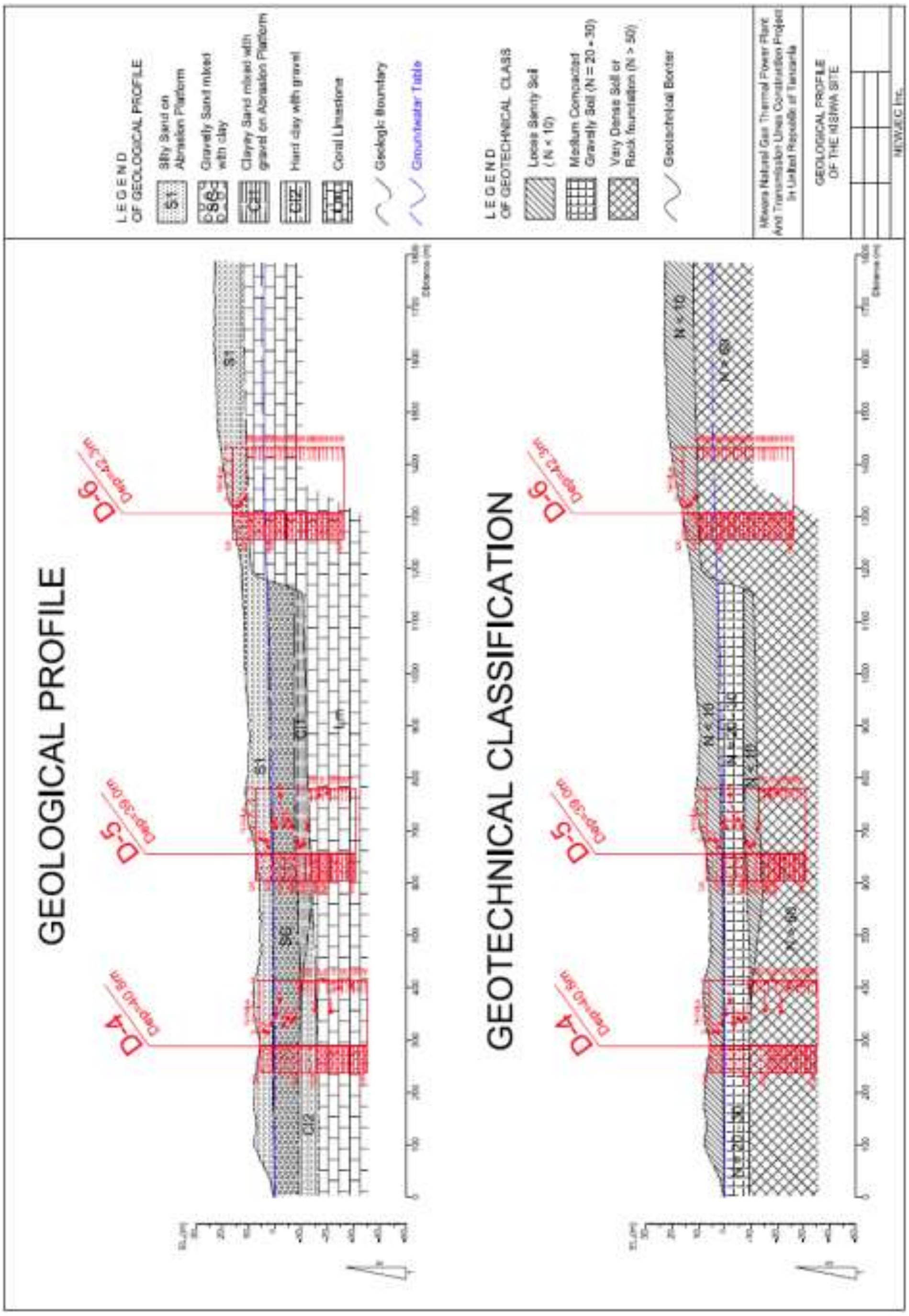


Figure 4-10 Geological Profile in the Project Site

Source: JICA Study Team, 2018

Offshore Geology

Bathymetry of the Sudi creek

The bathymetric survey was undertaken over the area of the tidal creek that was not previously surveyed by the Tanzania Ports Authority (TPA) as shown in ***Figure 4-11***. The sounding measurements were conducted using a hand-held echo sounder along evenly spaced sounding lines (designed to cross the channel). The distance between the sounding lines will be about 50m and the sounding points along each transect will be about 25 m or less. The positions of the sounding points were recorded using a hand-held GPS, where the depth, geographic position and time were recorded simultaneously to allow subsequent correction of the data for the tides.

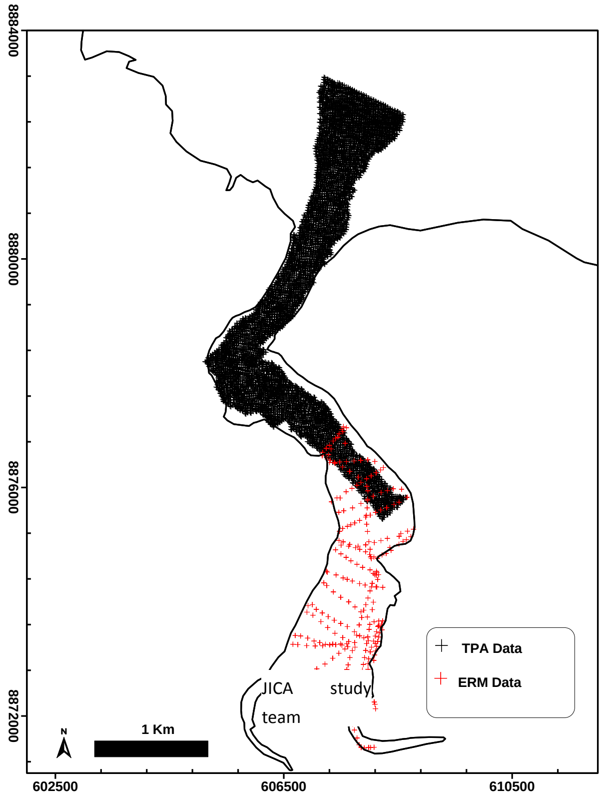
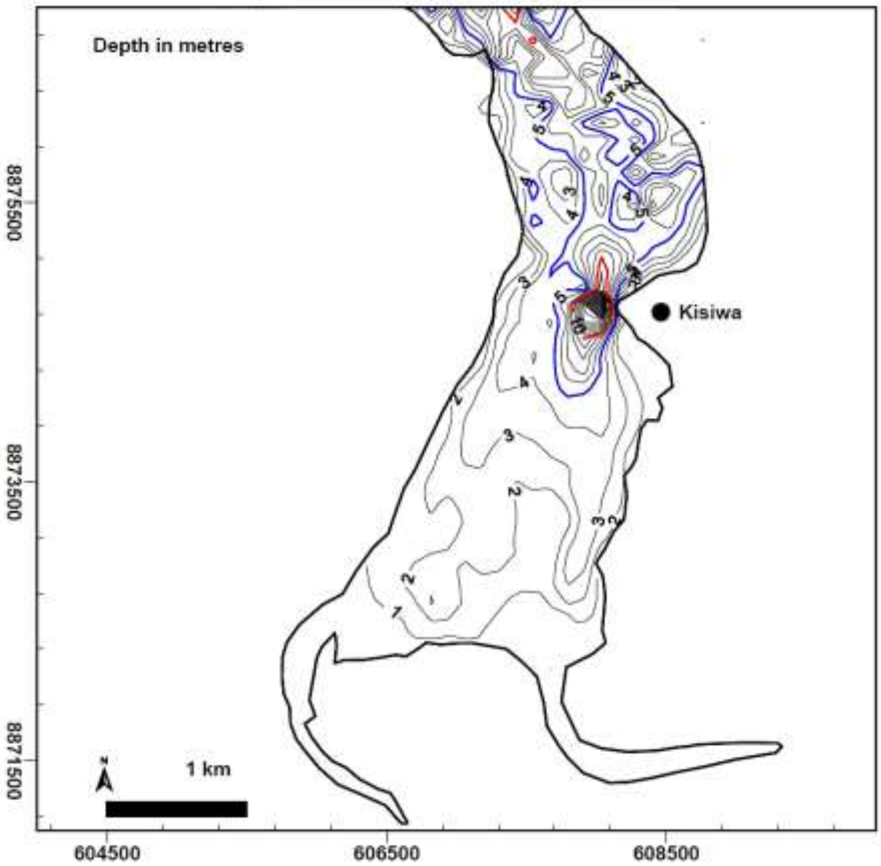


Figure 4-11 Sudi creek sounding points measured by TPA (black symbols) and JICA study team (red symbols)

Source: JICA study team, 2018



JICA study team

Figure 4-12 The sea bottom topography of the southern parts of the Sudi creek

Note: The 5 and 10 m contours are indicated in blue and red colours, respectively.

Source: JICA study team, 2018

Based on the result of the bathymetric survey, the sea bottom topography of the southern parts of the Sudi creek is shown in ***Figure 4-12***.

Sediment Thickness

In order to understand the geological conditions of the seafloor surface and to obtain the information necessary for estimating the movement mechanism of drift sand, seafloor survey was conducted. Since the distribution characteristics of sediments are considered to indicate the result of drift sedimentation phenomenon, it is possible to estimate the drifting direction and sources.

The area covered by the seafloor survey is shown in ***Figure 4-13*** and ***Figure 4-14***. Site A (indicated with blue "x") in ***Figure 4-14*** is the area where the cooling water intake will be installed. This area, approximately 160 x 60 meters, is in front of the sandy beach where the local fishermen are using the site as one of landing sites. Eighteen (18) points, marked with a blue "x", were investigated in this area (refer to T1, T2 and T3). On the other hand, seven (7) points, marked with a red "x" were investigated at Site B, where the discharge channel will be installed. Sampling points are assigned with letters "a" to "f" indicating points from the beach to the sea (e.g. T1a to T1f, T2a to T2f, T3a to T3f, and T4a to T4g).

Figure 4-13 Locations of Seafloor Survey (Overview)

Source: JICA Study Team, 2018

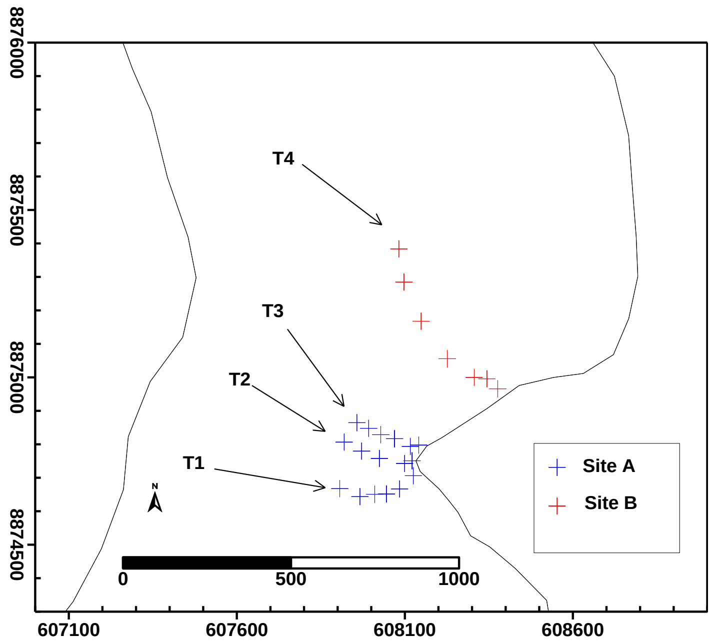


Figure 4-14 Locations of Seafloor Survey (Detailed)

Source: JICA Study Team, 2018

The results of sediment thickness at different sampling sites, presented in

Table 4-3, show that all the three outermost points at each transect had sediment thickness exceeding 2 meters, while the other three points located closer to the shoreline had sediment thickness varying between 0 and 1.5m.

Table 4-3 Sediment Thickness on the Sea Bottom at the Project Sites

(Unit: cm)

SITE A (Area of Water Intake)						SITE B (Area of Water Discharge)	
Site No.	Thick-ness	Site No.	Thick-ness	Site No.	Thick-ness	Site No.	Thick-ness
T1-a	8	T2-a	9	T3-a	10	T4-a	6
T1-b	39	T2-b	38	T3-b	40	T4-b	16
T1-c	145	T2-c	148	T3-c	149	T4-c	20
T1-d	>200	T2-d	>200	T3-d	>200	T4-e	>200
T1-e	>200	T2-e	>200	T3-e	>200	T4-f	>200
T1-f	>200	T2-f	>200	T3-f	>200	T4-g	>200

Source: JICA Study Team, 2018

The results mapped out in ***Figure 4-15*** show that the 200cm contour which is roughly located at about 7-8 m depth is relatively further away from the shore (about 400m) at the water discharge structure, and is much closer to the shoreline (about 200 m) at the water intake structure.

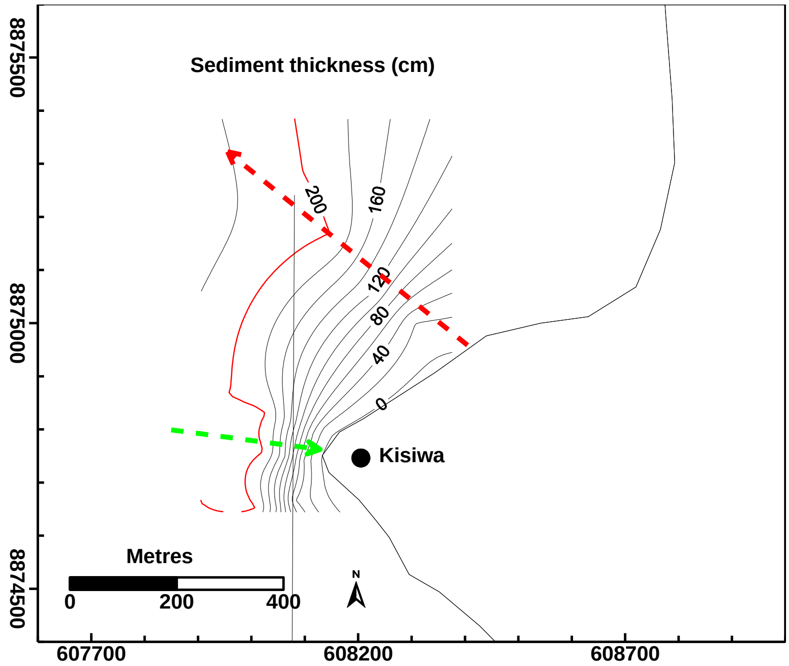


Figure 4-15 Sea Bottom Contour Map

Source: JICA Study Team, 2018

Note; *1: Red contour line marks the boundary between the shallow water areas, where the sediment thickness is below 200cm and the deeper areas, where the sediment thickness is more than 200cm.

*2: Red and green arrows show the location of the water intake and discharge structure

Sea Floor Condition

The nature of the sea bottom was not clearly discernible because of the poor visibility of the sea bottom at the outermost parts of all transects. From the outermost points to the intertidal areas the sea bottom sediments varied from fine sands to coarse sand/very coarse sand being consistent with the sieving analyses, and the sea bottom on the intertidal areas was also characterized by the presence of biogenic fragments/shells and sand ripples. ***Figure 4-16*** shows that sediments are composed of very coarse sand, with pebbles and shell fragments.

Low biodiversity and absence of corals in the investigated area have been observed. Increased sedimentation from land-derived sediment sources may have caused a physical change in the sea water quality with detrimental effects to the health of some of the carbonate producers such as the corals.

Figure 4-16 Sea Bottom Photograph at T-2f

Source: JICA Study Team, 2018

According to the result of the survey, bathymetric feature of the place, where the water discharge structure is planned to be installed, is shallow, and the depth of the structure is approximately 4 meters, hence, it is relatively easy to install water discharge structure. On the other hand, bathymetric feature around the water intake structure, rapidly deepens at the sea. Top of the water intake facility is approximately 10 meters deep and the deepest part is 18 meters below sea level, therefore, temporary works and construction scheme are important for the smooth implementation.

4.1.5 Air Quality

Combustion of natural gas mainly produces carbon dioxide and water. However, nitrogen oxides (NOx) are also produced depending on the temperature and composition of air in the combustion area.

In order to determine the existing air quality of the Project Study Site, air quality parameters (Particulate Matter and Nitrogen Oxides) were measured at one point within the Project Site. These parameters were chosen based on the potential impact of the Project on air quality. NOx gases are considered as the main pollutant during the operation of natural gas fired power plant, while particulate matter will be generated during construction.

Particulate Matter (PM10)

Particulate matter (PM) also known as particle pollution is the term for particles and liquid droplets (aerosols) suspended in the air. Particles between 2.5 and 10 micrometres in diameter are referred to as "coarse particles." On the other hand, particles less than 2.5 micrometres in diameter are known as "fine particles".

The TSI Dust Track model 8530 was used in the measurement of dust with 10 µm sieve size. Air quality measurements were conducted during 07:00 and 18:00 for seven days. For each measurement lasted for 30 minutes with log interval of 1 minute and time constant of 1 second.

The time Weighted Average (TWA) baseline dust level collected for seven days compared with the limits set by the World Health Organization (WHO) and TBS Standards, are presented in ***Table 4-4***. The maximum PM10 concentration recorded is 0.028 mg/m^3, while the minimum concentration is 0.007 mg/m^3. As observed, nearly all values of suspended particulate (PM10) are significantly below the limits set by TBS and WHO standards.

It is worth noting that the concentration of particulate matter in the air is higher in the afternoon compared to the morning (refer to ***Figure 4-17***). PM10 concentration varies linearly with time with minimum PM10 values recorded in the morning at 07:00pm and maximum values recorded in the afternoon at about 16:00pm. The increase of PM10 concentration with TZ local time can be attributed to the increase of dust stirred up by wind.

Table 4-4 PM10 Ambient Air Dust Concentration Measurements taken in the Project Area

Monitoring station1 - Plant site: GPS (0608362, 8874370)				
Date	Time of measurement	Time Weighted Average (TWA) [mg/m³]	TBS Standard [mg/m³]	WHO Standard [mg/m³]
23/03/2018	7:45	0.008	0.075	0.025
	12:09	0.014	0.075	0.025
	16:21	0.019	0.075	0.025
24/03/2018	7:00	0.007	0.075	0.025
	12:00	0.022	0.075	0.025
	16:07	0.028	0.075	0.025
25/03/2018	7:01	0.010	0.075	0.025
	12:03	0.016	0.075	0.025
	16:00	0.016	0.075	0.025
26/03/2018	8:08	0.007	0.075	0.025
	12:00	0.012	0.075	0.025
	16:00	0.013	0.075	0.025
27/03/2018	7:14	0.007	0.075	0.025
	12:06	0.013	0.075	0.025
	16:11	0.019	0.075	0.025
28/03/2018	6:52	0.008	0.075	0.025
	12:42	0.018	0.075	0.025
	16:11	0.017	0.075	0.025
29/03/2018	6:49	0.008	0.075	0.025

Source: IRA, 2018

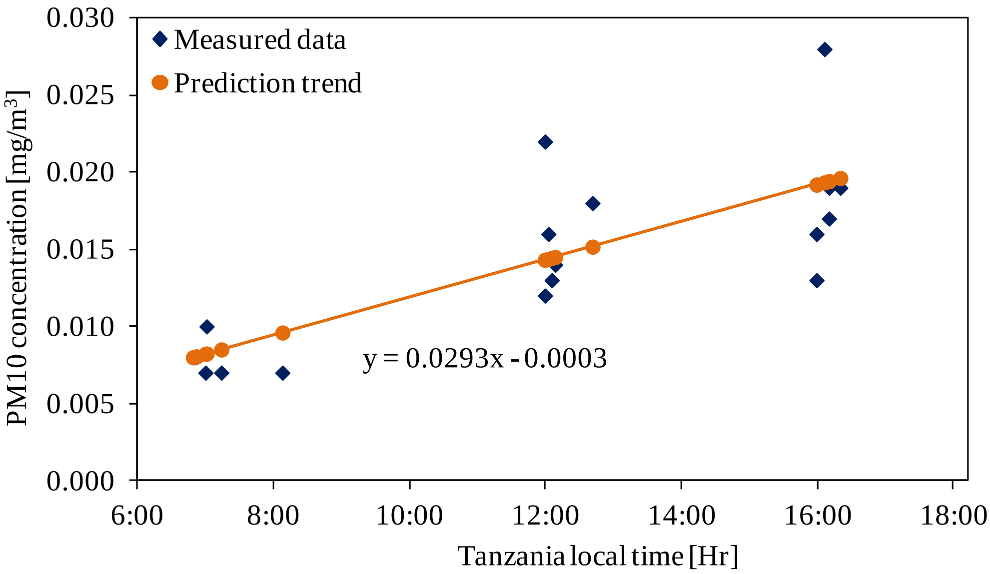


Figure 4-17 Linear regression of PM10 concentration vs time

Source: IRA, 2018

Nitrogen Oxides (NOx)

The concentration of Nitrogen Oxides were measured using a Dragger Pump and Tubes. The results obtained are summarized in ***Table 4-5***. Measured concentrations of NOx gases in the Project Site were below the detection limit (BDL).

Table 4-5 NOx Measurements taken in the Project Area

Date	Testing time	# pressing, n	NOx gas tested	Value	Min detection level	TBS Std mg/m^3	WHO Std mg/m^3
23/03/2018	07:30	5	Nitr.-0.5	BDL	0.5 ppm	0.075	0.025
24/03/2018	12:00	5	NO_2 - 0.5	BDL	0.5 ppm		
25/03/2018	16:00	5	NO_2 - 0.5	BDL	0.5 ppm		
26/03/2018	10:00	5	Nitr.-0.5	BDL	0.5 ppm		
27/03/2018	07:30	10	NO + NO_2	BDL	2 ppm		
28/03/2018	12:00	10	NO + NO_2	BDL	2 ppm		
29/03/2018	16:00	10	NO + NO_2	BDL	2 ppm		

Source: IRA, 2018

4.1.6 Noise

Ambient noise levels within the Project Study Area were measured at three locations – within the Project Site, in Kisiwa village, and in Namgogoli village. Noise levels were measured using Peak Tech 8005 sound level meter. The device was set in a slow response (1 unit per second), A-weighting with an automatic measuring range of 30 to 130 dB. The monitoring locations were isolated from human activities and the only source of noise was wind and leaves in motion.

Recorded noise levels, compared with TBS and WHO standard limits, are presented in ***Table 4-6***. It can be observed that recorded ambient noise levels at all monitoring stations were significantly lower than the limits set by the TBS and WHO standards.

Table 4-6 Noise Measurements (dBA, Leq)

Tanzania local time	Plant site 23/03/2018 [dBA]	Kisiwa village 24/03/2018 [dBA]	Namgogoli village 25/03/2018 [dBA]	TBS and WHO Standards
07:00	44.6	41.2	39.8	55
08:00	40.1	36.8	37.4	55
09:00	36.2	35.1	40.5	55
10:00	32.4	37.4	37.4	55
11:00	33.7	38.3	38.6	55
12:00	35.6	32.7	35.6	55
13:00	33.4	38.8	34.7	55
14:00	34.8	38.6	38.6	55
15:00	36.7	36.5	36.8	55
16:00	35.8	35.5	38.2	55
17:00	35.4	33.7	35.8	55
18:00	37.1	33.8	36.2	55

Source: IRA, 2018

4.1.7 *Hydrology*

The project area is located within Mambi catchment with the highest elevation of about 900 metres above sea level (***Figure 4-18***). The Mambi River is the southernmost major river of the southern coast basins.

The flood event of April 1990 has been reported in the Ruvuma and Southern Coast Basin (RSCB) Integrated Water Resources Management plan. The case was established through literature review and the impacts were extensive damage to the Mtwara-Lindi and Mkaya-Mtwara roads. Nine water supply schemes affected, plus most water sources polluted in the affected area. Hydrometric stations 1N3A and 1N4A destroyed. Locations affected included Mkwaya, Mtua and Mwena Ndada and tributaries affected included the Nanganga, Ndada, Nangoo and Mwena

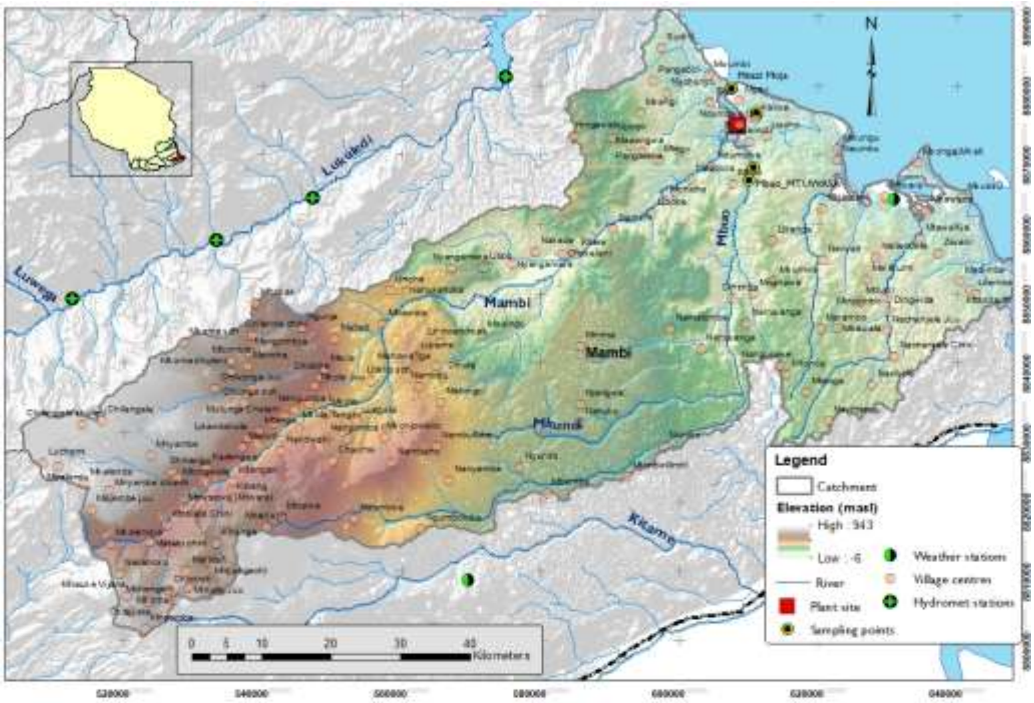


Figure 4-18 Location of Project Site in Mambi Catchment

Source: IRA, 2018

Sea Water (Sudi Creek)

Sea Water Level

Records of tidal and sea water levels at Mtwara Port, provided by the Tanzania Port Authority (TPA), are shown in ***Table 4-7***.

Table 4-7 Sea Water Level Records

Water Levels	Height (m)
Highest Astronomical Tide (HAT)	4.1 m
Mean High Water Springs (MHWS)	3.6 m
Mean High Water Neaps (MHWN)	2.6 m
Mean Sea Level (MSL)	2.0 m
Mean Low Water Neaps (MLWN)	1.4 m

Water Levels	Height (m)
Mean Low Water Springs (MLWS)	0.4 m
Lowest Astronomical Tide (LAT)	0.0 m

Source: IRA, 2018

Sea Water Temperature

Normally, seawater temperature is lower than the ambient temperature, but it was found that seawater temperature is higher than ambient temperature as a result of the actual measurements conducted on 15 December, 2017 (refer to ***Table 4-8***). This means that heat absorption from the sun exceeds the radiation heat of the atmosphere.

Table 4-8 Seawater Temperature at Various Depths

Coordinates (Zone 37L)		Time	Ambient temp. (°C)	Seawater temp (°C) Depth				
E	S			1 m	2 m	3 m	4 m	7 m
608088	8874302	11:20	28.0	30.5	30.0	30.0	29.5	29.5
608112	8874328	11:38	28.0	31.0	–	–	–	30.0
608413	8875058	12:06	28.0	30.0	30.0	30.0	29.0	–
608304	8874667	12:21	28.0	31.0	30.0	30.0	–	–

Source: JICA Study Team, measured in December in 2017 (rainy season)

Sea Water Quality

The proposed Mtwara power plant is located close to the Sudi Creek (also known as Kisiwa Bay) in Mtwara District. Analysis of the water quality of the creek was conducted at three locations (Mgao, Kisiwa, Namgogori) in September 2017 for dry season. The sampling locations are shown in ***Figure 4-19***.

Figure 4-19 Sea water sampling locations (Sudi Creek)

Source: IRA, 2018

The physico-chemical parameters for the seawater monitoring involved in-situ measurements of pH, Dissolved oxygen (DO), temperature and salinity, and collection of water samples using a Niskin bottle for subsequent laboratory measurements. The physical conditions of the sea water at three locations in Sudi Creek at different depths (1m and 5m) during wet and dry seasons are presented in ***Table 4-9***.

Table 4-9 Physical Properties of Sea Water in Sudi Creek (Wet & Dry Seasons)

Site	Temperature (°C)		Salinity (‰)		DO (mg/L)		TDS (g/L)		pH	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
@ 1m depth										
Namgogori	28.0	31.6	36.98	26.9	2.76	3.03	36.29	34.03	8.44	8.50
Kisiwa	27.8	31.7	36.75	26.9	3.45	2.88	36.08	34.94	8.49	8.14
Mgao	27.6	30.2	36.43	24.7	3.11	3.13	35.8	32.14	8.31	8.22
@ 5m depth										
Namgogori	28.0	31.3	37.03	26.3	2.90	3.11	36.33	34.26	8.44	8.50
Kisiwa	27.7	31.4	36.83	27.0	2.97	2.86	36.16	35.18	8.47	8.17
Mgao	27.5	30.2	36.42	23.7	2.96	3.24	35.79	30.79	8.47	8.22

Source: JICA study team, measured in September in 2017 (dry season)

The results of the laboratory analysis of sea water samples are as shown in ***Table 4-10***. According to the results, water quality in Sudi Creek is considered polluted as evident in high COD levels and significant concentrations of coliform and oil and grease.

Table 4-10 Results of Sea Water Quality with Laboratory Analysis (Wet and Dry)

Site	**COD**	**Chlorophyll-a (C mg/m^3)**		**TSS (g/l)**		**Total Coliform**		**Oil & Grease (mg/l)**		**Mineral Oil & Grease (mg/l)**	
	Wet	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
@1m depth											
Namgogori	11.58	1.78	2.85	0.030	0.029	19	31	0.09	27.69	0.09	25.0
Kisiwa	11.86	1.62	3.00	0.030	0.030	ND	35	0.02	41.44	0.02	22.15
Mgao	10.48	1.55	2.09	0.031	0.029	11	15	0.49	37.19	0.67	34.55
@5m depth											
Namgogori	13.48	1.70	3.60	0.031	0.036	22	29	0.20	22.85	0.19	18.76
Kisiwa	13.34	1.71	3.59	0.029	0.030	12	37	2.05	28.56	1.85	24.44
Mgao		1.85	2.10	0.029	0.029	14	19	1.19	30.95	1.07	27.25

Note: N.D = Not detected
Source: JICA study team, measured in September in 2017 (dry season)

Groundwater

Groundwater sources

Mtwara/Mikindani Municipality is supplied with water from two main water sources namely, Mtawanya well field and Mchuchu water source. There are eight boreholes at the Mtawanya well field. The properties of these boreholes are summarized in ***Table 4-11***.

Table 4-11 Groundwater Sources of Mtwara/Mikindani Municipality

Borehole	Depth	Discharge	Pump Capacity		Water Level		Diameter
number					Static	Dynamic	(casing)
	(m)	(m^3/hr)	(m^3/hr)	(kW)	(m amsl)	(m amsl)	(mm)
05/86	40.2	240	180	(8.5)	2.9	0.2	230
12/78	53.5	72	60	8.5	5.9	-	230
14/86	41.6	72	60	8.5	2.2	0.9	198
18/86	54.5	72	60	12.5	20.4	6.2	198
20/86	63.6	72	60	8.5	10.0	7.8	198
31/86	57.0	180	120	25.4	4.2	1.6	240
63/86	52.2	60	30	8.5	2.3	1.8	240
87/86		72	Not Installed				

Source: MoWI, URT (2011)

Installed source capacity at Mtawanya well field is 13,680 m^3/day. The Mchuchu source is situated at Mikindani village and has one spring and one borehole (as medium depth well) each with a capacity of 25 m^3/h. Combined source capacity of these Mchuchu water sources is 1,200 m^3/d.

The villages in the project area use water from shallow wells in Namgogololi, Kisiwa, and Mgao. There is a MTUWASA borehole located at Mbuo village with the capacity of 30 m^3/hr. The water is pumped from the MTUWASA borehole at Mbuo to the storage tank in Namgogoli village with the capacity of 225 m^3 and then distributed to the villages through the gravity system.

Shallow well at Namgogoli village (established on 24/5/1957)

Storage tank at Namgogoli village

Source, IRA, 2018

Groundwater quality

The quality of groundwater sources within the Project Study Area was identified by collecting samples from shallow wells and the borehole at Mbuo village. Parameters such as temperature, pH and salinity were measured in the field, while other parameters were analysed in a laboratory.

Results of the groundwater quality analysis are summarised in ***Table 4-12***. The results indicate that most of the parameters are within the range of acceptable limits set by the TZS drinking water standards, except for salinity and total coliform content in both Mashine and Mnazi Moja shallow wells.

Table 4-12 Groundwater quality analysis results

S/N	Parameters	Mbuo Sampling Time: 09:45	Namgogoli/Mwaha Sampling Time: 13:05	Mashine/Kisiwa Sampling Time: 11:11	Mnazi Moja Sampling Time: 12:09	TZS drinking water standards	Remarks
	pH	7.2	6.5	7.02	6.68	6.5-9.2	Acceptable
	Temperature (^oC)	29.4	29.1	27.2	30.3	-	
1	EC (μS/cm)	1821	1007	2226	2780	<2000	High salinity for Mashine and Mnazi Moja shallow wells
2	Total dissolved solids (mg/l)	920	510	1130	1410	1000 - 1500	Acceptable
4	Turbidity (NTNU)	2.12	3.40	0.96	2.45		
5	Total hardness (mg/l $CaCO_3$)	385	205	450	580	500 -600	Acceptable
6	Calcium hardness (mg/l $CaCO_3$)	238	160	260	390	-	
7	Magnesium (mg/l)	67	50	81.6	92.4	50-100	Acceptable
8	Calcium (mg/l)	126	75	140	188	75-300	Acceptable
9	Chloride (mg/l)	170	94	200	260	200-800	Acceptable
10	Sulphate (mg/l)	135	75	164	215	200 - 600	Acceptable
11	Nitrate (mg/l)	3.4	0.8	6.2	7.0	10 - 75	Acceptable
12	Total Coliform (No./100ml)	0	0	15	20	0	Unsatisfactory for Mashine and Mnazi Moja shallow wells
13	BOD_5 (mg/l)	3.0	3.0	3.0	3.0	< 6	Acceptable
14	COD (mg/l)	5.0	5.0	6.0	5.0	< 10	Acceptable

Source: IRA, 2018

Groundwater from the Proposed Water Supply Source

Water that will be used by the Project will be supplied by wells near Mbuo River. In order to identify the water quality of the proposed water supply, samples from newly developed MTUWASA wells (Wells No. 1-3) should have been taken and analyzed. However, this was not possible because the wells were covered. As alternatives, tap water in Kisiwa village (Point E) and upstream well of Mbuo River (Point F) were taken and analyzed (refer to ***Figure 4-20***). Since the sampling locations are both located in the same catchment area of Mbuo River, water quality is assumed not to vary significantly with that from existing wells.

E. Tap Water of the Kisiwa Village

F. Upstream of the Mbuo River

Figure 4-20 Location of Wells and Water Sampling

Source: IRA, 2018

The results of water quality analysis are presented in Table 4-13. According to the analysis results shown, all parameters meet the quality of Tanzania Drinking Water Supplies and the World Health Organization Guidelines (WHO) for Drinking-water Quality.

Table 4-13 Groundwater Quality in the Mtwara Region

Parameter	Standards		E: Kisiwa (Mtwara Rural)	F: MBUO (Mtwara Rural)
	Tanzania	WHO	Mar/2018	Mar/2018
pH	6.5-9.2	6.5-8.5	7.61	7.35
EC(µs/cm)	2000		1241	598
TDS(mg/l)		500	683	242
Turbidity (NTU)	0-30	0-15	9	11
Total Hard (mg/l)	600	500	174.83	83.18
Ca (mg/l)	300	200	49.4	28.4
Mg (mg/l)	100	150	12.5	2.98
Fe (mg/l)	0-1.0	0-0.3	0.02	0
Mn (mg/l)	0-0.5	0-0.1	0.016	0.06
SO4 (mg/l)	600	400	8	2
Cl^- (mg/l)	800	250	385.67	106.23
Alk. (mg/l)	500	500	80.0	76.0
NO3 (mg/l)	10-75	0-30	4.8	6.9
F (mg/l)	0-8.0	0-1.5	0	0
Na (mg/l)	250	200	46	184
K (mg/l)	100	-	28.39	35.95
Temperature (°C)	35.0 (Highest)		30.2	30.8

Source: IRA, 2018

4.1.8 *Ecology*

Protected areas

Mtwara District, where the Project Site is located, has forest reserves and a marine park. These protected areas are mapped out in ***Figure 4-21***. The proposed Project Site is not inside any of these protected areas.

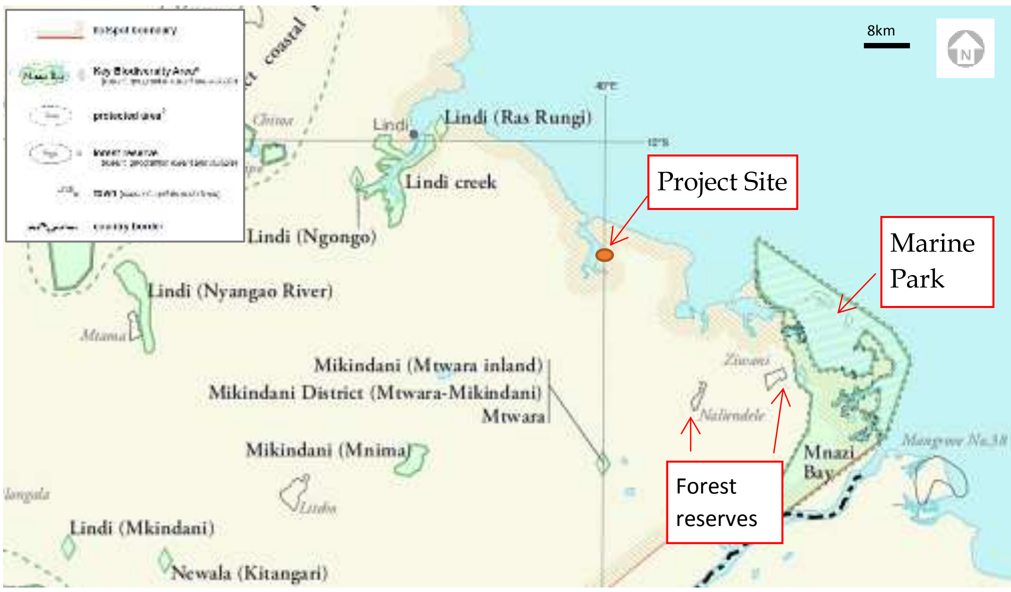


Figure 4-21 Protected Areas in Mtwara Region

Source: Center for Applied Biodiversity Science at Conservation International, 2006

Forest Reserves

There are five forest reserves in Mtwara District. Three of these are under the management of Central Government. Forest reserves managed by the Mtwara District Council include Mtiniko/Mnivata (1,736ha) and Mtuluhinju (296ha). The closest forest reserves to the proposed power plant site are Naliendele and Ziwani forest reserves, which are approximately 65 km away. The Ziwani forest reserve is being transformed into plantation forest following high level of degradation. The forest agency (TFS) is now planting *Tictona grandis* (Tick trees) one of the high value timber species.

Marine Park

There is one national marine park in Mtwara District, the Mnazi Bay Ruvuma Estuary Marine Park (MBREMP). After being recognized as an area of high biodiversity value at both the national and international levels, the MBREMP was gazetted as a Marine Park (Government Notice No. 285) in 2000 under Section 9 of the Marine Parks and Reserves Act, No. 29 of 1994. The IUCN Management Category for this marine park is VI (protected area with sustainable use of resources). Therefore, it is possible to utilize resources within the park provided these are done sustainably.

The MBREMP covers a total area of 650 square kilometers and 45 km of coastline, including the estuary of Ruvuma River. Within its boundaries, there are 11 villages that also border the Republic of Mozambique. Resources and boundaries of the MBREMP are shown in ***Figure 4-22***. The proposed power plant is 90km away from the MBREMP.

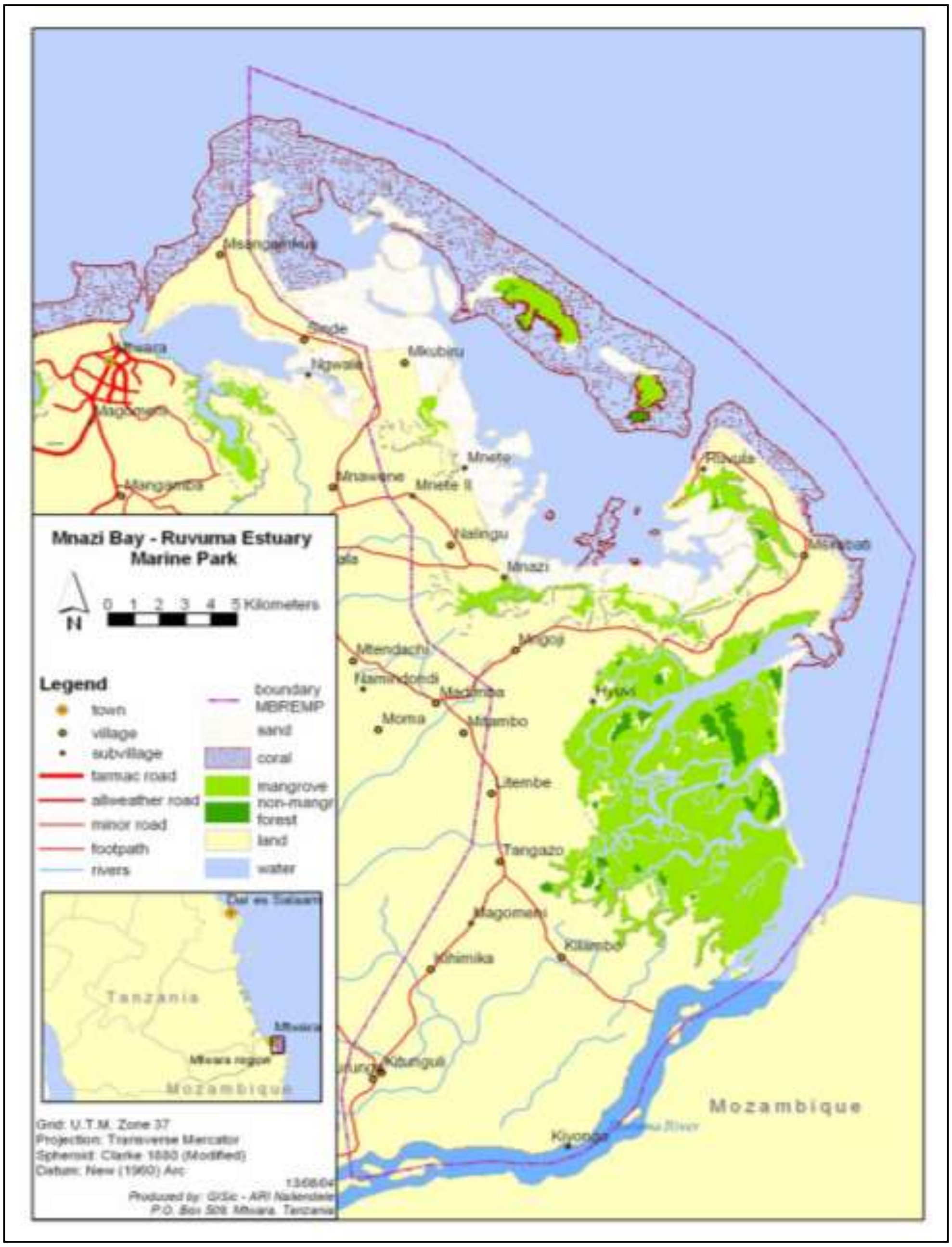


Figure 4-22 Mnazi Bay Ruvuma Estuary Marine Park (MBREMP)
Source: MNRT

Ecologically Sensitive Areas

Important Bird Area (IBA) and Key Biodiversity Area

Mnazi Bay is considered as an Important Bird Area (IBA) and Key Biodiversity Area due to the presence of "significant population of globally threatened species and significant congregations of one or more bird species at certain times in their lifecycle or seasonal migration". It is the closest IBA and KBA to the Project Site, located at an approximate distance of 25km (refer to ***Figure 4-23***).

This IBA/KBA provides habitat connection to the inland coastal forests for number of birds including migrating species from Europe and Asia. Various species of birds found in nearby coastal forests migrate into the mangrove forest found onshore where they feed. Also, the birds feeding in these areas utilize the intertidal zones rich in crustacean and crabs. Key species that are present in the IBA are listed in ***Table 4-14***. These include eight bird species of Least Concern (LC) and two Vulnerable (VU) plant species.

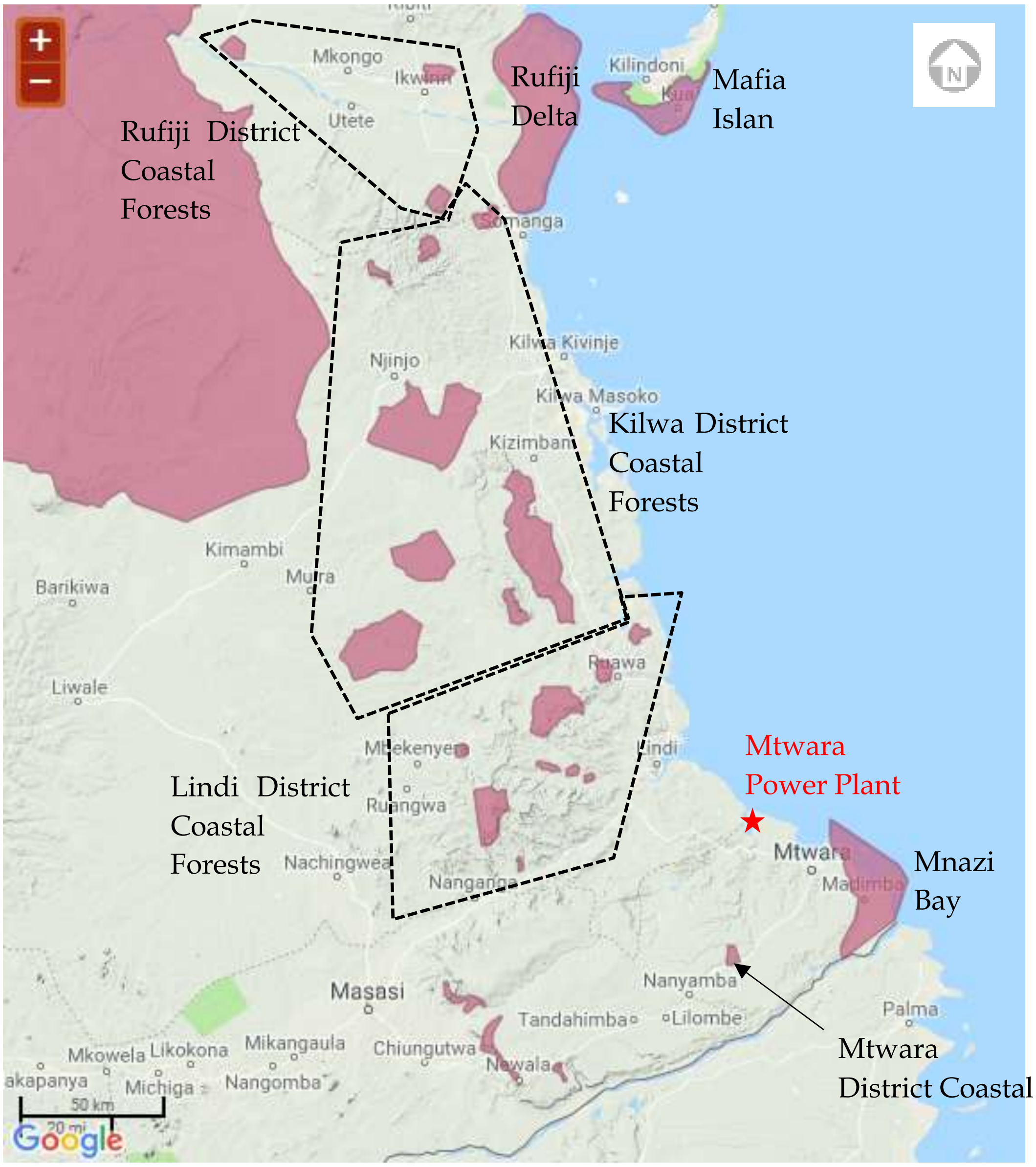


Figure 4-23 Location of the IBAs around the project area
Source: IBAT Alliance 2018 (https://www.ibat-alliance.org/ibat-conservation/mapviewerol213)

Table 4-14 Key Species in Mnazi Bay IBA/KBA

IBA/KBA	Key Species	IUCN Red List Status
Mnazi Bay	East Coast Batis (*Batis soror*); Greater Sandplover (*Charadrius leschenaultia*); Mouse-coloured Sunbird (*Cyanomitra verreauxii*); Crab-plover (*Dromas ardeola*); Zanzibar Red Bishop (*Euplectes nigroventris*); Mangrove Kingfisher (*Halcyon senegaloides*); Black-bellied Starling (*Notopholia corusca*); Brown-headed Parrot (*Poicephalus cryptoxanthus*)	LC
	Baphia marocalyx; *Belinia orientalis*	VU

Source: IBAT Alliance 2018

Feeding and nesting sites/habitats

The loggerhead turtle (*Caretta caretta*) is considered vulnerable while the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (Lepidochelys olivacea), and leatherback turtle (*Demochelys coriacea*) are all considered endangered by Frazier (1976) and Thiagarajan (1991). Information on sea turtles indicates that all Five species of sea turtle found in the West Indian Ocean have been sighted in Tanzanian waters (Tanzania Coastal Management Partnership, 2004). These are the Green turtle, Hawksbill turtle, Olive Ridley turtle, Loggerhead turtle and Leatherback turtle. Two of the five species, Green and Hawksbill, are known to nest on the Tanzanian beaches. Quantitative nest data indicates that concentrated nesting activity occurs on Misali Island in Pemba, Mnemba Island in Unguja, Mafia Island in Juani Island and Kungwi, Madete and Mtwara in Msimbati and Litokoto and Kingumi Islands.

The Leatherback and Hawksbill are classified by the IUCN as Critically Endangered because of a population decline of over 80% in the past 50 years while the others are categorized as Endangered. These are also listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 2011), which prohibits international trade in the species on the list.

According to a study about the status of turtles in Mnazi Bay (Muir, 2004), four nesting sites have been observed within the MBREMP. The closest nesting site is approximately 30km away from the Project Site.

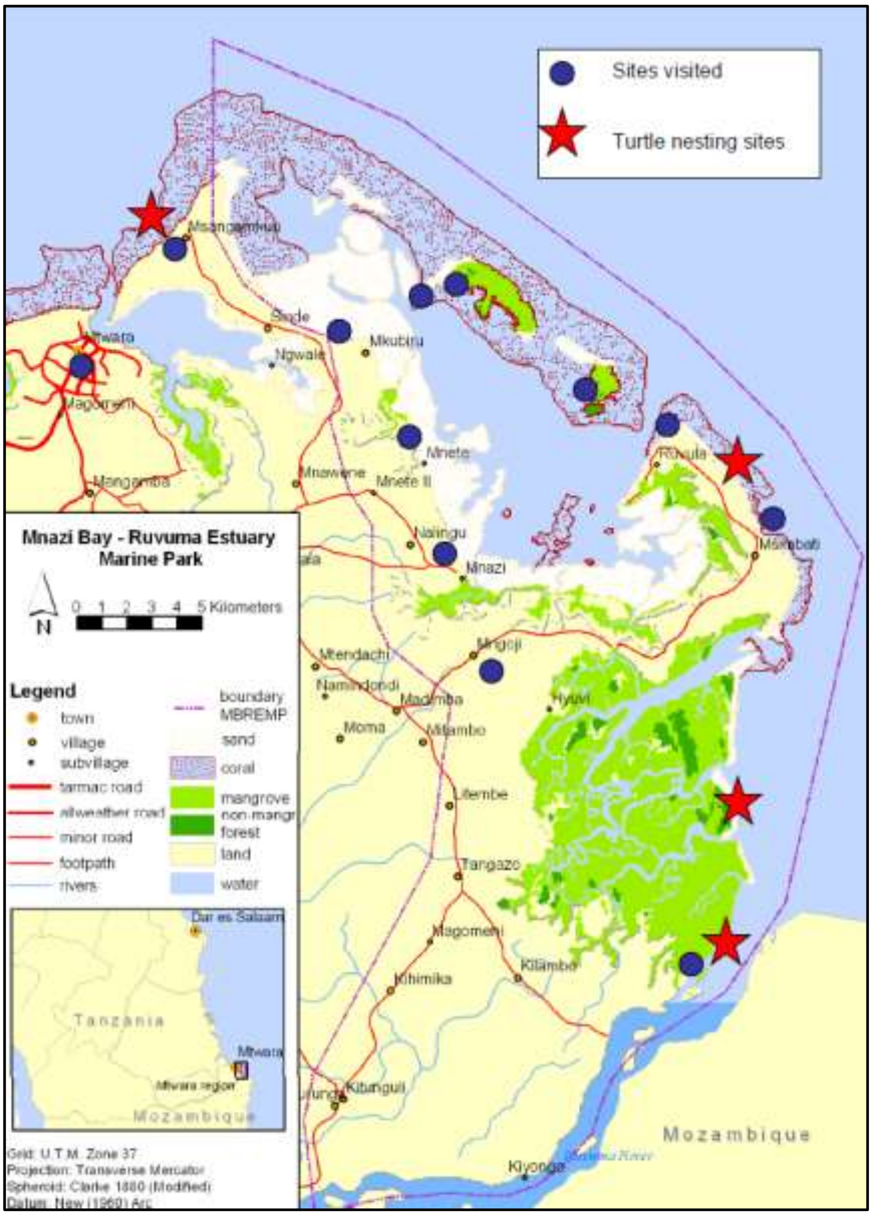


Figure 4-24 Turtle Nesting Sites in Mnazi Bay

Source: Muir, C. E. (2004): An Assessment of the Status of Turtles, Dugongs and Cetaceans in Mnazi Bay Ruvuma Estuary Marine Park & Recommendations for a Conservation Strategy, vi + 69pp.

Flora

Marine and coastal vegetation

In Tanzania, seagrass beds are widely distributed from high intertidal to shallow subtidal areas including along the shoreline in Lindi region and Mtwara region. They are found in sheltered areas of the coast around Kilwa, Rufiji, Ruvu and Moa. Seagrass beds are highly productive and serve many ecological functions. These include providing breeding, nursery, and feeding areas for many invertebrate and vertebrate species including commercially important species of finfish and shellfish; and shelter and refuge for resident and transient adult animals. Seagrasses are an important food source for herbivorous invertebrates, fish, dugong, and green turtles.

Additional ecological functions of seagrass include the trapping of sediments, which reduces sedimentation over coral reefs and therefore protects shorelines, and the dissipation of wave energy, which also provides protection to the beaches. Major threats to the survival of seagrass beds come from excessive sedimentation of coastal waters resulting from the different human activities; from increased turbidity, which tends to cut down the light penetration; and from inshore prawn trawling and seine nets, which destroy seagrass beds.

Marine and coastal vegetation within Sudi Creek and the connecting seashore is shown in ***Figure 4-25***. Green dotted area is mangrove vegetation. No sea weed bed is located inside the creek.

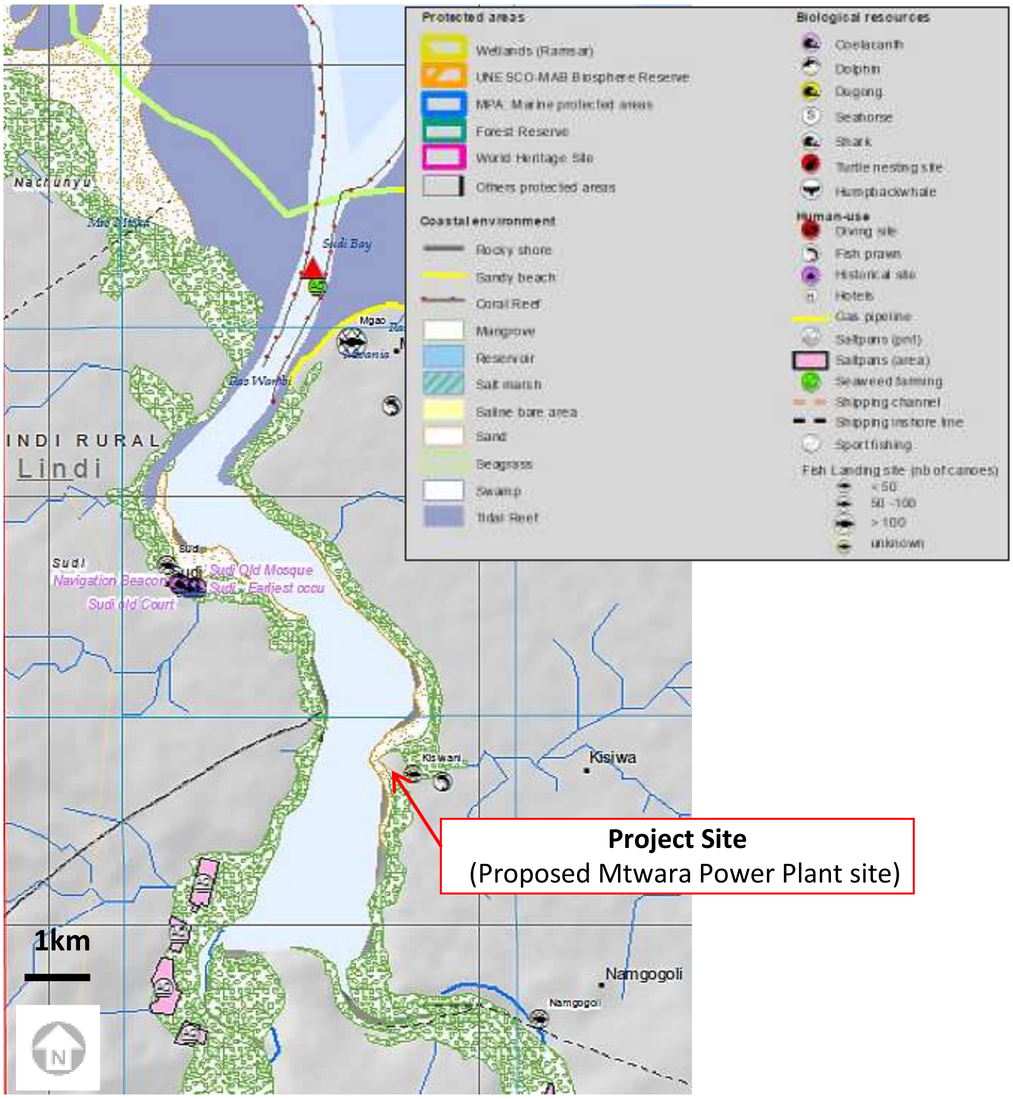


Figure 4-25 Coral and seaweed location around Project Site

Source: Tanzania Sensitivity Atlas, Institute of Marine Sciences of University of Dar es Salaam, Samaki Consultans Ltd., Obscom Paris, 2015

Terrestrial vegetation

The characteristic terrestrial vegetation of the Project Study Area can be broadly classified into Coastal thickets/bushlands, Mangrove forest, and secondary vegetation consisting of cashew farmlands. The vegetation of the project area is mainly coastal thickets with dense to sparsely distributed Mangrove forest on muddy shore.

Coastal Thicket/Bushland

This vegetation type is characterised by an assemblage of woody plants shrubs with scattered emergent trees with small patches of evergreen forest canopy height ranging between 5-8m tall. Common tree species includes; *Spyrostachys africana, Cleistanthus schlechteri, Dalbergia melanoxylon, Acacia, Acacia polyacantha, Lamprothamnus zanguebaricus, Afzelia quanzenzis* and *Lannea stuhlmanii*. In small patches of evergreen relic forests trees species of *Hymanaea verrucosa, Manilkara sulcata, Lecaniodiscus fraxinifolius, Pteleopsis myrtifolia, Berlinia orientalis, Manilkara zanzibarica, Markhamia obtusifolia, Dichrostachys cinerea, Diospyros zombensis.,Haplocoelium inopleum* and *Maerua angolensis* becomes common. Much of these vegetation is covering the proposed plant site. Among the species identified, it has been noted that three species are included in IUCN's Red List (refer to Table below), with one type of legume species (*Berlinia orientalis)* identified as vulnerable. The other two species have lower conservation status - *Dichrostachys cinerea* (Least Concern) and *Dalbergia melanoxylon* (Not Threatened)


Figure 4-26 Observed coastal thickets and bushland during field survey

Source: IRA, 2018

Mangrove forest

This vegetation category is defined as trees and shrubs that grow in estuarine areas characterized by combination of saline and coastal habits in the tropics and subtropics. The mangrove community in the project area is dominated with species of *Rhizophora mucronata, Ceriopsis tagal, Sonneratia abla* and *Avicennia marina*. At district level, the mangrove vegetation are characteristics on all bays, creeks and low laying coastal mashes.

In the project area, this type of vegetation occurs at Kisiwa intake and discharge site, closer to power plant location. The estimated distance of the mangrove zone to be affected is about 50 - 60 m long and 5 m wide (approx. 275m^2), which constitutes an insignificant loss compared to the existing stand size. So far TFS has not carried out inventory to determine the magnitude of loss and calculate the cost for compensation.

Consultation with TFS was necessary as a stakeholder with regards to forest and forest related products in this case mangrove forest. Therefore, during the EIA process, consultation with TFS-mangrove Unit and Fishery Unit in Mtwara was done and they had the following views and comments: They both pointed out to the importance of marine organisms as one of the potential biodiversity resources. The TFS regional manager pointed out that within the area proposed for development, the only forest resource likely to be affected was mangrove. Also he clarified on the procedures to be followed before implementing the project that would affect forest resources. The manager insisted that if the proposed development project will clear mangroves, compensation should be paid to TFS as stipulated in the GN. 255, of THE FOREST (AMENDMENTS) REGULATIONS, 2017. The regulation states that for forest resources likely to be cleared and compensated, TFS will carry out inventory to quantify the amount to be lost and cost to be paid.

Source: IRA, 2018

Figure 4-27 Observed mangrove forests during field survey

The Sudi Creek mangrove forest is composed of five magrove species commonly found in Tanzania. *Rhizophora mucronata*, *Ceriops tagal* and *Bruguiera gymnorrhiza* are the dominant species. Other species that are well represented include, *Avicennia marina* and *Sonneratia alba*. Among these species, *Avicennia marina* (gray mangrove), *Sonneratia alba*, and *Ceriops tagal* are in the IUCN Red List under the "Least Concern" category.

S. alba and *A. marina* are used for constructing boats and for lime burning, whereas *R. mucronata, C. tagal* and *B. gymnorrhiza* are used for house construction. However, all mangroves are used for firewood.

All mangrove forests in Tanzania are protected by law. Sudi Creek mangroves are managed in accordance with the national Mangrove Management Plan (URT, 1991), which divides mangrove forests into four zones, namely zone I, II, III and IV. Zone I mangroves receive total protection, zone II is a production area where harvesting is permitted, zone III are degraded areas whereby harvesting is closed during certain periods to allow recovery and rehabilitation. Zone IV is an area that is set aside for development activities including salt production (URT, 1991). The Sudi Creek mangroves fall under zone I of the Management Plan.

Cashew nut -Coconut vegetation

This vegetation type is characterised by a land which its natural vegetation have been cleared being replaced with agricultural crops and settlements. This vegetation type extends from raised plateaus to low laying area with well drained soils. The characteristics species include Cashew nut (Anacardium occidentale), Coconut trees (Cocos nucifera), cassava field (Manihot esculenta) and Mango(Mangifera indica).

The project activities will affect this vegetation type especially the substation site, transmission, establishing access road and gas pipeline to the plant and other auxiliary activities of the project.

Source: IRA, 2018

Figure 4-28 Observed Cashew Nut/ Coconut Plantation

Flora in the Project Site

The terrestrial flora in the Project Site consists mainly of coastal thickets and mangrove vegetation. Although these are in degraded state, some species that are under IUCN Red List have been identified during field survey. Those species are summarized in ***Table 4-15*** below.

Table 4-15 Key Flora Species in the Project Site

	Species name	Red list status	Picture
1	*Milicia Excels*	LR/nt	

	Species name	Red list status	Picture
2	*Pterocarpus angolensis* GPS: 0575893S 8873819E	LC	
3	Dalbergia melanoxylon GPS: 0564518S 8908316E	LR/nt	
4	*Vitex zanzibarensis* GPS: 0564518 S 8908316 E	VU	
5	*Monanthotaxis trichocarpa* GPS: 0562328 S 8889304 E	LC	
6	*Dialium holtzii* GPS: 0575893S 8873819E	VU	

Source: IRA, 2018

Fauna

Marine and Aquatic Fauna

Corals: Due to the narrowness of the continental shelf of most of Tanzania, coral reefs are typically situated close to land. Coral reefs are common along much of the Tanzanian coastline, and well-developed barrier reefs occur along most of the ocean-facing eastern coastline of the islands. There are also extensive coral reefs and coral outcrops on the leeward side of the islands, and these vary in species diversity. In Mtwara, coral reefs are a major feature in the inner part of Mikindani Bay and adjacent to Shangani waterfront. There are also extensive reefs located on the outer, open sea facing shore of the Msangamkuu Peninsula and the Pemba to the north. There are about 700 species of reef-associated corals world-wide, and 150 species of scleractian corals have been reported from Tanzanian reefs.

Invertebrates: A high diversity of marine invertebrates such as gastropods (branched murex [*Chicoreus ramosus*], tulip snails [*Fasciola trapezium*]); Bivalves (prickly pen shell [*Pinna muricatum*], giant clam [*Tridacna squamosal*]); Crustacea (crabs, lobster, and shrimps); Mollusca (squid, octopus, sea snails, and shellfish); Cnidaria (jellyfish, sea anemones, and corals); Echinodermata (sea stars, sea urchins and sea cucumbers) and other invertebrates are common along the sea waters of Mtwara coastal areas.

There are no live corals observed at Kisiwa (inside Sudi Creek), probably due to low dissolved oxygen levels and high turbidity of the water in the area. However, some corals have been observed close to Mgao village (outside the mouth of Sudi Creek). The list of observed corals is presented in ***Table 4-16***.

Table 4-16 Observed coral species outside the mouth of Sudi Creek

Family name	Species name	IUCN category
Poritidae	*Porites lobata*	Near threatened
Acroporidae	*Acropora* sp.	Near threatened
Merulinidae	*Pachygyria* sp.	Least concern
Faviidae	*Favites* sp.	Least concern
Diploastreidae.	*Diploastrea heliopore*	Near threatened
Lobophylliidae	*Lobophylla hempriochii*	Least concern
Faviidae	*Leptoria* sp.	Near threatened
Agariciidae	*Pavona decussata*	Vulnerable

Source: IRA, 2018

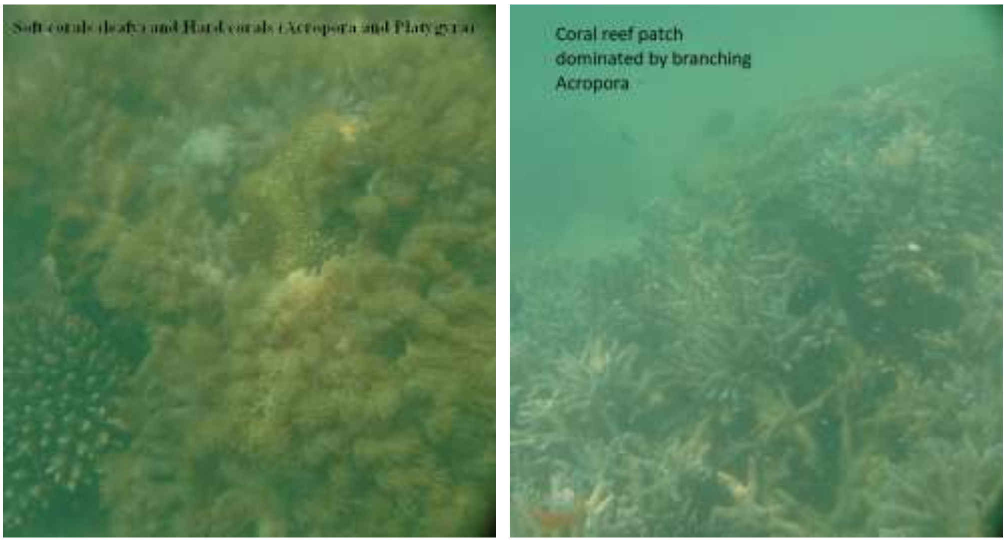


Figure 4-29 Photographs of observed corals outside Sudi Creek (close to the mouth)

Source: IRA, 2018

Marine vertebrates except fish: Marine mammals are not found inside Sudi Creek. Also, there are no known turtle nesting sites in the vicinity of the project area (refer to Section 5.9.2).

However, some marine mammals are occasionally sighted outside the mouth of the creek. A list of these mammals is presented in

Table 4-17. Among the species in the list, there are two species which are endangered – the humpback whale (*Megaptera novaeangliae*), green turtle (*Chelonia mydas*), and loggerhead (); and one species which is critically endangered – the hawksbill turtle (*Eretmochelys imbricata*).

Table 4-17 Marine mammals that occur occasionally outside Sudi Creek

Family name	**Species name**	**IUCN category**
Physeteridae	*Physeter macrocephalus*	Vulnerable
Balaenopteridae	*Megaptera novaeangliae*	Endangered
Delphinidae	*Tursiops aduncus*	Least concern
Delphinidae	*Stenella longirostris*	Data deficient
Delphinidae	*Sousa chinensis*	Data deficient
Delphinidae	*Delphinus delphis*	Least concern
Delphinidae	*Stenella attenuate*	Least concern
Dugongidae	*Dugong dugon*	Vulnerable
Cheloniidae	*Chelonia mydas* (Green Turtle)	Endangered
Cheloniidae	*Eretmochelys imbricata* (Hawksbill)	Critically endangered
Dermochelyidae	*Dermochelys coriacea*; Ngámba (Leatherback)	Vulnerable
Cheloniidae	*Caretta caretta*; Duvi (Loggerhead turtle)	Vulnerable
Cheloniidae	*Lepidochelys olivacea*; Gome (Olive Ridley)	Vulnerable

Source: IRA, 2018

Marine Fish: Marine fishes that are potentially found inside and outside (near the mouth of) Sudi Creek are listed in ***Table 4-18*** and ***Table 4-19***, respectively. None of these species is considered to be endangered or threatened. Most of the species have a conservation status of least concern. The Bigeye tuna is the only species considered to be vulnerable.

Table 4-18 Marine fish species identified inside Sudi Creek

Family name	Species name	Local name	IUCN category
Scombridae	Bigeye tuna (*Thunnus obesus*)	Jodari macho	Vulnerable
Scombridae	Sword fish (*Xiphias gladius*)	Nduwaro	Least concern
Scombridae	Mackerel tuna (*Euthynus afinis*)	Sehewa	Least concern
Scombridae	Indian mackerel (*Rastrelliger kanagurta*)	Vibua	Data deficient
Serranidae	Peacock hind (*Cephalopholis argus*)	Chewa	Least concern
Siganidae	White-spotted spinefoot (*Siganus canaliculatus*)	Tasi	Least concern
Sphyraenidae	Barracuda (*Sphyraena obtusata*)	Msusa, Mzia	Not evaluated

Source: IRA, 2018

Table 4-19 Marine fish species identified outside Sudi Creek

Family name	Species name	Local name	IUCN category
Siganidae	White-spotted spinefoot (*Siganus canaliculatus*)	Tasi	Least concern
Lutjanidae	Black and White snapper *(Macolor macularis*	Changu	Least concern
Mullidae	Freckled goatfish *(Upeneus Tragula))*	Mkundaji	Least concern
Lethrinidae	Black-blotch emperor (*Lthrinus harak*)	Changudoa	Least concern
Mugilidae	Bluetail mullet *(Valamugil buchanani)*	Mkizi	Least concern
Serranidae	Peacock hind *(Cephalopholis argus)*	Chewa	Least concern
Octopidae	Lanket octopus *((Octopus chromutus)*	Pweza	Least concern
Shyraenidae	Obtusa barracuda *(Sphyraena obtusata)*	Mzia	Not evaluated
Scombrinidae	Indian mackerel *(Rastrelliger kanagurta)*	vibua	Data deficient
Casionidae	Yellowback fusilier *(Caesio xanthanata)*	Mbono	Least concern
Loliginidae	Indian squid *(Uroleuthis duvaucelli)*	Ngisi	Not evaluated

Source: IRA, 2018

Terrestrial Fauna

The existing vegetation types that characterize various sections of the Project Site, creates a habitat for small populations of mammals, reptiles, amphibians and birds (Table B). The contribution of the coastal thicket habitat on fauna is important when treated relative to the size of remaining coastal thicket in southern Tanzania, and its impact to the fauna species is insignificant. Thus, consideration of individual taxa groups such as mammals, or amphibians, their populations in these habitats is relatively small.

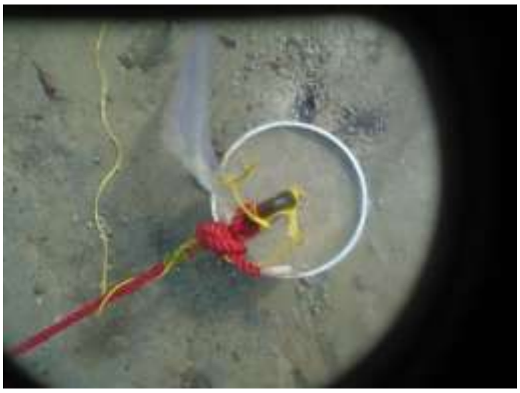
Mammals: The assessment carried out at Kisiwa power plant sites did not register sightings of any single mammal species; nonetheless signs of presence of mammals like African hare, Dikdik, Impala (LC), wild pig (LC) and Impala

(LC) were noted particularly in terms of droppings and tracks. Also, the assessment encountered large numbers of traps locally made by villagers targeting the mentioned species. The combination of these field signs and reports from stakeholder consultations made the team to conclude that the population of these small mammals has been ravaged by local hunting of the said wildlife.

Reptiles: The project area indicates significant population of reptiles mostly on disturbed coastal thickets. The survey observed different types of reptiles including snakes and lizards. Snakes observed include black mamba, Egyptian cobra and sand snake.

Benthic Environment

There was considerable difference between the sea bottom ecological environment at Kisiwa (inside Sudi Creek) and sea bottom ecological environment at Mgao (outside Sudi Creek, near the mouth). The sea bottom at Kisiwa was generally devoid of visible living fauna/flora. It is dominated by very coarse sand, enriched with pebbles and shell fragments. On the other hand, the sea bottom at Mgao was highly enriched with visible living marine fauna such as diversified species of corals and sea grass beds, sea urchins, bivalves, and others.



Sea bottom inside Sudi Creek

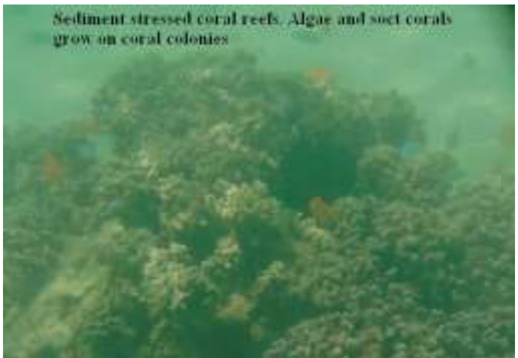


Figure 4-30 Underwater ecological environment at the mouth of Sudi Creek

Source: IRA, 2018

Ecological Sensitivity of the Study Area

The sensitivity of the Project area is largely related to the presence of mangrove vegetation which will be affected by the construction and operation of the waste water discharge pipeline from the power plant. A corridor of about 274m^2 will necessitate the estimated distance of the mangrove zone to be affected is a clearance of mangroves, although the amount of loss is likely to be insignificant compared to the remaining Mangrove stands.

With regard to wildlife, the coastal thickets identified at the Project area largely creates habitat for sluding mall populations of mammals (Dikdik, Impala and wild pig), reptiles (snakes including black mamba, Egyptian cobra and sand snake) and lizards, amphibians and birds. The mangrove vegetation in particular tends to support marine or estuarine organisms. The contribution of the coastal thicket habitat on fauna is important when treated relative to the size of remaining coastal thicket in southern Tanzania, otherwise its impact to the fauna species is insignificant.

In terms of birds the presence of mangrove forest together with the intertidal zone of the sea shore creates suitable habitats for birds both resident and migrating birds. The assessment captured different type of birds both aquatic and terrestrial, including long distance migrating birds. IBA international list Mtwara district coastal forest, Lindi district coastal forests and Kilwa district coastal forests together with the high density of mangroves as important bird areas (Baker and Baker, 2003).

4.1.9 Natural Disasters

Seismic Condition

As confirmed at the Mtwara Meteorological Observation Station, there are no known records of records of earthquakes in the region.

Historical records of earthquakes with magnitude 4.0 and above, in between 627 and 1994 in Eastern Africa and South Africa, have been plotted in Figure 4-31. As shown in the Figure, earthquakes occurred frequently along the East Africa Rift Valley but there is no record of earthquake occurring around the Kisiwa Site.

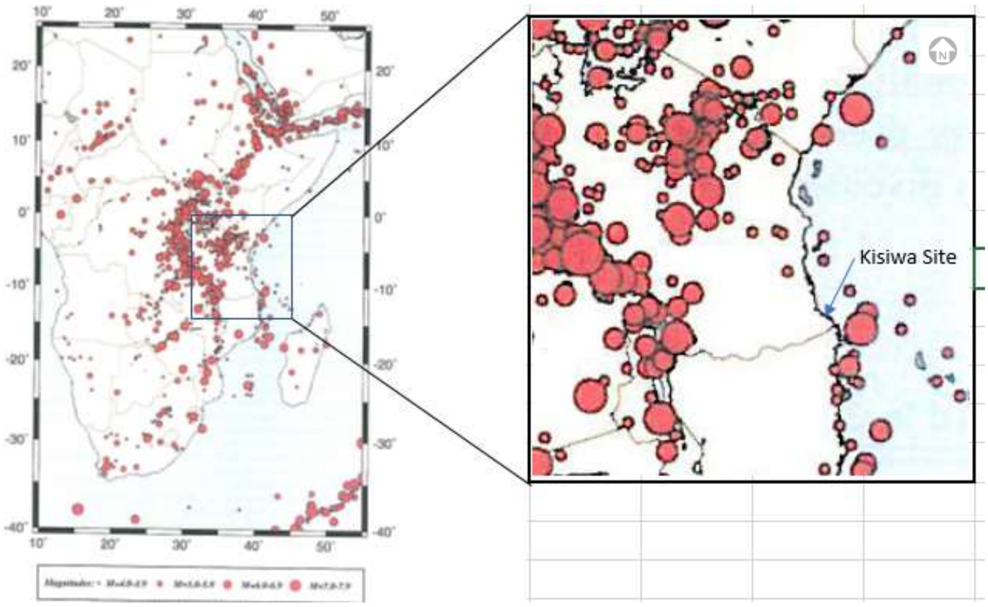


Figure 4-31 Seismic Hazard Record of East and South Africa

Source: Seismic Hazard assessment in Eastern and Southern Africa 1999

Based on the Modified Mercalli Scale, developed by OCHA Regional Office for Central and East Africa, the earthquake risk of the Project site falls under Degree VI, which corresponds to strong perceived shaking and light potential damage.

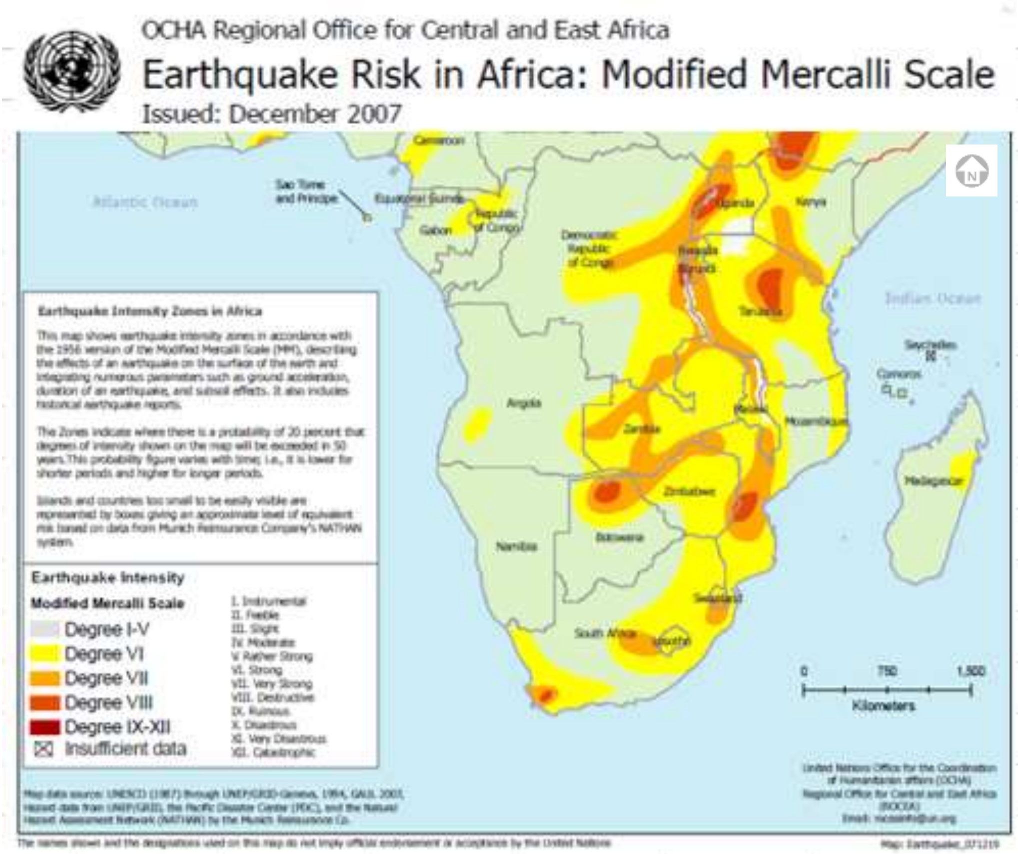


Figure 4-32 Earthquake Risk in Africa

Source: OCHA (December, 2007)

Flood

Storm-water management is a critical issue in the overall planning area of the Mtwara Master Plan[1]. The area experiences regular flood mainly due to the natural topographic characteristics of the region. Most of the flood-prone areas fall below sea level and are part of catchment areas, which receives water from many rivers, streams, and valleys. Another reason for flooding is the high water table in many parts of Mtwara. Flood prone areas are shown in Figure 4-33.

At present, potential factors that increase flood risks in Mtwara, include:

- a combination of considerable rainfall events;
- a topography that includes many low-lying areas or basins;
- a coastline which is low and prone to coastal flooding from storm surges combined with high tides;
- lack of adequate storm water management provisions; and
- construction of built structures within floodplains and basins.

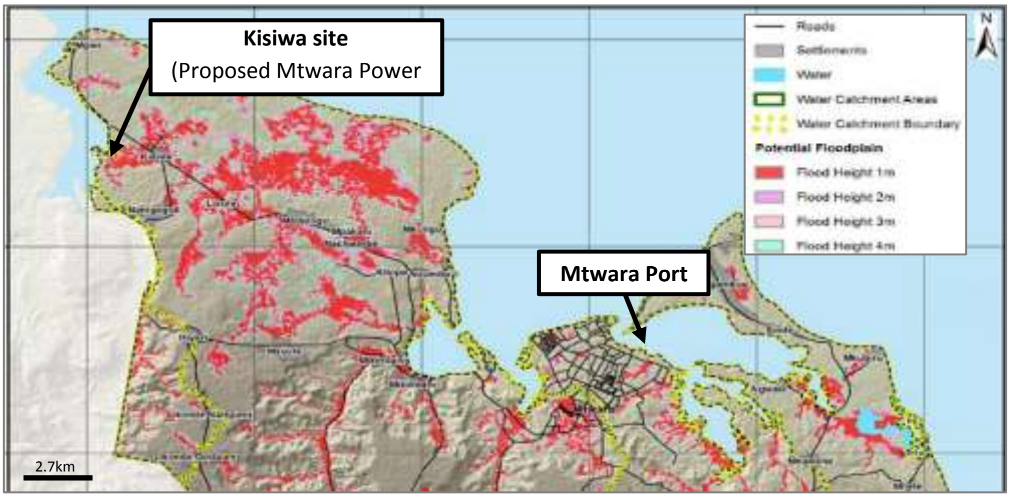


Figure 4-33 Flood Plains in Coastal areas of Mtwara Region
Source: Mtwara Master Plan, 2016

Debris Flow

Based on the past records of natural disasters of the Project Site's surrounding area, it can be noted that a debris flow disaster caused by the torrential rain occurred in the beginning of April 1990. The National Road B5 Lindi - Masasi route was damaged at two (2) places by this debris flow. One superstructure of the Nanganga Bridge was washed away by a flood and the river bed was eroded, and sunk more than 10 meters in depth in the upstream of the bridge. The other is Mkwara Sandy Area where it was buried by a debris flow.

Although the project's surrounding area is not a steep terrain and most of area forms gradual slopes, the probability of occurrence of debris flow disasters

1 Mtwara Master Plan 2015-2035, Ministry of Lands, Housing and Human Settlement Development, 2017

should be considered during the implementation of design and construction work of transmission line and site development.

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Figure 4-34 Location Map of the Debris Flow Disasters
Source: Debris Flow Disaster on Road in Tanzania, Tetsuya Kubota, 1992

4.1.10 *Landscape*

The District is divided into four ecological zones.

The Coastal Zone

The Zone covers an area of 28,200 hectares is potential for agriculture, fishing and tourism. Food crops grown include sorghum, cassava, rice, maize and legumes. Cash crops produced in order of importance are cashew nut, simsim, coconuts and ground nuts. Fishing is done in small scale due to poor fishing tools and lack of fishing tools and fishing gears. However fishing activity support most of the coastal people's life, it is a continuous activity, compared to agriculture which is seasonal. Tourism is found in Msimbati where there is an 18km beach, and one beach camp. Fishing industry in the District is still dormant despite the tourism potentials the District has. It is expected that Mtwara corridor and Mnazi Bay Gas project will bring up tourism

The Makonde plateau

This is the biggest zone in the District covering 269,700 hectares. The zone covers the central part of the District; it covers the whole Nanyamba division and large part of Kitaya, and Dihimba divisions. It is the most productive zone for both food and cash crops, and small stock keeping. The main economic activity is only agriculture and since there is neither river nor lake. Fishing is not experienced, crops grown in order of their importance are cassava, sorghum, maize, upland paddy and legumes. Cash crops include cashew nut, coconut, simsim and groundnuts.

The Ruvuma valley zone

The zone has very fertile soil, which is fed by river deposits. People in this zone are mainly engaged in Agriculture and fishing. Agriculture is done in the valley plains and upland areas. Lowland paddy is grown in this zone along with cassava, sorghum, legumes and maize, cashew nut, coconut, simsim and groundnuts to support the people's life as source of income. Fishing is done both in the River and Indian Ocean, for income generation and as a protein subsidy.

The Kitere plain

The Kitere plain covers as area of 18,700 hectares. The plain is found in Mpapura division and covers all most the whole Kitere Ward. The plain is accompanied by Lake Kitere, which collects water from upland areas of Njengwa and parts of Lindi Region. The plain is very rich in producing paddy and vegetable. Other food crops include cassava, sorghum, maize and legumes. Cash crops grown are cashew nuts, coconuts, simsim, and groundnuts.

4.2 SOCIO-ECONOMIC ENVIRONMENT

This section reviews the project's socio-economic environment, the baseline of which is drawn up at national, regional and local levels. It presents the economic and social conditions in the baseline, using secondary data obtained from the various planning and analysis departments, as well as databases and documents obtained from the Mtwara district, who are actively involved in the preparation of socio-economic profile of the district. In addition, the Socio-Economic Survey was conducted from 08th to 17th, August, 2018 using open ended and closed ended questionnaires which were administered to the households that were found within the project area. These sources are supplemented by information obtained from consultations with the various stakeholders at ministerial, regional and village levels. Within the context of the socioeconomic component of the ESIA, two levels of influence have been considered with regard to the study area:

- The first level involves the project core impact area: This is the area where the actual plant will be located and where the electricity will be generated and auxiliary infrastructure are actually located and, which would bear the most impacts than the rest.
- The second level involves the immediate impact area: This is the area that is outside the core area but plays an important role or bears relatively some of the impacts (positive or negative) felt in the core area. The immediate impact area in the case of the proposed thermal power generation project would generally include the Mtwara district with its villages.

4.2.1 *Administrative boundaries and Administrative framework*

Mtwara Rural District (MRD) is one of the five Districts of Mtwara Region. It is bordered by Lindi District (Lindi Region) to the North, by the Indian Ocean to the East, the Republic of Mozambique to the South and Tandahimba District (Mtwara Region) to the West. The District has an area of 3,579 km^2 of which 72% is arable. Approximately 48% of the total arable land is currently being used for cultivation.

Administratively, the District is divided into 5 divisions, 21 wards, 110 villages and 421 hamlets "Vitongoji". The District has one constituency as shown in ***Table 4-20*** and ***Figure 4-35***. There are 29 councillors, of which 1 is Member of Parliament. 21 are elected while 7 are nominees for special seats (women).

Table 4-20 District Administrative Set-up

No.	DIVISION	WARD	VILLAGE	HARMLETS
1	Dihimba	4	20	52
2	Kitaya	2	9	56
3	Mayanga	3	19	69
4	Mpapura	4	21	86
5	Ziwani	8	41	158
	Total	**21**	**110**	**421**

Source: Mtwara district profile, 2015

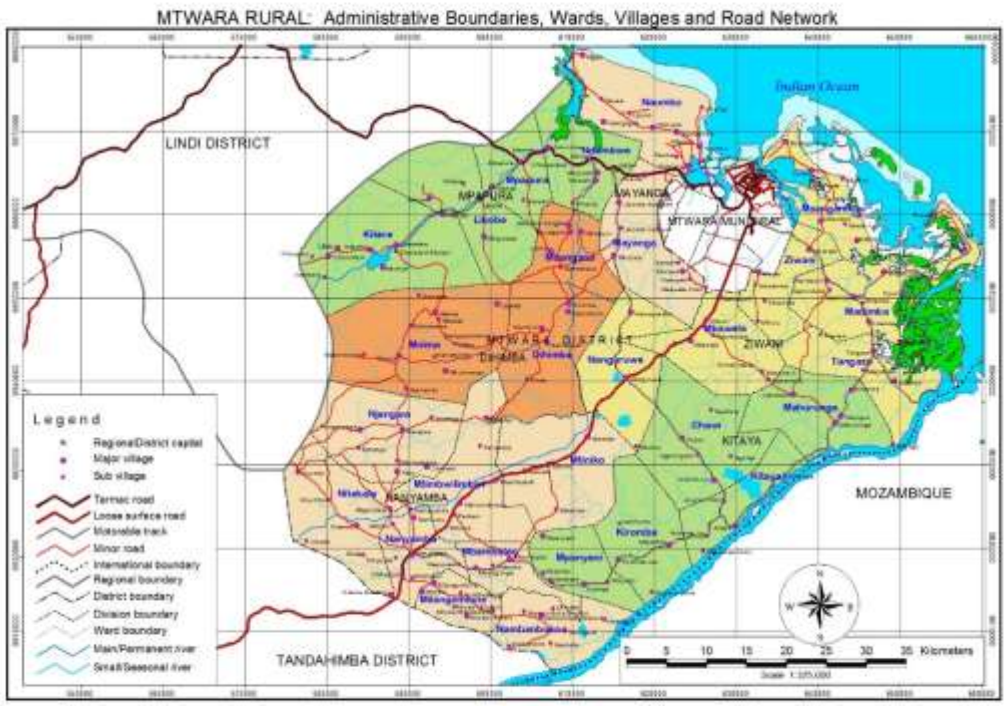


Figure 4-35 Administrative Boundaries of Mtwara District

Source: Mtwara district profile, 2015

4.2.2 *Demographic profile*

Population and Demographic Patterns

The population is an important resource for development; at the time the growth of population increases demands for food, water, energy and other natural resources. Moreover, the growth and distribution of population determines the demand for essential social services, such as education, health, water, transport and housing. ***Table 4-21*** presents the population distribution in the project area in relation to different administrative levels of government – national, regional, and district levels.

Table 4-21 Population Distribution in Mtwara Region

Location	Population					HH	
	Male	Female	Total population	Sex ratio	Inter-censual growth rate	Number of Households	Average household size
Tanzania	21,869,990	23,058,933	44,928,923	95	2.7	9,276,997	4.8
Mtwara Region	599,648	671,206	1,270,854	89	1.2	344,834	3.7
Mtwara District	107,922	120,081	228,003	90	1.2	-	3.9
Naumbu Ward	4,662	5,083	9,745	92	-	-	3.9 -
Kisiwa village	540	628	1168	86	-	325	-
Namgogoli village	998	1045	2043	96	-	523	-

*Source:*2012 Tanzania Population and Housing Census
*Village office data, 2018

Based on the 2012 census (***Table 4-21***), Mtwara district has a population of 228,003. Among the population, 107,922 are males and 120,081 are females. The Mtwara rural district population annual growth rate stood at 1.2 which is similar to the Mtwara regional annual population growth and lower than the national population annual growth rates which stood at 2.7. By area the sex – ratio of the population varies from one location to another, however, the general trend of sex ratio shows that the female population is slightly higher than the male population. The district had an average household size of 3.9 persons. The average household size was slightly higher than the regional and lower than the national average household size which stood at 3.7 and 4.8 respectively

Population Density

The average population density of Mtwara rural District is estimated to be 64 people/ km² and the regional population is estimated at 76 people/km². In general, the district and the regional population density is higher than the national population density which stood at 51.0.

Human migration

Mtwara rural district like other rural areas in Tanzania, its population growth is influenced positively by natural births and in-migration and negatively by deaths and emigrations. The District attracts many people from rural areas in search of better life mainly through better employment opportunities in different economic sectors taking place in the District (e.g. commerce, manufacturing, agriculture, and fishing). On the other hand, people also leave the District for the same reasons. The later phenomena also affect the working/productive group within the municipality due to loss of man power needed in economic production. (*Mtwara Environmental Profile, 2013*)

Ethnic composition and religious distribution

According to the focus Group discussion with elders in Kisiwa and Namgogoli Villages, the original inhabitants in the villages were the Makonde, however, currently; there is a significant rate of migrants who are attracted by fishing activities and availability of land for agriculture and pasture. Due to this, there are other groups such as the Makua, Yao, Wamwera and few Sukuma who are agro-pastoralists. In terms of religion, the majority of the population is made up of mainly Muslims, with a small proportion of the population of other religion.

Gender analysis in the project area

Gender differences are a significant attribute in agriculture, from access, control and ownership of land to marketing of raw and processed produce. In Tanzania, despite constitutional proclamations of gender equality and many laws that promote equal opportunities for both men and women, it remains the case that on both smallholder farms and large plantations, men and women carry out different types of work, have different levels of access to resources, and are unequally rewarded for their contributions to the agricultural system, with women typically having less access and lower incomes (Rubin, 2010)

During the FGD it was revealed that there is clear demarcation of activities between men and women in crop production that extends to cassava and sesame. Generally the division of labor tends to follow along the lines of gender relations emanating from traditional practices and religious norms. It was also noted that division of labor vary between activities related to food and cash crops; and marital status. From the FGDs, interview with local authorities it was revealed that in Female Headed Households (FHH) women perform male based activities in both cash and food crops.

There is uneven distribution of labor between men and women. Land preparation activities and marketing in cassava and sesame production are mainly undertaken by males. Females primarily carry out activities from planting/sowing to harvesting. However, in FGDs, it was revealed that both men and women were mainly involved at various stages in plowing to harvesting. Findings from the FGDs showed that at some point women do men's tasks and vice versa and this happens during peak times of cultivation, harvesting, change in marital status and overtime with change in priority of crops as food or cash crops. Despite sharing of roles, overall women are overburden by having more activities and working hours.

Generally, gender equality in the study area is a problem due to cultural practices, religious norms, lower levels of education, poverty, and limited participation in decision making at all levels. It was noted in the FGDs that women have internalized the patriarchal system by being submissive, by losing their bargaining power and by being totally powerless without rights, influence and resource less.

4.2.3 *Archaeological and Cultural sites/resources*

In general, cultural and historical sites at the village level are neither recognized nor recorded at the regional and/or central government levels. The official process recognized in Tanzania is to consult the Village Executive Officer or Village Chairperson to inquire about such information.

Based on consultation with the Village Chairperson, random surface walkover archaeological surveys, and ethno-historical surveys, it was possible to identify culturally and/or historically important sites within or nearby the Project Site.

Family graveyard site

The graveyard is located in between the nose and the boundaries of the Project Site. The area may be bisected by the intake port channel. Based on visible stone signs, one can estimate that there are approximately over 50 graves. The site also contains a ritualistic Baobab tree.

Based on consultation, it is the desire of the relatives not to relocate the family graveyard. In response to this, TANESCO shall provide access to the graveyard during important religious and family events.

Former archaeological research sites

Certain parts of the Project Site used to be an archaeological excavation and study site. Rich Iron Age pottery sites have been discovered in the area, with concentrations and scatters of potsherds – diagnostic and none diagnostic decorative motifs. It appears these items date back to be Early Iron Age pottery. However, this area is not designated as a cultural heritage site under the Antiquities Act of 1979.

4.2.4 *Economic Activities and Livelihoods*

Introduction

The socio-economic activities included in this section has been included mainly to give an idea of the challenges facing the potential affected population at Kisiwa and Namgogoli project area, particularly farmers as well as fishermen who will be affected by the proposed Gas power plant. It also suggest what the project need to take into account especially in relation to potential economic displacement and resettlement. This includes information on employment/unemployment, household's economic activities, income, trade, community infrastructures such as education, electricity, transport and communication as well as water and sanitation.

Employment

Unemployment rates in Tanzania differ substantially depending on the locality. Thus, the rural areas tend to have the lowest unemployment rate of 7.5% followed by urban areas. The Integrated Labour Force Survey 2014 shows that unemployment rates are highest for persons below 35 years of age in all areas. The total number of employed youths (aged 15-34) according to the National Definition is 11,007,809 while the unemployed youths are 1,463,182 about 10.0% of the total youth workforce (ILFS, 2014.)

Agriculture feeds and employs the majority of the population in Mtwara district and the youth should be given incentives to remain in Mtwara and benefit from it, especially cashew nuts. Before 2007/08, cashew nut farming was not seen as profitable because farmers were being 'sucked dry' by middlemen. This is why the youth left the region. Agriculture can be improved by improving markets and adding value to local products. Finding markets for all parts of the cashew nuts (shell, oil, kernel and husk) can add profits for farmers. Youths with a primary school education will not be able to be absorbed into factories or plants which often require technical skills.

Agriculture

Agriculture is the predominant economic sector in Mtwara District. About 90 per cent of the agricultural output is by small holder farmers. 7 per cent of the total population involving in fishing activities, 2 percent in business and 1 percent are employed. The district depends on farming as the main source of income, of which contributes about 75% of the total income. Mtwara district has a total of 358,700 hectors of land, 250,000 hectors arable land; this is 69.5% of the total land. Land under cultivation is 184,385 this is 73% of the total arable land or 51% of the total land. Land under people's settlement is 5,000 hectors, under water is 1,800 hectors and under forest reserve is 55,465 hectors. Potential land for livestock is 16,651 hectors. 160,000 people out of the district population are provided as farm labor.

Food crops grown include: cassava, sorghum, rice, maize, sweet potatoes and legumes. Cash crops include: cashew nuts, sesame, coconuts and groundnuts. At present, the yield of all crops in the District is significantly lower compared to the national yield index. At present the district always have food deficit and always becomes food aids recipients from the National reserve.

The present utilization of labor is 1.15 hectares per labor annually this can be increased to 1.5 hector per labor annually and utilize all arable land in the district. The district and the Nation as a whole think therefore that all these goals can be achieved through District Agricultural Development Plans (DADPs).

Livestock keeping

As an income – generating activity, livestock keeping is not traditional among the region's population, hence contribution of this sector to the region's and district's economy is insignificant. Livestock keeping is partly a result of in -

migration of agro pastoralists. In the recent years pastoralist and agro pastoralist from the northern and western circuits in the country have migrated in Mtwara district, bringing with them large herds of cattle.

The number of livestock owned corresponds to wealth, but it is not the main determinant of wealth. Livestock provide some additional income in the form of cash from livestock sales: mainly chickens for very poor and poor households; goats and chickens for middle households; and cattle, goats and chickens for better off households. Poultry is the most common livestock, 44% of respondents reported to have chicken13). Only better off households own cattle, which provide both milk and a much higher market value than the other livestock. Chickens and goats tend to be slaughtered and eaten during festivals. Both men and women look after the livestock within the household

Fisheries

Regional/District Level

The Mtwara Region and Mtwara district in particular, is one of Tanzania's coastal regions with a long (ca.130 km) coastline, which offer various economic opportunities. The Ruvuma River estuary is being utilized for fishing of prawns, lobster and other shellfish. There are also potentials for aquaculture (fish farming) brought about by awareness programs regarding marine and fish farming (including in Ruvuma River). Moreover, the Region has excellent beaches attractive for domestic and international tourism (e.g. spot fishing, mangroves and dolphins).

Currently, the region has about 5,459 registered fishermen involved in artisanal fisheries. By using simple fishing gear and equipment, the fishermen are not able to reach far distances beyond offshore (2km or more). Gears and equipment used in fishing in Mtwara Region are in poor condition, including dug-out canoes, dhows, motorized boats, fish nets and hooks.

Marine fisheries contribute 97% of the revenue collected from the fishing sector, while water contributes only 3%. Apart from fishing in the Indian Ocean, fishing is also undertaken in rivers (Ruvuma and Lukuledi) and in ponds (in Chidya na Kitele). The region has a total of 46 fish ponds in various districts. Also there is crab fattening, and seaweed farming (of Pearl oysters).

During the last five years, fish production in the Region has been declining from 60,474 tons in 2009 to 48,487 tons in 2013, resulting in declining revenues valued at Tsh 172,106,140.00 (***Table 4-22***). The main challenges facing the fishing industry are associated with human population growth, increased dynamite fishing, overexploitation, and overuse of coastal and marine resources (e.g. mangroves cutting, coral mining, dynamite fishing, and construction along the coast). Others include absence of fish storage facilities and processing industries, as well as lack of education on sustainable fishing, inadequate regional budget for this sector, and lack of alternative jobs in rural coastal areas.

Table 4-22 Fisheries Yield Trends in Mtwara Region

Year	2009	2010	2011	2012	2013
Approximate Weight (tons)	60.45	64.3	64.6	58.0	48.5
Revenue (Tzs)	168,808,741	182,109,670	83,298,350	204,255,645	172,106,140

Source: Mtwara Regional Secretariat, 2015

Mtwara District council is faced with the same challenges. Fishing is done on a 125 km coastal strip and along the Ruvuma River using poor equipment and dynamite. The fishing industry in the district is faced with an acute shortage of modern fishing gear (see photos).

Figure 4-36 Aquaculture and fishery at Kisiwa village in Mtwara district

Source: IRA 2018

The proposed measures for future development of fishing industry in the region include:

- Protection of fish breeding grounds.
- Establishment of sea fish farming.
- Provision of Morden fishing gears and equipment.
- Enforcement of national fisheries policy, rules and regulations.
- Establishment of fish processing facilities in the region

For management purposes, there are a total of 34 Beach Management Units (BMUs) in Mtwara Region, most of which are in Mtwara Mikindani.

Village Level (Project Site)

The Project Site extends to the seashore. Only a little area of the site faces the seashore line like the nose. The nose area is being utilized as the mooring point of fishing boats. Consultation with fishermen in Kisiwa village at the fishing landing site revealed that the existing fishing land site is currently being used by two villages – Kisiwa and Naumbu kusini. They highlighted the importance of the area because it is the only one place for mooring available in these two villages. The fishing land site is currently used by a total of 61 fishermen who have a total of about 244 dependants of which 52 are spouses and 192 are children.

Table 4-23 Fish Production in Mtwara District

Fish catch (Kg)		Fish sold (Kg)		Amount earned	
2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
-	2,160Kg	76,964.2	19,408.00	183,127,866.7	437,389,216.00

Source: Mtwara District Profile, 2015

Salt Production

Salt is also recovered from evaporation of seawater collected in salt pans located along the coast, adjacent to mangrove forests. Salt mining and illegal live coral mining has resulted into dramatic decrease in mangrove forests, destruction of coral reefs and marine environments in late 1990's.

There are a good number of saltpans in Mtwara, some of which are abandoned and/or have been converted to milkfish farming. While the saltpans in Mtwara are sometimes owned by one person, the milkfish ponds in Mtwara and elsewhere are owned by groups of people. This may be because they were initiated by the environmental groups who are more interested in helping Groups rather than individuals. (*Msuya e.t.al 2007*)

Figure 4-37 Salt farms at Kisiwa village in Mtwara rural district

Source: IRA, 2018

Trade

While the number of small businesses has doubled since 2004, the rate of growth has slowed since 2006. The numbers of larger businesses have grown by 20-40%, and one can safely assume that more formal jobs have been created by these businesses. Whether the growth of larger businesses can be fully attributable to the onset of power in 2006 may be open to debate, it is reasonable to assume that big businesses would not have established themselves in Mtwara without a reliable and affordable supply of power. Using business registration and size as a proxy, between 3,400 and 13,000 new jobs within the private sector may come available each year if growth continues at the same pace that it has reached to date.

The artisanal fisheries is one sub-sector in Tanzania that makes a valuable economic contribution to coastal communities including Mtwara district. In terms of output volume, output value and employment, the sector is much more important than the commercial fisheries (Sobo, 2004). It also provides protein-rich food, employment and income, thus making a significant contribution to livelihoods along the coast. The fishery does not, however, make a significant contribution to foreign exchange earnings and revenue in the country due to fishing equipment.

4.2.5 *Community infrastructure and public services*

Education

Education in Mtwara District

According to the Mtwara District profile (2015), the District has a total of 117 pre-primary schools in 2014. Approximately more than 93% of eligible 5 to 6 years old attended pre-schools in 2014. The data show that gender distribution is more or less the same. The average number of students per class is 49 in the District. On the other hand, the average number of pupils per teacher varies significantly. The District average is 1:49.

The District has a total of 127 primary schools with a total enrolment estimated at 46519. Girls are 23,138 of the total enrolment, whereas boys are 23381. Enrolment in primary schools stands at 92%, whereas, drop out and truancy rate stands at 38%. On the other hand, while pass rate at standard seven is estimated at 63%. 100% of those who qualify that are selected to join secondary education. In the project area, each village has one primary school which includes pre - primary schools.

The Council has a total of eleven (11) secondary schools which are owned by Government. The total student body in these schools stands at 5,561 with 2,396 boys and girls 3,165. Transition rate from primary to secondary school stands at 100%. But this does not mean that the facilities especially classrooms, Libraries, Laboratories and Hostels are enough, it just imply that, on one hand the available secondary schools can meet the demand or the pass rate at standard seven.

Access to Primary School

According to the study findings, it was reported that about 92.3% households had access to primary schools while 7.7% had no access to primary schools. The status of the quality of primary schools was good 74.4%. Shortage of teachers and teaching materials were reported to be the major concerns of parents and teachers. Also, the study findings unveiled that most (50.0%) of the households or PAPs access primary schools at a distance of 0.1km –0.5 km. See Table 4-24.

Table 4-24 Distance to primary school

Distance	Number of Interviewed PAPs	Percent
0-0.1km	18	50.0
0.1km – 0.5km	12	33.4
0.5km -1.5km	3	8.3
Above 1.5	3	8.3
Total	36	100.0

Source: IRA, 2018

Access to Secondary School

According to the study findings, it was reported that about 61.1% of respondents had access to secondary schools while 38.9% had no access to secondary schools. The status of the quality of secondary schools was good by 91.7%. Also, the study findings unveiled that most (61.1%) of the households or PAPs access secondary schools at a distance of 0 – 0.1km. See Table 4-25 and Table 4-26.

Table 4-25 Access to Secondary School O-level

	Number of Interviewed PAPs	Percent
Yes	22	61.1
No	14	38.9
Total	36	100.0

Source: IRA, 2018

Table 4-26 Distance to Secondary School O-level

Distance	Number of Interviewed PAPs	Percent
0-0.1km	17	47.2
0.1km – 0.5km	7	19.4
0.5km -1.5km	7	19.4
Above 1.5	5	13.9
Total	36	100.0

Source: IRA, 2018

Education Level

The household survey results indicate that the majority of head of household have attained basic primary education (66.6%), and 2.8% with secondary education and university graduate respectively. The head of household with no formal education account for 22.2%.The number of drop-out in both primary and secondary schools which constitute about 2.8% and 1.7 percent respectively were also experienced in the project area. The head of household level of education is shown in Table 4-27.

Table 4-27 Percent distribution of Education attainment in relation to household head

	Number of Household Head	Percent
No formal education	8	22.2
College undergraduate	1	2.8
Primary school	24	66.6
Secondary school - Olevel	1	2.8
Primary drop out	1	2.8
Secondary school drop out	1	2.8
Total	36	100.0

Source: IRA, 2018

Health Facilities

Health Facilities

Mtwara District has a total number of 41 health facilities - four (4) health centres and thirty four (37) dispensaries (refer to Table 4-28). These facilities are owned and managed by both public and private institutions. However, health service is adversely affected by limited funds. This has resulted into shortage of medicines, materials, qualified and skilled personnel, and poor incentive for the existing staff.

Services being provided in the health facilities include curative services, rehabilitation services, family planning services, child health services, hygiene and sanitation

Table 4-28 Health facilities by operating agency

Facility Type	Government	Private	Total
Hospital	-	-	-
Health centres	3	1	4
Dispensaries	41	-	41
Grand Total	**44**	**1**	**44**

Source: JICA Survey Team, 2018

Figure 4-38 Expansion of Nanguruwe Health Centre

Source: Mtwara District Socio-economic profile, 2015

Public Health

The most common diseases are malaria, respiratory and gastro-intestinal infections. Malaria has been the number one cause of illness for three consecutive years. During the 2010/2011 fiscal year, malaria alone accounted for almost 60% of all the cases that attended OPD and IPD. In addition, tuberculosis, leprosy, AIDS, schistosomiasis and filariasis are endemic.

Life expectancy at birth in Tanzania is 51 years and in MRD it is 46 years. Also in MRD, the infant mortality rate is 146 per 1,000 live births, the under 5 mortality rate is 167 per 1000 live births and maternal mortality rate is 340 per 100,000 live births.

Access to Health Services

According to the field survey findings, it was reported that about 56.6%respondent's households had access to health services while 44.4% had no access to health services as shown in Table 4-29. The status of the quality of health services was good by 39.6% and moderate by 69.4% of the respondents shown in Table 4-30. Also, the study findings unveiled that most (61.1 %) of the households or PAPs access health services at a distance of 0 0.1km as shown in Table 4-31

Table 4-29 Access to dispensary

	Number of Interviewed PAPs	Percent
Yes	20	56.6
No	16	44.4
Total	36	100.0

Source: IRA, 2018

Table 4-30 Status of dispensary

Status of Health Services	Number of Interviewed PAPs	Percent
Good	11	30.6
Moderate	25	69.4
Bad	0	0.0
Total	36	100.0

Source: IRA, 2018

Table 4-31 Distance to dispensary

Distance	Number of Interviewed PAPs	Percent
0-0.1km	22	61.1
0.1km – 0.5km	9	25.0
0.5km -1.5km	3	8.3
Above 1.5	2	5.6
Total	36	100.0

Source: IRA, 2018

Electricity and Energy

Electricity

The common sources of energy range from biomass, electricity (mainly from natural gas), solar power, kerosene and the currently discovered sources of hydrocarbons (oil and gas reserves). The major ones so far are biomass, electricity and solar power. Less than 3% of the population of Mtwara and Lindi Regions has a reliable electricity source. About 25% of urban residents have access to electricity, compared to less than 0.5% of the rural population. Power is supplied by generators which uses natural gas/ARTUMAS Project Phase II. The town is connected to 132 kV transmission line. Currently, General Electric (GE) and Symbion Power

The main source of lighting in urban areas is electricity (64%) while in per-urban areas most households use kerosene and wick lamp. There are few households that use solar power. Firewood and charcoal are the primary source of fuels/energy for cooking constituting about 59% households. In the peri-urban areas fire wood is the main source of energy for cooking (92%) while in the urban areas charcoal was the main source for cooking (67%) followed by firewood (26%).

Mtwara District is benefited from the Canadian based independent energy producer (Artumas) which is aim to deliver a total energy solution to targeted urban and rural population. The Artumas total energy solution provides least-cost electricity by converting stranded natural gas reserves to power generation.

Fuel wood

The use of firewood in rural areas and charcoal in urban is the traditional way to the preparation of food, heating water etc. With only 2.2% the district's household gaining access to electricity, fuel wood is indeed the predominant energy source for domestic purposes. Intensive and extensive use of fuel wood is depleting the region's forest slowly but surely.

Other forms of Energy

Fossil fuels are also important for domestic lighting purposes; kerosene is the number one source in both rural and urban areas. Secondly, exploration for natural gas in Msimbati bay could yield an abundant alternative source of domestic energy.

Source of lighting and cooking energy within the project area

The socio-economic survey found that about 25.0% were using kerosene for lighting, 27.8% responded to use electricity and, 47.2% were using solar energy for lighting as shown in Table 4-32. The socio-economic survey found that about 75.0% were using fuelwood for cooking and 25.0% responded to use charcoal for cooking as shown in Table 4-33.

Table 4-32 Source of lighting energy

Type of lighting energy	Number of Interviewed PAPs	Percent
Kerosene	9	25.0
Electricity	10	27.8
Solar Energy	17	47.2
Total	36	100.0

Source: IRA, 2018

Table 4-33 Source of cooking energy

Type of cooking energy	Number of Interviewed PAPs	Percent
Fuel wood	27	75.0
Charcoal	9	25.0
Total	36	100.0

Source: IRA, 2018

Transport and Communication

The Mtwara-Masasi road is the only tarmac road which runs across Mtwara Distr. Bicycles are the major means of transport. Boats also facilitate easy access to Mtwara town by people living along the coasts. The district had no railway and airport. District Council has a total of 951 km of roads, out of these, only 36km are tarmac, 25 km gravel, 561 km are earth roads. Further, desegregation shows that 25 are trunk roads, 286.8 regional roads, 544 district roads and 92.5 Feeder roads.

However, there is a network of roads within the Municipality, both earth, gravel and tarmac roads including a main road from the South-North to Dar es Salaam (tarmac/earth). There are few cases of local cargo ships/boats operating between Mtwara, Kilwa, Lindi, Dar es Saalam, Zanzibar while other cargo and fishing boats operates between Mtwara and neighbouring Mozambique country. During harvesting season, about 4 to 6 cargo ships docks in Mtwara Port for transporting agricultural cash crops such as cashew nuts, pigeon peas and sesame to India and Bangladesh. Other foreign marine vessels are cargo ships bringing cargo/supplies to oil and gas companies operating within the Municipality. The Mtwara Airport has 2258 meters runway length capable of landing Boeing 737, passenger jets and C 130 cargo plane. The current air traffic is 5 times per week, with an average of 200 passengers-inbound and outbound together available between Mtwara and Dar es Salam airports. (*Mtwara Environmental Profile, 2013*)

The proposed transportation route for the Project consists of several unpaved roads. These roads are also being used for transporting cashew nuts during harvest season. Thus, there is a need to consider traffic congestion during rainy season and high crop season of cashew nuts during the transportation of construction materials.

Existing Traffic Condition towards the Power Plant

The approach road to the project site is earth road connected to a gravel road. There is no significant traffic traversing the earth road compared to the gravel road that connects Mgao and Kisiwa Villages. The Lindi Mtwara highway carries significant amount of traffic since it is a trunk road connecting Mtwara with other parts of the country.

In order to identify existing total daily traffic, peak hour traffic and traffic composition on the approach roads to the Project site and the major roads from major areas of concern (i.e. Mtwara Port, traffic survey was conducted. The survey focused on two locations (refer to ***Figure 4-39***). The first location was at the junction which connects the road joining Mgao and Kisiwa village with the access road to proposed plant site. The second location was near the junction connecting Lindi – Mtwara Highway and the road to Kisiwa/Mgao villages. Traffic count was carried for 12 hours beginning from 6 a.m. to 6 p.m., on August 4-10, 2018 covering both for weekends and weekdays.

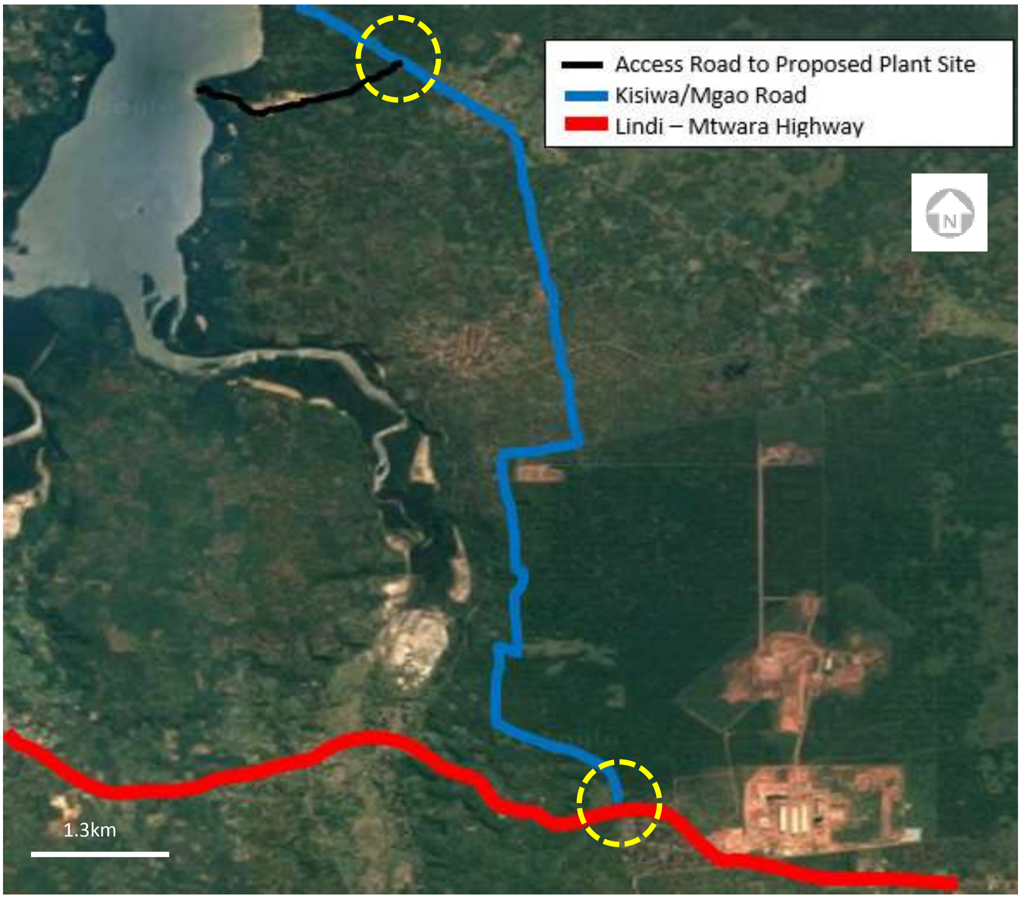


Figure 4-39 Traffic Survey Locations

Source: IRA, 2018

Peak hours are defined as four consecutive fifteen minutes (1 hour) periods having the highest traffic volume. Peak hours at the selected locations are summarized in Table 4-34. Based on the traffic survey results, Lindi – Mtwara Highway experiences heavy traffic on Friday evenings. There are only 10 recorded motorized vehicles that used the proposed access road.

Table 4-34 Traffic Peak Hours

Road	Traffic Category	Time	Day	Traffic Volume
Access Road To Proposed Plant Site	NMT	11:00 - 12:00 (AM)	Wednesday	17
	MT	9:30 – 10:30 (AM)	Saturday	10
Mgao – Kisiwa Road	NMT	9:15 – 10 :15 (AM)	Sunday	25
	MT	3:00 – 4:00 (PM)	Sunday *(Football match at Kisiwa)*	44
		3:30 – 4:30 (PM)	Saturday	28
Highway – Kisiwa/Mgao Road	NMT	6:30 – 7:30 (AM)	Friday	27
	MT	9:30 – 10:00 (AM)	Thursday	8
		3:30 – 4:30 (PM)		
		9:30 – 10:00 (AM)	Friday	
Lindi – Mtwara Highwa	NMT	6:15 – 7 : 15 (AM)	Thursday	15
	MT	4:30 – 5:30 (PM)	Friday	101

Source: IRA, 2018

Marine Traffic

There are few cases of local cargo ships/boats operating between Mtwara, Kilwa, Lindi, Dar es Saalam, Zanzibar while other cargo and fishing boats operates between Mtwara and neighboring Mozambique country. During harvesting season, about 4 to 6 cargo ships docks in the Mtwara Port for transporting agricultural cash crops such as cashew nuts, pigeon peas and sesame to India and Bangladesh. Other foreign marine vessels are cargo ships bringing cargo/supplies to oil and gas companies operating within the Municipality.

Sudi Creek is mainly being used by fishermen in the nearby villages. A few number of small handmade wooden fishing boats can be seen in the area. The landing area close to the project site is used as a main dock for these small boats. Since the landing area within Sudi Creek will be acquired and used by TANESCO, fishermen will have to seek the use of other landing sites or fishing areas. With this, marine traffic in the area may be reduced significantly. It is highly unlikely that boats from outside use Sudi Creek for fishing because the marine ecosystem is more thriving outside Sudi Creek.

Water and Sanitation

Water

About 62.2% of rural population access adequate clean and safe water through piped water supply schemes, deep and shallow wells fitted with hand pumps, charcoal dams and rain water harvesting tanks. The coverage of water supply falls below the national water supply coverage (65% in rural coverage by June, 2015). This situation is attributed by several factors such as inadequate funds, malfunction of water facilities, dilapidated water facilities and lack of reliable water sources. The daily water demand in the council is 5, 987,000 litres; however, the daily water supply is about 2,692,800 litres.

Table 4-35 The main source of drinking water in Mtwara District Council

Type water supply of Facility	Total	Functional	Non Functional	Average Population Served	% served
Shallow wells fitted with hand pump	368	246	122	45,601	20
Deep wells fitted with hand pump	71	69	2	18,240	8
Piped Water Supply Schemes	25	19	6	69,997	30.7
Charco dams	10	8	2	7,296	3.2
Rain Water Harvesting Tanks	98	98	0	684	0.3
Total				**141,818**	**62.2**

Source: Brief report of district development status 2015

According to customers of MTUWASA, currently, the water supply is not sufficient. Water supply is often stopped. The reason is that no electricity is supplied to the pumps. This means that the electricity supply situation is not good in Mtwara. However, if the power plant of this project will start operation, the issue of water supply due to power shortage will be solved. This project is also important for stabilizing water supply in Mtwara.

Based on the study findings, it was reported that all households had different access to water services. The majority of sampled respondents (72.2%) reported to access water from communal stand pipe, followed by 16.7% who accessed water from pipe within house. Other respondents reported to access water from other sources such as borehole (5.6%), wells (2.8%) and those who buy water accounted for (2.8%) of the respondents. The respondents were also required to explain the status the water quality in their villages, the majority of respondents described the status to be good 94.4% and moderate quality by 5.6%. Also, the study findings unveiled that most (38.9%) households or PAPs access water at a distance of 0.1km – 0.5km. See Table 4-36 and Table 4-37.

Table 4-36 Source of Water Supply

Type of water supply	Number of Interviewed PAPs	Percent
Pipe within house	6	16.7
Communal stand pipe	26	72.2
Borehole	2	5.6
Well	1	2.8
Bought Water	1	2.8
Total	36	100.0

Source: IRA, 2018

Table 4-37 Distance to Water

Distance	Number of Interviewed PAPs	Percent
0 - 0.1 km	14	38.9
0.1 – 0.5 km	14	38.9
0.5 – 1.5 km	7	19.4
Above 1.5 km	1	2.8
Total	36	100.0

Source: IRA, 2018

Sanitation

The household survey examined availability and status of sanitation facility such as toilets along the villages traversed by the proposed power plant. In view of the findings of the study, it was reported that about 8.3% of the respondents had flush toilet, 50.0% of respondents are using pit latrine (VIP) and 58.9% of respondents are using pit latrine. Refer to Table 4-38.

Table 4-38 Status of sanitation facilities

Type of toilet facilities	Number	Percent
Flush toilet	3	8.3
Pit Latrine (VIP)	18	50.0
Pit Latrine	15	41.7
Total	36	100.0

Source: IRA, 2018

Solid waste generation and Management

Mtwara town has a well-established municipal landfill to handle different types of wastes. Similarly there is private owned recycling plant designed to recycle different types of waste including natural gas related waste, remain from exploration and other activities related to natural gas processing. These two facilities can be used for disposal of waste generated from the proposed thermal power plant.

The collection system is based on community collection points at which all nearby residents dump their waste. People bring waste to the collection points either manually, with push carts, or with private vehicles. There are 25 collection points, most of which are sand-block structures covered with corrugated iron sheets. They were designed to collect wastes brought by community based organizations (CBOs) assigned to collect wastes from individual households and markets. Currently the collection points are served with skip containers in which individuals throw their waste, Transportation of the waste is conducted by municipal vehicles. The municipality has two skip masters and four tipper trucks for the transportation of waste to the dumpsite located at Mangamba about 10 km from the town centre.

The solid waste system described provide services to the municipal areas whereas the rural areas like Kisiwa and Namgogori villages such elaborate system of waste collection is lucking. Most of the rural setting practice burning or buried in individual household pits where different types of waste are dumped without sorting.

The increase in industries related to cement and natural gas will pose a challenge in dealing with the waste generated. The sanitary landfill developed at Mgamba site is designed to handle domestic to light industry waste. There will be a need to find a proper way of handling waste generated from the proposed power plant.

4.2.6 *Socio-economic characteristics of Project Affected People*

Demographics of Project-Affected Persons (PAPs)

Age Distribution

Based on the household survey, the results show that 41.0% of the sample respondent in the project area aged between 0 – 14 years of age. The age group of 15 -24, 25 – 44 and 45 – 64 accounted for 53.5% and those above 64 years of age accounted for 5.5%. ***Table 4-39*** show the percent distribution of age group of the sampled respondents. From the assessment, it is evident that the majority of the affected respondents are working age group, therefore, the implementation of the Project which have acquired a large piece of land will significantly affect their livelihoods. Thus, if the sources of livelihood of these people are to be adversely affected by the Project, there have to be mitigation measures to ameliorate any economic and social impacts.

Table 4-39 Population Distribution by Age

	Number	Percent
children (0-5)	35	17.5
6-14	47	23.5
15-24	42	21.0
25-44	35	17.5
45-64	30	15.0
65 and above	11	5.5
Total	200	100.0

Source: IRA, 2018

It is also important to note the implications of the project on the significant number of old people (above 60 years). Most of the aged are not strong enough to engage in any active social and economic activities for survival. Therefore, any disruption in their economic and social lives without immediate measures to mitigate the possible impact is likely to hinder their survival.

Gender Distribution

The larger proportion of the respondents is composed of males, who make up 88.9%, while females headed households make up 11.1% only of the respondents. In a cultural environment where males are assigned leading roles and responsibilities in the family system, it is essential that appropriate measures be put in place to mitigate the potential impacts of the project on the affected female headed household's persons before implementation. The percentage distribution of sampled affected population and head of households by sex is shown in ***Table 4-40***.

Table 4-40 Population Distribution by Sex

	Household's members from sampled population		Sampled Head of households	
	Number	Percent	Number	Percent
Male	105	52.5	32	88.9
Female	95	47.5	4	11.1
Total	200	100.0	36	100.0

Source: IRA, 2018

The presence of substantial number of female headed household that will be affected by the Project must be factored into any plans for the implementation of the project because women is one of the vulnerable group that need special consideration during resettlement and compensation process.

Economic Status of PAPs

Economic Activities of the PAPs

The major and dominant economic activity throughout the project area is agriculture accounting for 85.5% of the sampled population. Although fishing is common activity along the coast in Kisiwa and Namgogoli villages few people are engaged as shown in ***Table 4-41***.

Table 4-41 Population Distribution by Primary Occupation

Occupation	Primary occupation		Secondary occupation	
	Number	Percent	Number	Percent
Farmer	129	85.5	9	17.3
livestock keeper	1	0.8	5	9.6
Petty trader	9	5.9	30	57.7
Casual labour	9	5.9	7	13.5
fisherman	3	1.9	1	1.9
Total	**151**	100.0	**52**	**100.0**

Source: IRA, 2018

Table 4-42 Primary Occupation in relation to household head

	Number of household head	Percent
Farmer	29	80.6
Livestock keeper	0	0
Petty trader	1	2.8
Casual labourer	3	8.3
Fisherman	3	8.3
	36	100.0

Source: IRA, 2018

The involvement of high proportion of potentially affected people in farming activities means that significant adverse impact on farming activities and farm lands will have far reaching adverse social and economic consequences not only for the population of the affected communities, but also for the surrounding communities.

Average household and major source of income

The annual income of selected respondents in the study area is shown in the ***Figure 4-40***. The Figure shows that a significant number of respondents (40.2%) earn less than 100, 000/= per month. Furthermore, the analysis show that 36.6% of respondents earn between 100,000 – 200,000. Another group of respondents (15.9%) reported to have a monthly income ranging from 200,000 – 500,000 and 23% were earning an average monthly income of more than 500,000.

Based on the survey, it is evident that the average monthly income profile is characterized by low-income earners. This is not surprising because the majority of those interviewed are engaged in subsistence agriculture and fishing activities with limited agricultural inputs which lead to low production of crops.

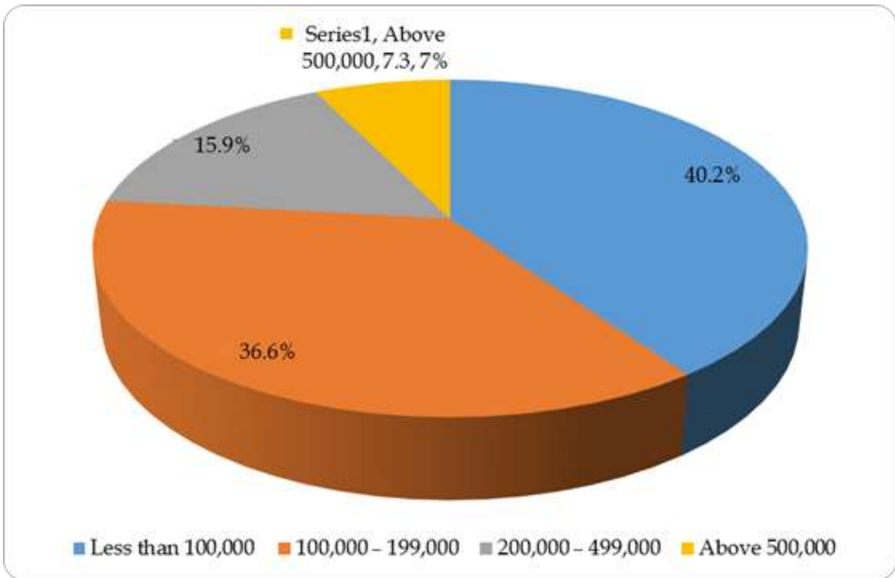


Figure 4-40 Percent distribution of Average Household Annual income

Source: IRA, 2018

Ownership of Durable Goods

The household survey indicated that majority of households had reported to have durable assets, although the level of ownership of durable assets differs from household to another depending on their socio-economic status. The percentage distribution of household's ownership of durable assets is shown in ***Table 4-43***.

Table 4-43 Ownership of Durable Goods

Durable Assets	Yes		No	
	Number	Percent	Number	Percent
Motorbike	6	16.7	30	83.3
Motor vehicle	1	2.8	35	97.2
Bicycle	27	75.0	9	25.0
Push cut	0	0	36	100
Tricycle	0	0	0	0
Refrigerator	1	2.8	35	97.2
Television	5	13.9	31	86.1
Electric fan	6	16.7	30	83.3
Electric stove	2	5.6	34	94.4
Computer/Laptop	1	2.8	35	97.2
Radio	30	83.3	06	16.7
Mobile phone	32	88.9	04	11.1

Source: IRA, 2018

Ownership of Other Assets (Livestock)

The assessment of ownership of livestock as shown in ***Table 4-44***, show that livestock keeping is taking place in the two affected villages. Since a significant number of people will be affected by loss of agricultural land, therefore, there is a need to encourage and raise awareness to the local people to engage on other alternative means of livelihood such as livestock keeping rather than depending of farming activities alone.

Table 4-44 Ownership of Other Assets (Livestock)

Cow	Goats	Sheep	Chicken	Pig	Dog	Cats
06	121	12	349	00	00	00

Source: IRA, 2018

5 STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION

5.1 INTRODUCTION

Stakeholder participation and involvement is important in the EIA process. Section 89 of the EMA No. 20 of 2004 emphasize its importance by providing guidance on public participation issues and states its importance in the EIA. Regulation 17 of the EIA and Audit Regulations (URT, 2005) provides further directives and procedures for public participation in the EIA process. Stakeholder participation involves processes whereby all those with interest in the outcome of a project.

Public consultation was viewed as an important activity of this ESIA study since helped the study team to get the stakeholders' views on the perceived environmental and social effects of the project on the project area and their ideas on how the adverse impacts can be mitigated. Participatory public consultation for this project was carried out with a wide range of stakeholders in the project area, relevant government institutions, Non-Governmental Organizations and other interested parties. It is expected that consultations for this project will continue throughout the project implementation phase. The basic objective of the consultations was to raise awareness, get feedback from the stakeholders and improve decision-making by tapping on local knowledge and information through the involvement of individuals, groups and organizations with a stake in the proposed project.

5.2 AIMS AND OBJECTIVES OF THE PUBLIC CONSULTATION

The purpose of public consultation during the scoping was to ensure that the views, interests, and concerns of project stakeholders are taken into account in the assessment of the potential impacts of the project as well as in project decisions, particularly in the design of mitigation measures. In addition, the public consultation aims to improve communication between the project and impacted or interested groups. In the course of preparing for stakeholders consultation, the following activities were undertaken:

- Stakeholder identification and analysis;
- Determine the type of consultation activities to be undertaken with each category of stakeholders;
- Information disclosure, specifically the provision of timely and meaningful information that is accessible to all stakeholders;
- Prepare the approach to and mechanisms for obtaining stakeholder feedback on the information disclosed;
- Prepare principles and ground rules guiding consultation with local communities; and the program for consultation to ensure timely notification of consultation activities and to tie in with key stages in the ESIA process.

5.3 *STAKEHOLDER IDENTIFICATION AND ANALYSIS*

Identification of stakeholders is a first and essential step in effective engagement. It is necessary to determine exactly who the stakeholders are and understand their priorities and objectives in relation to the proposed project. By classifying and analyzing the stance, influence, capacity and interests of stakeholders it was possible to develop a plan that was tailored to the needs of different stakeholder groups. This information was then used to tailor engagement to each type of stakeholder. As part of this, it was important to identify individuals and groups who may find it more difficult to participate and those who may be differentially or disproportionately affected by the project because of their marginalized or vulnerable status. It was also important to understand how each stakeholder may be affected - or perceives they may be affected – so that engagement can be tailored to inform them and understand their views and concerns in an appropriate manner.

For the Mtara Power Plant Project stakeholders were identified on an ongoing basis by:

- Identifying the different categories of parties who may be affected by or interested in the project; these groups are presented in Table 5-1 ; and

- Identifying specific individuals or organizations within each of these categories taking into account:

  - the expected area of influence of the project, that is the geographical area over which it may cause impacts (both positive and negative) over its lifetime, and therefore the localities within which people and businesses could be affected; and

  - the nature of the impacts that could arise and therefore the types of government bodies, nongovernmental organizations, academic and research institutions and other bodies who may have an interest in these issues.

Stakeholder identification was a particular priority at the beginning of the ESIA process; however additional stakeholders were identified during the full ESIA study. The process of identifying the individuals and organizations within each group is a continuing one. A large number of potentially affected and interested parties were identified from:

- contacts that the project has already made with communities, government departments and other organizations as part of its public consultation and government relations activities to date; consideration of the area of influence of the project as it has currently been defined during the initial stages of the ESIA;

- contacts made through a ESIA done for the other related thermal plant located within the project area and

Details of individual stakeholders are shown in the Table below; however, the list will be periodically updated throughout the engagement process. Stakeholders were pre-determined based on the nature of the project as follows:-

Table 5-1 List of stakeholders

Category	Institution/Group	Role and Responsibility
National level	Vice President's Office (Division of Environment)	• Coordinate various environment management activities in Tanzania • Advise the Government on legislative and other measures for the management of the environment • Advise the Government on international environmental agreements. • Monitor and assess activities, being carried out by relevant agencies in order to ensure that the environment is not degraded • Prepare and issue a report on the state of the environment in Tanzania; • Coordinate the implementation of the National Environmental Policy
National level	National Environmental Management Council (NEMC)	• Carry on environmental audit and environmental monitoring • Carry out surveys which will assist in the proper management and conservation of the environment • Undertake and co-ordinate research, investigation and surveys in conservation and management • Review and recommend for approval of Environmental and Social Impact Report • Enforce and ensure compliance of the national environmental quality standards • Initiate and evolve procedures and safeguards for the prevention of accidents which may cause environmental degradation and evolve remedial measures where accidents occur; • Undertake in co-operation with relevant key stakeholder's environmental education and public awareness; • Render advice and technical support, where possible to different stakeholders
National level	Ministry of Energy	• To set and monitor implementation of policies, strategies and laws for sustainability of energy to enhance growth and development of the economy
National level	Ministry of Lands, Housing and Human Settlements Development	• Land use planning • Issuing of Right of Occupancy • Valuation and compensation
National level	Occupational Safety and Health Authority (OSHA)	• Registration of the workplace • Issuance of OSHA Compliance certificate • Inspection on OSH related aspects • Enforcement of Occupational Health and Safety Act, 2003 (Act No. 5/2003)
National level	Tanzania Petroleum Development Corporation (TPDC)	• Provisional of Natural Gas for the power plant
National level	TANESCO	• Mandated with electricity generation, transmission, distribution, supply, system

Category	Institution/Group	Role and Responsibility
		operation, import and export of electricity and electrical installation. • Ensuring the operating conditions for power plant
National level	Energy and Water Utilities Regulatory Authority (EWURA)	• Licensing, • Tariff review • Monitoring performance and standards with regards to quality, safety, health and environment. • Promoting effective competition and economic efficiency, protecting the interests of consumers and promoting the availability of regulated services to all consumers including low income, rural and disadvantaged consumers in the regulated sectors.
National level	Tanzania Meteorological Agency (TMA)	The Agency is responsible for the provision of Meteorological services; weather forecasts, climate services and warnings and advisories information for the country.
National level	Tanzania Forest Services Agency (TFS)	The Agency is mandated to sustainably undertake conservation, development and utilization of national forest and bee resources including mangroves so that they contribute to the social, economic, ecological and cultural needs of present and future generations.
Government agencies	Mtwara Urban Water Supply and Sewerage Authority (MTUWASA)	Responsible for infrastructure development – Water supply pipeline to the Kisiwa site
Government agencies	TARURA – Mtwara Regional office	Responsible for infrastructure development – Access road to the Kisiwa site.
Regional level	Mtwara Regional Secretary Office	• Responsible for environmental coordination of all advice on environmental management in the region and liaises with the Director and the Director General on implementation and enforcement of the Environment Act. • A Regional Environment Management Expert appointed by the Minister responsible for Regional Administration heads the secretariat. • The Regional Environment Management Expert is responsible for advising the local authorities on matters relating to the implementation and enforcement of the Environment Act. The Expert links the region with the Director of Environment and Director General. • Advice on implementation of development projects and activities at Regional level
District level	MtwaraDistrict Executive Director Office and Head of department	• District Executive Director in cooperation with head of departments. • Baseline data on social and economic conditions • Plan and coordinate activities on community-based natural resource and environment management • Enforcement of laws & regulations • Coordinate environmental matters at the District level
District level	Mtwara District Commissioner office	• Oversee and advice on implementation of national policies at District level • Proper management of the environment in their areas of jurisdiction

Category	Institution/Group	Role and Responsibility
		• Carrying out directives given to promote and enhance sustainable management of the environment and as provided under the Local Government; • Performing any functions as provided by the Local Government (District) Authorities Act, 1982. • Advice on implementation of development projects and activities at District level
District level	Mtwara District: Head of Departments -Planning/ Natural Resource/ Health/Community Development Departments etc.	• Plan and coordinate activities on community-based natural resource and environment management • Enforcement of laws and regulations • Issue license for forest/mangrove utilization • Provides guidelines for forest/mangrove use and management within project area and area of influence Baseline data on social and economic conditions
District level	District Environmental Officer and Environmental Committee	• Coordinate environmental matters at the District level
Ward Level	Ward Development Committees – (Ward Councilor, WEO, Ward Environment Committee	• Oversee general development plans for the Ward. • Provide information on local situation and Extension services • Technical support & advice • Project Monitoring
Community level	Village Council (Chairman/ VEO, Environment Committee); Other leaders–Health officer, Teachers, Elders, Vulnerable Groups etc), Communities groups (farmers, women, youth, etc.)	• Information on local social, economic, environmental situation • View on socio-economic and cultural value of the sites and on proposed project operations. • Rendering assistance and advice on the implementation of the project • Project Monitoring (watchdog for the environment, ensure wellbeing of residents and participate in project activities
Community level	Local NGO/CBO and academic institutions	• With direct interest in the proposed Project, and its social and environmental aspects and that are able to influence the Project directly or through public opinion. • Monitoring and management of the project area • Forest/environment conservation • Socioeconomic development in the area
Bilateral and Multilateral Organizations	Development Agencies Financial Institutions - Japan International Cooperation Agency (JICA)	It may have useful data or insight into local and national issues of relevance to the proposed Project.

Source: IRA, 2018

5.4 *METHODS OF STAKEHOLDER'S PARTICIPATION*

Stakeholder participation involves processes whereby all those with a stake in the outcome of a project actively participate in decisions on planning and management. They share information and knowledge, and may contribute to the project design or even alternatives, so as to enhance the success of the project and hence ultimately their own interests. Effective public/stakeholder involvement requires attention to improving the opportunities for such involvements as well as enhancing awareness among the public/stakeholders of those opportunities (Hughes, 1998). Thus, having identified the relevant stakeholders, the ESIA team had to establish clear lines of communication and interaction with the stakeholders. The techniques used varied from one stakeholder group to another. However, simple methods such as consultations, focused group discussion and interviews were used.

The consulting team started to conduct scoping exercise with various stakeholders as well as securing and reading through several documents that deal with the thermal power plants and environmental characteristics of the project area. The consultation was undertaken was undertaken in two phases. The first phase was during scoping from 20th March to 08th April 2018 where two affected villages were involved. The second phase of consultation was conducted during the full ESIA study from 8th – 17th August, 2018. The consultation was undertaken by sending prior information through letters to the Regional Administrative offices of Mtwara region. The Regional Administrative Secretary allowed the consultants to proceed with consultation in Mtwara district council. From Mtwara district, letters were prepared and sent to the wards and village leaders in Kisiwa and Namgogoli villages. These letters apart from providing the program details, they were requesting the above named government leaders to inform their respective Wards Executive officers about the program. Wards Executive officer in collaboration with Kisiwa and Namgogoli village leaders informed the villagers to be prepared and attend the consultation meetings with the consultants. In general, the consultation activities were undertaken based on the following categories of stakeholders;

5.4.1 *Consultation with Regional and District Officials*

The consultation was undertaken with Mtwara Regional Administrative Secretary which was followed by consultation at the Mtwara district level. Within the district discussion and interviews were conducted with Acting District Executive Directors' offices which was followed by the discussion with the head of departments including Land Officer, Community Development Officer, Sports and Culture, Economics and Planning, TARURA, District Engineer, Education Officer as well as Natural Resources and Environment offices. The aim of these consultations was to explain to them about the ESIA process, share the layout of the proposed thermal power plant and its associated infrastructure, discuss various impacts associated with the project, give them an opportunity to air their views and concerns regarding the proposed project as well as determine alternatives for the project and additional potential stakeholders within their areas of jurisdiction.

5.4.2 *Consultations with Other Relevant Stakeholders*

In Mtwara district consultation was conducted by visiting and discussing with key stakeholders such as TANESCO – regional office (project proponent to share issues raised by stakeholders mainly associated with compensation issues), Tanzania Forest Service, Marine Parks, Mtwara Port Authority, existing power plant in Mtwara and two NGO's namely Volunteer for Youth in Health and Development and MSOAP.

Figure 5-1 Meeting with various relevant agencies
Source: IRA, 2018

5.4.3 Meetings with Ward and Village Leaders

Village meetings were conducted with ward, village leaders. The meeting aimed at collecting specific data at the village as well as identifying sensitive sites/areas such as cultural sites that are within the village or its neighbourhood. A checklist was also administered during the meeting to help gather relevant data related to infrastructure available, likely to be impacted, availability of land in case relocation is due. The meeting also aimed at sensitizing the village leaders regarding how they can handle compensation matters and also to ensure that they will continue to sensitize and inform other villagers who were unable to attend the village public meetings.

5.4.4 Village Public Meetings

To ensure that all Kisiwa and Namgogoli villagers are well informed of about the project, the team conducted public meetings in two phases.
The 1st phase of public meetings was conducted four times in the three villages from 22nd March, 2018 to 07th April, 2018. The first meeting was undertaken with village government leaders, then followed by village meeting which was attended by a significant number of villagers both men and women. The third and the fourth public village meetings were undertaken at Namgogoli and Mgao villages. The meetings aimed at informing the PAPs and the villagers regarding the project and the impacts that are associated with the project. Villagers were able to express their concerns in relation to the positive and adverse impacts of the project which include loss of land, possibilities of increase spread of HIV/AIDS especially during the construction phase as well as other environmental and social impacts associated with the project. In these meeting villagers were also sensitized on their right to be compensated and

what is to be compensated if they will either loose land, crops and houses. Villagers were also given an opportunity to ask questions, raise their concerns and provide information to the team on issues such as availability of land in the village for resettlement purposes.

Figure 5-2 Meeting with Village Leaders at Kisiwa Village (Mar 22, 2018)

Source: IRA, 2018

The 2nd phase of public meeting was held in August 2018 and the minutes for village meeting conducted in August 2018 was prepared as Appendix 6. The village meetings were attended by males and females.

5.4.5 Focus Group Discussion and Interview

A Focus Group Discussion and interview was done with different categories of people in the village. The first FGD was undertaken with fishermen at the fishing land site. The group comprised of two women and four men. Elders were considered to be an important source of history of the village in terms of major environmental and social events, which have occurred in the area which might have implications to the proposed thermal power plant. The selected elders also represented a group of vulnerable people in the project area, which is critical to be considered in ESIA study. Another focus group was conducted with members of Beach Management Unit in order to obtain information to fishing activities and the role of the unit in the environmental management along the coast. On 8th August, 2018, another FGD was undertaken with a group of fishermen. Their views and concerns are shown stakeholder's views and concerns in Table 5-2.

The second phase of consultation also intends to demonstrate how the information and views of stakeholders were taken into account in the preparation of Terms of Reference and in project decision making; and to discuss mitigation and benefit enhancement measures. The minutes for focus group discussion conducted in August 2018 was prepared as Appendix 6.

In addition to the focus groups, interviewers were conducted with an opportunity sample of four local residents in the village who were engaged in provision of health and education services. The interview with village health an education officials was undertaken in order to understand the health and education conditions and facilities in the village and what will be the implications of the proposed development to these facilities.

The second phase of consultation also intends to demonstrate how the information and views of stakeholders were taken into account in the preparation of Terms of Reference and in project decision making; and to discuss mitigation and benefit enhancement measures.

5.5 SUMMARY OF STAKEHOLDER ENGAGEMENT ACTIVITIES

The main outputs of stakeholder engagement activities conducted for the Project are summarized in the Table below.

Table 5-2 Summary of Stakeholder Engagement Activities

Main Topic/Meeting Name	Place	Dates	Number of Participants		Main Comments from the Participants	Response of TANESCO to Comments
			Male	Female		
Sensitization and awareness meeting with Regional Officials	Mtwara town	Phase 1. 21 – 23 .03.2018	01	00	The project will be beneficial to the community as it will help solve electricity problem in Mtwara region as well as increase the level of electricity generation capacity to the National Grid.	The development of the project will be a winning point for the political leaders because it will help solve electricity problem in the community
					The construction of the power plant will result to water pollution and impact on aquatic resources and marine biodiversity including the mangroves, there is a need to take this into consideration especially during the construction and operation of the project.	Waste water treatment plant and all discharge will meet IFC and Tanzania standards. There will monitoring plots in Mangrove to monitor changes of species composition of marine organism
					The Project Affected Persons (PAPs) should be compensated and given relative amounts that will help them restore their livelihoods and if possible, provide alternative areas for the relocation of the PAPs.	The PAPs will be considered during the compensation process through in kind or cash compensation and public properties will be in kind compensated.
					The road from Mikindani to Kisiwa village is challenging as it has corners around, and the best way to transport the other heavy electrical equipment which will behaving above 50 tones and can't dismantled is through waterways.	The road will be improved to enable transportation of heavy machines. Besides, waterways will also be used to some of the equipment.
					There is a need to conduct Cost Benefit Analysis for the best transportation of the electrical equipment either through water ways or by road transport to minimize or to avoid any harmful impacts that could occur during the transportation of the equipment.	Both means of transport will be used depending on the type of machines to be transported
					The project area have been demarcated as an industrial area. This plant will increase the national grid, of electricity generations; and will be a catalyst to country's industrialization.	
					The land has been demarcated and valuation has been conducted but the PAPs have not been compensated.	TANESCO is aware of the delayed compensation which have been caused by lack of funds and valuation of additional land take at Kisiwa village. However, the funds are now

						available and the PAPs will be paid with interest as required by Tanzanian laws.
					Tanzania National Roads Agency (TANROADs) is responsible for the construction of the access roads and the costs will be catered for by Tanzania Electric Supply Company Limited (TANESCO).	TANESCO has agreed to cater the cost for road expansion to Kisiwa Power Plant.
Sensitization and awareness meeting with District Officials	Mtwara Town	Phase 1. 21 – 23 .03.2018	22	04	The road from Mikindani to Kisiwa through Namgogoli village is easily accessible and it will require minimal compensation as it will affect a number of farms rather than settlements.	The mentioned road have been chosen for transportation of machines
		Phase 2. 07.08.2018	03	0	The preferred access road by the community to be upgraded is the one from Mikindani to Kisiwa site through Naumbu, Mkungu, Majengoand then Kisiwa as it will serve many villages but a number of settlements will be affected. Upgrading of the roads will help to reduce costs for the district council.	Although, it is true that the proposed road will save many people, the road is too long and it involve demolition of housed and more land take, therefore, it is not recommended by TANESCO
					There were two phases of valuation; 2016and2018. The Valuation process was participatory, the village council members, the PAPs and the community at large were involved through public meetings.	
					The PAPs have not been compensated so far. Different costs will be considered during the valuation process including; Disturbance, accommodation and transportation allowances	TANESCO is aware of the delayed compensation which have been caused by lack of funds and valuation of additional land take at Kisiwa village. However, the funds are now available and the PAPs will be paid with interest as required by Tanzanian laws.
					The forests in Mtwara district are protected by Government, community and Non- Governmental Organizations. The project area for the construction of the power plant is a fishing landing site and isused by many villagers; there is a need to find alternative landing site for the fishermen.	The alternative fish landing site is available at Mgao village
					Mangroves protected by Marine Park from Msangamkuu area to Msimbati	
					There are protected forests under Tanzania Forest Services (TFS) at Ziwani village and Maili kumi.	These forests are direct affected by the project
					Village Land Forest Reserves (VLFRs)at Naumbu,	

					There are breeding sites for aquatic species from Mgao to Naumbu.	Noted, but not directly affected by the project
					There are cultural sites from Naumbu to Mng'au village.	Noted, but not directly affected by the project
					The ecology at Kisiwa bay should be restored after the power plant construction	
					Land is available in Mtwara region because the land demand has decreased due to the decline in Gas supply market. The presence of the power plant project will result to the increase in the land demand at Kisiwa and Mgao villages.	
					The project area for the construction of the power plant is a fishing landing site and is used by many villagers; there is a need to find alternative landing site for the fishermen.	The alternative fish landing site is available at Mgao village. Other means of livelihood restoration have been proposed.
Meeting and consultation with village leaders	Kisiwa and Namgogoli villages	Phase 1. 21.03.2018	08	04	As part of Corporate Social Responsibility, the school and dispensary should be improved. During construction of the project, the community around should be given priority in employment opportunities. This will enhance acceptance and support to the project since they will feel that they are part and parcel of the project. The project has been accepted by the community and they agree the project initiated in their area because it is for the development of the nation.	Although it is the responsibility of TANESCO to provide social services to the villages, it is expected the project will provide services such as dispensary to the workers, this will be accessed by villagers as well. The contractor will ensure that all activities which does not need specialized skilled are undertaken by villagers, however, this will depend on the arrangement of the village government and accountability of those who will be recruited.
		Phase 2. 08.08.2018	04	02	The villagers should benefit from the project through the provision of social services such as schools and dispensary as well as employment opportunities.	Although it is the responsibility of TANESCO to provide social services to the villages, it is expected the project will provide services such as dispensary to the workers, this will be accessed by villagers as well
Public meeting and awareness with normal villagers	Kisiwa and Namgogoli villages	Phase 1. 22.03.2018	252	97	Some of the members in the community depend on the ocean for fishing activities to earn their living, they should be provided with alternative sources of income once the land has been acquired.	Livelihood restoration measures have suggested in the DDR report.

					The village has got one dispensary and not easily accessible; the dispensary has insufficient medicine for the patients, they walk 26 km to the dispensary. The proposed project may result to the increase in the number of people in the community during the construction and after the completion of the project, it is necessary to consider the social services including dispensary, school and road infrastructure. The community around the project area should be given employment opportunities, such as casual labor.	The project will consider how to support the provision of health facilities, given the fact that there will be an increase in the number of people in the village due to the project.
		Phase 2. 08.08.2018	104	31	Valuation was conducted in 2016 and some have stopped developing their areas including farms and land. What is the current status of the payment because the PAPs have not been compensated so far? The proposed project has been accepted by the community because it will be of benefit to them. They complained of delayed compensation. There is an alternative site for fishing activities at Namgogoli but the challenge is that it doesn't have access road. The potential landing site is in Mgao village.	The chief valuer has already signed the document, the PAPs will be compensated with interest due to the delay
Focus Group Discussion **JIKOMBOE WOMEN GROUP** KHADIJAMWENDO NAWANGA. **GROUP SECRETARY** Focus Group Discussion with Fishermen	Kisiwa and Namgogoli villages	Phase 1. 22.03.2018	0	16	The group has been registered and it is supported by SWISSAID and fishing being the main source of living. They areals involved in Farming and pastoralism activities. They were not involved during the valuation process. Will they be allowed to access the area once the land has been acquired? There are salt farms in Kisiwa village belonging to the women group in Namgogoli village, they stopped extracting salt after the valuation process. They have been extracting salt within60 meters close to the ocean.	No activities will be allowed at the site once construction has started, this is for the sake of security purpose. Two farms will be accessed but the other two farms will not be accessed during project construction and operation They will be compensated once the land has been acquired

		Phase 2. 08.08.2018	08	00	Expressed their concerns about the inability to access the fish landing site as one of the area they depend for their livelihoods. Is possible to continue with fishing activities during project construction? Requested the developer to provide an alternative means of livelihood compensate for the loss of landing site such livestock keeping, provided with modern fishing gears to enable them for deep sea fishing. It is possible to have an alternative fish land site in Mgao village, however, the challenge distance to their village unlike the location at Kisiwa village which was close to their home	The response with regard to the possibility of continuing with fishing activities was that, yes it will possible to continue with fishing but, but the area cannot be used as fish landing site due to the presence of plant and water discharge facilities. An alternative means of livelihood will be considered in the livelihood restoration program.
Consultation with other Stakeholders	Mtwara Town	Phase 1. 22 –24.03.2018				
		NGO's **VOLUNTEERFOR YOUTH IN HEALTH AND DEVELOPMENT (VOYOHEDE) NON GOVERNMENTAL ORGANISATION (NGO).**	01	00	The organization has been registered to work with the whole community within boundaries of Tanzania as a nation and deals with provision of advocacy and health advice to women but also advice youth to engage on development activities even by volunteering as to keep them away from engaging on unethical influential groups. Currently, they are concerned with 50social issues with HIV/AIDS being the main case. The organization has been working with Majengo and Vigaeni wards and is being supported by different donors to assist those families living in with poor health and unpleasant environment. 12 women dealing with tailoring have been provided with maternity health education and 56 people home basic care.	
		MTWARA SOCIETY AGAINST POVERTY (MSOAPO) -NGO	03	0	The organization has 17 staffs, it deals with provision of assistance in different sectors including agriculture, health, good governance, pastoralism, environment and Natural resources. There is an ongoing project supported by World Wide	

					Fund for nature (WWF) in Newala, the project is about better use of solar system, which include installation, maintenance and repair. The organization is also working with USAid through deloitte Company on issues concerned with health especially HIV/AIDs, Nutrition, TB, Family planning (Reproduction) and Gender violence. The project area is also their area of consideration because they are working with Mtwara rural by dealing with HIV/AIDs victims through reminding them on proper use of their medications. There is another project in which the organization is working together with Oxfam, and it is divided into 3subdivisions. Oil and Gas (as to make the community understand opportunities together with direct and indirect benefits of Oil and Gas). Gender (establishment of groups of women engaging with farming and pastoralism as well as creation of better relationship with the surrounding community). Good governance and involvement. There is another project about supporting agriculture in which they are working with Swiss Aid and more than 500 people are being benefited from the project. Animation approach has been the best strategy though the use of famous people on villages to educate their fellow villagers on different development matters as been trained by the organization, this will be easy to educate the villagers.	
		TANZANIA RURAL AND URBAN ROADS AGENCY	01	00	There are two alternatives for transportation of electrical equipment; road and waterways. Technically, Cargo above 50tonnes should be	

		(TARURA) PATRICK MKUNYANGA- **TARURA ENGINEER**			transported via maritime while loads/heavy truck less than 50tonnes via road never the less municipal roads carry less than 20tones. They are two options for the access road need to be observed; • From Hiyari-Namgogoli-Kisiwa is (10km). • From Mchina through Kamisera-Kitope junction, Naumbu, Mkungu left to Riso junction, Riso village to kisiwa village(17km). The preferred access road to be upgradedistheoneof17km,becausewillservemany rural people as it crosses to many villages	
		MTWARA URBAN WATER AND SANITATION AUTHORITY (MTUWASA) ENG. MASHAKASITTA MANAGING DIRECTOR	01	00	The main source of water at Mtwara is groundwater. The Ruvuma Southern Coast Basin (government agency) is responsible for the provision of permits for drilling the boreholes. MTUWASA depends on the boreholes to supply water in the villages and in town. There are boreholes at; ▪ Mikindani ▪ Mitengo ▪ Mtawanya (8boreholes) ▪ Mbuo (2 boreholes though one is operating) They are able to provide three hundred meter cubic of water per day (300m^3/day) during the construction and implementation of the project. There is a sub tank at Namgogoli village that gets water from Mbuo borehole that has the capacity to carry 225m^3 and supplies waterto14villagesincludingMgao, Mbuo, Kisiwa and Namgogoli villages. The members of the community get water from MTUWASA, water is sold at 50 Tshs for 20 liters bucket through kiosks.	

					There are boreholes in the communities, some of them are accessed only during the dry season in July, August and September. Most of the time they use water from MTUWASA	
		TANZANIA PORTS AUTHORITY NELSON C.MLALI –PORT MASTER	02	00	They accept the project, the project will stimulate investment to the country because it will ensure sufficient power to run the industry. They are able to handle all cargo required by the proposed project because they have equipment which can dismantle large electrical equipment to small load which can be transported by the road. There is unauthorized port in Kisiwa which is used by as a landing site for fishermen, there should a discussion between TANESCO, Tanzania petroleum Development Corporation (TPDC) and the ports authority about the maintenance of the port so that it can handle electrical equipment. TPA has acquired land in Mgao village, valuation has been conducted but they have not been compensated. Mtwara Port has the ability to handle 93%ofcargo landing in the port and in a year about four hundred thousand tons per year (400,000 tonnes/year) of load are landing in this port.	

		TANZANIA FOREST SERVICE AGENCY (TFS)	03	00	• They all pointed out the importance of marine organisms as one of the potential biodiversity. • TFS regional manager pointed out that within the area proposed for development the only forest resource likely to be affected is mangrove. Mangrove forest has been zoned into 4 zones namely Protection zone, Regeneration zone, Rehabilitation or recovery zone and Development zone where in development zone implementation of development projects is allowed. • Also he clarified on the procedures to be followed before implementing the project that will affect forest resources. • The manager insisted that if the proposed development project \will clear the mangroves, compensation should be paid to TFS as stipulated in the GN. 255, of THE FOREST (AMENDMENTS) REGULATIONS, 2017. • The regulation states that for forest resources likely to be cleared and compensated, TFS will carry out inventory to quantify the amount to be lost and cost the amount to be compensated • Any inventory on the mangroves is controlled by chief and the district does not have inventory section as it is situated in zonal office in Masasi. • Requisition letter should be written and addressed to the manager of Masasi (South Zone) so as to be provided or not and from then it will be decided on who to do the inventory because our role as at the district level is just taking action as directed by higher levels. • Mainly inventory is funded by the developer and for this project, the government will be responsible.	
	Kisiwa village	Vulnerable people (Elders)	02	00	The vulnerable groups including the elders should be considered for additional assistance. The project will result to acquisition of the fishing landing site; in order to restore the livelihood, Provision	

					of concessional loans to the youth to support them to start business. Formulatefishinggroupsandsupportthemwithmodernboatssothattheycanbe able to sail to a farther distance. Is it allowed to continue cultivating around the area that has been valuated?	Proposal for additional support to vulnerable people and restore the livelihood of the PAPs is provided in this report.
Consultation with Sectoral Ministries	Dodoma	Phase 1.	0	0		
		Phase 2. 28.08.2018 Ministry of Energy	01	00	The proposed project is one of the national priorities in power sector with the purpose of improving availability of power in the southern part of the country. And meet the government target to get 4915 by 2020. The proposed project will enable utilization of resources, gas being the source of the proposed electricity. The project proposed project will ensure voltage stabilization in order to avoid voltage loss and reliability. The Ministry in collaboration with Ministry of Finance and Planning an TANESCO is responsible to make all Project Affected People are compensated before commencement of the project, however, timely availability of funds have remained a challenge to many power project in the country. In a situation where the compensation have delayed, the PAPs are paid with interest that are determined by government valuers as required the law. In order to ensure timely compensation, there is a need to convince project funders to include compensation package as part of the loan.	
		Ministry of Natural Resource and Tourism.	03	00	There is a need to involve the Tanzania Forest Service in the process to determine the magnitude of forest destruction and assessment of biomass, especially during project construction.	

		Wildlife Division and Forest and Beekeeping			Undertake inventory in order to understand the species that will be affected by the project. The Ministry will write a letter to TFS to emphasize the need for TFS involvement in in critical stages of project implementation such as mobilization and construction to ensure all issues related to forest management is stages ensure that the contractors and client respect	
		Ministry of Land and Human Settlement Development Policy and Planning Department	01	01	It is important to raise awareness to the people who will be affected by the project to ensure they well informed about the implication of the project and their rights, especially where there is a need for land acquisition. The issue of compensation is governed by Tanzanian laws. The land to be acquired for project implementation should be compensated. Chief Government Valuer is responsible for approval of all valuation reports in the country. In case of any delay in compensation, PAPs should be paid with interest as required by law	
		04/10/2018 **Tanzania National Roads Agency (TANROADS)** **Eng. Ebenezer Mollel (Acting Director of Planning)**	01	00	• Many access roads within a short distance along high ways are not preferable for security purposes as it accelerate chances of road stability • Access road is a black spot and major sources of accidents. • The best approach is to improve and use the existing access roads instead of introducing new road. Since there are two access roads within the project area; TANROAD is recommending one of the existing road be an entry while the other one for exit. • There should be a proper design of the new access road if need be so as to avoid any negative impacts along the surrounding community. • It is important to consult the TANROADs Regional Manager with the design of the new access road before the establishment so as to ensure that the road	

					constructed is of good quality and mechanisms established in order to minimise risks that may occur as a result of the new access road.	
		04/10/2018 **Tanzania Petroleum Development Corporation (TPDC)** **Alex Ilemesa (Senior Environmental Officer)** **Deusdedit Kiheka (Environmental Health and Safety Officer)**	**01**	**01**	The project is well known, even though discussions and related communication is done between TANESCO and high managerial level staffs within TPDC. Considering the current existing gas, demand is very low than the supply of it and our clients are TANESCO, Industries and domestic clients. In that case sustainability is assured with no qualms at all. There is plan of supplying gas to domestic houses on surveyed and planned areas and there is a study done about it considering that TPDC is governed by both The Environmental Management Act, 2004 and Petroleum Act, 20 As an advice, the developer should practice 'Contribution to Life' around the community to avoid complains with the IFC. Developer has to seek permit from TPDC at every stage of development when trying to access gas so as we can provide the Emergency Response Team to assist client at the moment's accident occur. Erosion is the main challenge facing our gas plants and Somanga Fungu is basically a flood plain so there is a need to find measures to overcome the associated damages especially destruction of gas pipeline that will be connected from our main pipe. The villagers could not differentiate activities undertaken by TPDC and those which are undertaken by TANESCO. In a situation where there is conflict, the villagers are not sure where to present their grievances.	During the village public meeting, the consultants with collaboration with TANESCO provided explanation on the responsibility of each government institutions in their respective project area. Besides, a Grievance Redress mechanisms committees will be formed to ensure that those who are grieved have access to responsible authority. The final report will be shared to key stakeholders

					Awareness about the project is to be provided to the community together with setting up of grievance solving mechanism to avoid unnecessary complains. The final document for this Environmental Impact Assessment study has to be shared with us so as we can have the Environmental Management Plan. Nevertheless, the project is perfect because it leads to National Development as we are trying not to rely on single source electric energy.	
		05/10/2018 **Occupational Safety and Health Authority (OSHA)** **Zakaria John**	**01**	**00**	DURING CONSTRUCTION PHASE If the land has been acquired legally, it is a viable project, however, all compensation to the Project Affected Persons (PAPs) should be settled before construction begins and ensure public project demarcations for this project Drawing Design should be submitted to OSHA hence to see if the proposed designs are familiar to workers health and safety operations in terms of layout material and cooperation. Contractors should register the project and get certificate of compliance during construction phase. Contractors should adhere to international and national standards as stipulated by the laws and regulations. The contractors should have Health and Safety Policy on place and ensure good (practices) implementations of that policy. Contractors/employer should conduct awareness induction training to workers before commencement of the project, also should have periodic/regular inductions to workers.	

					We emphasis on Health Status; contractors should conduct Medical Examination (fitness) to workers. Basing on the main three (3) categories, i.Pre-Medical Examination, that is checkup before commencement of the work. ii.Periodic/regular Medical Examination, checkup of work, during project execution. iii. Exist Medical Examination, recommended to conduct medical checkup for workers soon after left from working contract. Emphasizing on incidence recording and notifications in order for authority to do investigations. Also the contractor should ensure that all workers have Health Insurance, during construction. On risk assessment, contractors and/or employer should conduct risk assessment in order to minimize risk exposure and adequate response to incident, near miss and hazards also ensure adherence on good practices during construction phase. Employer/contractors should have Primary Prevention Strategy and ensure all facilities (such as PPE and health facilities and other equipment) that are used for Health and Safety. <u>DURING OPERATION PHASE</u> On risk assessment, contractors and/or employer should conduct risk assessment in order to minimize risk exposure and adequate response to incident, near miss and hazards also ensure adherence on good practices during operation. The contractors should have Health and Safety Policy on place and ensure good (practices) implementations of that policy.	

					Employer/TANESCO should register the project and get certificate of compliance during operation phase. Also the employer should ensure that all workers have Health Insurance, during operation phase. Ensure the provision of PPE and other equipment to workers and guest during a site visits.	
Total			**423**	**156**		

Source: IRA, 2018

5.6 *IDENTIFIED ISSUES AND CONCERNS DURING CONSULTATIONS*

As a result of public engagement and consultation, a number of issues and concerns were identified and are addressed. In general, stakeholders have different opinions with regard to implementation of the proposed project that mainly focus on issues of compensation and environment as well as benefits of the project to the nation and local communities. Their view and concerns include the following:

5.6.1 *Environmental concerns*

Natural disasters

The discussion with district and municipal council officials revealed that, Mtwara town experienced natural disasters particularly floods during rainy season. For example during the wet season, the area experienced flush floods in flats and low lying areas/valleys such as parts of Kyangu, Chuno, Mdenga and Chipuputa. Prolonged wet season coupled with land degradation increases the volume of surface runoffs and increases erosion and washing sediment into the Indian Ocean and manmade ponds like Dabwada and Mdenga na Maji. They pointed out that Municipal Council had also experienced El Nino (global phenomena) in the past in late 1997, 1998 and in 2012 where in 2012 there was a devastated impact. However they pointed out that the gas power plant at Msimbati Bay which is located close to sea shore had experienced massive sea erosion in the year 2015. Therefore a thorough assessment should be done on the proposed site so as clear mitigation measures could be provided.

Environmental pollution

Municipal and District Environmental officers were consulted and concerned about levels of pollution likely to be caused by project activities, atmospheric air pollution was mentioned to cause local climate change. Similarly management of waste emanating from power plant operation may contribute to water and soil pollution. Similarly, other forms of waste would be generated from the construction activities, operation and decommissioning of project activities thus contributing to environmental pollution.

Environmental/biodiversity issues

Consultation with stakeholders especially dealing with conservation were concerned about the level of damage that the project will cause to the environment and affect biodiversity of the area. For example views from TFS-mangrove Unit in Mtwara and Fishery Unit in Mtwara they all pointed out the importance of marine organisms as one of the potential biodiversity. TFS regional manager clarify on the procedures to be followed before implementing the project. The manager pointed out that, Mangroves has been zoned into 4 zones namely. Protection zone, Regeneration zone, Rehabilitation or recovery zone and Development zone where in development zone implementation of development projects is allowed. They also insisted that if the proposed development project ¥will clears the mangrove compensation should be paid to

TFS as stipulated in the GN. 255, THE FOREST (AMENDMENTS) REGULATIONS, 2017 They further insisted on the participation of TFS officials during the detailed EIA process so that they can give out detailed procedures.

Temperature change effect

The ambient temperature change at the ocean at the moment is 30-31degrees centigrade; the construction of the power station at Kisiwa will result to the increase in temperature of the water body by 3 degrees especially during the discharge of the cooling water of the steam to the ocean. The increase in temperature will impact the resources found in the ocean such as aquatic resources and marine biodiversity including the mangroves.

5.6.2 Socio-economic concerns

Land acquisition and compensation

The land department in Mtwara District council were consulted. The project has acquired a large piece of land used villagers for agricultural activities and settlements. The acquired will be used for various project activities such as power generation, access roads to the power plant, and auxiliary buildings as the complex power plant has been proposed. This would create challenges in terms of the size of land acquired, fair and prompt compensation, and land ownership issues, as well as procedures for acquiring the land. The villagers at Kisiwa and Namgogoli were concerned about fair and prompt compensation on the properties to be affected by the proposed project development. Land officers revealed that the valuation exercise has been done since November, 2017 and PAPs are keenly waiting their compensation.

Migration and population growth

Unlike previous years where Mtwara was known as sending region, currently, the region has experienced influx of people from within and outside the country who are searching job opportunities, particularly, in relation to gas exploration, cement manufacturing industry and agricultural activities. Discussion with stakeholders at Kisiwa and Namgogoli villages revealed that there is an influx of people from Dar es Salaam city and other urban areas searching for land and business opportunities. The influx of people could pose a very serious problem in land availability and social services in the future

Economic potentials

PTA and TANESCO officials were consulted and mentioned the economic potential of the proposed project. The proposed project would increase efficiency of electricity supplied by the National grid and facilitate growth of industries, agribusiness, and other auxiliary activities in Mtwara, Lindi and the entire nation. For example officials from TANESCO Mtwara have a concern on the power crisis in Mtwara due to mushrooming of industries and mining sectors in Mtwara and Lindi. Similarly they pointed out that, development of the proposed project will enhance production of the Dangote Cement factory and several proposed industries in Mtwara and Lindi.

Loss of livelihood

There are women groups in the village involved in different activities including fishing, farming and livestock keeping. Some of the women depend on fishing as their means of living. There is a group called Jikomboe dealing with fishing activities at the project site for household consumption and commercial purpose. The group has a total of 10 members including six males and ten females with a total of 55 dependants, mainly children. Their fish farm will be affected by the project, they complained of not being involved during the valuation process, there is a need to consider this especially during the compensation process.

Improvement of social services

The proposed project will lead to the increase in the number of people at Kisiwa village, the social services including school and dispensary may not be sufficient for the community. The members of the community ask for the improvement of social services available so as to suite the population that will be available.

Employment opportunities

During construction of the project, the community around should be considered in the provision of employment opportunities both skilled and unskilled labor. This will enhance acceptance and support of the community to the project since they will feel that they are part and parcel of the project

6 IMPACT ASSESSMENT AND MITIGATION MEASURES: BIOPHYSICAL IMPACT

6.1 IMPACT ASSESSMENT METHODOLOGY

Impact identification and assessment starts with scoping and continues through the remainder of the ESIA Process.

- **Impact Prediction:** to determine what could potentially happen to resources/receptors as a consequence of the Project and its associated activities;
- **Impact Evaluation:** to evaluate the significance of the predicted impacts by considering their magnitude and likelihood of occurrence, and the sensitivity, value and/or importance of the affected resource/receptor;

6.1.1 *Impact Prediction*

The terminology and designations used to describe impact characteristics are shown in ***Table 6-1*** below.

Table 6-1 Characteristic of Impacts

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the potential impact to the Project (in terms of cause and effect).	Direct Indirect Induced
Extent	The "reach" of the potential impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.).	Local Regional International
Duration	The time period over which a resource / receptor is potentially affected.	Temporary Short-term Long-term
Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.).	[No fixed designations; intended to be a numerical value or a qualitative description of intensity]
Frequency	A measure of the constancy or periodicity of the potential impact.	[No fixed designations; intended to be a numerical value or a qualitative description]

Source: JICA Study Team

The definitions for the type designations are shown in ***Table 6-2***.

Table 6-2 Type of Impact

Type	Definition
Direct	Potential impacts that result from a direct interaction between the Project and a resource/receptor (e.g., between occupation of a plot of land and the habitats which are affected).
Indirect	Potential impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
Induced	Potential impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).

Source: JICA Study Team

Once impact characteristics are defined, the next step in the impact assessment phase is to assign each potential impact a "**magnitude**". Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood (for unplanned event).

Magnitude essentially describes the intensity of the change that is predicted to occur in the resource/receptor as a result of the potential impact. The universal magnitude designations are:

- Positive;
- Negligible;
- Small;
- Medium; and
- Large.

In addition to characterizing the magnitude of impact, the other principal impact evaluation step is definition of the "**sensitivity/vulnerability/importance"** of the impacted resource/receptor. As in the case of magnitude, the sensitivity/vulnerability/importance designations themselves are universally consistent, but the definitions for these designations vary on a resource/receptor basis.

- Low;
- Medium; and
- High.

6.1.2 *Evaluation of Impact Significance*

Once magnitude of impact and sensitivity/ vulnerability/ importance of resource/ receptor have been characterised, the significance was assigned for each impact. Impact significance is designated using the matrix shown in ***Figure 6-1*Error! Reference source not found.**.

		Sensitivity/Vulnerability/ Important Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	High
	Large	Moderate	High	High

Figure 6-1 Impact Significance

Source: JICA Study Team, 2018

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix.

6.1.3 *Mitigation Hierarchy*

- **Mitigation and Enhancement:** to identify appropriate and justified measures to mitigate potential negative impacts and enhance potential positive impacts. The following mitigation hierarchy is considered.

  - *Avoid at Source, Reduce at Source*: avoiding or reducing at source through the design of the Project (e.g., avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity);

  - *Abate on Site*: add something to the design to abate the impact (e.g., pollution control equipment, traffic controls, perimeter screening and landscaping);

  - *Abate at Receptor*: if an impact cannot be abated on-site then control measures can be implemented off-site (e.g., noise barriers to reduce noise impact at a nearby residence or fencing to prevent animals straying onto the site);

  - *Repair or Remedy*: some impacts involve unavoidable damage to a resource (e.g. agricultural land and forestry due to creating access, work camps or materials storage areas) and these impacts can be addressed through repair, restoration or reinstatement measures; and

  - *Compensate in Kind, Compensate Through Other Means*: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (e.g., planting to replace damaged vegetation, financial compensation for damaged crops or providing community facilities for loss of fisheries access, recreation and amenity space).

- **Residual Impact Evaluation:** to evaluate the significance of potential impacts assuming effective implementation of mitigation and enhancement measures.

6.2 *SCOPING OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS*

The environmental and social concerns related to the proposed Mtwara power plant have been identified based on the JICA environmental and social consideration guidelines (April 2010), relevant environmental legislation in Tanzania, and environmental and social conditions in the area concerned.
For each impact item, potential impacts in each stage of development (in planning and construction, and in the operation phase) are divided into negative impacts (－) and positive impacts (＋), and the degree of impacts is classified as shown below. Table below shows the scoping result.

A (+/ -): Major positive / negative impacts are projected
B (+/ -): A certain degree of positive / negative impacts is projected
C: Impacts are unclear (further investigation is needed. Impacts may become apparent as the survey progresses)
D: No impacts are Projected

Table 6-3 Scoping result for the Mtwara power plant (including gas pipeline, access road)

	Impact item	Assessment: Planning / Construction	Assessment: Operation	Reason for the assessment and points of attention
Pollution control measures				
1	Air pollution	B-	B-	**Construction phase:** Sand and fine particles may fly up when carrying in or out construction materials, and conducting civil engineering works. The scope of impacts from such pollutants is expected to be limited to the vicinities of the construction areas. **Operation phase:** NO_x emission by the operation is anticipated. Measures should be taken to observe the environmental criteria of Tanzania or the values in the IFC EHS guidelines.
2	Water pollution	B-	B-	**Construction phase:** Influence from the generation of muddy water during construction is anticipated. **Operation phase:** Thermal water discharge, plant wastewater, domestic waste water and oil-containing waste water will be generated. Water treatment with chlorine is expected as a common practice. Measures for effluent discharge should be taken to observe the environmental criteria of Tanzania or the values in the IFC EHS guideline.
3	Waste	B-	B-	**Construction phase:** The construction work is expected to general waste, hazardous waste, and construction waste such as surplus soil and scrap wood. **Operation phase:** General waste and hazardous waste are expected to be generated.
4	Soil / groundwater contamination	B-	B-	**Construction phase:** The possibility of soil contamination by the spill of oil for construction is anticipated. **Operation phase:** Spillage of lubrication oil and fuel during operation of the power plant are likely to cause contamination in the soil.
5	Noise and vibration	B-	B-	**Construction phase:** Noise due to the operation of construction equipment, vehicles is anticipated. **Operation phase:** Attention should be paid so that noise caused by operation will meet the environmental criteria of Tanzania and the IFC EHS guideline.
6	Ground subsidence	D	D	There is no ground subsidence due to groundwater pumping anticipated, because groundwater will not be used.
7	Odor	D	D	There are no substances considered to cause a bad smell at the thermal power plant.
Natural environment				
8	Nature reserve	D	D	The project site is not located in the protected area.
9	Ecosystem	C	B-	**Construction phase:** The land cover in the project site is wood vegetation with human intervention such as farming. The site is not expected to be an ecologically important habitat. However, some mangrove trees are to be cut to install the outfall structure into the creek. **Operation phase:** There is a possibility that the deterioration of the atmosphere environment and would influence the surrounding ecosystem. Thermal discharge from the power plant might have some influence in the aquatic ecology.

No.	Impact item	Assessment: Planning / Construction	Assessment: Operation	Reason for the assessment and points of attention
10	Hydrology	B-	B-	**Construction phase:** As an influence on hydrogeology during construction, it is expected that alteration in the shape and quality of the land may temporarily affect the drainage pattern. **Operation phase:** There is a possibility that the terrain will be altered, which would affect the surrounding water environment. Measures against alteration of the drainage pattern especially during the rainy season, such as the construction of a drainage path, should be considered.
11	Topography and geology	B-	D	**Construction phase:** The site construction and access road construction are expected to alter the terrain. **Operation phase:** Operation does not involve the activities that alter the terrain.
Social environment				
12	Involuntary resettlement	B-	D	**Before construction work:** · Land acquisition for the power plant complex area of 160ha (excluding the land for the gas pipeline and access road) is expected, which involves physical and economical relocation of the local people. According to the approved valuation report, the number of affected persons is 128. Three households with 15 people are expected to be physically relocated. In addition to this 160ha of land, additional land acquisition is also expected causing acquisition of the fish landing site and physical relocation of 4 households (around 20 people). · In order to establish the gas pipeline from the BVS 01 (block valve station) to the Mtwara power plant site, necessary land will be acquired by TPDC. The length is approximately 10km to 16km. · Although transportation route is along the existing road and the road planning is based on the Mtwara Master Plan, land acquisition might be involved. Details will be confirmed with the local government (Mtwara District council).
13	Poverty	B-/ B+	C	**Construction phase:** Affected households may need to change their livelihood due to this project. At the same time, there is a possibility that the project can generate job opportunities related to construction work, which would help increase the income of local people. **Operation phase:** Job opportunities may increase for the affected local communities, with the increase of employment related to this project.
14	Ethnic minorities, indigenous people	C	C	**Construction and operation phase:** Influence on ethnic minorities and indigenous people is not expected. Tanzania has a multi-ethnic population with more than 125 different ethnic communities. Four of these, the Hadzabe, the Akie, the Maasai and the Barabaig, identify themselves as indigenous peoples. The majority of the indigenous peoples live in northern Tanzania, in the Arusha and Manyara regions. In Mtwara District, The dominant ethnic group is the Makonde.
15	Cultural heritage	B-/C	B-/C	According to the local village leader during the preliminary survey, there is no cultural heritage in the proposed site. However, within the piece of the land which is expected to be additionally acquired, there is a grave yard. This is expected to be relocated in accordance with Graves Act. The village historical site is located outside the project site (north of the site).
16	Landscape	B-	B-	**Construction and operation phase:** The establishment of the power plant is expected to alter the landscape. However, the surroundings of the site have no scenic spots, no significant impact on such spots is expected.

Impact item		Assessment: Planning / Construction	Assessment: Operation	Reason for the assessment and points of attention
17	Local economy such as employment and means of livelihood	B-/ B+	B-/ B+	**Construction phase:** ・ Affected local communities may need to change their livelihood. At the same time, there is a possibility that employees involved in the construction continue to be hired, and new job opportunities for local communities may be created. ・ Establishment of gas pipeline might have some influence on livelihood due to the wayleave establishment. Details will be confirmed in the further study with TPDC. ・ There might be some influence on livelihood and daily life due to the project transportation along the transportation route such as disturbance of livelihood activities. Details will be confirmed in the further study. **Operation phase:** Job opportunities will increase through this project. Furthermore, the project may contribute to the development of a local economy through a stable power supply.
18	Utilization of land and local resources	B-	B-	**Construction / Operation phase:** 160ha of land will be acquired by TANESCO and will be used for power plant complex. Farming area within the acquired land is not accessible for local people after the acquisition.
19	Use of water	D	D	**Construction / Operation phase:** Given the topographic conditions and the distance, the use of groundwater at the site will not affect the wells in nearby villages.
20	Existing social infrastructure and social services	B-	B+	**Construction phase:** There is a possibility that construction work will influence existing social infrastructures due to the influx of construction workers. **Operation phase:** It is expected that TANESCO will allow the local people to use some water, which contribute to the communities in the surrounding area.
21	Social capital and social organizations such as decision making organizations	D	D	It is not anticipated that the social capital and social organizations will suffer any damage due to this project since the communities are away from the project site and number of affected households are 11. One landing site for fishery will be lost but, the villagers use multiple landing sites including the one with fish market, and the impact will be limited.
22	Imbalance of harms and benefits	B-	B-	A sense of unfairness might occur between the local people in the surrounding area who receive the benefits of a stable power supply and those who will lose their means of earning a living by this project.
23	Gender	B-	B-	As mentioned above, the power plant complex site was used by local people such as for farming. Relocations and livelihood restoration due to the land

Impact item		Assessment		Reason for the assessment and points of attention
		Planning / Constructio n	Operation	
				acquisition might have some influence on gender perspective. Considerations will be given to Gender during construction and operation.
24	Children's rights	D	D	**Construction / Operation phase:** It is not anticipated that construction and operation will involve children as workforce.
25	Contagious diseases (e.g. HIV[1]/ AIDS[2])	B-	D	**Construction phase:** An inflow of workers from outside is expected, due to the construction and service scale of this project. There is a risk of the occurrence of infectious diseases, such as HIV/AIDS, caused by the inflow of workers from outside. **Operation phase:** No influence on infectious diseases, such as HIV/AIDS, is anticipated.
26	Working environment	B-	B-	**Construction and operation phase:** Consideration should be given to the working environment for construction workers and operation staff.
Others				
27	Accident preventive measures	B-	B-	**Construction phase:** Consideration should be given to accidents during construction. **Operation phase:** Fire and traffic accidents are the expected risks by operation of facilities and vehicles.
28	Cross-border impacts and climate change	D	B-	**Construction phase:** It is not anticipated that the construction work will influence climate change, but the use of Gas for power will contribute to the reduction of CO2 emission. **Operation phase:** Greenhouse effect gas, such as CO_2, is expected to increase due to the increase of vehicles and operation of factories.

Legend
A+/ -: Major positive / negative impacts are projected
B+/ -: A certain degree of positive / negative impacts are projected
C : Impacts are unclear - further investigation is needed
D : No impacts are projected
Source: Prepared by the Survey Team

[1] Human Immunodeficiency Virus (HIV)
[2] Acquired Immune Deficiency Syndrome (AIDS)

6.3 *Biophysical Impact Assessment*

This chapter describes the potential environmental and social impacts of the proposed 300MW gas-fired thermal power plant at Kisiwa village in Mtwara District. Based on the methodology described in Chapter 4, it assesses how the project will interact with elements of the physical, ecological, social, cultural or human environment to produce impacts to resources/receptors, and the mitigation measures to the potential negative impacts. The potential environmental and social impacts due to the project activities are considered in the stages of the construction phase (construction of the plant) and the operation phase (operation and maintenance of the plant).

6.3.1 *Air Quality*

Sensitivity of the Study Area

The nearest air sensitive receptors (ASRs) are residents from Kisiwa and Namgogoli Villages. Kisiwa village is approximately 2km away, while Namgogoli is 3km away.

Construction Phase

The key activities which may potentially cause air quality impacts are listed below:

- Site clearance, site formation and levelling involving excavation and backfilling;
- Construction of substructure and superstructure of the main power plant facilities including infrastructure and buildings.

Potential air pollutants during construction include fugitive dust emissions from site preparation and construction activities, stock piles, handling and transport of materials; emissions from vehicles and other construction machineries.

Site formation and levelling works will be required within the Project site area where material handling from excavation, backfilling and stockpiling of materials will be carried out on site and there will be potential to cause fugitive dust impact. The excavated materials will be re-reused on site as far as practicable. The excavated materials suitable for backfilling will be temporarily stockpiled onsite.

In addition, trucks movements within the work sites and wind erosion of the open uncovered areas are also potential sources of fugitive dust emissions. Dust suppression measures and good site practices as mentioned below will be implemented to minimize the fugitive dust emission during the construction works.

Furthermore, construction equipment (electric and diesel-powered) will be operating in different areas within the Project site area and the associated emissions from their operation may also contribute to air quality impact during the construction phase.

With the implementation of the dust suppression measures and good site practices mentioned below, the fugitive dust impact arising from the potential dust generating activities and air quality impact from operation of construction equipment during the construction of the Project on the nearby air sensitive receptors (ASRs) is anticipated to be minor and transient.

Mitigation Measures

- Water spraying of or covering all exposed areas and stockpiles;
- Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust;
- Minimizing the size of exposed areas and material stockpiles and the periods of their existence;
- Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time;
- Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions;
- Cleaning wheels and the lower body parts of trucks at all exits of the construction site;
- Cleaning the entire construction work sites, as necessary;
- Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary;
- Watering the main haul road regularly to suppress dust emissions during truck movement;
- Prohibiting the burning of waste or vegetation on site;
- Compacting the reclaimed land immediately to avoid fugitive dust emissions

Table 6-4 Impact Significance

Impact	Fugitive dust emissions associated with the materials handling, wind erosion of open areas and truck movements on access roads within the construction worksite; and Air emissions including NO_2, SO_2, PM_{10} and $PM_{2.5}$ from construction equipment and trucks within the entire work areas.				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	**Direct**	Indirect	Induced		
	Impact on human health within the general population is direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impacts are considered short-term				
Impact Extent	**Local**	Regional	International		
	Impacts on human health within the general population are expected to be local.				
Impact Scale	The fugitive dust impacts are expected to be limited, localized (within 100m from the worksite boundary) and short-term. The air quality impacts are expected to be small provided that all mitigation measures and good site practices are implemented.				
Frequency	Throughout the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small as the fugitive dust impact will be reduced as much as possible after the proper implementation of all in-place dust suppression measures and good site practice.				
Receptor Sensitivity	**Low**	Medium	High		
	The receptor sensitivity is considered low as the ASRs identified in the surrounding are more than 2km form the construction site.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is considered to be **Negligible.**				

Source: JICA Study Team, 2018

Operation Phase

The key emission source associated with the operation of the Project is stack emissions from the combustion of natural gas during combined cycle and simple cycle operation. The key air pollutant of concern is NO_2.

The Project consists of two sets of gas turbine generating units and heat recovery steam generators (HRSG). The Project will be designed to operate continuously throughout the year in either simple cycle or combine cycle mode. Each set of gas turbine and HRSG is equipped with one bypass stack for simple cycle mode and one main stack for combined cycle mode. The stack locations are shown in Figure below (refer to green tags).

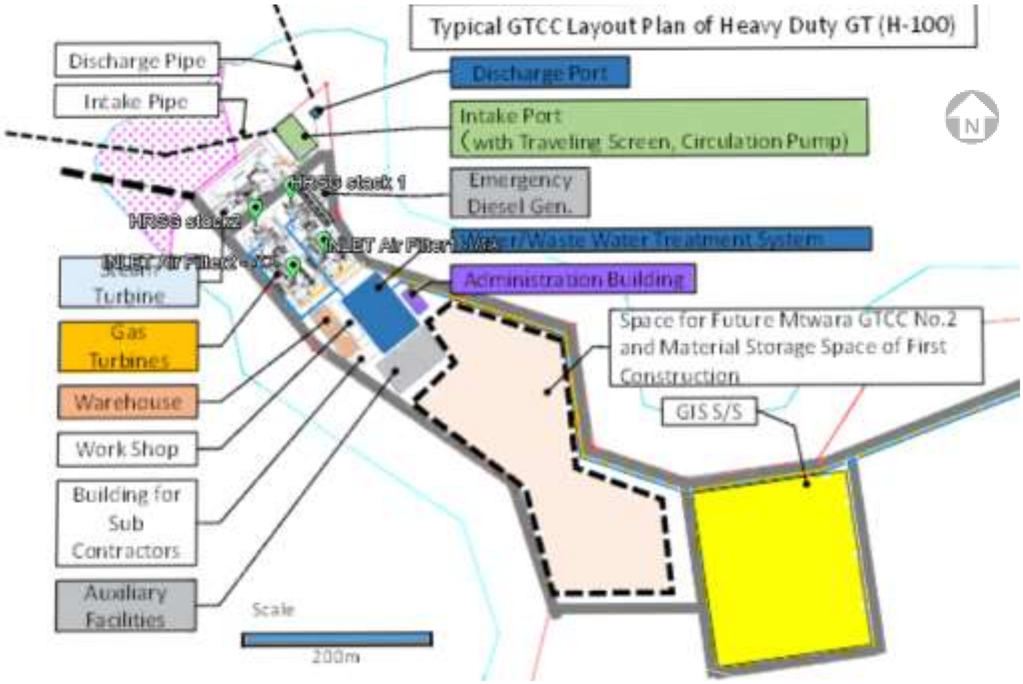


Figure 6-2 Location of Stacks
Source: JICA Study Team, 2018

During combined cycle operation, the heat of exhaust gas will be admitted to the HRSG where superheated steam will be produced which will then drive the steam turbine to generate additional electrical power. The flue gas from the HRSG will be emitted via the main stack. During simple cycle operation, the flue gas from the gas turbine will be emitted via the bypass stack. The main stack and the bypass stack will not be operating concurrently at any time.

The contributions of stack emissions from the Project during operation phase have been quantitatively assessed using an air dispersion model, AERMOD (version 18081) (1). The modelling input data for the main stacks and bypass stacks are presented in ***Table 6-5 below***.

(1) AERMOD is an internationally recognized model, and is one of the preferred and recommended models of the US Environmental Protection Agency (US EPA).

Table 6-5 Point Source Emission Inventory

Input Parameter	HRSG Main Stacks	Bypass Stacks
Operation mode	Combined-cycle	Simple-cycle
Number of stacks	2	2
Coordinates of stack (X, Y)	11_MS: 608462, 8874336 12_MS: 608424, 8874312	11_BS: 608484, 8874311 12_BS: 608450, 8874284
Stack height (m above ground)	40	40
Diameter of each stack (m)	5	5
Flue gas exit temperature (°C)	87.75	541.9
Flue gas exit velocity - wet (m/s)	35.7	36.1
Flue gas exit flow rate under operating condition (m^3/hr)	2.52×10^6	2.55×10^6
NOx Emission rate (per stack) (@15%O2)(g/s)	24.9 ppm (@15%O2)	24.9ppm (@15%O2)

Note:

(a) Stack design parameters and emission information are provided by the client.

Source: JICA Study Team, 2018

As the representative ASRs are generally low-rise village houses, ground level concentrations (GLCs) at 1.5m above ground (breathing level of human receptors) of these ASRs have been modelled. These ASRs, which are residents in Kisiwa and Namgogoli Villages, are located 2-3km from the project site (refer to blue dots in ***Figure 6-5***).

For the purpose of this assessment, it was assumed that either combined cycle or simple cycle mode will be operated continuously throughout the year. Main stacks and bypass stacks will not be operational concurrently.

NO_2 is assumed to be 50% of NO_x for short-term averages (i.e., hourly and daily averaged) and 100% of NO_x for long-term average (annual average) as a conservative approach. This assumption made reference to the air quality modelling guidelines recommended by the *Air Quality Modelling and Assessment Unit of UK Environmental Agency* (1).

Quantitative assessment has been conducted for stack emissions of NO2 at the identified air sensitive receptors and the area within 10km from the centre of the stack locations.

The 1-hour and annual NO_2 impacts arising from the combined cycle operation of the Project at the identified ASRs have been predicted to be low and well below the relevant air quality standards as shown in ***Table 6-6*** below. The highest project contribution at the ASRs is about 4% of the relevant air quality standard (1-hour average NO_2).
Contour plots of maximum 1-hour average and annual average NO_2 concentrations at ground level for the five assessment years (i.e. 2013 to 2017) under combined cycle operation are shown in ***Figures*** below. The highest

(1) UK EA, Air Modelling Guidelines on conversion ratio for NO_x to NO_2 : http://www.environment-agency.gov.uk/static/documents/Conversion_ratios_for__NOx_and_NO2_.pdf

project contribution at off-site locations that are not existing ASRs within an area of 10km from the Project site is about 35ug/m^3 (1-hour average NO_2), which is about 17.5% of the relevant air quality standard.

Table 6-6 Predicted NO2 Concentrations at Sensitive Receptors

		Combined Cycle		Simple Cycle	
ASR	Description	Max 1-hr NO2	Annual NO2	Max 1-hr NO2	Annual NO2
A1	Kisiwa Village	7.69	0.04	2.02	0.02
A2	Namgogoli Village	5.78	0.05	1.81	0.02
	WHO Criteria	200	40	200	40
	Max % of Project Contribution to Criteria	3.8%	0.13%	1.01%	0.05%

Source: JICA Study Team, 2018

The maximum project contribution at the identified ASRs is only about 4of the relevant air quality standards during combined cycle operation. Therefore, the magnitude of impacts at the identified ASRs as a result of stack emissions from the operation of the Project is considered "negligible" as the maximum project contribution is smaller than 25% of the relevant air quality standards within a non-degraded airshed. As the nearest resident is not located at a distance of 2km, the sensitivity of the receptor (e.g. human health) is considered "low". Therefore, the overall significance of impact from the operation of the Project at identified ASRs is considered **negligible.** The impact assessment is summarised in ***Table 6-7*** below.

Mitigation Measure

- Install continuous emission monitoring system (CEMS) to monitor the NOx emission concentrations and other relevant parameters at the main stacks and bypass stacks.

Table 6-7 Impact Significance

Impact	Stack emissions potentially affecting the identified Air Sensitive Receptors				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on human health within the general population is negative.				
Impact Type	**Direct**	Indirect	Induced		
	Impact on health within the general population is direct.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long-term, as the impacts will occur throughout the operation of the power plant.				
Impact Extent	**Local**	Regional	International		
	Impacts on human health are mostly expected to be local within 10 km.				
Impact Scale	The scale of the impact is estimated to be the area within 10 km area from the power plant boundary.				
Frequency	Throughout the operation period of power plant.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Impact magnitude is considered negligible as the project contribution within the non-degraded airshed is smaller than 25% of the relevant air quality standards at the identified ASRs.				
Receptor Sensitivity	**Low**	Medium	High		
	The receptor sensitivity is considered as low as the ASRs identified in the surrounding are generally population.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is considered to be **Negligible.**				

Source: JICA Study Team, 2018

Source: JICA Study Team, 2018

Figure 6-3 NO2 Concentration Dispersion (1-Hr Ave)

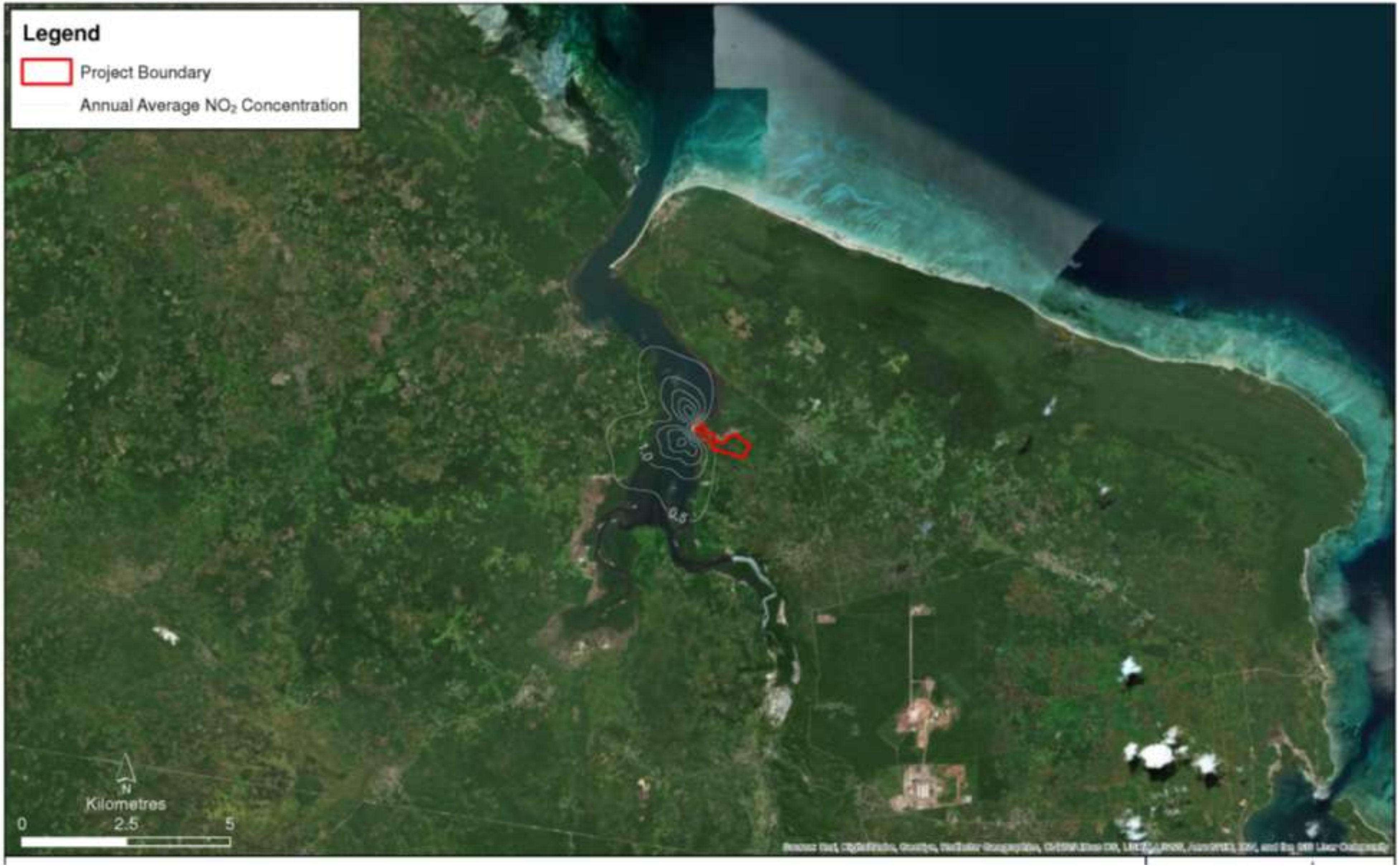


Figure 6-4 NO2 Concentration Dispersion (Annual Ave)
Source: JICA Study Team, 2018

6.3.2 *Noise*

Construction Phase

The construction activities that may cause significant noise are noted below:

- Site preparation and establishment;
- Pile driving and foundation works;
- Construction of the infrastructure such as internal access roads, storm water drains, temporary workers camp and security fence; and
- Construction of offices and installation of equipment.

Operation of powered mechanical equipment (PME) will be the major source of noise impact to the noise sensitive receptors (NSRs) - Kisiwa Village (approximately 2.5km away) and Namgogoli Village (approximately 3.5km away). An indicative construction plant inventory for the construction activities during daytime period is summarised in ***Table 6-8***.

The SWL of plants are adopted from the Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control. British Standard, BS5228: Part 1: 2009. Site hoarding along the Project site boundary was also considered in the assessment to provide 5dB noise reduction (barrier correction).

Table 6-8 Indicative Construction Plant Inventory

Plant Item	Reference[(a)] Descriptions	Reference[(a)] Code	Quantity during Peak hour	On-time %	Unit SWL, dB(A)	Sub-Total SWL, dB(A)	Overall SWL, dB(A) [(b)] [(c)]
Group A [(d)] Site clearance							**123**
Crawler cranes	Mobile crane	BS D7 114	1	100%	101	101	
Rough-terrain cranes			1	100%	105	105	
Truck cranes	Lorry mounted crane	BS D6 39	5	100%	116	123	
Power lift	Diesel scissor lift	BS C4 59	1	100%	103	103	
Engine driven generator	Generator	BS C4 84	1	100%	102	102	
Backhoe	Wheeled Backhoe Loader	BS C4 14	1	100%	95	95	
Group B [(d)] Piling and foundation works							**124**
Crawler cranes	Mobile crane	BS D7 114	1	100%	101	101	
Rough-terrain cranes			1	100%	105	105	
Truck cranes	Lorry mounted crane	BS D6 39	5	100%	116	123	
Power lift	Diesel scissor lift	BS C4 59	1	100%	103	103	
Trailer	Trailer	BS C4 75	1	100%	107	107	
Air compressor	Compressor, 10.5 m3/min	BS D7 30	1	100%	105	105	
Engine driven generator	Generator	BS C4 84	1	100%	102	102	
Engine driven welders	Hand-held welder (welding piles)	BS C3 31	1	100%	101	101	

Plant Item	Reference[(a)] Descriptions	Reference[(a)] Code	Quantity during Peak hour	On-time %	Unit SWL, dB(A)	Sub-Total SWL, dB(A)	Overall SWL, dB(A) [(b)] [(c)]
Backhoe	Wheeled Backhoe Loader	BS C4 14	1	100%	95	95	
Clamshell			1	100%	106	106	
Earth auger	Crane mounted auger - for Rotary bored piling – cast in situ	BS C3 14	1	100%	111	111	
Sand pile driving machine	Driven cast in situ piling - hydraulic hammer	BS C12 3	1	100%	103	103	
Group C [(d)] Building and general site activity							**118**
Crawler cranes	Mobile crane	BS D7 114	1	100%	101	101	
Truck cranes			5	100%	105	112	
Power lift	Diesel scissor lift	BS C4 59	1	100%	103	103	
Engine driven generator	Generator	BS C4 84	1	100%	102	102	
Engine driven welders	Hand-held welder (welding piles)	BS C3 31	1	100%	101	101	
Backhoe	Wheeled Backhoe Loader	BS C4 14	1	100%	95	95	
Bulldozer	Bulldozer	BS C5 14	1	100%	114	114	
Vibratory hammer	Hydraulic hammer for sheet piling	BS D4 13	1	100%	106	106	
Concrete pump truck	Concrete pump, stationary/lorry mounted	BS D6 36	1	100%	106	106	
Concrete chipping machine	Pneumatic chipping hammer	BS D6 49	1	100%	106	106	
Group D [(d)] Fit out							**113**
Truck cranes			5	100%	105	112	
Power lift	Diesel scissor lift	BS C4 59	1	100%	103	103	
Engine driven generator	Generator	BS C4 84	1	100%	102	102	
Engine driven welders	Hand-held welder (welding piles)	BS C3 31	1	100%	101	101	
Group E [(d)] Landscaping							**112**
Crawler cranes	Mobile crane	BS D7 114	1	100%	101	101	
Truck cranes			5	100%	105	112	

Notes:

(a) *Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control*. British Standard, BS5228: Part 1: 2009.

(b) The figures are rounded-up to a whole number.

(c) The overall SWL represents the maximum potential noise impact during construction phase.

(d) Either Group A, B, C, D or E will be in operation at any one time during construction phase, ie no overlapping of Group A, B, C, D and E.

Source: JICA Study Team, 2018

The noise levels at sensitive noise receptors have been predicted by converting noise levels from the source to another point separated by a certain distance. These predicted noise levels are converted into cumulative noise levels by taking into consideration background noise (Table 6-9 below). Results show that both N1 (Kisiwa village) and N2 (Namgogoli village) will comply with the IFC standards (55 dB(A) for Daytime 7:00-22:00 and 45dB(A) for Night time 22:00-7:00) and Tanzanian standards (50dB(A) for Daytime 6:00-22:00).

Table 6-9 Predicted Noise Levels

NSR	Predicted Noise Level (A) [(a)], dB(A)	Daytime Averaged Background Noise Level (B), dB(A)	Cumulative noise level (C), dB(A) [(b)]	Increase in background noise [(b)], dB(A)	Compliance [(c)]
N1, Kisiwa village	A: 37 B: 38 C: 32 D: 27 E: 26	37.2	A: 40 B: 41 C: 38 D: 38 E: 38	A: 3 B: 3 C: 1 D: 0 E: 0	A: Yes B: Yes C: Yes D: Yes E: Yes
N2, Namgogoli village	A: 27 B: 28 C: 22 D: 17 E: 16	37.8	A: 38 B: 38 C: 37 D: 37 E: 37	A: 0 B: 0 C: 0 D: -1 E: -1	A: Yes B: Yes C: Yes D: Yes E: Yes

Notes:

(a) It is assumed no overlapping of construction activities in construction noise assessment.

(b) Cumulative Noise Level (C) = $10 \times \log (10^{(A/10)} + 10^{(B/10)})$

(c) Noise assessment criterion: maximum increase in background levels of not more than 3 dB(A).

Source: JICA Study Team, 2018

Mitigation Measures

- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttle down machines and equipment when not in use ;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.

Table 6-10 Impact Significance

Impact	Noise impact due to pre-construction and construction activities				
Impact Nature	Negative	Positive	**Neutral**		
	Adverse potential noise impacts would not be anticipated.				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The impact from construction activities is temporary for the duration of the proposed Project.				
Impact Extent	**Local**	Regional	International		
	Noise impact from construction equipment and activities will have localised impact.				
Impact Scale	NSRs near Project area may have significant impact due to construction activities.				
Frequency	Throughout construction period				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The predicted noise levels at all NSRs comply with the daytime criterion. The magnitude of the noise impact is **Negligible**.				
Receptor Sensitivity	**Low**	Medium	High		
	The identified NSRs are located more than 2km from the construction site.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be **Negligible**.				

Source: JICA Study Team, 2018

Operation Phase

Noise generating equipment in the power plant and the estimate noise levels that will be generated at source and at a distance of one meter, are listed in ***Table 6-11***. Assuming that all the equipment will be operating simultaneously for 24 hours, overall noise impact from the Project on noise sensitive receptors (Kisiwa Village, N1 and Namgogoli Village, N2) has been calculated and noise contours has been developed (refer to ***Figure 6-5***).

Based on the results, it is estimated that noise from the power plant will be 32dB at Kisiwa Village and 24dB at Namgogoli Village. These values are below noise limits for residential area during daytime (50dB) and night time (35dB), set by the Tanzania National Environmental Standards.

Table 6-11 Indicative Operation Plant Inventory

ID	Description	Height (m)	SPL (1m) dB(A)	SWL dB(A)
ST	ST (Steam Turbine), placed inside the Steam Turbine Building	10	77	85
GT1	GT1 (Gas Turbine)	40	85	93
GT2	GT2 (Gas Turbine)	40	85	93
CWP1	CWP1 (Sea water intake pump)	10	107	115
CWP2	CWP2 (Sea water intake pump)	10	107	115
GTA1	Gas turbine Air Inlet 1	10	85	93
GTA2	Gas turbine Air Inlet 2	10	85	93
HRSG1	Heat Recovery Steam Generator 1	27	85	93
HRSG2	Heat Recovery Steam Generator 2	27	85	93
HRSGST1	Heat Recovery Steam Generator Stack 1	40	85	93

Source: JICA Study Team, 2018

Figure 6-5 **Noise Contour (Operation Phase)**
Source: JICA Study Team, 2018

In order to take into consideration existing noise levels (baseline) and the predicted noise that will be generated by the power plant, cumulative noise levels have been calculated for the two sensitive noise receptors. Details are presented in ***Table 6-12***. According to the results, noise impacts from the Project may be negligible or may increase existing noise levels by 1dB(A). Even with this change, noise levels at the villages will still be under the IFC noise standards for daytime and night time.

Table 6-12 Cumulative Noise Impacts

NSR	Predicted Noise Level dB(A) - A	Background Noise Level dB(A) - B	Cumulative Noise Level dB(A) - C	Increase in Background Noise dB(A)	IFC EHS Standards dB(A)	
					Daytime 7:00-22:00	Night time 22:00-7:00
N1	32	37	38	1	55	45
N2	24	38	38	0		

Notes:
(a) Cumulative Noise Level (C) = 10 x log (10(A/10)+ 10(B/10))
(b) Noise assessment criterion: maximum increase in background levels of not more than 3 dB(A).

Source: JICA Study Team, 2018

Mitigation Measures

- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Avoid transportation of materials on- and off-site through existing community areas

Table 6-13 Impact Significance

Impact	Noise impact due to operation activities				
Impact Nature	Negative	Positive	**Neutral**		
	Adverse potential noise impacts would not be anticipated.				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The impact from construction activities is temporary for the duration of the proposed Project.				
Impact Extent	**Local**	Regional	International		
	Noise impact from construction equipment and activities will have localised impact.				
Impact Scale	NSRs near Project area may have significant impact due to construction activities.				
Frequency	Throughout construction period				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The predicted noise levels at all NSRs comply with the daytime criterion. The magnitude of the noise impact is **Negligible**.				
Receptor Sensitivity	**Low**	Medium	High		
	The identified NSRs are located more than 2km from the power plant.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be **Negligible**.				

Source: JICA Study Team, 2018

6.3.3 *Soil*

Sensitivity of the Study Area

The surrounding communities rely on groundwater sources for their domestic water uses. They are particularly sensitive to changes in groundwater quality.

Construction Phase

Site preparation activities

Soil works, including vegetation clearance, potential grading and levelling, compaction, backfilling, and construction of various structures will be carried out at the power plant site and access roads. Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil. Since the topography of the Project Site is characterized by a gentle slope from Southeast corner sloping down to Northwest (10% slope towards the seashore), there is a possibility of risk to soil erosion. The anticipated volume of soil to be removed due to excavation activities is 143,000m^3.

If compaction and erosion are not managed, associated potential impacts could include sedimentation of local waterways, loss of topsoil and reduction in soil fertility. Soil erosion is a particular concern during periods of high rainfall.

Mitigation and/or Management Measures

- Delineation of clearance boundaries to limit the areas to be cleared.
- Scheduling clearance activities, if possible to avoid extreme weather events such as heavy rainfall, extreme dry and high winds.
- Revegetation areas with temporary land use, conducting progressive rehabilitation.
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers.
- Reuse topsoil as much as possible within rehabilitation activities.
- Control erosion through diversion drains, sediment fences, and sediment retention basins.

Table 6-14 Impact Significance

Impact	Impact on top soil due to site preparation activities				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impact on topsoil is direct				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impacts are considered long term as a loss of topsoil may occur over a period longer than the construction phase				
Extent	**Local**	Regional	International		
	Impact is expected to be limited to the project footprint only, and therefore the extent is considered local.				
Scale	The scale of this impact is expected to be small given that it will occur over a relatively small area compared to the rest of the landscape.				
Frequency	This impact will occur throughout the construction phase, with the most intensive time being during the clearance of the power plant site.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts associated with topsoil loss are anticipated to be small based upon the limited extent and scale.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The resource sensitivity (being the topsoil) is considered to be medium as it a valuable asset which can be easily lost due to inappropriate management				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

Accidental leaks, spillage, and contamination

Soil contamination may occur on the project site and surrounding areas during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel. Spills and leaks may occur during vehicle/equipment operation (e.g. fuelling, and maintenance) and from improper handling and storage of chemicals and fuel.

Mitigation and/or Management Measures

- Fuel tanks and chemical storage areas will be sited on sealed hardstand areas, provided.
- Secondary containment, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude storm water run-off from entering the contained area.
- Any refuelling activities will only take place within a designated hard stand area with spill kits present.
- A dedicated storage area for construction material will be developed to minimise the potential for damage or contamination of the material.
- Sufficient space will be left between all waste containers so as to identify any spills or leaks.

- Unloading and loading protocols will be developed to ensure that staff are able to undertake these tasks in a manner that minimises the risks of spills occurring.
- A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency response procedures and practices related to contamination events.
- Appropriate management, storage and disposal of all waste streams will be implemented.

Table 6-15 Impact Significance

Impact	Soil Contamination due to Potential Leaks, Spills				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to soil would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to soil would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 30-35 months. However, if a groundwater aquifer is impacted, it may take a long time for natural recovery, unless active measures are taken to remove the contaminants. The duration is therefore long- term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the aquifer in the Project area and neighbouring area, and hence would be considered to be local.				
Scale	The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence. The amounts of fuels, oil, chemicals or waste spills/leaks, if they occur are expected to be small and are already reduced with the existing controls.				
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential reduction of soil quality in Project area is expected to be of Small magnitude, given that any spills of fuels, oil, chemicals or wastes, if they occur are expected to be very localised and small.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The project site is located beside Sudi Creek. Storm/rain water runoff will be flowing towards the creek and will not affect nearby villages. The marine ecology in the Creek may be impacted. Thus, receptor sensitivity is Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

Operation Phase

Accidental leaks, spillage, and contamination

Accidental releases from operational activities have the potential to impact surrounding soil and seawater. Leakage from chemical storage facilities may also result in contamination. The significance of potential impacts to soil due to contamination from accidental spills and leaks during the operation and maintenance phase are assessed in the following ***Table 6-16***, and mitigation measures are presented.

Mitigation and/or Management Measures

- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.
- Standard Operation Procedures (SOPs) will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc.
- Operating personnel will be trained on the SOPs.

Table 6-16 Impact Significance on Soil Quality due to accidental leaks/spills

Impact	Soil contamination due to potential leaks and spills during operations.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to groundwater would be considered to be adverse				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to soil would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 25 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project area and neighbouring area, and hence would be considered to be local.				
Scale	The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.				
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
Magnitude	Positive	Negligible	**Minor**	Medium	Large
	Potential impacts to groundwater quality in the project area due to accidental leaks/spills will result in an overall Minor Impact.				
Receptor/ Resource Sensitivity	Low	Medium	High		
	The project site is located beside Sudi Creek. Storm/rain water runoff will be flowing towards the creek and will not affect nearby villages. The marine ecology in the Creek may be impacted. Thus, receptor sensitivity is Medium				
Significance	**Negligible**	Minor	Moderate	Major	
	The combination of a Low Resource Sensitivity and Small Impact Magnitude will result in an overall Negligible Impact.				

Source: JICA Study Team, 2018

6.3.4 *Water resources*

Construction Phase

Wastewater and Storm water Runoff

Workers will be accommodated in a worker camp adjacent to the site, and sanitary wastewater streams from the workers could potentially impact seawater. Sanitary facilities, including toilets and septic tanks, will be provided for the use of the construction workforce both on-site and at the workers' accommodation. If not adequately designed and positioned, untreated sanitary wastewater due to leakages or overflows could have the potential to enter seawater and/or subsurface water.

The approximate number of people onsite during the construction phase is expected to be approximately 1,100 people per day during peak period. Conservatively assuming 100 L/person/day of water consumption, and considering sanitary wastewater production to be 80% of water consumption per person (for non-continuous use), this equates to the production of 88,000 liters of sanitary wastewater daily. Septic tanks will be installed to store and treat sanitary wastewater. The type and design of the septic tank will be decided once the contractor has been decided.

In addition, construction activities such as site clearance, earthworks, disposal of back fill materials, and installation of hard standing areas could cause runoff of unconsolidated sediments during rainfall. The generation of sediment laden run off could be transferred to the Creek, which could increase total suspended solids and turbidity in receiving waters.

Wastewater may also be generated from washing of equipment and machinery on site, as well as from the concrete batching plant. This wastewater may contain suspended solids and traces of hydrocarbons. The discharge of wastewater produced during concreting can also lead to changes in the pH of the receiving water body, if not first treated.

Mitigation and Management Measures

- Adequate sanitary facilities will be provided for the construction workforce. Septic tanks will be provided to treat sanitary discharge.
- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge.
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site.
- Design drainage for the controlled release of storm flows.
- Regularly, and particularly following rainstorms, inspect and maintain drainage and erosion control and silt removal measures to ensure proper and efficient management at all times.
- Mulch to stabilise exposed areas, where practicable and appropriate. Re-vegetate areas promptly, where practicable and appropriate.
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage of open stockpiles of construction materials.
- Construct wells/ sediment basins for the separation of oil in the wash water and stormwater drains.
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps.
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors.

Table 6-17 Impact Significance on Water Quality due to potential leaks/spills

Impact	Potential for impacts to water resources due to wastewater discharges and stormwater runoff.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to water resources would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 31-36 months. The duration of potentialimpacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	The total approximate quantities of wastewater that could be a potential source of impact during this stage (assuming an maximum of 1,100 workers per day) include 88,000 L/day of sanitary wastewater.				
Frequency	Impacts to seawater from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Potential impacts to seawater quality in the Project area from wastewater discharges and runoff are expected to be of Medium magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Groundwater is a valuable water resource for the villages, but the villages are located more than 2km from the construction site. The Project is near some sensitive receptors with regards to seawater quality such as Sudi Creek. Thus, overall sensitivity is rated as Medium.				
Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude willresult in an overall Moderate Impact.				

Source: JICA Study Team, 2018

Waste Storage and Disposal

During the construction phase, waste materials, if not stored and disposed of appropriately, have the potential to cause water contamination through direct release or from contaminated stormwater runoff.

The majority of the generated wastes from the project during the construction phase will be non-hazardous. General construction waste will comprise of surplus or off- specification materials such as concrete, steel cuttings/filings, wooden planks, packaging paper or plastic, wood, plastic pipes, metals, etc. Domestic wastes consisting of food waste, plastic, glass, aluminium cans and waste packages will also be generated by the construction workforce. A small proportion of the waste generated during construction will be hazardous, including used paint, engine oils, and hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on site.

The total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage (assuming an maximum of 1,100 workers per day) include 550 kg/day of solid (non-hazardous) waste. Hazardous wastes will be contracted out to authorized industrial waste

companies. All wastes will be handled, stored and disposed in accordance with applicable guidelines.
The significance of potential impacts to water resources due to contamination from inappropriate waste storage and disposal during the construction phase are assessed in the following table, and mitigation measures are presented.

Potential impacts would be limited to the project area and its downstream, and hence would be considered to be local.

Mitigation and Management Measures
The following measures will be put in place for the project during construction phase:

- Implement the same mitigation measures to minimize impacts to Waste Management.
- Provide training to labourers for waste disposal in designated areas and use of sanitation facilities.
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type.
- Store waste systematically to allow inspection between containers to monitor leaks or spills.
- Ensure that storage areas have impermeable floors and containment.
- Dispose of waste by licensed contractors.

Table 6-18 Impact Significance on Water Resources due to improper waste management

Impact	Potential for water contamination from inappropriate waste management.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse (negative)				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to water resources would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 31-36 months. The duration of impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project area and its downstream, and hence would be considered to be local.				
Scale	Construction activities will take place within the project area. The total approximate quantities of waste that could be a potential source of impact during this stage (assuming a maximum of 1,100 workers per day) include 550 kg/day of solid waste. The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, but appropriate waste management				
Frequency	Impacts to water resources due to inappropriate waste storage and disposal could occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to water quality in project area due to inappropriate waste disposal are expected to be of Small magnitude.				
	Low	**Medium**	High		

Receptor/ Resource Sensitivity	Water quality analysis from the baseline surveys indicated that the groundwater near the project site had elevated levels of total coliform and total suspended solids. The project is near sensitive resources with regards to water quality, such as agricultural lands and domestic use. Overall sensitivity is rated as Medium.			
Significance	Negligible	**Minor**	Moderate	Major
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.			

Source: JICA Study Team, 2018

Accidental Spills and Leaks

Water contamination may occur during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel from heavy equipment, and improper chemical/fuel storage. Additionally, HRSG chemical cleaning during the pre-commissioning activities may impact surrounding seawater quality, should leakages of HRSG cleaning chemicals occur. Such spills can impact water quality either due to direct discharge or indirect discharge due to stormwater runoff.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and workers will be trained not to dispose of waste improperly in the area. Liquid effluents arising from construction activities will be treated to the applicable World Bank/IFC guidelines prior to discharge.

The significance of potential impacts to water resources due to contamination from accidental spills and leaks during the construction phase are assessed in the following table, and mitigation measures are presented.

Mitigation and Management Measures

The following measures will be put in place for the Project during construction phase:

- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal.
- Hazardous waste storage areas will comply with best practice/ international standards.
- Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stages of the Project implementation.
- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks.
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals.
- Use of spill or drip trays to contain spills and leaks.
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters.

- Contractor will implement a training program to familiarise staff with emergency response procedures and practices related to contamination events.
- Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated.
- Store wastes in closed containers away from direct sunlight, wind and rain.
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills.
- Ensure storage areas have impermeable floor and containment.
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).

Table 6-19 Impact Significance on Water Resources due to potential leaks/spills

Impact	Potential for impacts to water resources due to contamination from accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper chemical/fuelstorage.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to seawater would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 31-36 months. The duration of potentialimpacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project site footprint and gas pipeline, and hence would be considered to be local.				
Scale	The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.				
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to water quality in the project area due to accidental releases is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	The nearest villages are located more than 2 km from the construction site. The elevation of these villages is higher compared with the power plant site. Thus, there is low possibility that the groundwater quality of the villages may be affected by construction activities				
Significance	Negligible	**Minor**	Moderate		
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

Operation Phase

Wastewater Discharges and Runoff

Industrial wastewater and sewage water will be collected and treated in the power plant prior to discharge. Wastewater conditions will comply with the applicable standards as described in ***Section 2.3.1***. Approximately 230m3/day of treated wastewater will be released to the ocean (via Sudi Creek) as shown in **Error! Reference source not found.**.

Mitigation and Management Measures

- Domestic wastewater will be discharged into septic tanks.
- Provide adequate sanitary facilities for onsite personnel.
- Design drainage culverts for the controlled release of storm flows
- Treated effluent will comply with WB/IFC EHS Guidelines as described in Section 3.9. The wastewater discharged will be monitored in accordance with the Environmental and Social Monitoring Plan as described in Section 9.2.

Table 6-20 Impact Significance on Water Resources due Wastewater discharges and Runoff

Impact	Potential impacts on water resources due to wastewater discharges during plant operation.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to seawater would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 25 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project site footprint, as well as areas downstream of the project site, and hence would be considered to be local.				
Scale	Sources and estimated quantities of wastewater generation from the plant during the operation and maintenance phase are as show in Section 2.4.3. The scale of potential impacts due to release of wastewater is potentially large due to the quantities present during this stage, but in-place treatment and management systems will reduce effluent levels to within IFC standards.				
Frequency	Impacts to seawater from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the operation phase (25 years).				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to water quality in the project area from wastewater discharges and runoff are expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Based on existing seawater quality analysis results, the water quality in Sudi creek exceeds Japanese sea water quality standard. However, local people use the area as fishing site. Thus, receptor sensitivity is considered Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

Water abstraction

The project's water supply requirements of 300 m^3/day can be accommodated by the two wells developed by MTUWASA, with a combined supply rate of 1,200 m^3/hr. With the installation of the third well, supply rate is expected to increase to 1,850m3/day. Thus, it is expected that the existing water supply will be able to provide the Project's water requirements and the Project is not expected to have any significant impacts on groundwater resources.

Mitigation and Management Measures

- Keep close coordination with MTUWASA to ensure that water requirements of the Project will not affect water supply of the nearby villages.

Table 6-21 Impact Significance on Water Resources due to Water Abstraction

Impact	Potential impact on existing water resources due to water abstraction				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to hydrology and water use would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to groundwater would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 25 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Water use impacts from the project would be local to the project footprint and vicinity of water abstraction at the Project site and surrounding areas.				
Scale	Water will be withdrawn from existing MTUWASA wells. The water requirement of the Project is approximately 25% of the supply rate of the two wells in operation. Another well is underway of being developed.				
Frequency	The Project will require constant water supply during its operation.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to groundwater resource in project area due to water abstraction are expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	There are a number of current water uses around project area, and the groundwater is considered an important water resource. The resource/receptor sensitivity is considered Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

Accidental Spills and Leaks

Accidental releases from operational activities have the potential to impact surrounding seawater and groundwater. Leakage from chemical storage facilities may result in surface & groundwater contamination. A further risk to water resources during the operational phase is from a potential spill in back up fuel. Theses discharges may have a direct impact on the water quality which in turn would have ecological implications.

Spill control measures such as storage and handling of chemicals and fuels on impervious areas will be implemented to minimize impacts in case of spills. Heavy equipment will be checked for lubricant leaks, and workers will be trained not to dispose of waste improperly in the area. All hazardous materials will be segregated, stored and disposed of appropriately.

Mitigation and Management Measures

- The storage areas for oil, fuel, chemicals and waste will be surrounded by containment/spill control measure to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters.
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.
- Use of spill or drip trays to contain spills and leaks
- Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals.
- SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs.

Table 6-22 Impact Significance on Water Resources due to potential leaks/spills

Impact	Impact on water resources due to accidental releases of hazardous substances such as fuels, oils or lubricants, as well as improper handling and storage of chemicals and fuel				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to seawater would be considered to be adverse (negative).				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to seawater would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 25 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project site footprint, and hence would be considered to be local.				
Scale	Sources and estimated quantities of waste generation from the plant during the operation and maintenance phase are as show in Section 2.4.3. The scale of potential impacts due to release of hazardous materials is potentially large due to the quantities present during this stage, but accidental release is an unlikely, unplanned occurrence.				
Frequency	Potential impacts would be expected to be infrequent, only taking place during rainfall, after loss of containment or accidental spills.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to seawater quality in the project area due to accidental releases is expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Water quality analysis from the baseline surveys indicated that the groundwater near the project site had elevated levels of total coliform and total suspended solids. The Project is near sensitive resources with regards to seawater quality, such fishing areas and agricultural land. Overall sensitivity is rated as Medium.				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

6.3.5 *Terrestrial ecology*

Construction Phase

The Project has the potential to impact the local ecological environment, especially during site preparation activities (e.g. vegetation clearing). There is a potential to cause habitat loss, fragmentation, degradation, disturbance of native species and fauna mortality within the proposed power plant site. According to baseline survey results, two species, classified as vulnerable under IUCN Red List have been identified within the Project Site.

The Project would require clearing of mangrove area (less than $200m^2$) along the coast to give way to the outfall pipeline. This mangrove area is protected under the Forest Act (Forest Regulation, 2017). The location of the affected mangrove area is shown in ***Figure 6-6***

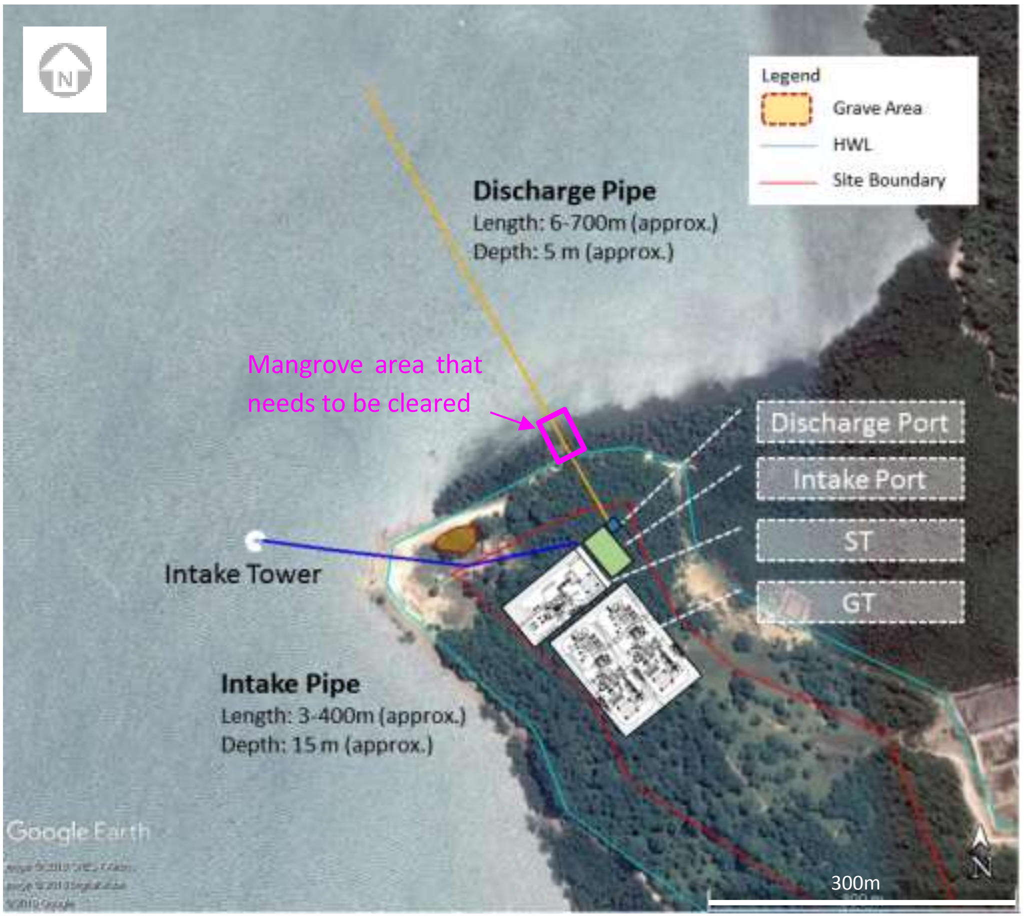


Figure 6-6 Affected Mangrove Area

Source: JICA Study Team, 2018

Also, during construction, alien/invasive species could be introduced through imported vehicles, construction equipment and machines. Due to the fact that Kilwa district has now began to experience large heard of cattle from different area of the country particularly northern region is area will begin to experience new exotic species brought in by livestock.

Mitigation and Management Measures

- Vegetation clearance should be confined only to necessarily designated sites. The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing.
- Valuable timber removed from woody biomass be made available for public consumption where possible.
- For construction areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible.
- The Project shall implement landscaping and re-vegetation after completion of construction using native species where possible where possible.
- Weed and pest management measures shall be implemented to avoid introduction of invasive weeds to natural and modified habitat areas.
- Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors.
- Appropriate speed limits for construction vehicles will be enforced to limit noise and dust generation and to minimise potential for fauna strike.
- Obtain necessary permits prior to clearing of mangrove areas.

Table 6-23 Impact Significance

Impact	Impact on terrestrial flora and fauna due to pre-construction and construction activities				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on the terrestrial ecological environment is negative				
Impact Type	**Direct**	**Indirect**	Induced		
	Direct terrestrial habitat loss in the project footprint in areas to be developed. Indirect effects on remnant/ isolated habitats.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	Although construction is estimated to take 31-36 months, the loss/ conversion of habitats will be permanent.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local for habitats.				
Impact Scale	It is anticipated that the project will be located within the acquired land covering a land area of approximately 160 ha.				
Frequency	Construction occurs only once.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Existing vegetation within the Project Site which covers 160ha, will have to be cleared, the overall magnitude of this impact is **Medium**				
Receptor Sensitivity	Low	**Medium**	High		
	Although terrestrial vegetation is in a degraded state, two forest species, identified as Vulnerable according to the IUCN Red List, have been observed within the project Site, thus sensitivity is **Medium**.				
Impact Significance	Negligible	Minor	**Moderate**	Major	Critical
	The significance of this impact is **Moderate**.				

Source: JICA Study Team, 2018

Operation Phase

Operational activities that have potential to disturb native fauna include the use of night lighting at infrastructure and facility locations. Lighting required for operation and safety at the facilities can influence nocturnal foraging behaviours.

Mitigation and Management Measures

- Vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation.
- For areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible.
- Appropriate speed limits for vehicles will be enforced to minimise potential for fauna strike.

Table 6-24 Impact Significance

Impact	Operation of the Mtwara power plant				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on the terrestrial ecological environment is negative				
Impact Type	**Direct**	**Indirect**	Induced		
	Direct terrestrial habitat loss in the project footprint in areas to be developed. Indirect effects on remnant/ isolated habitats.				
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
	The loss/ conversion of habitats will be permanent.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local for habitats.				
Impact Scale	It is anticipated that the project will be located within the acquired land covering a land area of approximately 92 ha.				
Frequency	Operation is continuous.				
Impact Magnitude	Positive	**Negligible**	**Small**	Medium	Large
	Considering the magnitude of impacts to modified habitat discussed above, the overall magnitude of this impact is Negligible to Small.				
Receptor Sensitivity	**Low**	Medium	High		
	Given the small proportion of the area affected and the area is modified habitats, the overall sensitivity is considered Low.				
Impact Significance	**Negligible**	**Minor**	Moderate	Major	Critical
	The significance of this impact is **Negligible.**				

Source: JICA Study Team, 2018

6.3.6 *Marine Ecology*

Construction Phase

Wastewater and Stormwater Runoff

Construction activities such as site clearance, earthworks, disposal of back fill materials, and installation of hard standing areas could cause runoff of unconsolidated sediments during rainfall. The generation of sediment laden run off could be transferred to the Sudi Creek.

Wastewater may also be generated from washing of equipment and machinery on site, as well as from the concrete batching plant. This wastewater may contain suspended solids and traces of hydrocarbons. The discharge of wastewater produced during concreting may have adverse impacts on fishes and other aquatic species if not first treated.

Mitigation and Management Measures

- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge.
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site.
- Design drainage for the controlled release of storm flows.
- Regularly, and particularly following rainstorms, inspect and maintain drainage and erosion control and silt removal measures to ensure proper and efficient management at all times.
- Mulch to stabilise exposed areas, where practicable and appropriate. Re-vegetate areas promptly, where practicable and appropriate.
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage of open stockpiles of construction materials.
- Construct wells/ sediment basins for the separation of oil in the wash water and stormwater drains.

Table 6-25 Impact Significance

Impact	Potential for impacts to water resources due to wastewater discharges and stormwater runoff.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to water resources would be direct impacts from Project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The construction phase will last approximately 31-36 months. The duration of potentialimpacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the Project site footprint, as well as areas downstream of the Project site, and hence would be considered to be local.				
Scale	Releases of wastewater at Sudi creek would occur only after heavy rain and washing activities.				
Frequency	Impacts to seawater from wastewater discharges could occur intermittently but repeatedly throughout the construction phase.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Potential impacts to seawater quality in the Project area from wastewater discharges and runoff are expected to be of Medium magnitude.				
Receptor/ Resource Sensitivity	Low	**Medium**	High		
	Some fishermen in Kisiwa village go to Sudi Creek to catch fishes by using the landing site to be affected by the project. However, they use multiple landing sites including the one with fish market, and the impact is not high.				
Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium Resource Sensitivity and Medium Impact Magnitude willresult in an overall Moderate Impact.				

Source: JICA Study Team, 2018

Operation Phase

Thermal water discharge

The modeling for onshore thermal discharge operations was performed using the hydrodynamic 3-D surface water modeling software, DELFT3D, to compute the hydrodynamics of the site and the dispersion of thermal discharge from onshore facilities. DELFT3D is driven primarily by tidal boundary condition from the predicted water level from the TOPEX/Poseidon Global Inverse Solution.

Data for simulation and field measurement

Data consist of followings were collected to set up the hydrodynamic model.
· Bathymetry and shoreline data
· Meteorological conditions, tidal elevation and current data
· Cooing water effluent discharge location and configuration, flow rates, discharge temperature and discharge salinity
Major data / information for the modelling exercise and the potential sources are summarized below.

Table 6-26 Data Sources for Thermal Discharge Modelling

Data / Information	Source
Bathymetry	Field measurement in the Sudi creek by JICA study team The bathymetric data developed by the Tanzania Port Authority (TPA)
Coastline	Based map provided from the Institute of Marine Science of University of Dar es Salaam (USDM)
Meteorology Data	Tanzania Meteorological Agency
Tide conditions	Field measurement in the Sudi creek by JICA study team Harmonic tide components derived from the TOPEX/Poseidon Global Inverse Solution Model
Salinity and water temperature	Field measurement in the Sudi creek by JICA study team Hybrid Coordinate Ocean Model (HYCOM)
Current velocity and direction	Field measurement in the Sudi creek by JICA study team
Effluent temperature and flow rate	JICA study team
Outfall and intake location, depth and design	JICA study team

Source: JICA Study Team, 2018

In order to set-up the hydrodynamic model, field measurement was conducted at three locations as shown in the Table below.

Table 6-27 Location and Depth of Analysis Points

Location	Location: UTM (Arc1960)		Sensor height from sea bed (tide level and current, temperature, salinity)
	Easting	Northing	
Mgao point	607403	8880151	0.7 meter
Kisiwa point	607900	8874340	0.7 meter
Namgogoli point	608044	8873051	0.7 meter

Source: JICA Study Team, 2018

The result of the measurement of tidal level is as shown in Figure below.

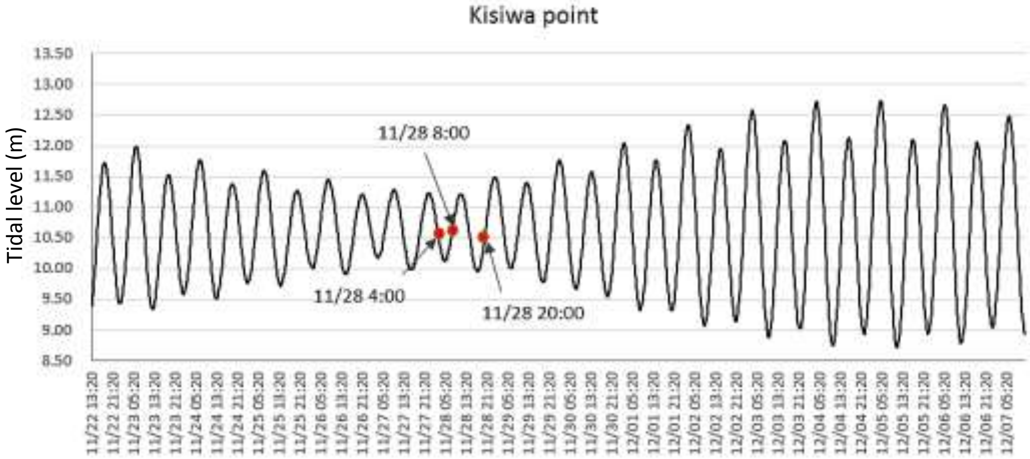
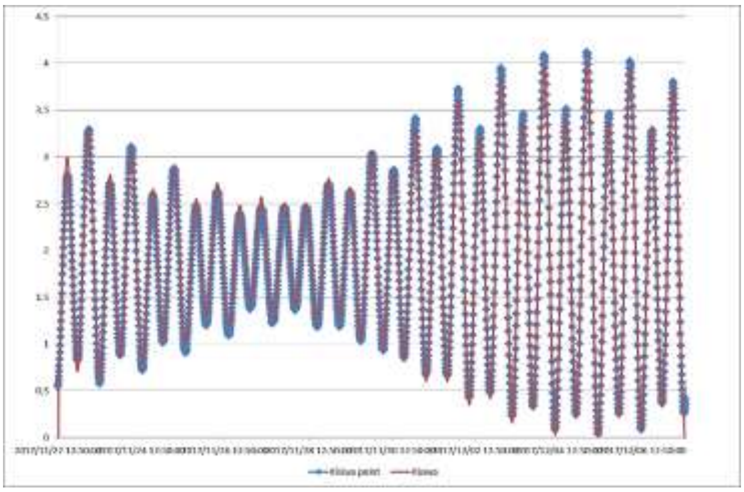


Figure 6-7 Tidal measurements at Kisiwa Point

Source: JICA Study Team, 2018

<u>Model construction</u>

Delft3D with CORMIX, which is also referred by IFC EHS Guidelines, was be used to compute the hydrodynamics of the site and the dispersion of thermal discharge from onshore facilities. The baseline model is tidally-driven based on harmonic tide info extracted from the Water Level (WL) survey data from Mgao. The modelled water level match well with the surveyed water level at all three locations.



Source: JICA Study Team

Figure 6-8 Modelled (Blue) vs. Surveyed (Red) Water level at Kisiwa Point

The modelled current velocity matches quite well with survey data at low current velocity. Discrepancy with field measurement arises as current velocity increases. This is expected to be a result of smaller control volume modelled in the creek (due to insufficient depth data coverage deep in the creek). In general, smaller modelled control volume would mean more significant change in water temperature within the creek, hence more conservative in terms of predicted water temperature elevation. In terms of water temperature, the model is driven by a combination of (1) water temperature at model boundary, (2) air temperature and (3) solar irradiation. (1) is derived from the survey data at Mgao, (2) is derived from the weather data during the survey period and (3) is obtained from NASA website[1] .The modelled water temperature matches well with the survey observations. Average deviation is about 0.3°C.

Configuration of Project Case

The thermal discharge simulation was conducted for the 300MW project case. The location of the intake and outfall is same for both project case as shown in Figure below. The depth is from MLLW.

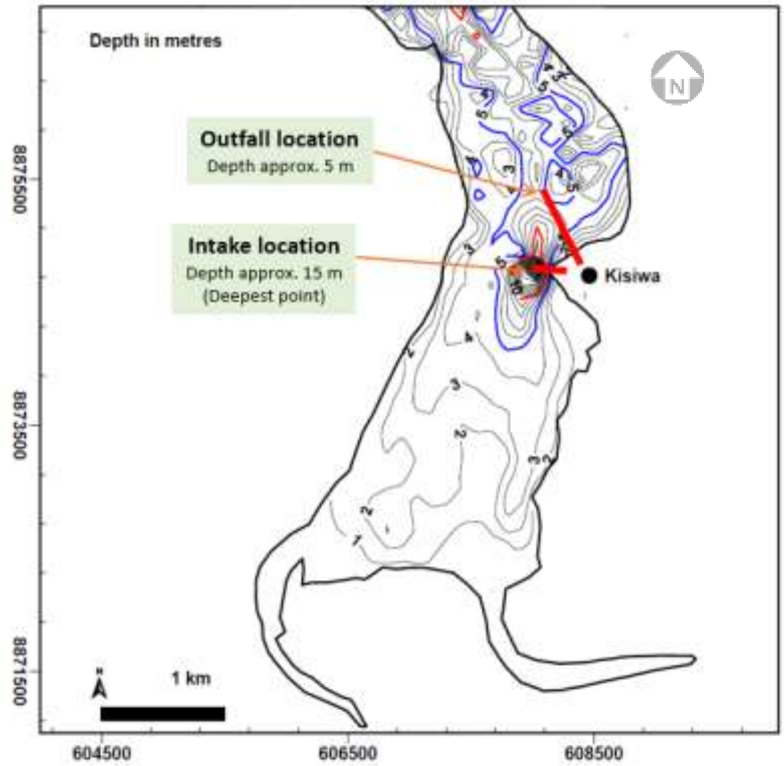


Figure 6-9 Location of Intake and Outfall points

Source: JICA Study Team, 2018

Configuration of the 300 MW Case

The simulation for 300MW project case is based on the configuration shown in Figure 6-10. Temperature difference between intake and outfall is 7°C.

[1]https://eosweb.larc.nasa.gov/cgi-bin/sse/retscreen.cgi?email=rets%40nrcan.gc.ca&step=1&lat=-10.1695&lon=39.985568&submit=Submit

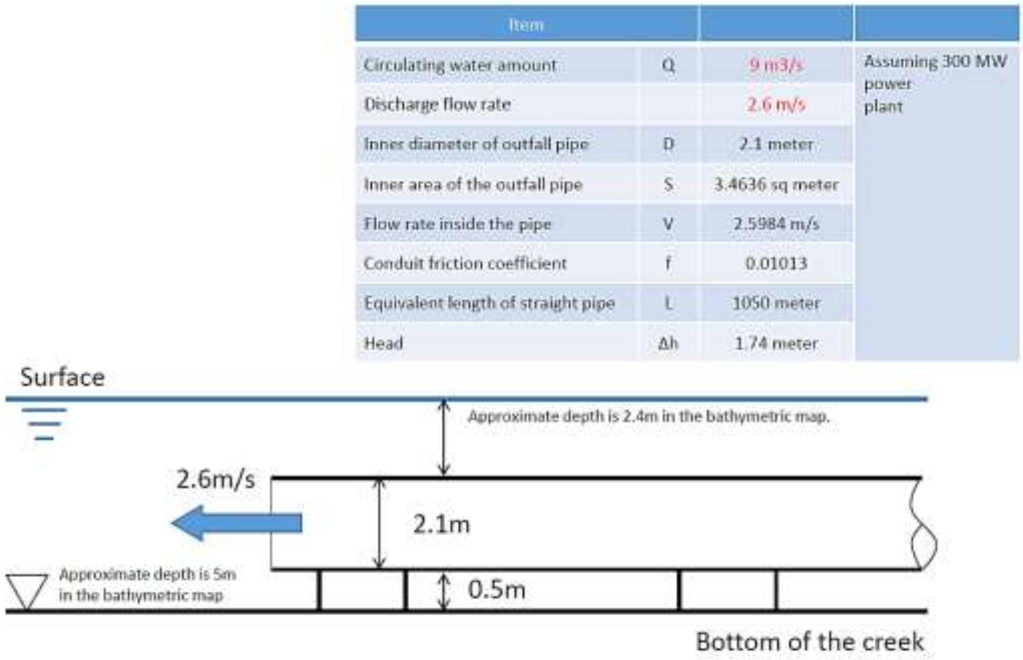


Figure 6-10 Outfall Configuration for 300MW Case

Source: JICA Study Team, 2018

Simulation results

300MW Project case assumed thermal discharge of 9 m3/s with temperature differential of 7 degree celsius. Predicted temperature elevation above baseline scenario indicated thermal plume could travel quite a long distance. Some level of recirculation is predicted.

The average 0.83 degree celsius increase in dry season and wet season at intake is predicted for the 300MW case (Table 6-28, Table 6-29). Contour plots showing instantaneous temperature elevation are as shown Figure ***6-11***, Figure 6-12. The water measurement was undertaken in dry season in 2017 and in wet season in 2018.

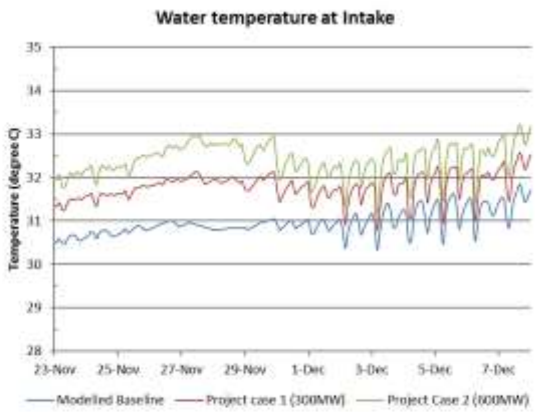


Table 6-28 Water Temperature at Intake (Dry Season)

	Baseline (W/o proj)	Project case (300MW)	Project case (600MW)
Ave	30.96	31.79	32.40
Max	31.85	32.56	33.21
Min	30.33	30.79	31.18

Figure 6-11 Water Temperature at Intake (Dry Season)

Source: JICA study team

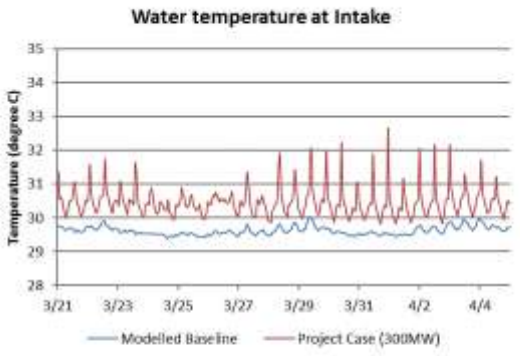


Table 6-29 Water Temperature Intake (Wet Season)

	Baseline (w/o Proj)	Project case (300MW)
Ave	29.62	30.45
Max	30.02	32.65
Min	29.39	29.81

Figure 6-12 Water Temperature at Intake (Wet Season)
Source: JICA study team

<u>Applicable Standard</u>

In Tanzania, there is no specific national standards or regulation on thermal discharge at the time of writing of this report. In the absence of specific national thermal mixing zone guidelines, IFC standards will be referred to within this assessment. The IFC recommends that for all mixing zones an assessment should be carried out based on an understanding of the specific sensitivities of the site and a prediction of the location, severity and extent of the resulting mixing zone. The outfall should be designed in order to minimise the impacted area through adequate dilution.

The IFC Guidelines for Thermal Power specifies the following requirements in relation to the temperature increase due to discharge from cooling systems:

- Site specific requirement to be established by the local environmental regulator; and
- Elevated temperature areas due to discharge of once-through cooling water (e.g., 1°C above, 2°C above, 3°C 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.

The IFC General EHS Guidelines states that the thermal wastewater discharge does 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.

<u>Modelling Analysis Results</u>

According to the modelling results, the temperature rise due to the thermal discharge is limited by the river creek and will generally disperse slowly out of the creek under the influence of tidal current (as well as river discharge in wet season). This temperature rise is likely to be evident near surface level and becomes less evident in mid-depth level. Also, the area with increase in water temperature, which exceeds the proposed assessment criterion of 3°C (IFC EHS Guidelines), mostly occurs near surface and could reach up to about 500 m away from the outfall (mixing zone). The expected temperature increase is less than 0.2 to 0.3 degrees where coral habitat is observed outside the creek, which is not within the mixing zone. Most of the mangrove habitat is also outside the mixing zone.

Therefore, the impact of thermal water discharge on marine ecology will be limited to the vicinity of the outfall structure where no endangered species and no sensitive species such as coral reefs are identified within Sudi Creek (Kisiwa Bay). Since fishery is conducted mainly outside Sudi Creek (Kisiwa Bay), no significant impact is expected on fishery. Also, the impact will be varied due to natural factors such as tidal movements and rainfall that can reduce this impact. The impact on mangrove is also expected to be minimized by locating the intake in the middle of the Sudi Creek (Kisiwa Bay), and limiting the temperature difference between intake water and discharged water up to 7 degrees. Through the mitigation measures, only small part of the mixing zone edge is touching the mangrove temporarily.

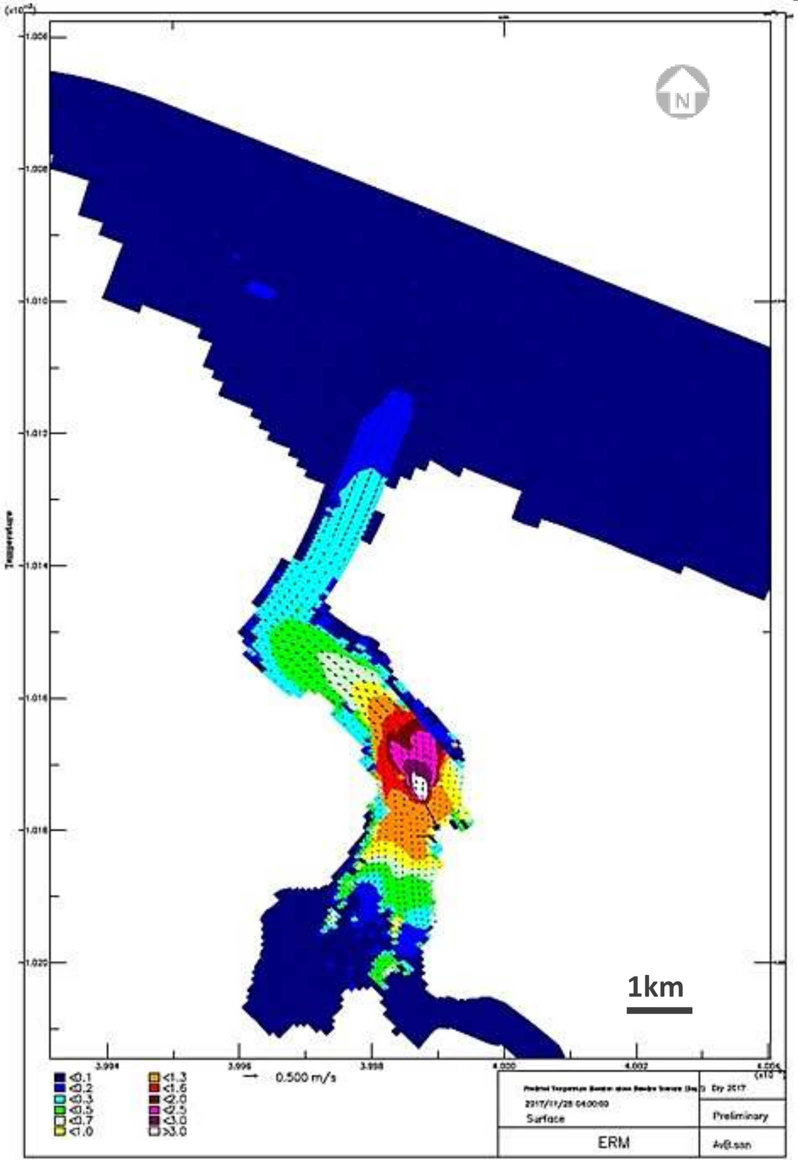


Figure 6-13 Temperature Rise at Surface (Dry Season, Nov 28 04:00)
Source: JICA study team

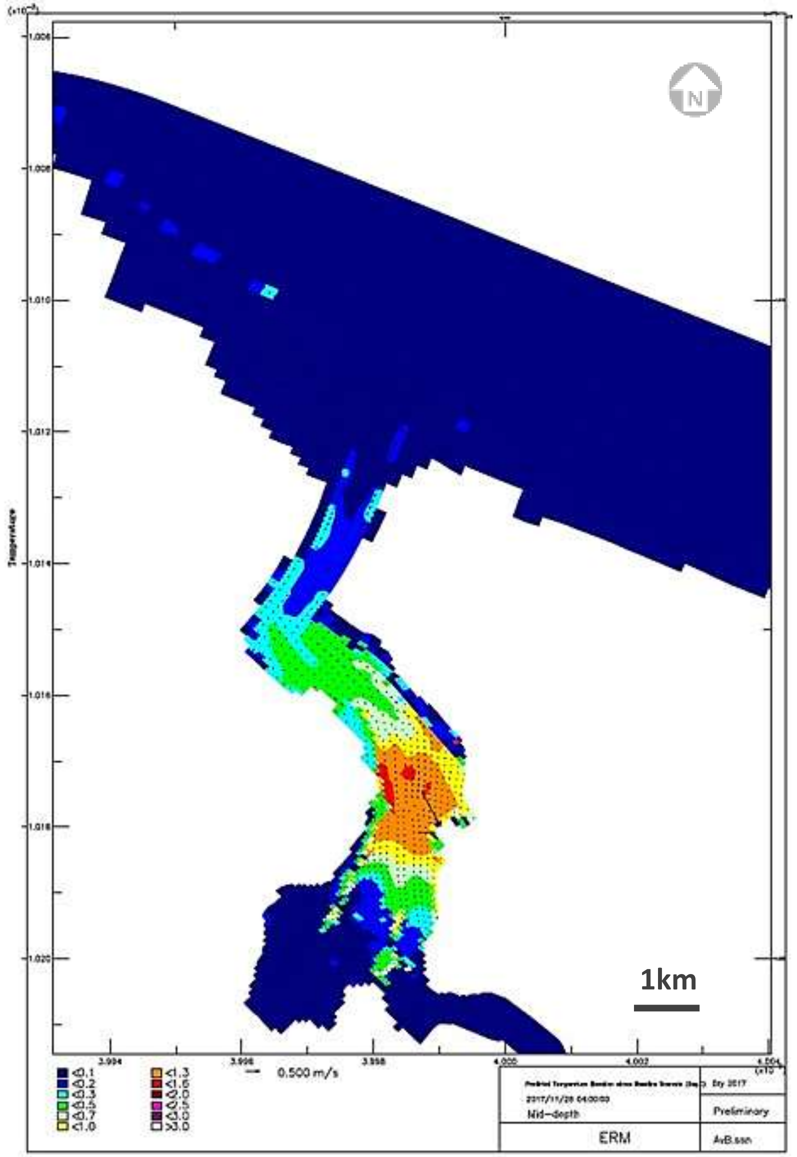


Figure 6-14 Temperature Rise at Mid-depth (Dry Season, Nov 28 04:00)
Source: JICA study team

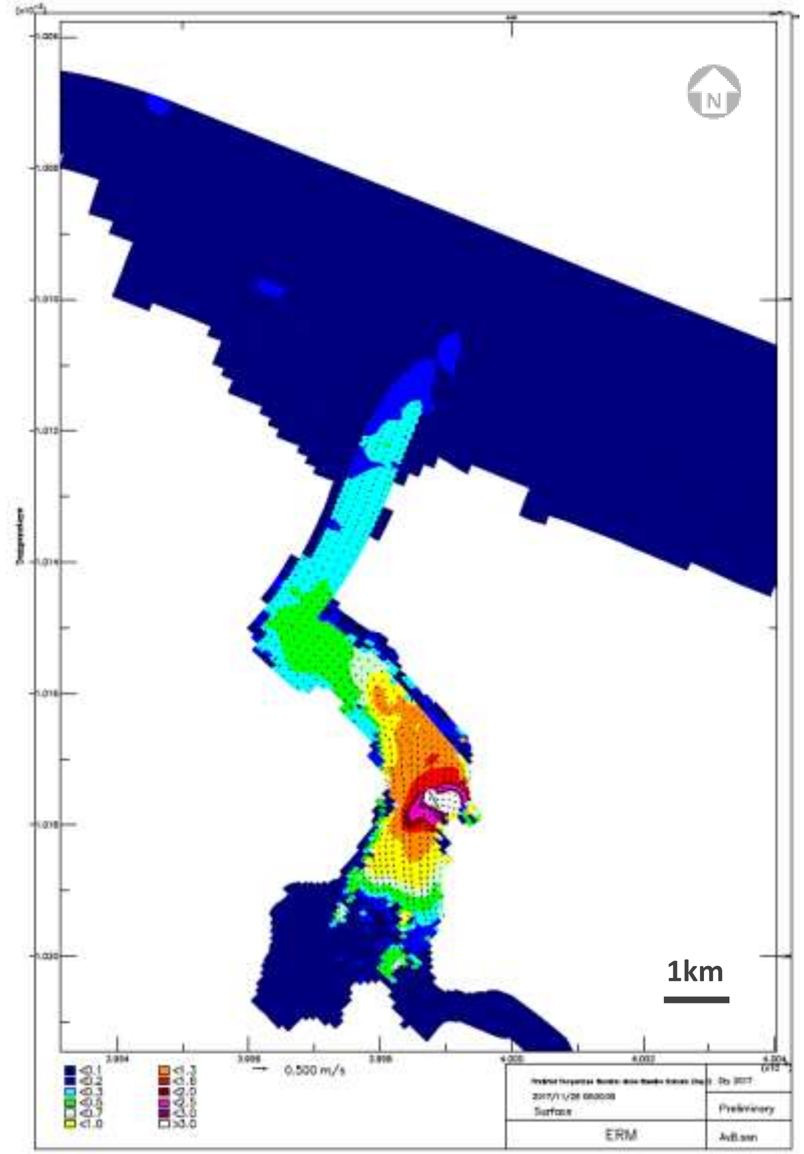


Figure 6-15 Temperature Rise at Surface (Dry Season, Nov 28 08:00)
Source: JICA study team

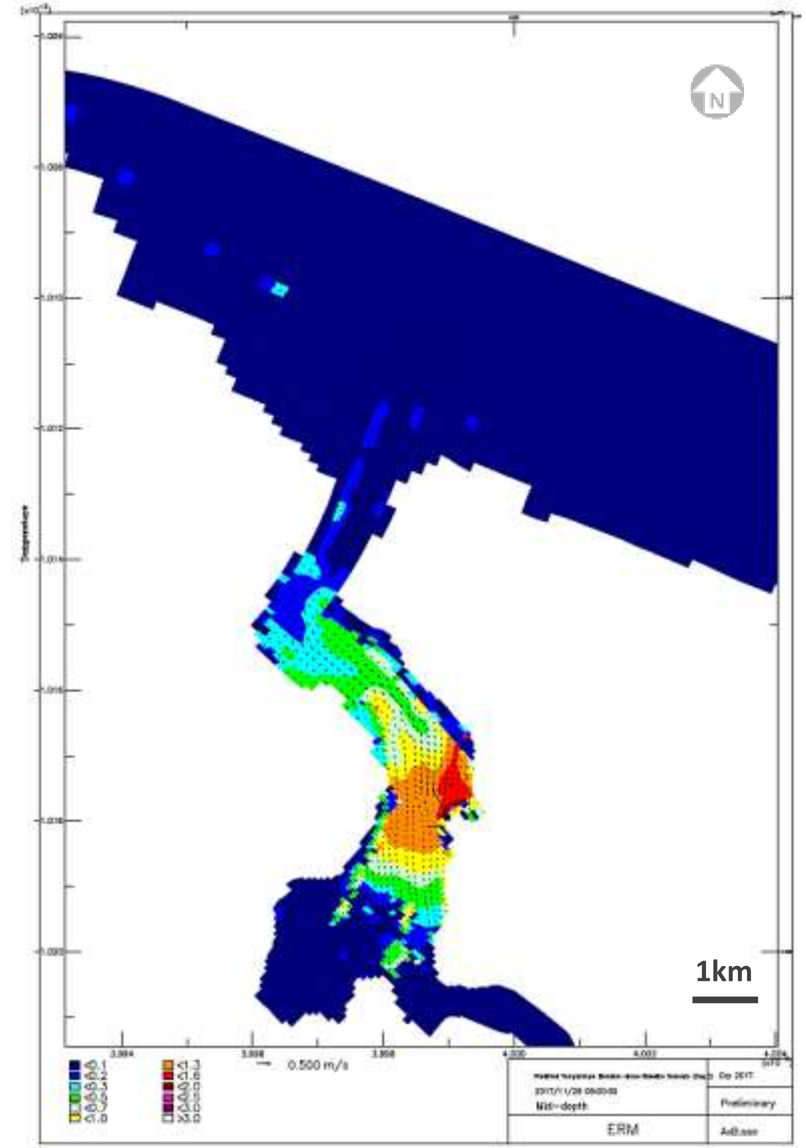


Figure 6-16 Temperature Rise at Mid-depth (Dry Season, Nov 28 08:00)
Source: JICA study team

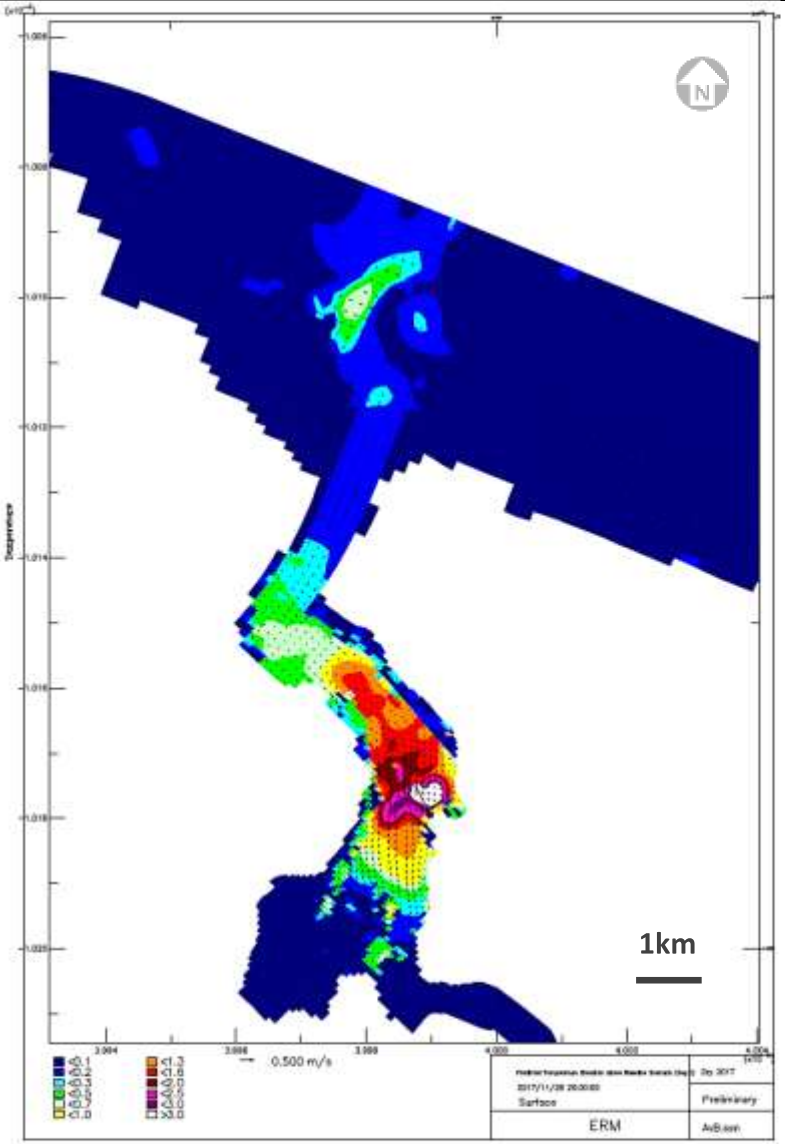


Figure 6-17 Temperature Rise at Surface (Dry Season, Nov 28 20:00)
Source: JICA study team

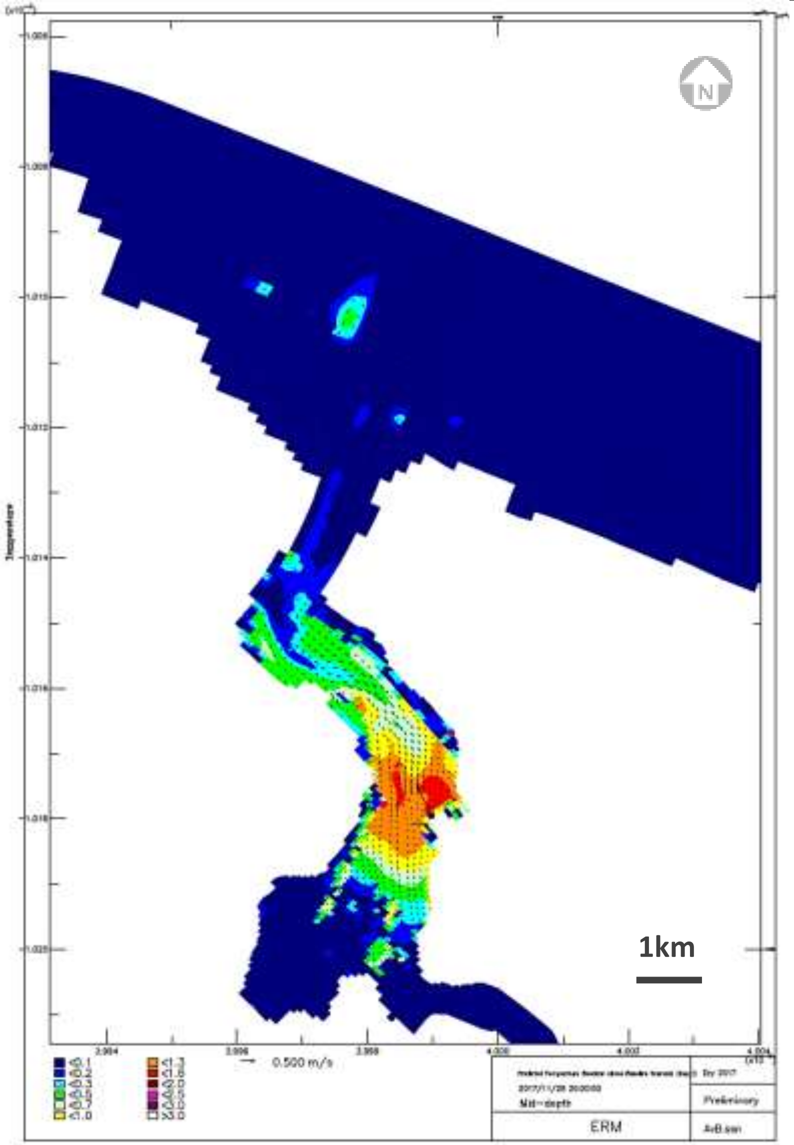


Figure 6-18 Temperature Rise at Mid-depth (Dry Season, Nov 28 20:00)
Source: JICA study team

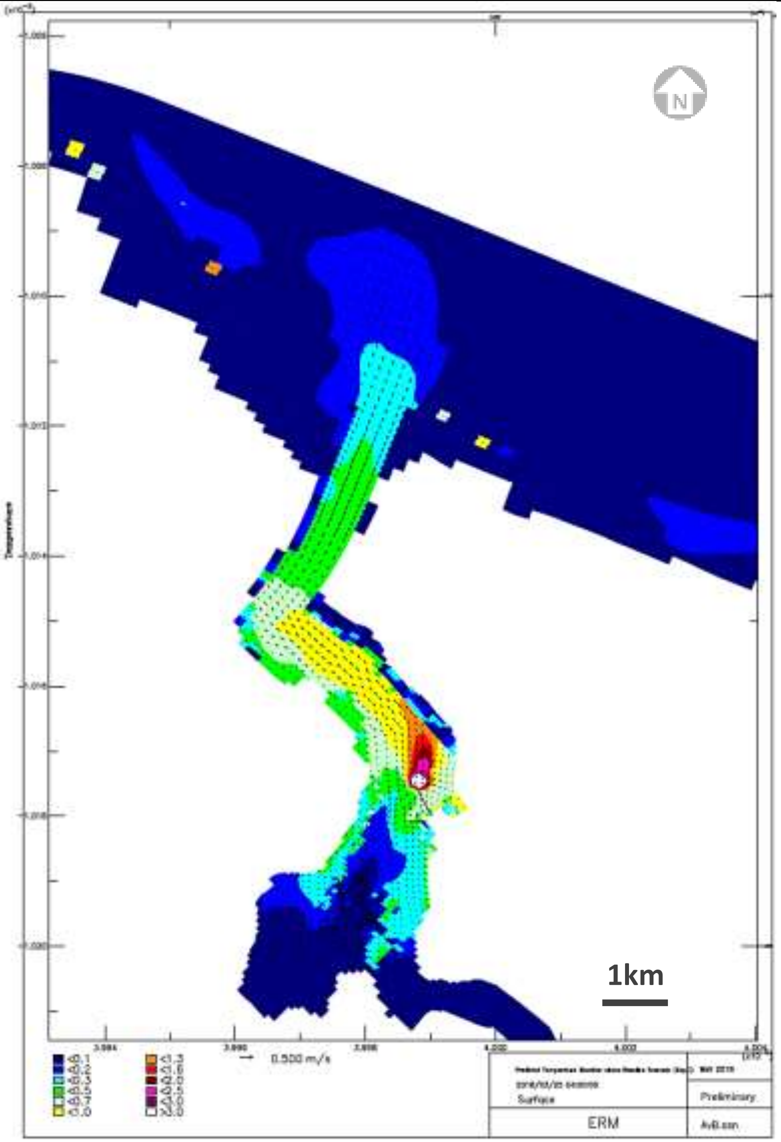


Figure 6-19 Temperature Rise at Surface (Wet Season, Mar 25 04:00)
Source: JICA study team

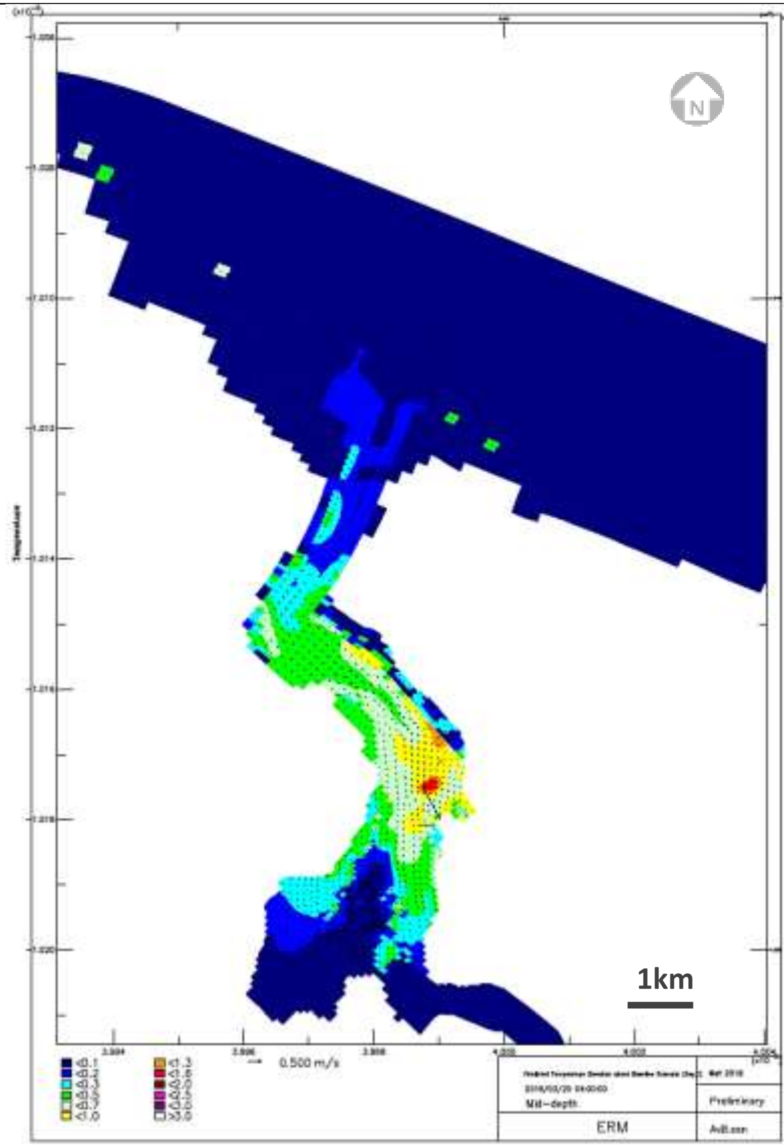


Figure 6-20 Temperature Rise at Mid-Depth (Wet Season, Mar 25 04:00)
Source: JICA study team

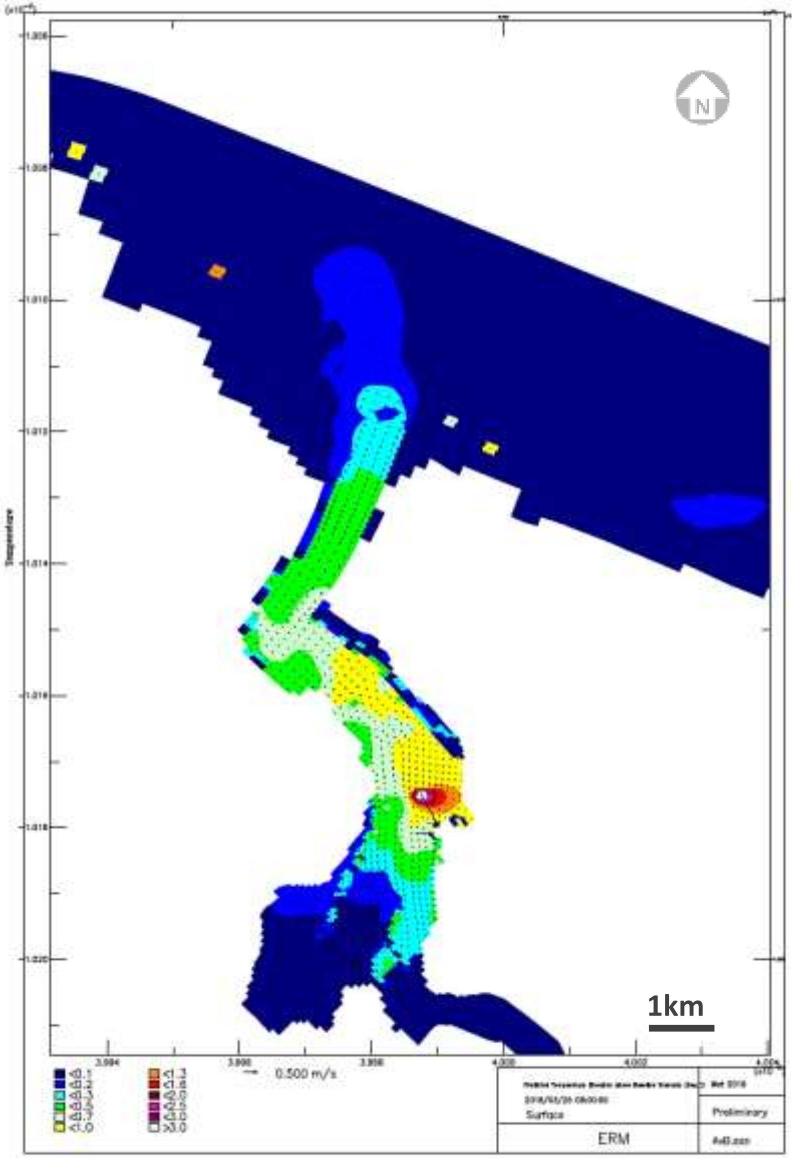


Figure 6-21 Temperature Rise at Surface (Wet Season, Mar 25 08:00
Source: JICA study team, 2018

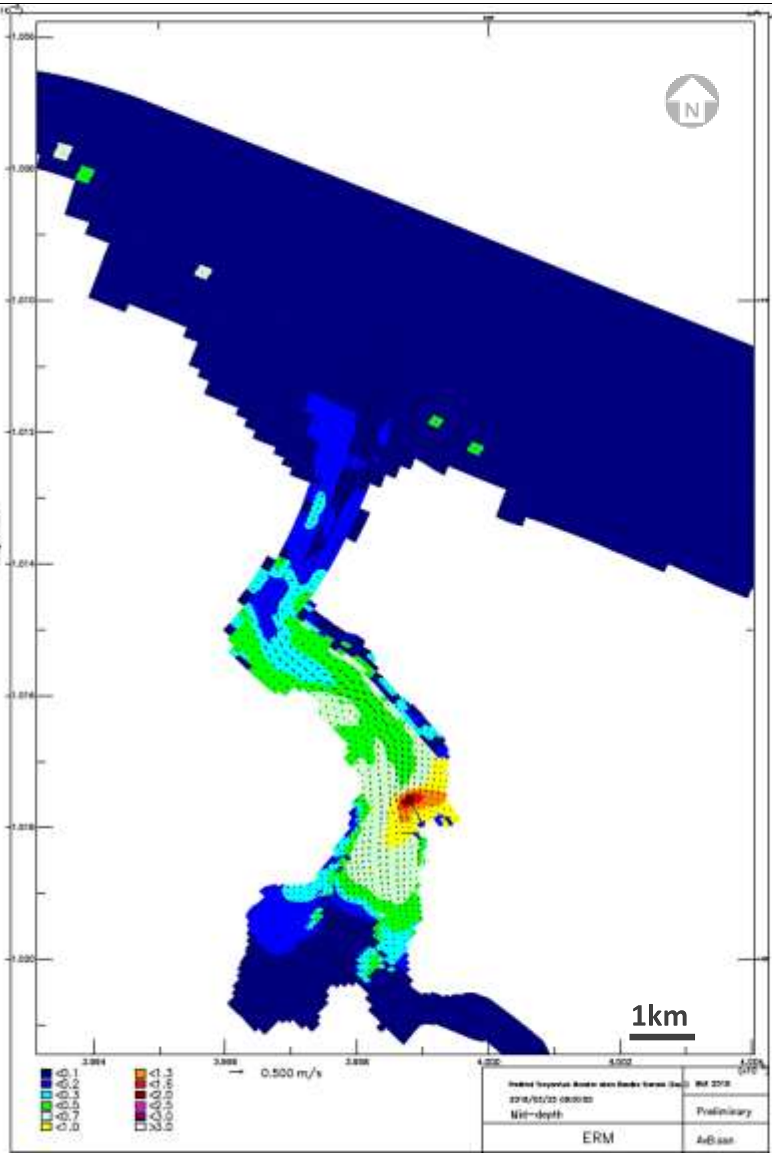


Figure 6-22 Temperature Rise at Mid-Depth (Wet Season, Mar 25 08:00)
Source: JICA study team, 2018

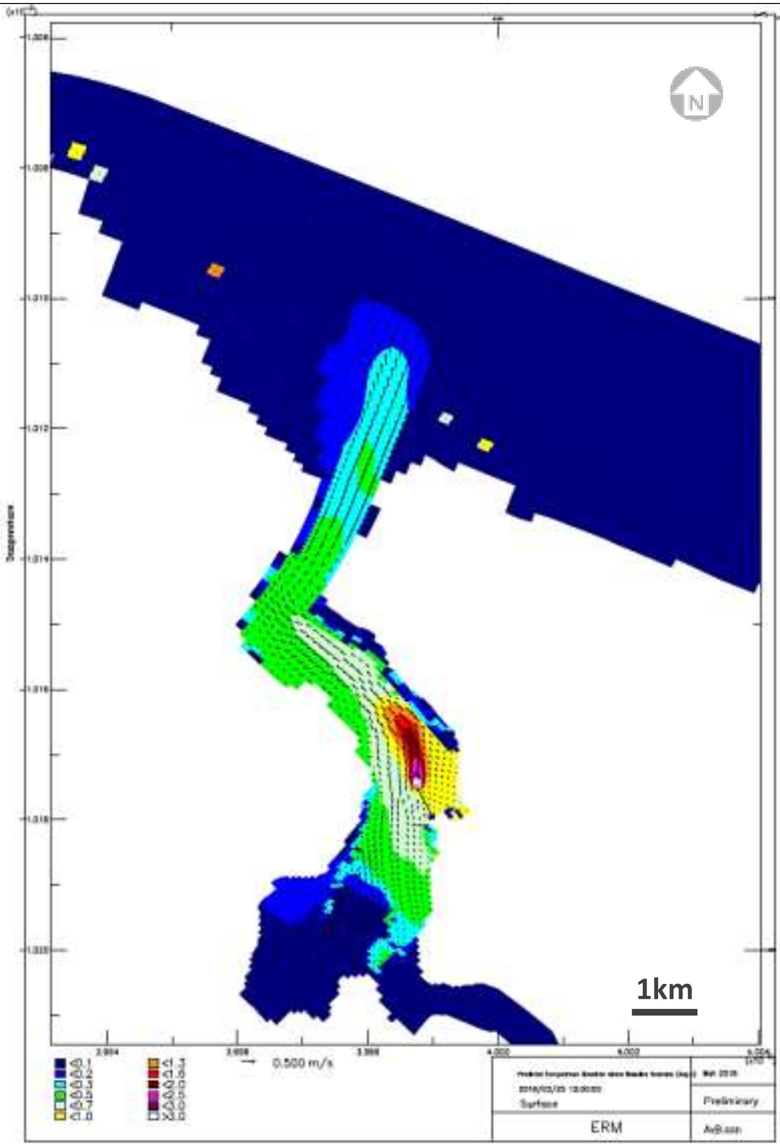


Figure 6-23 Temperature Rise at Surface (Wet Season, Mar 25 12:00)
Source: JICA study team, 2018

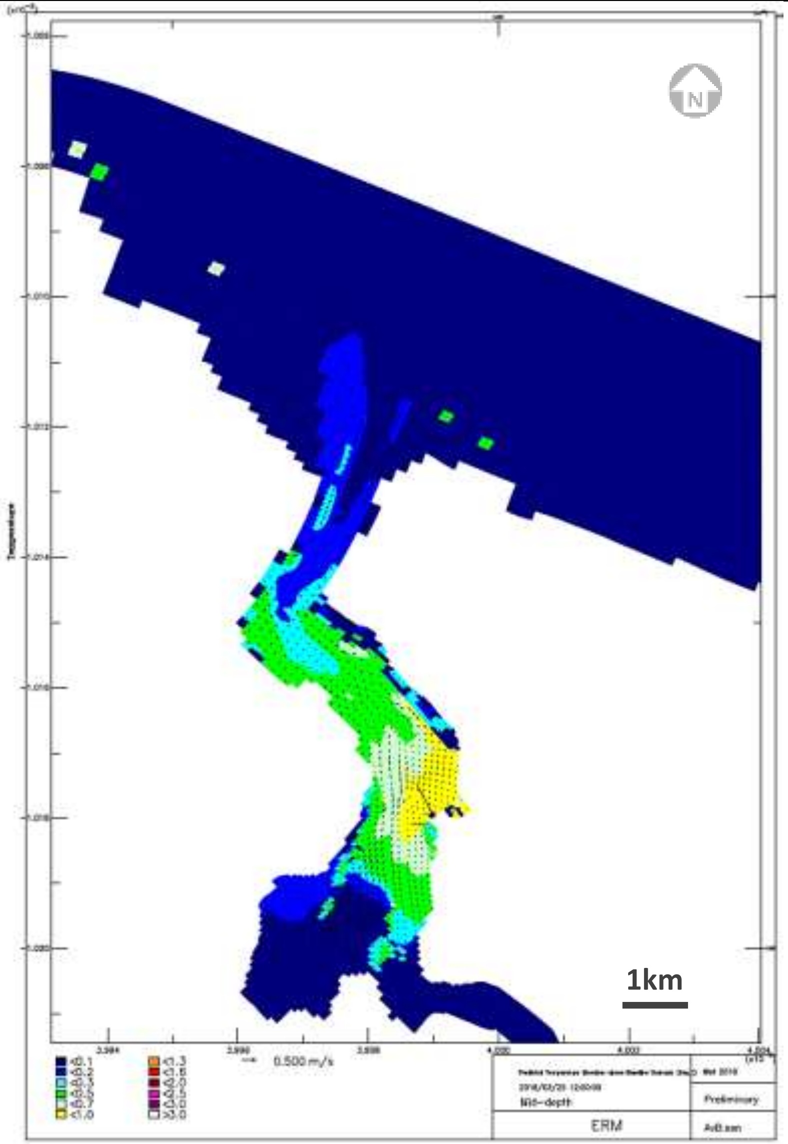


Figure 6-24 Temperature Rise at Mid-Depth (Wet Season, Mar 25 12:00)
Source: JICA study team, 2018

Mitigation and Management Measures

- Monitor temperature of thermal water discharge at discharge point
- Design the outfall structure that can minimize impact on marine species, as possible.

Table 6-30 Impact Significance on Marine Ecology due to Thermal Water Discharge

Impact	Impact of thermal water discharge from the operation of the Mtwara power plant on marine ecosystems.				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on marine ecological environment is negative				
Impact Type	**Direct**	**Indirect**	Induced		
	Thermal water discharge can affect the marine ecosystem and species directly (alter biological processes) and indirectly (decrease dissolved oxygen levels).				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact will continue within the duration of the power plant operation.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local and limited to the area within Sudi creek.				
Impact Scale	Thermal water discharge is expected not to result in significant temperature change in the receiving water.				
Frequency	Operation is continuous.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Considering the magnitude of impacts to modified habitat discussed above, the overall magnitude of this impact is Small.				
Receptor Sensitivity	Low	**Medium**	High		
	Sudi Creek is being used by local villagers as fishing site for catching fish, oyster, shells, among others. Thus, receptor sensitivity is Medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	Critical
	The significance of this impact is **Minor.**				

Source: JICA Study Team, 2018

Impact of Water Intake Facility

A water intake facility will be constructed to obtain water for the power plant's cooling system. A water intake port will consist of fish prevention screen, bar screen and sea water intake pump. The bar screen is a facility to remove large objects such as marine litter. The rotary screen facility can remove small objects such as marine creatures that passed through the bar screen.

The operation of the water intake facility may impact marine species through impingement and/or entrainment. Impingement refers to the condition wherein marine species are trapped against the screens of the intake facility due to the force of flowing water, while entrainment refers to the condition wherein small marine species (small enough to pass through screens) enter the intake system and pass through treatment facilities.[1]

[1] US EPA (2011). "Desalination Plant Intakes: Impingement and Entrainment Impacts and Solutions" (https://www3.epa.gov/region1/npdes/schillerstation/pdfs/AR-026.pdf)

Mitigation and Management Measures

- Consider existing marine ecology in Sudi Creek in the planning such as siting and design of the water intake facility.
- Employ design and technology(ies) that lessen impact on marine species, as practical

Table 6-31 Impact Significance of Water Intake Facility on Marine Species during Operation

Impact	Impact of water intake facility operation on marine species in Sudi Creek				
Impact Nature	**Negative**	Positive	Neutral		
	The impact on marine ecological environment is negative				
Impact Type	**Direct**	Indirect	Induced		
	The operation of the water intake facility can affect the marine ecosystem and species directly.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact will continue within the duration of the power plant operation and thus will be considered as long-term.				
Impact Extent	**Local**	Regional	International		
	The impact is expected to be local and limited to the area within Sudi creek.				
Impact Scale	Operation of the water intake facility may cause impingement and entrainment of marine species in Sudi Creek				
Frequency	Operation is continuous.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Considering built in mitigation measures, the impact magnitude is considered Small.				
Receptor Sensitivity	Low	**Medium**	High		
	Marine fishes that are commonly found inside Sudi Creek are not considered to be endangered or threatened. However, Sudi Creek is being used by local villagers as fishing site. Thus, receptor sensitivity is Medium.				
Impact Significance	Negligible	**Minor**	Moderate	Major	Critical
	The significance of this impact is **Minor.**				

Source: JICA Study Team, 2018

Wastewater Discharges and Runoff

Storm water, industrial wastewater and sewage water will be collected and treated in the power plant prior to discharge. Wastewater conditions will comply with the applicable standards. Treated wastewater will be collected, monitored and discharged to Sudi Creek as shown in ***Figure 2-16***. Wastewater will be discharged mixed with the thermal wastewater and it is planned to discharge meeting the IFC and Tanzanian national standards.

.

Mitigation and Management Measures

- Install oil/water separators to treat surface run-off prior to discharge to the storm water system. Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream.
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps.
- Implement adequate sanitary facilities for onsite personnel.
- Design drainage culverts for the controlled release of storm flows

- Stormwater drainage, sewage and wastewater will be treated prior to discharge to the discharge point and the treated effluent will comply with WB/IFC EHS Guidelines as described in Section 3.9. The wastewater discharged will be monitored in accordance with the Environmental and Social Monitoring Plan as described in Section 9.2.

Table 6-32 Impact Significance on Water Resources due Wastewater discharges and Runoff

Impact	Potential impacts on aquatic species due to wastewater discharges during plant operation.				
Nature	**Negative**	Positive	Neutral		
	Potential impacts to water resources would be considered to be adverse				
Type	**Direct**	Indirect	Induced	Cumulative	
	Impacts to seawater would be direct impacts from project activities.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The operation phase will last approximately 25 years. The duration of potential impacts is therefore long-term.				
Extent	**Local**	Regional	International		
	Potential impacts would be limited to the project site footprint, as well as areas downstream of the project site, and hence would be considered to be local.				
Scale	Sources and estimated quantities of wastewater generation from the plant during the operation and maintenance phase are as Section 2.4.3. The scale of potential impacts due to release of wastewater is potentially large due to the quantities present during this stage, but in-place treatment and management systems will reduce effluent levels to within IFC standards.				
Frequency	Impacts to seawater from wastewater discharges could occur intermittently but repeatedly throughout the day for the duration of the operation phase (25 years).				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to water quality in the project area from wastewater discharges and runoff are expected to be of Small magnitude.				
Receptor/ Resource Sensitivity	Low	Medium	High		
	Some fishermen go to Sudi Creek to catch fishes. Therefore, sensitivity is high				
Significance	Negligible	**Minor**	Moderate	Major	
	The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall Minor Impact.				

Source: JICA Study Team, 2018

6.3.7 *Waste*

Construction Phase

Solid and liquid waste will be generated from construction works mainly from site clearance and material leftovers such as unused concrete. During the land leveling activities, excavated soil with an approximate amount of 340,000m^3 will be generated. The excavated soil will be utilized as filling material within the site.

Other solid wastes would include general waste such as food waste, wrapping materials, paper, cardboards, wood, tree leaves, tires, bottles, metals, plastic materials, drums, containers, cables, packaging materials, and other remains generated from construction activities. Medical wastes from first aid including medicines sharp objects from workers' camp are also expected to be generated.

Assuming per capita solid waste generation of about 0.5 kg/day and approximately 1,100 workers during peak period will be employed by the project about 550kg of solid wastes would be generated daily from worker camp alone. In total the amount of waste emanating from the activities of the project is significant and if not appropriately disposed may become environmental and health hazard.

Mitigation Measures

- Prior to the start of construction, a waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse during the construction and operation phases for all the waste streams identified.
- Engage with local authorities and other stakeholders to determine the capacity of the local waste management network to accommodate waste streams from the Project during construction and operation.
- Conduct training to workers on site regarding how to avoid, reduce and reuse wastes.
- Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately.
- All waste collected should be managed and disposed of in accordance with the required regulations.
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed.
- Monitoring of appointed waste contractors to ensure proper waste disposal, in accordance with applicable regulations.
- The appointed waste contractors shall report on regular basis on any cross-boundary transport of waste.

Table 6-33 Impact Significance of Wastes Generated during Construction

Impact	Potential impacts due to wastes during construction				
Impact Nature	**Negative**	Positive	Neutral		
	Potential waste impacts would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	The impact from construction activities is short-term.				
Impact Extent	**Local**	Regional	International		
	Waste impact from the project will have localised impact.				
Impact Scale	Construction activities will take place within the project area. The scale of potential impacts due to release of waste cannot be large as long as the waste management network and capacity of disposal site of the area are ensured.				
Frequency	Throughout construction phases				
Impact Magnitude	Positive	**Negligible**	**Small**	Medium	Large
	Potential impacts to soil quality, health and sanitation in project area due to inappropriate waste disposal is expected to be of small magnitude.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is medium because neighbouring areas are being used for agriculture.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	The combination of Receptor Sensitivity and Impact Magnitude results in an overall Minor impact.				

Source: JICA Study Team, 2018

Operation Phase

Wastes from maintenance (e.g. pain residue, metal scraps), packaging materials, general wastes from offices, sanitary wastes, oil sludge, and chemicals from the warehouse will be generated.

Table 6-34 Expected amount of waste produced from the power plant during operation phase

Type of waste	Waste amount	Treatment	Final waste disposal
Waste oil	20 m³/year	Store in drums and transport it to outside the site	Certified waste disposal contractor
Sewage sludge	220 m³/year	Collect at the site and transport it by rolly truck to outside the site	Certified waste disposal contractor
General waste	7 ton/month		Certified waste disposal contractor

Source: JICA Study Team, 2018

Mitigation and management measures

- Develop a waste management plan
- Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately.
- All waste collected should be managed and disposed of in accordance with the required regulations.
- Education to workers on site shall be undertaken to avoid, reduce and reuse wastes generated.
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed.
- Monitoring of appointed waste contractors to ensure proper waste disposal, in accordance with applicable regulations.

Table 6-35 Impact Significance of Wastes during Power Plant Operation

Impact	Potential impacts due to wastes				
Impact Nature	**Negative**	Positive	Neutral		
	Potential waste impacts would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact from operational activities is long-term for the duration of the proposed Project.				
Impact Extent	**Local**	Regional	International		
	Waste impact from the project will have localised impact.				
Impact Scale	Operation activities will take place within the project area. The scale of potential impacts due to release of waste cannot be large as long as the waste management network and capacity of disposal site of the area are ensured.				
Frequency	Throughout construction and operation phases				
Impact Magnitude	Positive	**Negligible**	**Small**	Medium	Large
	Potential impacts to soil quality, health and sanitation in project area due to inappropriate waste disposal is expected to be of small magnitude.				
Receptor Sensitivity	Low	**Medium**	High		
	Receptor sensitivity is medium because neighbouring areas are being used for agriculture.				

Impact Significance	Negligible	**Minor**	Moderate	Major
	The combination of Receptor Sensitivity and Impact Magnitude results in an overall Minor impact.			

Source: JICA Study Team, 2018

6.3.8 Greenhouse Gas (GHG) emissions

To determine the GHG emission reduction of Project, the methodology from JICA Climate-FIT Version 2.0 for Thermal Power Generation/ Fuel Efficiency Improvement, was adopted. GHG emission reduction of the Project (ERy) is calculated by getting the difference between GHG emissions of a plant with the same electricity generation as the project but uses current technology/facility (Baseline Scenario, BEy) and GHG emission of the Project using its fuel consumption (Project Scenario, PEy).

$$ER_y = BE_y - PE_y$$

where,

ER_y: Emission reduction through the Project in a year y (t-CO_2e/y)
BE_y: GHG emission from the baseline scenario in a year (t-CO_2e/y)
PE_y: GHG emission from the project scenario in a year (t-CO_2e/y)

Calculating of Base Scenario

$$BE_y = EG_{PJy} \times GE_{BL} \times NCV_i \times EF_{fuel,i}$$

where,
EG_{PJy}: Amount of electricity generated by the Project in a year (MWh/y)
GE_{BL}: Specific fuel consumption of baseline facilities (t/MWh)
NCV_i: Net caloric value of the fuel I used for power generation (TJ/t)
$EF_{fuel,i}$: CO2 emission factor of the fuel I used for power generation (t-CO_2/y)

For the Project, amount of electricity that will be generated in a year is approximately 2,198,410 MWh/yr.

EG_{PJy} = (Power output – Internal power) x Operating Pd x Efficiency
= (320MW – 6.3MW) x 24hr x 365 days x 0.8
= 2,198,410 MWh/yr

For the baseline facilities, fuel consumption of existing gas-fired power plants in Tanzania (e.g. Kynerezi I, Ubungo II) is used.

GE_{BL} = fuel consumption / power output
= (723,647m3/day) / (1,406m3/day) / (2477.399MWh/day)
= 0.208 ton/MWh

For NCV_i = 0.046865 TJ/ton is the Net caloric value of the fuel that will be used by the Project

For $EF_{fuel,i}$ = 56.1 t-CO_2/TJ is the mission factor of the fuel that will be used by the Project

Therefore,
BE_y = 2,198,410 MWh/yr x 0.208 ton/MWh x 0.046865 TJ/ton x 56.1 t-CO_2/TJ
=1,202,219 t-CO_2/yr

Calculating of Project Scenario

$$PE_y = FC_{PJ,i,y} \times NCV_i \times EF_{fuel,i}$$

Where,
$FC_{PJ,i,y}$ is Consumption of the fuel I used for power generation in the Project (t/y)

$FC_{PJ,i,y}$ = power output x period of operation x fuel efficiency x net calorific value
= 0.006313 TJ/kWh x 320,000 kW x 24hr x 365 days x 0.8x 0.046865 TJ/ton
= 296,139 ton/yr

Therefore,
PE_y = 302,087 ton/yr x 46.865TJ/ton x 56.1 t-CO_2/TJ
= 778,587 t-CO_2/yr

Calculating Emission Reduction

Therefore, the estimated annual emission reduction of the Project is approximately 423,632 t-CO_2/yr. This is equivalent to approximately 3% of the 10% GHG emission reduction target (13.8MtCO2e – lower limit), stipulated in Tanzania's INDC.

Impact Significance

Impact magnitude of GHG emissions is considered medium as emissions contribution will exceed the threshold that defines significant emitters of GHGs by IFC PS3 (25,000 tons CO2e per year). The Project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

Receptor sensitivity is considered medium because significant increase of GHG concentration in the atmosphere beyond the level of naturally occurring concentrations could result in more heat being held within the atmosphere. Therefore, significance of the impact is considered moderate.

Mitigation and Management Measures

The following mitigation and management measures are recommended to mitigate GHGs emitted to the atmosphere by Project activities during operation:

- Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO2e unit.
- Develop and implement preventive maintenance plan for power generators, machines, and engines to ensure combustion efficiency.

Table 6-36 Assessment of GHG Emissions during Operation Phase

Impact	Potential impacts on climatic condition due to GHG emissions.				
Impact Nature	**Negative**	Positive	Neutral		
	Potential impacts to climate would be considered to be adverse (negative).				
Impact Type	**Direct**	Indirect	Induced		
	Potential impacts would likely be direct impacts through the release of emissions from project operation.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.				
Impact Extent	Local	Regional	**International**		
	Greenhouse gases can potentially affect the Earth's climate.				
Impact Scale	The GHG emissions from the power plant are calculated to be 1,112,360.3 tonnes CO_2e per annum.				
Frequency	Emissions will be released continuously throughout the operation period.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	GHG will be emitted as a result of the Project. The emissions from power plant are calculated to be 778,587 tons CO_2e per year. This is considered significant emissions according to IFC PS3 (25,000 tonnes CO_2e per year). Magnitude is therefore considered Medium.				
Receptor Sensitivity	Low	**Medium**	High		
	GHG is global pollutants. The greenhouse effect is enhanced by greenhouse gas emissions of anthropogenic nature. Receptor/resource sensitivity is rated as				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	The combination of a Medium resource sensitivity and Medium impact magnitude will result in an overall Moderate potential impact.				

Source: JICA Study Team, 2018

6.4 SOCIAL IMPACT ASSESSMENT

This chapter describes the predicted socio-economic impacts associated with construction and operation of the project. It is based on the baseline data presented in Chapter 4 and the impact assessment methodology detailed in Chapter 6.

A project's area of influence generally includes the following:

- Direct footprint of the land that will be acquired and used. This is generally the land area that will be fenced and reserved for the project and where the public will not be allowed access.
- A physical distance around the direct footprint at a scale depending on the emissions related to a particular activity.
- A physical distance around the direct footprint at a scale depending on the indirect effects of a particular activity.

Impacts are described in the context of the effect that a project or a project's activities will have on a receptor. In this instance, the project receptors are the local people located within the area of influence that may be impacted or influenced by the project (as a result of their proximity to the project site and/ or project associated infrastructure).

This includes people living in Mtwara District in Mtwara Region. Especially following villages in are considered based on their location from the project site:

- Kisiwa Village
- Namgogoli Village

- Mgao Village

The power plant site is located close to Kisiwa village and Namgogoli villages. The land acquisition by TANESCO took place within these villages.

6.4.1 Employment and economy

The project will generate a range of employment opportunities. During construction, it is expected that approximately estimated 50 to 100 workers will be required and this will increase to 400 to 1,100 workers needed during the peak of construction. This includes both skilled and unskilled workers.

The number of people employed by the project will decrease at the end of the construction phase. It is anticipated that approximately 80 to 90 employment opportunities will be created during the operation of the power plant.

In addition, the project will require goods and services throughout its lifecycle. There are opportunities for local businesses to provide these goods and services (e.g. construction equipment, food for the accommodation camp). As a result, existing local businesses may expand or new businesses may be established locally to meet these demands, providing employment opportunities.

On the other hand, acquisition of the fish landing site (nose area in Sudi Creek) may impact about 62 fishermen who use the area. With the implementation of the project, the fishermen will lose access to the area. However, according to an interview to the head of Kisiwa village conducted in September 2018, there are multiple landing sites in the area, including the one with fish market in other place. Similarly, livelihood of farmers whose land will be acquired will also be impacted. According to consultation meetings, several of these fishermen and farmers have other forms of livelihood. Therefore, the impact on livelihood due to land acquisition is recognized as minor.

In the socio-economic survey of the PAPs, about 50.1% of the respondents reported the availability of an alternative fish landing site at Mgao village. Other respondents proposed different means of livelihoods such as livestock keeping especially goats and chicken.

To respond to their concern, TANESCO arranged the meeting between Kisiwa village leader and Mgao village leader and confirmed that Kisiwa villagers will be able to use Mgao landing site and to have access to the fish market.

Measures to maximize positive impacts

- Develop and implement a local recruitment and procurement management plan. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers.
- Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the project.
- Inform local villagers of job opportunities in a timely manner.

- Inform local businesses of contracting opportunities in a timely manner such as awareness on forthcoming investment and employment opportunities, including sensitization of farmers for production of required quality of foods such as vegetables.

Mitigation and Management Measures

- Keep open communication with the affected people
- Study the alternative options for livelihood restoration
- Develop a livelihood restoration plan based on the Due Diligence Report (DDR) mentioned in Section ***6.4.6***.

Table 6-37 Significance of Impact on Livelihood of Fishermen and Farmers

Impact	Impact on Livelihood of Fishermen and Farmers				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of communicable diseases in the local area is negative.				
Impact Type	**Direct**	Indirect	Induced		
	The impact is direct.				
Impact Duratio	Temporary	Short-term	Long-term	**Permanent**	
	The impact will be permanent since the Project will exclusively use the landing				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to the project site.				
Impact Scale	The impact scale is Medium. The number of affected fishermen is limited and majority of these fishermen also have other livelihoods.				
Impact Frequency	The impact will occur only once, prior to the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **Small.**				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is likely to be **Low.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **Minor.**				

Source: JICA Study Team, 2018

6.4.2 *Community health, safety and security*

Sensitivity of Study Area

The existing local healthcare facilities have limited capacity to respond to an increase in the transmission of communicable diseases, leaving the local villagers vulnerable. Neighboring villages (Somanga and Namgogoli) are located at a distance of 2-3km from the project site, thus impacts from the construction site (e.g. dust, noise, vibration) will cause minimum disturbance to the villagers.

Construction Phase

The project will require thousands of workers during the construction phase. There is potential for the influx of workforce to introduce and/ or increase the rate of spread of communicable diseases in the project area. This includes the introduction of a new disease and/ or a more virulent strain of an existing disease.

The influx of people to the village will influence the change of behaviour of some members in the community due to the interaction of people with different lifestyles and behaviour. This will increase the chances of infection of diseases including

HIV/AIDs and Sexual Transmission Diseases (STDs). Also, the influx of workers in the area may increase level of crime and insecurity among community members.

The transport of workers and goods to and from the Project site will also impact traffic conditions. Heavy cargo will be transported via main road. With an increase in vehicles, particularly heavy haulage vehicles, comes the increased potential for accidents and inquiries to occur. This is exacerbated by the fact that people living in the local villages typically reside immediately adjacent to roads. Villagers are not accustomed to the presence of large vehicles and heavy traffic.

In addition, with the use and acquisition of the landing area within Sudi Creek, fishermen will have to seek and use other landing sites or fishing areas. With this, marine traffic in Sudi Creek may be reduced significantly. In order to avoid accidents and other health and safety risks in marine traffic, particularly during the transport of power plant machineries, proper consultation and information dissemination to the villagers (fishermen groups) will be conducted.

Given the planned management measures, the local extent and scale of the impact, the impact was assessed as Minor and negative.

Mitigation Measures

- Training for all workers about communicable diseases, sensitization of enforcement of HIV/AIDS law and regulations.
- Establish amenities at the worker camp to that help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers.
- Establish a workforce code of conduct. Include in the code specific measures on anti-social behaviour.
- Vector management procedures, including consideration of whether pesticides will be utilized to reduce the presence of vectors onsite.
- Provision of onsite healthcare, to ensure that medical attention can be sought.
- Emergency management procedures, should a health issue escalate and require a rapid response.
- Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic.
- Conduct consultations and information dissemination to villagers (fishermen groups) regarding the use of Sudi Creek during transport of materials.
- Provide appropriate training for security personnel and monitor implementation of the training over time
- Create awareness on all security issues including activities the community police (polisi jamii) in the area.

Table 6-38 Significance of Impact on Community Health, Safety and Security during Construction

<table>
<tr><td>Impact</td><td colspan="4">Impact on community health, safety and security during construction</td></tr>
<tr><td rowspan="2">Impact Nature</td><td>Negative</td><td colspan="2">Positive</td><td>Neutral</td></tr>
<tr><td colspan="4">Increase of risk in community health, safety and security is negative.</td></tr>
<tr><td rowspan="2">Impact Type</td><td>Direct</td><td colspan="2">Indirect</td><td>Induced</td></tr>
<tr><td colspan="4">The impact is direct.</td></tr>
<tr><td>Impact</td><td>Temporary</td><td>Short-term</td><td>Long-term</td><td>Permanent</td></tr>
</table>

Duration	Impact can range from short to long-term, if not properly addressed				
Impact Extent	**Local**	Regional		Global	
	The impact is limited to the local villages located close to the power plant.				
Impact Scale	The impact scale is Medium.				
Impact Frequency	The impact is likely to occur during the construction phase, at certain inevitable occasions.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Influx of workers and impacts of construction activities may pose risks to community health, safety and security. The impact magnitude is likely to be **Medium.**				
Vulnerability of Receptors	**Low**	Medium		High	
	The neighboring villages are located at a distance of 2-3km from the project site. However, there are houses located close to access roads. Also, local healthcare facilities have limited capacity. Thus, the receptor sensitivity is considered **Low.**				
Significance	**Negligible**	**Minor**	Moderate	Major	
	The significance is likely to be **Minor.**				

Source: JICA Study Team, 2018

Operation Phase

During operation, community safety and security impacts largely result from increase in traffic, establishment of onsite infrastructure and the management of wastes and hazardous materials. Activities of the power plant (e.g. noise, air quality, wastes) may affect community health. However, since the adjacent villages are located at more than 2km and based on modelling results for air and noise, impacts on community health during operation is deemed negligible.

Table 6-39 Significance of Impact on Community Health during Operation

Impact	Impact on Community Health, Safety and Security during Operation				
Impact Nature	**Negative**	Positive		Neutral	
	Increase of health risks due to project operation				
Impact Type	**Direct**	Indirect		Induced	
	The impact is direct.				
Impact Duratio	Temporary	Short-term	**Long-term**	Permanent	
	The impact could be long lasting, even permanent, if left untreated.				
Impact Extent	**Local**	Regional		Global	
	The impact is limited to the local villages.				
Impact Scale	The impact scale is Medium.				
Impact Frequency	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitud	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **Small.**				
Vulnerability of Receptors	**Low**	Medium		High	
	The vulnerability of receptor is likely to be **Low.**				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be **Negligible.**				

Source: JICA Study Team, 2018

6.4.3 *Occupational Health and Safety*

Construction Phase

The construction of power plant will require approximately 1,100 workers during the peak of construction. These workers will be exposed to noise, dust, vibration at source and other occupational hazards related to site preparation and construction works.

It is important to note that construction period will only last for approximately 22 months. Operation of construction machineries will also be intermittent. Thus, these impacts will be temporary and intermittent. In order to ensure the protection of health and safety of all the workers, mitigation and management measures will be implemented in accordance with applicable laws and regulations.

Mitigation measures

- Develop and implement a health and safety plan.
- Provide personal protective equipment (PPE)
- Provide appropriate training for workers on risks to health and safety in the workplace
- Create awareness on all security and safety issues and hazards at the site
- Provide safety signs
- Equip the site with a first aid kit

Table 6-40 Significance of Impact on Occupational Health and Safety during Construction

Impact	Impact on occupational health and safety during construction				
Impact Nature	**Negative**	Positive	Neutral		
	Potential health and safety risks to workers are negative				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the workers' health and safety.				
Impact Duratio	Temporary	Short-term	Long-term	Permanent	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is Medium.				
Impact Frequenc	The impact will likely occur during the construction phase with rare frequency.				
Impact Magnitu de	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **Medium** since the workers are directly exposed to the hazards.				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium** since hundreds of workers will be involved in the project				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Source: JICA Study Team, 2018

Operation Phase

During operation phase, it is anticipated that approximately 80-90 people will be employed as full-time employees. These workers, particularly those who will be engaged in the operation of equipment and handling of chemicals and other hazardous substances will be exposed in health and safety hazards (e.g. exposure to noise and chemicals).

In order to ensure the protection of health and safety of all the workers, mitigation and management measures will be implemented in accordance with applicable laws and regulations.

Mitigation measures

- Provision and enforcement of the proper use PPEs
- Provide health checks to the employees
- Provide appropriate training on occupational health and safety
- Monitor implementation of the training over time
- Provision of safety signs

Table 6-41 Significance of Impact on Occupational Health and Safety during Operation

Impact	Impact on occupational health and safety during operation				
Impact Nature	**Negative**	Positive	Neutral		
	Risks to health and safety of workers is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the workers' health and safety.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impact may be short-term but it has the potential to have lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited to workers involved in the project.				
Impact Scale	The impact scale is Medium.				
Impact Frequency	The impact is likely to occur during the operation phase with rare frequency.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **Medium.**				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is likely to be **Low** since workers will be limited during operation phase and there will be mitigation and management measures in place.				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Source: JICA Study Team, 2018

6.4.4 *Community infrastructure and public services*

Construction Phase

During construction, the workforce is expected to peak at approximately 1,100 workers. A number of these workers is expected to be from outside the local area. It is the workers from outside the area as well as the influx associated with in-migration that contributes to the pressure that is experienced by community infrastructure and services such as roads and health centres.

However, during construction the workforce will be accommodated at a worker camp, which will have a range of on-site amenities. This will minimize the need for the workforce to utilize or rely on local infrastructure, minimizing the pressure that may be experienced by community infrastructure and services.

Traffic may still create an issue particularly during construction when transport needs are higher. An increase in traffic along the B2 trunk road will potentially displace current users to some extent. This means that road users may need to modify their activities (i.e. during specific points in the construction phase). This is expected to be a very temporary situation during the construction phase.

Mitigation Measures

- Provide appropriate amenities at the workers' camp. This will help reduce the need for workers to utilize local infrastructure and services.
- Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the project.

Table 6-42 Significance of Impact on Community Infrastructure and Services during Construction

Impact	Impact on Community Infrastructure and Services during Construction				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of pressure that is experienced by community infrastructure and services in the local area is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community infrastructure and services.				
Impact Duratio	**Temporary**	Short-term	Long-term	Permanent	
	Impact is likely to be temporary.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is small.				
Impact Frequenc	The impact likely occurs during the construction phase with the rare frequency.				
Impact Magnitud	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **medium.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **Moderate.**				

Source: JICA Study Team, 2018

Operation Phase

In terms of the operation phase, it is anticipated that approximately 50 people will be employed. It is assumed that some of these workers will come from outside the local area. Considering the duration of the project, it is anticipated that some workers will bring their families with them. These workers may place some additional pressure on the local infrastructure. However, given the small workforce, it is anticipated that this additional pressure can be accommodated.

Also, there is potential to impact more widely on community infrastructure (e.g. schools, community centers). This assumes that workers will be brought in from other areas and bring with them their families. This may occur, but is expected to result in only a handful of families moving into the area. As a result, the extent and scale of the impact is likely to be local and the overall impact is likely to be small. For these reasons, the impact was assessed as minor and negative

Mitigation measures

- Develop and implement a traffic management plan.
- Develop and implement a site safety management plan. This plan will need to ensure appropriate and adequate health care services are provided on site

Table 6-43 Significance of Impact on Community Infrastructure and Services during Operation

Impact	Impact on Community Infrastructure and Services				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of additional pressure on the local infrastructure is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community infrastructure and services.				
Impact Duratio	Temporary	**Short-term**	Long-term	Permanent	
	Impact is likely to be short-term.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is small.				
Impact Frequenc	The impact likely occurs during the operation phase with the rare frequency.				
Impact Magnitu	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **medium.**				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is likely to be **minor.**				

Source: JICA Study Team, 2018

6.4.5 *Cultural heritage*

Construction Phase

Loss of artifacts

The proposed project will involve digging the ground for various activities including angle towers. As noted above, there were isolated potsherds in the project area that were discovered. It is possible that there will be loss of similar archaeological artifacts during such project activities.

Mitigation measures

- Implement a Chance Finds Procedure according to IFC standard 8

Impact on graveyard

A family graves/graveyard exists close to the landing area. Since the relatives do not agree with relocation, TANESCO would have to provide access to that area during special religious and/or family events.

Mitigation measures

- Coordinate closely with family members
- Take precautions in not disturbing the area particularly during transfer of heavy equipment

Table 6-44 Significance of Impact on archaeological and cultural heritage during construction

Impact	Impact on archaeological and cultural heritage during construction				
Impact Nature	**Negative**	Positive	Neutral		
	Impact on heritage sites and items during construction is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the sites and objects with values.				
Impact Duratio	Temporary	Short-term	**Long-term**	Permanent	
	Impact is likely to be long-term until the duration of the project.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the affected localities..				
Impact Scale	The impact scale is negligible but has the potential to be high depending on unplanned discoveries.				
Impact Frequenc	The impact likely occurs during the construction with the rare frequency.				
Impact Magnitud	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is likely to be **medium.**				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is likely to be **Negligible.**				

Source: JICA Study Team, 2018

Operation Phase

Once the power plant has been built, there will be no excavation of new areas, thus no impact is foreseen.

6.4.6 Land acquisition and resettlement

Impact on Land, Assets and Crops/Trees

The total land to be acquired by TANESCO will be 159.8 ha in total in Kisiwa and Namgogoli villages. Results from the valuation reports revealed that 140 landowners will be affected by the proposed Project as shown in ***Table 6-45***.

Table 6-45 Number of Landowners per Admin Unit

Valuation Report	**Village**	**Number of Land Owners**
October 2017	Kisiwa	99
	Namgogoli	29
February 2018	Kisiwa	12
	Total	140

Source: Valuation Reports in October 2017 and February 2018

Table 6-46 Number of Potential Affected People by Necessity of Relocation

Type of loss	No. of Affected Households			No. of Affected People		
	Formal	Informal	Total	Formal	Informal	Total
To be relocated	11	0	11	62	0	62
No need of relocation	129	0	129	722	0	722
Total	**140**	**0**	**140**	**783**	**0**	**783**

Source: IRA 2018

Table 6-47 Affected Land by Type

Category of Land	Land size in hectare
Land for agriculture at	
Kisiwa village	123.5
Namgogoli village	35.8
Addition land take in Kisiwa village in 2018	
Land for agriculture	0.5
Land for houses/structures	0.04
Total	**159.8**

Source: Valuation Reports in October 2017 and February 2018

There are several residential structures within the proposed power plant that will be affected by the project. The affected houses are in Kisiwa villages resulted from additional land acquisition near fish landing site. These structures are to be demolished to pave for the project site. The structures to be demolished according to the valuation reports include; Houses (11), Sheds (4), Barns for livestock (3), and Well (1) as shown in ***Table 6-48.***

Table 6-48 Affected Structures

Valuation Report	Village	House	Other facilities		
			Shed	**Barn**	**Well**
October 2017	Kisiwa	3	1	0	0
	Namgogoli	0	0	0	0
February 2018	Kisiwa	8	3	3	1
	Total	**11**	**4**	**3**	**1**

Source: Valuation Reports in October 2017 and February 2018

Affected households who lose more than 10% of their productive income generating assets are considered severely affected. Among 36 interviewed households of the proposed Project, 22 HHs will lose more than 10% of productive land (***Table 6-49***). The socio-economic characteristics of Project Affected People (PAPs) is described in Section **4.2.6**.

Table 6-49 Household Losing more than 10 Percent of Land Size

Land size lost in percent	Number of interviewed Household	Percent
25 -40	3	13.6
41 - 80	3	13.7
81 - 100	16	72.7
Total	**22**	**100.00**

Source: IRA 2018

A total of 42 graves are going to be affected by the proposed Project as shown in ***Table 6-50***. Under the Graves relocation Act, TANESCO will be required to pay compensation to the owner of the graves and also arrange for the relocation of all the graves before the construction activities commerce.

Table 6-50 Loss of Private Graveyards

Administrative Unit	Number of graves
Kisiwa village	42
Namgogoli village	0
Total	42

Source: Valuation Reports in October 2017 and February 2018

Permanent crops include those that take more than a year to reach full maturity and can be harvested over a long period of time. The common permanent crops in along the proposed power plant include cashew nuts, coconut tree, banana trees, fruit trees as well as shades related trees. The land under the proposed projects is currently used by local people to grow various permanent crops used as food and cash crops. PAPs with standing crops and trees on their farms and plots within the project areas are entitled to compensation. Each tree or acre is counted and compensated according to its market value and age of maturity.

Seasonal crops are mainly those that take less than six months to reach total maturity that allows them to be fully harvested and then the land will be cleared. These crops mainly include maize, beans, rice, cassava, sweet potatoes and cotton. Disruption of farming activities and the disturbance of crops will occur during construction activities of the power plant. See **Table 6-51** for more detail.

Table 6-51 Affected Crops

Crops and Trees	June 2016		February 2016	Total
	Namgogoli	Kisiwa	Kisiwa	
Cashew	523	3467	0	3990
Timber Trees	531	1569	71	2171
Pineapple	268	216	0	484
Soursop	1	227	0	228
Mango Trees	13	157	0	170
Tamarind tree	20	136	4	160
Ebony tree	0	132	16	148
Banana	6	88	0	94
Sisal plant	13	74	0	87
Baobab	2	35	15	52
Pawpaw tree	0	52	0	52
Coconut	2	37	0	39
Mitopetope	0	0	19	19
Large Mango	0	17	0	17
Mmongo	0	15	0	15
Mitiasli	0	0	14	14
Orange tree	0	10	0	10
Pine tree	0	5	0	5
Lime	0	4	0	4
Margosa/Neem tree	1	0	1	2
Makaburi	2	0	0	2
Pepper	0	0	2	2
Hemp	0	1	0	1
Kapok tree	0	1	0	1
Mitimao	0	1	0	1

Source: Valuation Reports in October 2017 and February 2018

In trying to understand PAPs preferences on the mode of compensation PAPs were asked to indicate their preferences between cash compensation and in kind compensation and whether they will prefer to be relocated in the same village or would like to be relocated in the outside village or district. Compensation will replenish the lost assets if used for intended purpose and when is paid promptly. In kind compensation could be the best option for the vulnerable groups who are unable to utilize the compensation money to intended purposes (e.g. building a new house) due to disabilities, addiction, old age (elderly), and widow. These will need special assistance.

All sampled respondents expressed their preference to cash compensation. The major reason for the compensation was to enable them to buy another in an area where they prefer. According to the respondents, the option for in-kind compensation is not acceptable because they are not where they be located and the given land will meet their requirement. However, both cash and in kind compensation mode are considered in implementing compensation upon request.

Majority 97.2% of respondents are willing to relocate to pave the way for the construction of the power plant at Kisiwa and Namgogoli villages. 2.8% of the respondents were not willing to relocate because of difficult to get another land of the same quality.

Nearly 75.0% of the interviewed PAPs wanted to resettle in within the same village, if required to relocate from their existing plot or area to be acquired by the Project. Some 22.2% of the respondents were ready to relocate to another village within the district and 2.8% were ready to relocate outside the district (***Table 6-52***). Relocation in the same area or village will assist PAPs to link with the community they used to live with thus reducing the risk of households' disintegration with their communities.

Table 6-52 Preference of the Area to Resettle by the Interviewed PAPs

	Number of Interviewed PAPs	Percent
Within the village	27	75.0
Outside the village within the district	8	22.2
Outside the district	1	2.8
Total	**36**	**100.0**

Source: IRA 2018

Mitigation measures

- Conduct land acquisition process in accordance with the recommendation suggested in the Due Diligence Report.

  Note: The due diligence study was undertaken in addition to this ESIA study to make full reviews of the land acquisition and resettlement activities of the proposed Project. The result of due diligence study was compiled as the Due Diligence Report (DDR). It proposes actions to TANESCO to fill the gap between legislation in Tanzania and the JICA Guidelines for Environmental and Social Considerations (April, 2010) (JICA Guidelines) as well as the World Bank policies for involuntary resettlement.

The methodologies for preparing the DDR entailed desk reviews of relevant literature undertaken during initial preparations and continued throughout the assessment phase and preparation of the document. Information sources include documents from TANESCO, Ministry of Energy, Mtwara District Council, national and local data information centers/sources and the JICA Study Team including: Fieldwork, consultations were conducted by paying visits to Mtwara Regional Administrative Secretary, Mtwara District Council where the proposed Project will be located. In addition to fieldwork, Focus Group Discussion and socio-economic survey was also undertaken in Kisiwa and Namgogoli villages where the power plant and its associated infrastructures will be located.

This indicative cost estimation was prepared based on the best information available at the time of preparation of the DDR. As for compensation cost, the valuation reports (October 2017 and February 2018) were used as a reference for compensation on land, crops/trees and allowances. Compensation on structures were also referred the valuation reports, but figures without deduction of depreciation were used to pay compensation at the full replacement cost.

- Provide income restoration for those who will lose their livelihood due to land acquisition.
- Keep constant and open communication with PAPs and other stakeholders
- Setting up of a grievance mechanism to address any concern from the affected population.

Table 6-53 Significance of Impact on land acquisition and resettlement prior to construction

Impact	Land acquisition and resettlement impact				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of accidents or incidents in the local area is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duratio	Temporary	Short-term	Long-term	**Permanent**	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequenc	The impact will occur once prior to commencement of the construction phase.				
Impact Magnitud	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **Medium.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Source: JICA Study Team, 2018

Vulnerable households/population

These are people with special needs that would require special consideration and assistance from project implementers or community in general. They include the elderly, sick (HIV/AIDs afflicted persons), orphans, women with special needs (unmarried, widow, small-scale female) and farmers likely to suffer loss of land due to construction of Mtwara power plant, stations or terminals (whether owners, encroachers or tenants). These groups are being identified as particularly vulnerable so that special attention would be paid to them by identifying their needs from the baseline study. The household survey identified different categories of vulnerable people as shown in ***Table 6-54***.

Table 6-54 Vulnerable households/population of interviewed households

Type of vulnerability	Number
Women headed household	04
Elderly	08
Disabled – physical	01
Total	13

Source: JICA Study Team, 2018

Mitigation measures

- Provide Income Restoration Program for Vulnerable households
- Provide assistance on how to go through the compensation process.

Table 6-55 Significance of Impact on land acquisition and resettlement particularly on vulnerable households and people

Impact	Land acquisition and resettlement impact on vulnerable households and people				
Impact Nature	**Negative**	Positive	Neutral		
	Increase of accidents or incidents in the local area is **negative.**				
Impact Type	**Direct**	Indirect	Induced		
	The impact is **direct** to the community health.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	Impact has the potential to have a lasting effect.				
Impact Extent	**Local**	Regional	Global		
	The impact is limited within the local villages.				
Impact Scale	The impact scale is medium.				
Impact Frequency	The impact will occur once prior to commencement of the construction phase.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	The impact magnitude is likely to be **Medium.**				
Vulnerability of Receptors	Low	**Medium**	High		
	The vulnerability of receptor is likely to be **medium.**				
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is likely to be **moderate.**				

Source: JICA Study Team, 2018

6.5 ANALYSIS OF ALTERNATIVES FOR THE PROJECT

In order to be able to make better and informed decisions, it is important to consider alternatives that can enable achievement of the better results with less adverse effects. The main factors considered in the selection of alternatives include potentiality of the option in terms of economic development, location, magnitude of environmental loss and sensitivity of area. Based on identified project issues and foreseen impacts, the following alternatives are discussed at this preliminary stage for the proposed project.

6.5.1 *"No Project" Alternative*

The no project alternative entails maintaining current status of power generation sources in Tanzania and that Tanzania continues to struggle with shortage of power, quality of power supplies and stability. The proposed thermal power plant in Mtwara is one of the several candidate thermal power project considered for development under the revised Power System Master Plan of 2016. The proposed project is intended to generate 300MW that is expected to be connected to the national grid to provide electricity. Implementation of the no project alternative will deny this amount of power to the national grid which is required to supply the expanding power demand as forecasted by the Power System Master Plan 2016. Therefore this alternative does not seem viable since the country need power to supply to the expanding demand as the country is implementing and industrialization scheme to middle income country by 2030.

6.5.2 *Location alternative*

Power plant location

The location alternative means considering different sites for the proposed development. Two alternative sites for the proposed the Mtwara power plant, have been studied. These are the Mikindani site and the Project Site. The location of these two sites are shown in **Error! Reference source not found.**.

Figure 6-25 Location of Power Plant Site Alternatives

Source: JICA Study Team using Google Earth and Google map, 2018

The comparison results of candidate locations are presented in the ***Table 6-56***. Criteria used for evaluation include distance to cooling water source, fuel gas supply (Mnazi bay to Dar es Salaam gas pipeline offers opportunity for gas taping option), accessibility to the sites, and potential environmental and social impacts.

Mikindani site faces the Mikindani bay which has wider opening to the Indian Ocean than the Sudi creek (Kisiwa Site) and this is advantageous for sea water cooling. However, the Project Site is designated as an area for power plant development, according to the Mtwara Master Plan. It is more advantageous to ensure the land for the Project Site. In terms of environmental and social impacts, the Project Site is more desirable due to less resettlement and noise sensitive receptors.

Table 6-56 Comparison of Power Plant Site Candidates

Items	Project Site	Mikindani Site
Overall evaluation	◎ This area is designated as "power plant site" in the official local regional master plan, and the extent of necessary resettlement is smaller than Mikindani site.	△ Mikindani site is designated as residential area in the Mtwara Master Plan, therefore the master plan is required to be modified to use this site. In addition, the extent of resettlement is larger than Project Site.
Location	・Kisiwa village, Naumbu ward, Mayanga division, Mtwara District ・Population: 375 HH (1,119 people)	・Naumbu Kusini village, Naumbu ward, Mayanga division, Mtwara District ・Population: 322 HH (1,272 people) ・Major ethnic group is living in this area is Makonde. Some other groups such as Makau and Mwera are also living here.
Area	160 ha	12.5 ha (expected area)
Land Use	Power Plants should be installed in the power plant site or Industrial area as designated by the Mtwara Master Plan.	
	・The site is designated as power plant site in the Mtwara Master Plan.	・The site is designated as residential in the Mtwara Master Plan. (It is needed to change the land use designation for construction of power plant)
Land Acquisition	・Valuation for the land to be acquired by TANESCO was conducted in 2016 and approved in December 2016. ・Land price: According to the valuation in 2016 based on Tanzanian legislation: Land price per acre TZS 7,000,000	・No activities have been conducted for land acquisition in this site. It is necessary to conduct the whole process of the land acquisition including valuation. ・Land price: According to Mtwara District Council, the land price of Mikindani site is expected to be about at least double of the price of Project Site since it is near the town.
Resettlement	・2 households (HHs), within the area where the valuation was conducted in 2016. (Affected properties were three structures with 15 people living, according to the interview from the villager.)	・Several households are expected to be relocated because of the land acquisition. ・The neighboring settlement, Pneba Puan, is very close to the site and it seems difficult to meet the noise limit for residential area and therefore this settlement (164 HHs, approximately 900 people) seems to be subjected to relocation and compensation if any mitigation measures are not applicable to meet the noise limit.

Items	Project Site	Mikindani Site
Compensation	・For the loss of crops, lands, properties, disturbance allowances. ・Approved total compensation value based on Tanzanian legislation (Approval date is 29th December, 2016) : TZS 3,611,943,872.09 ・Number of people to be compensated: 128 (among them about 15 people are expected to be relocated.) ・The payment of the compensation value approved is underway by TANESCO.	・For the loss of crops, lands, properties, disturbance allowances. ・Mitigation measure for noise at the settlement (Penba Puan Hamlet of 164 HHs, approximately 900 people) adjacent to the site is expected to be required [1]. (See the explanation of Resettlement above.)
Cultural Heritage	・According to the village chairman, no historical and cultural site in the site. ・The historical site of Kisiwa village is located north of the Project Site around the baobab tree, where the villagers respect and protect.	According to the village chairman, no historical and cultural site in the proposed site.
Livelihood	・Acgriculture and fishery are the main livelihood of the villagers. ・Around 150 fishermen are active in the creek, more investigation is needed to confirm the expected impact. ・There are 8 fishery groups for Kisiwa and Namgogoli village.	・Fishery is the main livelihood of the villagers. Most of the households in the villages are engaged in fishery. ・Around 300 fishermen are active around the site.
Ecosystem	・Mangrove: Some of the mangrove trees are expected to be cut down to install intake and outfall facilities in case of seawater cooling. ・Coral: According to the village chairman, there are not so many corals in the creek but some corals are existing. ・There are two rivers that flow into the creek; Mbuo river and Mambi river.	・Mangrove: There are very limited number of mangrove trees observed near the site. ・Coral: According to the village chairman, coral is found along the shore line of the site. Coral might be damaged due to thermal water discharge.

Source: JICA Study Team, 2018

Transportation route

Most of the transportation route for the project will utilize existing roads. Two alternative routes are considered as transportation route from Mtwara Port to the power plant site (refer to ***Figure 6-26*** and ***Table 6-57***). Route 1 is preferred since two-thirds of the route is along the existing paved trunk road and less impact on local communities is expected.

Table 6-57 Comparison of Transport Route from Mtwara Port

	Route 1	Route 2
Overall evaluation	Road condition is better than Route 2 and less impact to local communities are expected.	Road condition is not good as Route 1 and more impact on local communities are expected.

[1] Tanzania Environmental Noise Standards. TZS 932:2006: Acoustics - General Tolerance Limits for Environmental Noise. The maximum limits of noise as per Tanzania regulatory for residential areas is 50 dBA during the day and 35 dBA during the night.

	Route 1	Route 2
Brief description	The route is along the trunk road B2 up to Dangote cement factory followed by unpaved road up to near the power plant site. Most of the route is along the existing road.	The route is along the B2 trunk road up to Mikindani followed by the unpaved road up to the power plant site. Most of the route is along the existing road.
Length	Approx. 40 km	Approx. 40 km
Time to the power plant site	Shorter than route 2	Longer than route 1
Environment	The route does not passes reserved area.	The route does not passes reserved area.
Socio-economic	Two third of the route is along the existing trunk road B2 with good condition. The route passes only one settlement area of Kisiwa village near the power plant site.	The route is rather narrow and passes several settlement areas. In the middle of the route is along the settlement area spanning for 2.5km and it is a community road. More impact on local communities is expected than Route 1.

Source: JICA Study Team, 2018

Figure 6-26 Transport Route Alternatives from Mtwara Port

Source: JICA Study Team using background map of Google Earth, 2018

6.5.3 *Technology alternative*

The technology alternative covers a wide range of issues including cooling system, water use efficiency and output maximization. In terms of cooling system for the proposed thermal plant, the design seems to come up with a once-through cooling system using seawater from Sudi creek with combined cycle system in power generation processes.

As cooling technology alternatives, seawater cooling (once-through cooling) and air cooled condenser (ACC) are considered. These have implications in terms of water use, energy efficiency, and associated environmental and social impact.

In once-through cooling systems, water is withdrawn from nearby body of water, Sudi creek, diverted through a condenser where it absorbs heat from the steam, and then discharged back to its original source at higher temperature, expecting 7 degrees higher than the water temperature at intake. Because once-through cooling systems do not recycle the cooling water, this leads to high volumes of daily water withdrawals.

On the other hand, ACC does not require such water withdrawals and thermal discharge into water bodies. The trade-off for these water savings and environmental benefits by ACC is a negative impact on efficiency. ACC has lower vacuum under high ambient temperature compared with water-cooled condensers, decreasing steam turbine efficiency, and thus requiring more fuel consumption for the same generation output. It also results in more GHG emission.

6.5.4 Resource alternatives

As a water source for the proposed power plant, it was originally planned to supply water from Mtwara-Ruvuma River water supply project. However, the project has not progressed since 2016. Therefore, as the alternative, the water from MTUWASA was considered to be source of water for the proposed power plant. MTUWASA is implementing a development project for the deep wells located near the Mbuo River. They have developed 2 deep wells, and the present water supply volume capacity is about 1,200 m3/day. Currently, the water, supplied solely to the demand in Kisiwa village and surrounding area, is about 400 m3/day. On the other hand, the water demand of this project is approximately 300 m3/day at Kisiwa site. MTUWASA committed that the use of water for the Project is totally acceptable.

Water supply volume of the third deep well is expected to be about 650 m3/day. In addition, there is a well about 2 km south of the above wells. About 30 m3/hr of water is flowing out from the well without pumping. Furthermore, MTUWASA continuously develops water sources in order to prepare for the future demand growth, especially for the planned Mikindani industrial zone.

7 MITIGATION MEASURES

Potential impacts from the project have been assessed in terms of its significance. While some impacts are negligible in nature, other impacts were rated as minor and moderate. In order to reduce residual impacts that may be caused by the Project during the pre-construction, construction and operation phases have been considered, mitigation measures are described in this Chapter.

7.1 ENHANCEMENT OF POSITIVE IMPACTS

- Develop and implement a local recruitment and procurement management plan. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers.
- Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the project.
- Inform local villagers of job opportunities in a timely manner.
- Inform local businesses of contracting opportunities in a timely manner such as awareness on forthcoming investment and employment opportunities, including sensitization of farmers for production of required quality of foods such as vegetables.

7.2 MITIGATION OF NEGATIVE IMPACTS (CONSTRUCTION PHASE)

7.2.1 Water Resources

Wastewater and stormwater runoff

- Adequate sanitary facilities will be provided for the construction workforce. Septic tanks will be provided to treat sanitary discharge.
- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge.
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site.
- Design drainage for the controlled release of storm flows.
- Regularly, and particularly following rainstorms, inspect and maintain drainage and erosion control and silt removal measures to ensure proper and efficient management at all times.
- Mulch to stabilise exposed areas, where practicable and appropriate. Re-vegetate areas promptly, where practicable and appropriate.
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage of open stockpiles of construction materials.
- Construct wells/ sediment basins for the separation of oil in the wash water and stormwater drains.
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps.
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors.

Waste Storage and Disposal

- Provide training to labourers for waste disposal in designated areas and use of sanitation facilities.
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type.
- Store waste systematically to allow inspection between containers to monitor leaks or spills.
- Ensure that storage areas have impermeable floors and containment.
- Dispose of waste by licensed contractors.

Accidental Spills and Leaks

- Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal.
- Hazardous waste storage areas will comply with best practice/ international standards.
- Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the early stages of the Project implementation.
- Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks.
- Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals.
- Use of spill or drip trays to contain spills and leaks.
- The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters.
- Contractor will implement a training program to familiarise staff with emergency response procedures and practices related to contamination events.
- Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials.
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated.
- Store wastes in closed containers away from direct sunlight, wind and rain.
- Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills.
- Ensure storage areas have impermeable floor and containment.
- Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).

7.2.2 *Air Quality (Dust Generation and Air Emissions)*

- Water spraying of or covering all exposed areas and stockpiles;

- Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust;
- Minimizing the size of exposed areas and material stockpiles and the periods of their existence;
- Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time;
- Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions;
- Cleaning the entire construction work sites, as necessary;
- Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary;
- Watering the main haul road regularly to suppress dust emissions during truck movement;
- Prohibiting the burning of waste or vegetation on site;
- Compacting the reclaimed land immediately to avoid fugitive dust emissions
- Maintaining and checking the construction equipment regularly.
- Switching off engines when idling.

7.2.3 Noise

- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Shut down or throttle down machines and equipment when not in use ;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable;
- Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable;
- Avoid transportation of materials on- and off-site through existing community areas; and
- Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.

7.2.4 Waste

- Prior to the start of construction, a waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse during the construction and operation phases for all the waste streams identified.
- Engage with local authorities and other stakeholders to determine the capacity of the local waste management network to accommodate waste streams from the Project during construction and operation.
- Conduct training to workers on site regarding how to avoid, reduce and reuse wastes.

- Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately.
- All waste collected should be managed and disposed of in accordance with the required regulations.
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed.
- Monitoring of appointed waste contractors to ensure proper waste disposal, in accordance with applicable regulations.
- The appointed waste contractors shall report on regular basis on any cross-boundary transport of waste.

7.2.5 *Soil*

Site Preparation activities

- Delineation of clearance boundaries to limit the areas to be cleared.
- Scheduling clearance activities, if possible to avoid extreme weather events such as heavy rainfall, extreme dry and high winds.
- Revegetation areas with temporary land use, conducting progressive rehabilitation.
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers.
- Reuse topsoil as much as possible within rehabilitation activities.
- Control erosion through diversion drains, sediment fences, and sediment retention basins.

Accidental leaks, spillage, and contamination

- Fuel tanks and chemical storage areas will be sited on sealed hardstand areas, provided.
- Secondary containment, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude storm water run-off from entering the contained area.
- Any refuelling activities will only take place within a designated hard stand area with spill kits present.
- A dedicated storage area for construction material will be developed to minimise the potential for damage or contamination of the material.
- Sufficient space will be left between all waste containers so as to identify any spills or leaks.
- Unloading and loading protocols will be developed to ensure that staff are able to undertake these tasks in a manner that minimises the risks of spills occurring.
- A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency response procedures and practices related to contamination events.
- Appropriate management, storage and disposal of all waste streams will be implemented.

7.2.6 *Terrestrial Ecology*

- Vegetation clearance should be confined only to necessarily designated sites. The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing.
- Valuable timber removed from woody biomass be made available for public consumption where possible.
- For construction areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible.
- The Project shall implement landscaping and re-vegetation after completion of construction using native species where possible where possible.
- Weed and pest management measures shall be implemented to avoid introduction of invasive weeds to natural and modified habitat areas.
- Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors.
- Appropriate speed limits for construction vehicles will be enforced to limit noise and dust generation and to minimise potential for fauna strike.
- Obtain necessary permits prior to clearing of mangrove areas.

7.2.7 *Marine Ecology*

- Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge.
- Use methods for minimising sediment runoff, as appropriate to the conditions on-site.
- Design drainage for the controlled release of storm flows.
- Regularly, and particularly following rainstorms, inspect and maintain drainage and erosion control and silt removal measures to ensure proper and efficient management at all times.
- Mulch to stabilise exposed areas, where practicable and appropriate. Re-vegetate areas promptly, where practicable and appropriate.
- Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage of open stockpiles of construction materials.
- Construct wells/ sediment basins for the separation of oil in the wash water and stormwater drains.

7.2.8 *Land Acquisition and Resettlement*

- Conduct land acquisition process in accordance with the recommendation suggested in the Due Diligence Report.
- Provide Income Restoration for those who will lose their livelihood due to land acquisition, including vulnerable groups.
- Keep constant and open communication with PAPs and other stakeholders
- Setting up of a grievance mechanism to address any concern from the affected population.

- Provide assistance to vulnerable groups on how to go through the compensation process.

7.2.9 *Community Infrastructure and Public Services*

- Provide appropriate amenities at the workers' camp. This will help reduce the need for workers to utilize local infrastructure and services.
- Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the project.
- Develop and implement a site safety management plan. This plan will need to ensure appropriate and adequate health care services are provided on site and at the worker camp to address/ manage worker illnesses and injuries.

7.2.10 *Employment and Economy*

- Keep open communication with the affected people
- Study the alternative options for livelihood restoration
- Develop a livelihood restoration plan

7.2.11 *Community health, safety and security*

- Training for all workers about communicable diseases,
- Sensitization of enforcement of HIV/AIDS law and regulations.
- Establish amenities at the worker camp to that help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers.
- Establish a workforce code of conduct. Include in the code specific measures on anti-social behaviour.
- Vector management procedures, including consideration of whether pesticides will be utilized to reduce the presence of vectors onsite.
- Provision of onsite healthcare, to ensure that medical attention can be sought.
- Emergency management procedures, should a health issue escalate and require a rapid response.
- Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic.
- Conduct consultations and information dissemination to villagers (fishermen groups) regarding the use of Sudi Creek during transport of materials.
- Provide appropriate training for security personnel and monitor implementation of the training over time
- Create awareness on all security issues including activities the community police (polisi jamii) in the area.

7.2.12 *Occupational Health and Safety*

- Develop and implement a health and safety plan.
- Provide personal protective equipment (PPE)
- Provide appropriate training for workers on risks to health and safety in the workplace

- Create awareness on all security and safety issues and hazards at the site
- Provide safety signs
- Equip the site with a first aid kit

7.2.13 *Cultural Heritage*

- Implement a Chance Finds Procedure according to IFC standard 8
- Coordinate closely with family members
- Take precautions in not disturbing the area particularly during transfer of heavy equipment

7.3 *MITIGATION OF NEGATIVE IMPACTS (OPERATION PHASE)*

7.3.1 *Water Resources*

Wastewater discharge and runoff

- Domestic wastewater will be discharged into septic tanks.
- Provide adequate sanitary facilities for onsite personnel.
- Design drainage culverts for the controlled release of storm flows
- Treated effluent will comply with WB/IFC EHS Guidelines as described in Section 3.9. The wastewater discharged will be monitored in accordance with the Environmental and Social Monitoring Plan as described in Section 9.2.

Water Abstraction

- Keep close coordination with MTUWASA to ensure that water requirements of the Project will not affect water supply of the nearby villages.

Accidental Spills and Leaks

- The storage areas for oil, fuel, chemicals and waste will be surrounded by containment/spill control measure to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters.
- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.
- Use of spill or drip trays to contain spills and leaks
- Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals.
- SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs.

7.3.2 *Air Quality*

Air emissions from the power plant

- Install continuous emission monitoring system (CEMS) to monitor the NOx emission concentrations and other relevant parameters at the main stacks and bypass stacks.

Greenhouse gas emissions

- Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO2e unit.
- Develop and implement preventive maintenance plan for power generators, machines, and engines to ensure combustion efficiency.

7.3.3 *Noise*

- Well-maintained equipment to be operated on-site;
- Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components;
- Reduce the number of equipment operating simultaneously as far as practicable;
- Avoid transportation of materials on- and off-site through existing community areas

7.3.4 *Wastes*

- Develop a waste management plan
- Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately.
- All waste collected should be managed and disposed of in accordance with the required regulations.
- Education to workers on site shall be undertaken to avoid, reduce and reuse wastes generated.
- Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed.
- Monitoring of appointed waste contractors to ensure proper waste disposal, in accordance with applicable regulations.

7.3.5 *Soil*

- All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground.
- Standard Operation Procedures (SOPs) will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc.
- Operating personnel will be trained on the SOPs.

7.3.6 *Terrestrial Ecology*

- Vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation.
- For areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible.
- Appropriate speed limits for vehicles will be enforced to minimise potential for fauna strike.

7.3.7 *Marine Ecology*

Thermal Water Discharge

- Monitor temperature of thermal water discharge at discharge point
- Design the outfall structure that can minimize impact on marine species, as possible.

Impact of Water Intake Facility

- Consider existing marine ecology in Sudi Creek in the planning such as siting and design of the water intake facility.
- Employ design and technology(ies) that lessen impact on marine species, as practical

Wastewater Discharges and Runoff

- Install oil/water separators to treat surface run-off prior to discharge to the stormwater system. Separated oil will be disposed of as part of oily wastes and handled as a hazardous waste stream.
- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps.
- Implement adequate sanitary facilities for onsite personnel.
- Design drainage culverts for the controlled release of storm flows
- Stormwater drainage, sewage and wastewater will be treated prior to discharge to the discharge point and the treated effluent will comply with WB/IFC EHS Guidelines as described in Section 3.9. The wastewater discharged will be monitored in accordance with the Environmental and Social Monitoring Plan as described in Section 9.2.

7.3.8 *Community Infrastructure and Services*

- Develop and implement a traffic management plan.
- Develop and implement a site safety management plan. This plan will need to ensure appropriate and adequate health care services are provided on site.

7.3.9 *Occupational Health and Safety*

- Provision and enforcement of the proper use PPEs

- Provide health checks to the employees
- Provide appropriate training on occupational health and safety
- Monitor implementation of the training over time
- Provision of safety signs

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 INTRODUCTION

Through a systematic assessment, the ESIA has identified a number of significant environmental and social impacts which may potentially result from the construction and operation of the Project. In order to manage and mitigate these impacts, a range of measures have been developed to reduce the overall residual impacts to acceptable levels and as low as reasonably practicable. Implementing and tracking the effect of these management and mitigation measures is an essential element to ensuring that the assessed residual impact levels are confirmed.

The key objectives of this Environmental and Social Management Plan (ESMP) are to:

- Collate the various mitigation and management measures developed throughout the ESIA into a single point;
- Identify implementation mechanism (e.g. responsible entities, financing sources, monitoring and reporting requirements) to ensure actual implementation of all mitigation and management actions throughout the various phases of the Project;
- Define monitoring requirements to determine the efficacy of all mitigation and management measures; and
- Provide clarity to all stakeholders as to what impacts have been identified, how they will be mitigated and managed, and through what means.

8.2 MODALITIES OF IMPLEMENTATION OF THE ESMP

TANESCO, together with its contractors, will be responsible for ensuring that mitigation measures in the ESMP are implemented throughout the life span of the project. The modalities of implementation of the proposed ESMP will have to be agreed with TANESCO.

Learning from experience in other project that TANESCO is undertaking, the monitoring activities have been partly contracted to supervising consultants. In this modality TANESCO and supervising consultant establishes a kind of consortium or collaborative organization involving key staff on engineering, environmental and social components working closely with counterpart staff from TANESCO. Data and reports on monitoring activities are reviewed and approved by TANESCO while requirements of the financiers is taken on-board.

8.3 OVERALL ROLES AND RESPONSIBILITIES OF THE PARTIES

The primary role and responsibility for implementation of the ESMP lies on TANESCO and its contractors. Regulators will have to make sure that the project proponent and the contractor are fully complying to the ESMP. In terms of the implementation of the recommended monitoring plan as described in Chapter 9, TANESCO staff will be responsible at the local implementation level, together with the Environmental Unit of TANESCO. TANESCO can as well hire consultant or any Institution to assist in implementation. Contractors will be responsible for implementation mitigation measures proposed in the plan and make sure they comply with the Tanzanian standards while considering requirements of financing agencies.

Based on the outcomes of the EIA, site specific detailed management plans are to be developed to guide TANESCO and its contractors in implementation of all mitigation and management measures. The detailed management plans will be leveraged by the Engineering, Procurement, and Construction (EPC) contractors in developing their own management plans.

The role of the regulator, in this case NEMC, will be following up to ensure the conditions of the issued certificates as well as the issues pointed out in the ESMP are comprehensively implemented and addressed by the proponent. Similarly NEMC will be receiving self-monitoring reports covering compliance of the issues indicated in the ESMP.

8.4 MANAGEMENT PLANS

Mitigation planning involves undertaking activities during the design, implementation and operation phases of a project to eliminate, offset, or reduce adverse environmental impacts to acceptable levels. The proposed impact mitigation/enhancement plan for the project is summarized in Table 8-1. The developer has to set aside source of funds to deal with some of the mitigation measures before project implementation starts, as most of the mitigation activities need to be incorporated within the various stages of project implementation.

The developer must integrate the cost of implementing these mitigation measures into the overall project cost. However, since some of the measures are expected to be implemented by the relevant local and central government institutions, the cost for such measures will be borne by the relevant institutions and/or shared with the develop. For example, the need to improve and upgrade social services within the project area, provision of security organization and judiciary in order to allow the existing systems to cope with expected changes resulting from project implementation. The central government will be responsible for undertaking such measures.

Table 8-1 Environmental and Social Management Plan (ESMP) for the Proposed Mtwara Thermal Power Plant at Kisiwa Village

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
Site Preparation and Construction Phase					
Water resources	• Wastewater Discharges and Runoff • Excavation of soil for building and equipment foundations	• Impaired quality of water resources (surface/subsurface water, groundwater) • Reduced surface water infiltration	• Adequate sanitary facilities will be provided for the construction workforce. Septic tanks will be provided to treat sanitary discharge. • Liquid effluents arising from construction activities will be treated to the applicable IFC guideline prior to discharge. • Use methods for minimising sediment runoff, as appropriate to the conditions on-site. • Design drainage for the controlled release of storm flows. • Regularly, and particularly following rainstorms, inspect and maintain drainage and erosion control and silt removal measures to ensure proper and efficient management at all times. • Mulch to stabilise exposed areas, where practicable and appropriate. Re-vegetate areas promptly, where practicable and appropriate. • Provide measures to prevent the washing away of construction materials, soil, silt or debris into any drainage of open stockpiles of construction materials. • Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. • Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors. Until the wastewater treatment facilities are installed, as necessary, they are transported by trucks etc. and then treated by sub-contractors.	TANESCO	50,000 USD
	• Waste Storage and Disposal	• Impaired quality of water resources (surface/subsurface water, groundwater)	• Implement the same mitigation measures to minimize impacts to Waste Management. • Provide training to labourers for waste disposal in designated areas and use of sanitation facilities. • Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type. • Store waste systematically to allow inspection between containers to	TANESCO	5,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
			monitor leaks or spills. • Ensure that storage areas have impermeable floors and containment. • Dispose of waste by licensed contractors.		
	• Accidental Spills and Leaks	• Impaired quality of water resources (surface/subsurface water, groundwater)	• Disposal sites to be designed for hazardous and non-hazardous waste, including sludge disposal. • Hazardous waste storage areas will comply with best practice/ international standards. • Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to TANESCO at the early stages of the Project implementation. • Contractor will prepare unloading and loading protocols and train staff to prevent spills and leaks. • Contractor will prepare guidelines and procedures for immediate clean-up actions following any spillages of oils, fuels or chemicals. • Use of spill or drip trays to contain spills and leaks. • The storage areas for oil, fuel and chemicals will be surrounded by bunds or other containment devices to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters. • Contractor will implement a training program to familiarise staff with emergency procedures and practices related to contamination events. • Provide dedicated storage areas for construction materials to minimise the potential for damage or contamination of the materials. • Segregate hazardous and non-hazardous waste and provide appropriate containers for the waste types generated. • Store wastes in closed containers away from direct sunlight, wind and rain. • Provide enough space to allow for inspection between waste containers so as to identify any leaks or spills. • Ensure storage areas have impermeable floor and containment. • Oil-contaminated water will be collected and handled by local licensed wastewater sub-contractors (if available, to be determined at a later stage).	TANESCO	10,000 USD
Air Quality	• Site preparation, filling and levelling. • Excavation of soil for building and equipment	• Dust Generation	• Water spraying of or covering all exposed areas and stockpiles. • Specifying transport networks and locating stockpiles as far away from the site boundary which is close to the air sensitive receptors, as practicable to minimize the impact of air pollutants and dust. • Minimizing the size of exposed areas and material stockpiles and the	TANESCO	30,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
	foundations. • Pile driving for the equipment foundation. • Concrete works. • Transportation related activities		periods of their existence. • Temporary stockpiles of dusty materials will be either covered entirely by impervious sheets or sprayed with water to maintain the entire surface wet all the time. • Covering the construction materials transported by trucks or vehicles entirely to prevent dust emissions. • Cleaning the entire construction work site, as necessary. • Controlling the height of unloading the fill materials during filling as far as possible. Where possible, this should be well below the height of the hoardings along the Project site boundary. • Watering the main haul road regularly to suppress dust emissions during truck movement. • Prohibiting the burning of waste or vegetation on site. • Compacting the reclaimed land immediately to avoid fugitive dust emissions.		
	• Operation of heavy machinery and transport vehicles • Operation of DG sets	• Vehicle exhaust	• Maintaining and checking the construction equipment regularly. • Switching off engines when idling.	TANESCO	30,000 USD
Noise	• Heavy machinery operations for construction works. • Piling for equipment foundation • Transportation related activities	• Increased noise disturbance/ vibration	• Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components. • Shut down or throttled down machines and equipment when not in use. • Reduce the number of equipment operating simultaneously as far as practicable. • Orientate equipment known to emit noise strongly in one direction so that the noise is directed away from receptors far as practicable. • Locate noisy plant (such as hydraulic hammer and lorry mounted concrete pump) as far away from receptors as practicable. • Avoid transportation of materials on- and off-site through existing community areas. • Use material stockpiles and other structures, where practicable, to screen noise sensitive receptors from on-site construction activities.	TANESCO	30,000 USD
Waste	• General Construction works • Construction workers camp	• Generate solid and hazardous wastes • Spillage of oil and any hazardous	• Prior to construction commencing, a waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse during the construction and operation phases for all the waste streams identified.	TANESCO	10,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
		material	• Engage with local authorities and other stakeholders to determine the capacity of the local waste management network to absorb the waste streams during construction and operation. • Education to workers on site shall be undertaken to avoid, reduce and reuse wastes generated. • Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately. • All waste collected should be managed and disposed of in accordance with the required regulations. • Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed. All end points for collected waste are to be inspected and audited and noted to be developed such that all wastes is able to be disposed of in an environmental responsible manner and in accordance with prevailing regulations. • Monitoring of appointed waste contractors for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with prevailing regulations. • The appointed waste contractors shall report on regular basis on any cross-boundary transport of waste.		
Soil	• Site clearing, sand filling and site preparation	• Loss of Soil due to improper management during site clearance activities	• Delineation of clearance boundaries to limit the areas to be cleared. • Scheduling clearance activities, if possible to avoid extreme weather events such as heavy rainfall, extreme dry and high winds. • Revegetation areas with temporary land use, conducting progressive rehabilitation. • Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers. • Reuse topsoil as much as possible within rehabilitation activities. • Control erosion through diversion drains, sediment fences, and sediment retention basins.	TANESCO	20,000 USD
	• Storage, handling and disposal of construction waste	• Soil contamination due to potential leaks, spills and importation of contaminated fill material during	• Fuel tanks and chemical storage areas will be sited on sealed hardstand areas. • Secondary containment, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any	TANESCO	30,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
		construction	hazardous spills and to exclude surface water run-off from entering the contained area. • Any refuelling activities will only take place within a designated hard stand area with spill kits present. • A dedicated storage area for construction material will be developed to minimise the potential for damage or contamination of the material. • Sufficient space will be left between all waste containers so as to identify any spills or leaks. • A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency procedures and practices related to contamination events. • Appropriate management, storage and disposal of all waste streams will be implemented.		
Terrestrial Ecology	• Site preparation and related activities • Construction and transportation related activities	• Loss of vegetation • Loss of vulnerable species, local terrestrial biodiversity and wild life	• Vegetation clearance should be confined only to necessarily designated sites. The planned clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing. Measurements required for monitoring mangroves and other terrestrial vegetation include ecological surveys where sampling on various ecological characteristics in terms of species composition change over time will be recorded/reported while comparing with the baseline data collected on permanently established monitoring plots as stated in mitigation measures for loss of local marine and terrestrial biodiversity. The measurements are taken based on the number of indicators outlined to demonstrate any likely change over time following implementation of the project. • Valuable timber removed from woody biomass be made available for public consumption where possible. • For construction areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible. • The project shall implement landscaping and re-vegetation (replanting and rebuilding the soil of disturbed land) after completion of construction using native species where possible. • Weed and pest management measures should be implemented to avoid introduction of invasive weeds to natural and modified habitat areas. • Oil, chemical and solid waste will be stored, and handled and disposed of by appropriately licenced waste management contractors. Construction	TANESCO	50,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
			materials and chemicals will be appropriately secured and locked down during flood season to avoid accidental release to the natural environment. • Appropriate speed limits for construction vehicles will be enforced to limit noise and dust generation and to minimise potential for fauna strike. • Compensate for the loss of Mangrove by replanting where applicable. Compensation should be paid to TFS as stipulated in the GN. 255, of THE FOREST (AMENDMENTS) REGULATIONS, 2017.		
Marine Ecology	• Site preparation and related activities • Construction and transportation related activities	• Destruction of corals	• In transporting the materials by ship, avoid the coral habitat area near the mouth of Sudi Creek (Kisiwa Bay). • Prevent leakage from ships for material transportation. • Conduct visual inspection of coral and measurement of water temperature around the mouth of Sudi Creek (Kisiwa Bay) to monitor any changes. • Conduct visual inspection of mangrove inside Sudi Creek (Kisiwa Bay)	TANESCO	5,000 USD
Land acquisition and Resettlement	• Land acquisition for the power plant complex area by TANESCO	• Physical and economical displacement of people in the proposed project site • Complains regarding land acquisition and resettlement	• Conduct land acquisition process in accordance with the Resettlement Policy Framework • Provide income restoration for those who will lose their livelihood due to land acquisition. • Keep constant and open communication with PAPs and other stakeholders • Provide assistance to vulnerable groups on how to go through the compensation process. • Setting up of a grievance mechanism to address any concern from the affected population. • Obtain necessary permit prior to clearing of mangrove area	TANESCO	
Community infrastructure and public services	• Increased construction worker • Transportation of personnel and use of road network	• Increased pressure on social services	• Provide appropriate amenities at the worker camp. This will help reduce the need for workers to utilize local infrastructure and services. • Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the project. • Develop and implement a site safety management plan. This plan will need to ensure appropriate and adequate health care services are provided on site and at the worker camp to address/ manage worker illnesses and injuries.	TANESCO	10,000 USD
Employment and economy	• General Construction activities	• Increased local market	• Develop and implement a local recruitment and procurement management plan. Development of the plan should involve consultation	TANESCO	10,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
		opportunities • Increased local employment	with relevant stakeholders, including government authorities and local villagers. • Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the project. • Inform local villagers of job opportunities in a timely manner. • Inform local businesses of contracting opportunities in a timely manner such as awareness on forthcoming investment and employment opportunities, including sensitization of farmers for production of required quality of foods such as vegetables.		
Community Health and safety	• Influx of construction workers	• Increased risk of HIV/AIDS and other STDS among works and local people	• Training for all workers on the transmission routes and common symptoms of communicable diseases • Sensitization of enforcement of HIV/AIDS law and regulations. • Establish amenities at the worker camp to that help minimize the interaction between the workforce (particularly temporary construction workers) and local villagers. • Establish a workforce code of conduct. Include in the code specific measures on anti-social behaviour. • Vector management procedures, including consideration of whether pesticides will be utilized to reduce the presence of vectors onsite. • Provision of onsite health care, to ensure that medical attention can be sought • HIV prevention awareness promotion for local communities.	TANESCO	100,000 USD
Community safety and security, Occupational Health and Safety	• Influx of construction workers • Heavy traffic movement	• Increased crime and insecurity • Increase risks, hazards and accidents	• Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic. • Conduct consultations and information dissemination to villagers (fishermen groups) regarding the use of Sudi Creek (Kisiwa Bay) during transport of materials. • Equip the first aid kit in the project site. • Provide appropriate training for security personnel and monitor implementation of the training over time • Create awareness on all security issues including activities the community police (*polisi jamii*) in the area. • Provide and enforce the proper use of PPEs.	TANESCO	5,000 USD
Cultural heritage	• General Construction activities	• Loss of heritage artifacts if discovered in the	• Implement a Chance Find Procedure in accordance with IFC Standard 8, if something has been discovered. • In case of such discovery during the construction activities, it is to be	TANESCO	20,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
		project site	reported to the relevant authorities such as Mtwara District Council and the Antiquities division of the Ministry of Natural Resource and Tourism (MNRT). • Ensure no cultural site, when notified prior to works, is disturbed without community agreement.		
		• Impact on graveyard	• Coordinate closely with the family members/ owners of the graveyard • Relocate graves when requested by local people. • Take precautions not to disturb the area particularly during transfer of heavy equipment • Provide access to the area during special religious and/or family events when graves are not moved.	TANESCO	2.5million USD
Land Acquisition and Resettlement	• Acquisition of land and properties	Physical and economic displacement of people in the proposed project site	• Conduct land acquisition process in accordance with the RAP (DDR). • Provide income restoration for those who will lose their livelihood due to land acquisition. Fishing activity is not the only means of livelihood of the PAPs, they are also engaged in other activities such as farming and livestock keeping, therefore, the PAPs will be supported in improving agriculture and livestock keeping. Also, it should be noted that they have access to other fishing site in nearby village where they can continue with their fishing activities. • Keep constant and open communication with PAPs and other stakeholders • Provide assistance to vulnerable groups on how to go through the compensation process. • Set up a grievance mechanism to handle concerns from the affected population	TANESCO	Included in the Land Acquisition Cost

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
Operation Phase					
Water resources	• Wastewater Discharges and Runoff	• Impaired quality of water resources (surface/subsurface water, groundwater) • Reduced surface water infiltration	• Domestic wastewater will be discharged into septic tanks. • Provide adequate sanitary facilities for onsite personnel. • Design drainage culverts for the controlled release of storm flows. • Chemical drains are treated in a wastewater treatment system after the neutralization treatment. Drains that may contain oil is treated in a wastewater treatment system after being treated with an oil separation system. • Treated effluent will comply with WB/IFC EHS Guidelines. The wastewater discharged will be monitored in accordance with the Environmental and Social Monitoring Plan as described in Section 9.2.	TANESCO	50,000 USD
	• Accidental Spills and Leaks	• Impaired quality of water resources (surface/subsurface water, groundwater)	• The storage areas for oil, fuel, chemicals and waste will be surrounded by containment/spill control measure to prevent spilled oil, fuel and chemicals from percolating into the ground or reaching the receiving waters. • All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground. • Use of spill or drip trays to contain spills and leaks. • Guidelines and procedures should be established for immediate clean up actions following any spillages of oil, fuel or chemicals. • SOPs will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs.	TANESCO	20,000 USD
Air quality	• Stack emissions	• Impact on ambient air quality	• Install continuous emission monitoring system (CEMS) to monitor the NOx emission concentrations and other relevant parameters at the main stacks and bypass stacks.	TANESCO	30,000 USD
	• Stack emissions	• GHG generation	• Conduct annual pollutant release inventory to monitor the GHG emissions from the Project. The GHGs emission shall be reported as CO2e unit.	TANESCO	10,000 USD
Noise	• Plant operations	• Increased noise disturbance/ vibration	• Well-maintained equipment to be operated on-site; • Regular maintenance of equipment such as lubricating moving parts, tightening loose parts and replacing worn out components; • Reduce the number of equipment operating simultaneously as far as practicable;	TANESCO	30,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
			• Avoid transportation of materials on- and off-site through existing community areas • Installing silencers, mufflers or acoustic enclosures to reduce sound power level of noisy equipment such as GT, ST, HRSG, etc. at all times if necessary.		
Waste	• Plant operations	• Waste Generation	• A waste management plan is to be developed which includes specific requirements to manage, avoid, reduce and reuse during operation phase for all the waste streams identified. • Education to workers on site shall be undertaken to avoid, reduce and reuse wastes generated. • Waste disposal facilities shall be sited and signposted in the project site. Solid waste generated by daily operations at the site should be collected using on-site bins before being disposed appropriately. • All waste collected should be managed and disposed of in accordance with the required regulations. • Contractors employed to manage the waste should clearly identify within their bidding documents how the collected waste will be managed • Monitoring of appointed waste contractors for the disposal of waste to ensure that it is able to be disposed of in an environmental responsible manner and in accordance with prevailing regulations.	TANESCO	20,000 USD
Soil	• Storage, handling and disposal of waste in operation	• Soil contamination due to potential leaks and spills	• All drainage/tanks, etc. will be positioned on concrete hard standing to prevent any seepage into ground. • Standard Operation Procedures (SOPs) will be prepared to manage any oil spills, leaks and/or seepages. SOPs will cover transport, handling, storage, use and disposal of oil/ oil wastes/ empty drums etc. Operating personnel will be trained on the SOPs.	TANESCO	10,000 USD
Terrestrial ecology	• Plant operations	• Impact on vulnerable species, local terrestrial biodiversity and wild life	• Vehicles and machinery will be maintained in accordance with industry standard to minimise unnecessary noise generation. • For areas requiring night-time lighting, lights will be used only where necessary and will be directed toward the subject area and away from habitat areas where possible. • Appropriate speed limits for vehicles will be enforced to minimise potential for fauna strike.	TANESCO	10,000 USD
Marine Ecology	• Thermal Water Discharge	• Impact on marine species and ecosystem	• Monitor temperature of thermal water discharge at discharge point and at the mouth of the Sudi Creek (Kisiwa Bay) , other 3 points and monitor the fish catch. In case, decrease of fish catch due to the project is confirmed	TANESCO	10,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
			additional measures such as income restoration measures will be discussed and implemented as necessary with the local communities and relevant authorities. • Thermal wastewater from the steam turbine is discharged after flowing into discharge pit, and treated wastewater with high temperature is discharged after lowering its temperature. • Conduct visual inspection of coral around the mouth of Sudi Creek (Kisiwa Bay) and mangrove inside the Sudi Creek (Kisiwa Bay) to monitor any changes. • Conduct visual inspection of mangrove to monitor any changes. • Design the outfall structure that can minimize impact on marine species, as possible		
	• Operation of the water intake facility	• Impact on marine species and ecosystem (e.g. impingement and entrainment)	• Consider existing marine ecology in Sudi Creek (Kisiwa Bay) in the planning such as siting and design of the water intake facility. • Employ design and technology(ies) that lessen impact on marine species, as practical	TANESCO	10,000 USD
Community infrastructure and public services	• Operation of the project and development of the neighbouring communities	• Increased pressure on social services	• Develop and implement a traffic management plan to minimize the impact experienced by road users as a result of the project. • Develop and implement a site safety management plan. This plan will need to ensure appropriate and adequate health care services are provided on site and at the worker camp to address/ manage worker illnesses and injuries.	TANESCO	5,000 USD
Employment and economy	• Operation of the project and development of the neighbouring communities	• Increased local market opportunities • Increased local employment	• Develop and implement a local recruitment and procurement management plan. Development of the plan should involve consultation with relevant stakeholders, including government authorities and local villagers. • Review opportunities to establish a skills training program with an aim of training interested local villagers to contribute to the project. • Inform local villagers of job opportunities in a timely manner. • Inform local businesses of contracting opportunities in a timely manner such as awareness on forthcoming investment and employment opportunities, including sensitization of farmers for production of required quality of foods such as vegetables.	TANESCO	5,000 USD

Affected Aspect	Project Activity and Affected Area	Potential Impacts	Proposed Mitigation Measures (If applicable)	Overall responsible Entity	Cost (USD)
Community safety and security, Occupational Health and Safety	• Operation of the project and increased populations in the neighbouring communities	• Increased crime and insecurity • Increase risks, hazards and accidents	• Provision and enforcement of the proper use PPEs such as hard huts and industrial boots. • Provide appropriate training for security personnel and monitor implementation of the training over time and create awareness on all security issues including activities the community police in the area. • Fencing of the Project Site with barbed wire • Putting up of safety signs	TANESCO	5,000 USD

Source: IRA, 2018

9 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

9.1 INTRODUCTION

This chapter provide an environmental and social monitoring plan for the proposed gas fired power plant at Kisiwa Village in Mtwara District. The mitigation plan and the monitoring plan together constitute the Environmental Management Plan (EMP) for the proposed development.

Monitoring refers to the systematic collection of data through a series of repetitive measurements over a period of time to provide information on characteristics and functioning of environmental and social variables in specific areas over time. Monitoring must include checking for effectiveness of mitigation and enhancement measures to deal with the predicted impacts of a particular project.

EMA No. 20 of 2004 defines roles for monitoring where the National Environment Management Council (NEMC) is empowered to enforce compliance to the environmental permits (Certificate) issued prior to development and follow in monitoring to ensure implementation of the Environmental Management Plans (EMP). NEMC therefore is required to conduct monitoring activities in collaboration with relevant sectors and other stakeholders.

There are different types of monitoring conducted in various project undertaking, these include;

- **Baseline monitoring:** the measurement of environmental parameters during a pre-project period and operation period to determine the nature and ranges of natural variations and where possible establish the process of change. Baseline monitoring for this project would entail observation of the types and rate of changes on the baseline conditions that has been identified in Chapter 5 and 6 which represent conditions prior to the start of the project.
- **Impact/effect monitoring:** involves the measurement of parameters (performance indicators) during construction, operation and decommissioning phase in order to detect and quantify environmental and social change, which may have occurred as a result of the project.
- **Compliance monitoring:** takes the form of periodic sampling and continuous measurement of levels of compliance with standards and thresholds – e.g. for waste disposal, air pollution, noise and vibration level. The monitoring for this project would mean collecting data on key parameters and compare them with national and international standards as provided in this report or other government notices.
- **Mitigation monitoring** aims to determine the suitability and effectiveness of mitigation measures and programmes, designed to diminish or compensate for adverse effects of the project. In this project, monitoring for this component would entail auditing the effectiveness of the mitigation

measures to ascertain whether changes are needed to enhance best practices.

9.2 *MONITORING PLAN*

Monitoring is a means verifying overall effectiveness of the management and mitigation measures contained within the management plans described in Chapter 8. Key objectives of the monitoring process are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (i.e. Tanzanian standards, JICA Guidelines, World Bank Safeguard Policies and IFC EHS Guidelines);
- Monitoring the status of, and impacts on, identified sensitive receptors;
- Provide an early warning that any of the control measures or practices are failing to achieve their desired performance and ensure changes can be implemented to remedy these practices;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of other activities or natural variation; and
- Provide a basis for continual review and improvements to Project design and execution.

Biophysical and social environmental management components of particular significance have been identified as indicators. A monitoring plan for each indicator has been prepared for all phases of the Project and is presented in Table 9-1.

Measurements required for monitoring mangroves and other terrestrial vegetation include ecological surveys where sampling on various ecological characteristics in terms of species composition change over time will be recorded/reported while comparing with the baseline data collected on permanently established monitoring plots as stated in mitigation measures for loss of local marine and terrestrial biodiversity. The measurements are taken based on the number of indicators outlined to demonstrate any likely change over time following implementation of the project.

9.3 *REPORTING ARRANGEMENTS*

The reporting system will ensure regular flow of information from the Project site to the Project headquarters/TANESCO head office and, as necessary, to regulatory authorities and financing entities. The reporting system will provide a mechanism to ensure that the measures proposed in the Project's ESMP are implemented.

Prior to the commencement of the construction activities, the project proponent will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring. Records of monitoring results should be kept in an acceptable format an easily accessible, and information reviewed and evaluated to improve the effectiveness of the environmental management plan. The results should be reported to the responsible authorities and relevant parties, as required by NEMC.

Table 9-1 Environmental and Social Monitoring Plan for the Proposed Gas fired Thermal Power Plant at Mtwara

Project Stage/ Affected Component	Potential Impact	Parameters to be monitored	Location	Measurements	Frequency	Overall Responsibility	Cost (USD)
Site Preparation and Construction Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and as specified in EPC Contractor document/ manual	Project activity areas and construction workers camp	Visual inspection of all active work areas	Daily	TANESCO	10,000 USD
Water	Impact on surface water quality	Turbidity, oil & grease	Project activity areas	Standard analytical methods	Weekly	TANESCO	20,000 USD
	Impact on groundwater quality	pH, temperature, EC, TDS, turbidity, total hardness, Cl, SO4+, NO3-, BOD, COD, Total Coliforms and heavy metals (As and Pb)	Neighbouring wells and boreholes	Standard analytical methods	Upon request from villagers	TANESCO	20,000 USD
Ambient Air	Dust Generation	Dust	• Within the construction site • Site described in the request	Visual inspection	• Within the site: Several times during construction • Other locations: Upon request/ complaint	TANESCO	5,000 USD
Noise	Noise Generation	Noise levels	• Within the construction site • Site described in the request	Noise level measurement	• Within the construction site: several times during construction • Other locations: Upon Request	TANESCO	5,000 USD
Waste	Solid waste management	Adequacy of solid waste management measures (e.g. appropriate storage, collection and disposal)	Waste storage areas, workers camp	Visual inspection of all waste collection sites, and confirmation of proper disposal	Daily	TANESCO	5,000 USD
Soil	Acceleration of soil erosion	Adequacy of measures to prevent soil erosion	Project activity areas	Visual inspection	After every rainy season	TANESCO	5,000 USD
Terrestrial Ecology	Loss of mangrove areas	Area of vegetation loss and re-vegetation if applicable (to ensure that no other areas will be disturbed)	Mangrove areas	Visual inspection	Weekly	TANESCO	5,000 USD

Project Stage/ Affected Component	Potential Impact	Parameters to be monitored	Location	Measurements	Frequency	Overall Responsibility	Cost (USD)
	Degradation of mangrove	Mangrove vegetation	Mangrove areas near the Kisiwa site	Visual inspection	Weekly	TANESCO	
Marine Ecology	Destruction of corals	Extent of destruction of corals	Coral habitat area near the mouth of Sudi Creek (Kisiwa Bay)	Visual inspection	Weekly	TANESCO	5,000 USD
Local Economy	Increased local market opportunities	local market opportunities	Affected communities and neighbouring communities	Interviews with local people and relevant authorities	During stakeholder engagement activities	TANESCO	3,000 USD
	Increased local employment	local employment	Affected communities and neighbouring communities	Interviews with local people and relevant authorities	During stakeholder engagement activities	TANESCO	3,000 USD
	Increased pressure on social services and infrastructure (e.g. roads)	Complaints from communities	Affected communities	As per the grievance redress mechanism	Upon receipt of complaint	TANESCO	As per the grievance redress mechanism
Community Health and safety	Increased crime and insecurity	Crimes and complaints	Affected communities	Crimes and complaints	Based on occurrence	TANESCO	1,000 USD
	Increase risks, hazards and accidents	Accidents, incidents and complaints	Affected communities	Incidents, accidents and community complaints	Based on occurrence	TANESCO	2,000 USD
	Increased risk of HIV/AIDS and other STDS	Prevalence of STDS	Affected communities	Health check described in Health & Safety Plan to be prepared by EPC	Yearly	TANESCO	5,000 USD
Occupational Health and Safety	Increase risks, hazards and accidents	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by EPC contractor	As defined in H&S Plan	TANESCO	5,000 USD
Operation Phase							
General	Inspection of mitigation compliance	General compliance with mitigation measures presented in the ESMP and operational manual	Project activity areas	Visual inspection of all active work areas	Daily	TANESCO	10,000USD/year
Water	Impaired surface water quality	pH, temperature, turbidity, BOD, COD, TSS, oil & grease, total coliform	At wastewater discharge point	Standard analytical method	Quarterly	TANESCO	20,000USD/year
Air Emissions	Stack emissions	NOx as NO2, O2, moisture content	Main stack and by-pass stack	CEMS	Continuous	TANESCO	70,000 USD

Project Stage/ Affected Component	Potential Impact	Parameters to be monitored	Location	Measurements	Frequency	Overall Responsibility	Cost (USD)
	Emission concentrations	CEM validation for NOx	Main stack and by-pass stack	Standard analytical methods	Annually	TANESCO	15,000USD/year
GHG Emissions	Climate change	GHG generation	Plant control room	Natural gas consumption	Annually	TANESCO	3,000USD
Waste	Solid waste management	Appropriate collection, transport and management	Waste collection sites in Project activity areas	Visual inspection of all waste collection sites and confirmation of proper disposal	Weekly	TANESCO	5,000 USD
Terrestrial Ecology	Degradation of mangrove	Mangrove vegetation	Mangrove areas near the Kisiwa site	Visual inspection	Quarterly	TANESCO	5,000 USD
Marine Ecology	Thermal Water Discharge	Temperature of thermal water discharge	Discharge point At the mouth of Sudi Creek (Kisiwa Bay) The other 3 points in the Creek	Standard analytical method	Continuous (The other 3 points: Quarterly)	TANESCO	10,000 USD
		Coral bleaching	Coral habitat area near the mout of Sudi Creek (Kisiwa Bay)	Visual inspection	Quarterly	TANESCO	5,000 USD
		Fish Catch	Sudi Creek	Interview with Fishermen, BMU and Mtwara District	Quarterly	TANESCO	5,000 USD
	Operation of the water intake facility	Impingement and entrainment of marine species	Intake facility	Visual inspection	Quarterly	TANESCO	3,000 USD
Local Economy	Increased local market opportunities	local market opportunities	Affected communities and neighbouring communities	Interviews with local people and relevant authorities	During stakeholder engagement activities	TANESCO	2,000 USD/year
	Increased local employment	local employment	Affected communities and neighbouring communities	Interviews with local people and relevant authorities	During stakeholder engagement activities	TANESCO	2,000 USD/year
	Increased pressure on social services (e.g. roads)	Complains from village members	Affected communities	Complaints from village members	As per the grievance redress mechanism	TANESCO	As per the grievance redress mechanism
	Changes in amount of fish caught	Amount of fish caught	Affected communities	Interviews with local people and relevant authorities	Annually	TANESCO	2,000 USD/year

Project Stage/ Affected Component	Potential Impact	Parameters to be monitored	Location	Measurements	Frequency	Overall Responsibility	Cost (USD)
Community Health and safety	Increase risks, hazards and accidents	Accidents, incidents and complaints	Affected communities	Incidents, accidents and community complaints	Based on occurrence	TANESCO	2,000 USD/year
Occupational Health and Safety	Increase risks, hazards and accidents	Near-misses, incidents, occupational diseases, dangerous occurrences	Project activity areas and construction workers camp	As defined in construction phase Health & Safety Plan to be prepared by EPC contractor	As defined in H&S Plan	TANESCO	2,000 USD/year

Source: JICA Study Team, 2018

10 COST AND BENEFIT ANALYSIS

The purpose of Cost-Benefit Analysis (CBA) is to determine whether a project will deliver net economic benefits to society.

10.1 OVERALL COST IMPLICATIONS

The costs of the proposed power plant include the actual investment cost, operational cost, and the costs on the environment and the socio-economic costs.

10.1.1 *Project costs*

In this project, the cost will include:

- Capital expenditure on construction, materials and equipment, which is estimated to be of the order of USD 593 million
- Operational and maintenance costs (fuel, maintenance material, security, office, etc.)
- Personnel costs (including consultants)
- Health, Safety and Environment management cost

10.1.2 *Environmental and socio-economic costs*

As described before, some potential environmental and social impacts are expected in relation to the project such as air emission, noise, waste generation, wastewater discharge, land acquisition, and displacement of people due to land acquisition. The environmental and social costs are related to mitigation and management of such impacts. Details of these impacts and mitigation measures are highlighted in chapter six, seven and eight of this EIA report.

The financial resources needed to mitigate these impacts from planned activities are expected to be rather small in comparison to the investment costs. The Project Affected People (PAP) will be compensated before the commencement of the project.

10.2 OVERALL POTENTIAL BENEFITS

10.2.1 *Environmental benefits*

The project is expected to benefit compared to the alternative power generation options such as gas engine power plant and diesel-fired power plant. The project gas-fired power plant is expected to have much lower NOx, SO2, Particulate Matter (PM) emissions compared to gas engine power plant and diesel-fired power plant. For example, NOx emission of the project is approximately one-third of gas engine power plant, and less than 5% of diesel-fired power plant. The project is also expected to reduce 423,632 t-CO2/yr compared to the existing gas fired power plants in Tanzania.

10.2.2 *Socio-economic benefits*

The project will generate electricity to the national grid for distribution to industries, companies and households in the country. This power source will assist TANESCO to meet current and future electricity demands in the country. The availability of additional power from the project will promote industrial and commercial activities as described below, which will subsequently drive productivity. Additionally, an increase in power use and subsequently productivity is anticipated to have a multiplier effect on revenue generation for the country.

10.2.3 *Other Benefits*

Industry, business, and local economy

The improved power quality of the grid will help industries to increase their productivity and avoid running costs of private generators.

Reliable electricity will induce the establishment of small and medium enterprises. This has multiplier effect both in employment creation, income generation and revenue to the government in form of tax.

Offices will be able to continue with their work without disturbance and use their equipment such as computers hence improve the utilization of ICT (information and communication technology) in business operation.

Using electricity in milling machines will lower costs incurred by the community people when there is no electricity and mill owners use diesel fuel.

Health service

Hospitals and dispensaries will be in a position to provide 24 hours services more conveniently than the period when there is no electricity.

Education

Students in schools will utilize properly their preparation study in the night time and laboratory will be equipped with electric apparatuses. In addition practical needed reliable electricity will be exercised.

10.3 CONCLUSION

As a conclusion on the proposed power plant project, the environmental and social costs are expected to be outweighed by the benefits to be realized from the project.

The implementation of the project will involve large amount of financial resources. However, in the absence of the project, the current power shortage and supply problem are expected to continue and affect significantly economic performance of the industry and individuals, and the country in general. The consideration of "No-Project" or "Do-Nothing" option is not adopted due to the need and desirability of the power plant to solve power supply/shortage problems in Tanzania.

11 DECOMMISSIONING

This EIA report has mainly focused on the potential impacts and associated mitigation measures during the construction and operation phase. This section deals with the decommissioning phase of the proposed project. Decommissioning is a stage the project or activity of the project is formally ending.

The proposed power plant is expected to operate for at least 25 years before it comes to end. The Regulations for Environmental Impact Assessment (URT, 2005) directs developers to address the implication of decommissioning process as part of the ESIA process.

There will be some components of the project that will be closed as soon as their requirement has come to the end. Activities to be done during decommissioning include, demolition of power plant and hauling rubble and waste materials from the demolition. Several impacts (negative and positive) are likely to occur as result of the decommissioning.

In implementing the decommissioning activities, TANESCO will prepare a detailed decommissioning plan to ensure that environmental and social impacts are minimized in order to comply with environmental legislations and policy requirements. In decommissioning phase, TANESCO will form a team of experts with a representative from the relevant national, regional and local government bodies to monitor the implementation of the decommissioning plan.

Impacts and mitigation measures which need to be considered during decommissioning include the following:

Soil Erosion

This is likely to occur during decommissioning as result of movement of vehicles heavy machines clearing the structures and leveling the project area. The following mitigation measures are proposed:

- The developer must confined all decommissioning activities to core areas.
- Developer to rehabilitate degraded areas with natural vegetation.

Surface run off and seawater quality

This is likely to occur during decommissioning and especially if it is done during the rain season. Surface run off may accelerate soil erosion and increase pollution of water bodies. The following mitigation measures are proposed:

- Developer to ensure all decommissioning activities is confined to core areas.
- Decommissioning to be scheduled during dry season.

- Ensure spoil material from demolished infrastructure is appropriately disposed away from wetlands, water sources.
- Undertake site landscaping in disturbed areas.

Noise and Vibration

Noise and vibration will occur as a result of movement of heavy vehicles and machines hauling rubble and waste materials from the demolition. Vibration may cause effect on nearby structures especially community's houses. The following mitigation measures are suggested:

- Developer to ensure all decommissioning activities is confined to core areas.
- Developer to ensure there is no unnecessary movement of vehicle.
- Mitgation measures proposed for construction phase will also be applied.

Waste generation

The decommissioning of the power plant will result into generation of wastes from obsolete materials and unwanted materials. Mechanisms of identifying, collecting and disposal will be in place to ensure all wastes have been collected, removed and rightly disposed of. The following mitigation measure is proposed:

- Equipments and machinery will have to be disposed-off or removed from the project site.
- Assessing the contents of hazardous materials in building and in process equipments.
- Removing them prior to initiation of decommissioning activities, managing their treatment and disposal.
- Cleaning of zones where necessary, emptying and rendering inert tanks.

Loss of electricity generation source

Decommissioning of the power plant will have significant impacts on power generation and supply as well as revenues resulting from power supplied to customers. The impact may result into reduced industrial production and other services. The following mitigation measure is proposed:

- TANESCO to look alternative sources of energy.

Loss of employment

The proposed power plant is expected to generate employment opportunities to the local communities. Decommissioning of the power plant will result into loss of employment and incomes accrue to the workers. Moreover the communities business will be affected. The following mitigation measure is proposed:

- TANESCO to provide awareness to worker engage in alternative income generating activities.

12 *SUMMARY AND CONCLUSION*

In accordance with the requirements of the Environmental Management Act, Cap 191 of 2004 and the Environmental Impact Assessment and Audit Regulations of 2005, this ESIA Report has been prepared to identify, assess, and mitigate the potential environmental and social impacts associated with the proposed 300MW gas-fired power plant. This Report was based on the technical information provided by the developer, existing studies and reports relevant to the Project, site visit, baseline environmental monitoring and the initial stakeholder engagement.

The Project is a gas-fired power plant (combined cycle gas turbine) with a generation capacity of 300MW. Generated electricity will be connected to the grid via an adjacent 400kV substation that will be part of a transmission line system connecting Mtwara and Somanga. The power plant is expected to be operated for 24 hours a day throughout a year, for a period of 25 years. The Project will be funded by JICA but will be owned and operated by TANESCO.

The Project Site is located beside Sudi Creek. It extends to the seashore, with a small area facing the seashore line (the "nose"). The nose area is currently being utilized as a mooring point of fishing boats. The Project Site is currently used for pastures, salt fields, and scattered residential areas. Existing terrestrial vegetation comprises primarily of coastal thickets and mangrove vegetation in degraded state. Two species are classified as vulnerable under IUCN Red List. Observed marine environment in Sudi Creek is limited to fish species with sea bottom generally devoid of visible living fauna/flora.

The villages close to the Project Site are Kisiwa Village and Namgogoli Village, which are located at approximately 2-4km away. Majority of the villagers are involved in multiple economic activities, with agriculture as the primary economic activity. Although fishing is a common activity along the coast, few villagers are engaged in such activities.

As a result of several engagement and consultation activities, it has been identified that there is overall support for the Project from various stakeholders. Different groups, particularly local communities, expressed expectations such as employment opportunities, access to stable electricity supply, and potential improvement in social services. However, stakeholders highlighted the need for the project developer to properly implement compensation for land acquisition, pollution control and mitigation measures and to support communities that will be affected by the Project.

Potential environmental and social impacts that will be caused by the Project have been identified and assessed. Based on the assessment, impacts during construction phase are expected to be more significant compared to during operation phase. During construction, potential impacts on water resources, marine ecology, wastes, community health and safety are considered significant. During operation phase, wastes, impact on marine species (due to wastewater discharge) and greenhouse gas emissions are the key considerations.

The Environmental and Social Management and Monitoring Plan has been prepared to ensure mitigation and management of identified environmental and social impacts. With proper implementation of these plans, together with some embedded control measures in the Project design, it can be ascertained that the Project is unlikely to cause any significant environmental and social impacts.

Overall, the benefits to be realized from the proposed Mtawara power plant project are expected to outweigh environmental and social costs. The Project presents opportunities for employment and improvement of the local economy. More importantly, it would contribute to increased improved stability of the national power supply and distribution.

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