PROJECT: MOZAMBIQUE LNG
COUNTRY: MOZAMBIQUE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) SUMMARY

Date: April 2019
1 INTRODUCTION

The Project entails the design, build, operate, and transfer of an integrated Liquified Natural Gas (LNG) plant, including: offshore extraction, underwater pipeline, onshore processing plant, as well as ancillary support facilities. The Project will have a capacity of 12.88 mmtpa of LNG and will source gas from the Golfinho-Atum (GA) field within “Area 1,” which is located 40 km off the coast of Mozambique. Area 1 has ~75 trillion cubic feet (Tcf) of recoverable gas, implying a resource life of ~120 years at the initial production rate of 12.88 m tonnes of LNG per year. The Project will supply gas for LNG exports (mainly to Europe and Asia) and domestic consumption, thereby fueling industrial development in the country and the larger southern African region.

An Environmental and Social Impact Assessment (ESIA) was undertaken in fulfilment of the requirements of Mozambique’s Environmental Law (Law No. 20/97 of 1 October) and those of Lenders, including the requirements of the AfDB’s Integrated Safeguards System (ISS) applicable to Category 1 projects. This ESIA Summary Report highlights the key environmental and social (E&S) assessments and corresponding management plans designed by the Project sponsors, Anadarko, to ensure that the proposed project activities comply with national and AfDB E&S policy requirements. This ESIA summary has been prepared from the original Environmental and Social Impact Assessment (ESIA) 2014 study (approved by authorities), Anadarko’s ESHIA Executive Summary latest version (May 2018) and subsequent complementary studies made to align with Lender requirements. A Resettlement Action Plan (RAP) was also developed and a summary thereof posted on the AfDB website in conjunction with this ESIA Summary Report.

1.1 Background

Natural gas discoveries made in the Rovuma Basin off the coast of northern Mozambique are among the world’s most significant discoveries in the last 20 years. Anadarko Moçambique Área 1, Lda (AMA1) holds rights to explore, develop and produce natural gas reserves in Area 1 in the Rovuma Basin.

The proposed LNG Project (hereinafter “the Project”) would see Mozambique become one of the world’s leading natural gas exporting countries. Figure 1.1 below illustrates the location of the Project.
The site of the onshore facilities was selected after a comprehensive site selection process. Empresa Nacional de Hidrocarbonetos (ENH) acquired the Right to Use and Enjoy Land (known as a DUAT) from the Ministry of Agriculture in 2012, in accordance with the Land Legislation. The DUAT was then transferred to the Mozambican company, Rovuma Basin LNG Land, Lda. (RBLL) incorporated by AMA1, Eni and ENH. The initially provided DUAT was approximately 7,000 ha on Afungi Peninsula but was modified to accommodate a new DUAT for the Replacement Village. The DUATS are shown in Figure 1.2. The area of the LNG Project DUAT is consistent with the Government of Mozambique’s vision for an LNG Park (which may include other operators and other trains on the site). The onshore LNG facility, comprising the LNG trains\(^1\), the common infrastructures, marine facilities, LNG storage tanks, etc., will be located within the DUAT.

\(^1\) LNG train is a liquefied natural gas liquefaction and purification facility. LNG is produced by cooling natural gas below its condensing temperature (-163 °C) and storing it near atmospheric pressure. This process typically undergo various stages of chilling resulting in the stream being cooled and liquefied provided by the refrigeration cycle. Once liquefied, the gas volume is 1/600 of its volume in gaseous form and makes it more economical to store and transport. Each LNG plant consists of one or more trains.
1.2 Benefit of the Project

The strategy, policies and practices of the Ministry of Mineral Resources (now called the Ministry of Mineral Resources and Energy) have the following goals:

- To ensure the sustainable exploration and development of mineral resources;
- The industrial development of the country and the local utilisation of its mineral resources;
- To add value to mineral resources through in-country processing;
- To promote partnerships, including the participation of Mozambican private enterprises in the sector;
- The periodic update of the legal and fiscal framework to maintain investment attractiveness in Mozambique; and
- The training and institutional strengthening.

The natural gas discoveries made to date are among the world’s most significant discoveries in the last 20 years. The purpose of the Project is to advance the sustainable exploration, development and production of these resources in Mozambique through the extraction, processing and export of the significant natural gas resources discovered in the offshore Area 1, Rovuma Basin. The Project represents an economic opportunity that could be transformational for the economy of Mozambique by allowing the country to become one of the world’s leading LNG exporting countries, potentially generating:

- Substantial tax and profit-sharing revenues for Mozambique, contributing substantially to the country’s gross national product;
- Significant foreign exchange income from external markets and gas supplies for industrial and domestic development in Mozambique;
Infrastructure and quality-of-life improvements for Mozambique’s people;

- The possibility for long-term technology and knowledge transfer, bringing economic development and improving the quality of life for its inhabitants;

- Direct and indirect employment opportunities for Mozambicans; and significant, long-term foreign direct investment.

The initial LNG development represents an overall investment of up to US $ 25–30 billion, making the Project the largest single investment project in Mozambique to date.

# 2 PROJECT DESCRIPTION

This section summarizes the Project description considered in the LNG ESIA Report 2014 (base case project description) and highlights changes that have been to the base case since the LNG ESIA approved (2014).

## 2.1 Alternatives

### 2.1.1 LNG Project

Site selection, pipeline routing and layout alternatives have been evaluated throughout the ESIA and ESHIA process, with the environment and social team working closely with, or in cooperation with the engineering/facilities team. In all cases, alternatives were evaluated based on environmental and social risks and impacts, technical feasibility and financial feasibility criteria. A key focus of the alternatives analysis was to avoid, minimize and mitigate potential environmental and social impacts.

Seven locations along Mozambique’s coast were initially evaluated for the location of the LNG Facility. After screening process the northern side of the Afungi Peninsula was selected.

Pipeline routes in the bay and the layout of the various onshore components were all investigated and optimum layouts were selected to minimize potential environmental and social impacts. The selected site and layouts are described in more detail in the following sections.

There are currently several gas pretreatment technologies and proprietary design options used at various LNG facilities worldwide. The technical evaluation of each of these processes will be undertaken during the ongoing engineering design of the Project, as part of the FEED process. The FEED process will entail detailed process design to assess the best available technology options and the most cost-effective approach, and to minimise environmental and social impacts.

### 2.1.2 No-Go Alternative

The no-go alternative implies that the proposed project would not be executed. Assuming that the offshore wells and onshore LNG Facility would not be developed, the onshore and offshore environment would remain in its current state and there would be no negative environmental and social impacts associated with the development.
Not proceeding with the Project, while taking all due consideration of potential environmental and social impacts, runs counter to the vision of the Government on a concerted growth strategy to address a number of social and economic challenges faced by the country and the country’s Natural Gas Master Plan. Assuming export of the LNG to the premium markets, the Government of Mozambique should see a significant increase in Gross Domestic Product and through its royalty, tax and equity gas rights. Mozambique will benefit from a substantial increase in Government revenue for the next several decades. This economic benefit could be used to improve the health, education and quality of life of the people of Mozambique. The no-go alternative would result in status quo conditions and the loss of substantial and long-lasting social and economic benefits for the people of Mozambique.

2.2 Base Case Project Description in LNG ESIA (2014)

The three main components of the Project include offshore, onshore, and nearshore components. Error! Reference source not found. presents a schematic view of the Project components and their location.

**Figure 2.1: Schematic view of the project components and their location**

2.2.1 Offshore Project Component

The term “Offshore” refers to the deep water environment. The Offshore Project entails production and delivery of 6 billion cubic feet (170 Mm³) per day based on the development production wells. Transport of natural gas takes place via subsea pipelines which are routed into a single corridor to onshore LNG facilities. The subsea gas fields are located 50 km offshore in the northern and eastern parts of Area 1. The main components are presented below.

**Wells:** Approximately 60 production wells during the life of the Project in Area 1 are a part of the Subsea Production System. The wells will be drilled at a rate of approximately one well every 75 days.
Subsea Production System: Natural gas from the production wells flows through the subsea production system and connecting infrastructure to a manifold that combines flow from other wells and directs the gas into the pipelines to the shore. The pipeline ends at the LNG Facility and umbilical cease at the onshore control center.

Figure 2.2: Indicative Layout of Subsea Gas Collection

2.2.2 Near-Shore Project Component

The Near-Shore Project includes the interconnection of the marine facilities (Offshore) and Onshore components of the overall Project. The design includes the marine facilities associated with the LNG Facility and the supporting infrastructures needed to maintain effective operations. Near Shore components (Figure 2.3) include:

- Multipurpose Dock (MPD): approximately 600 m wide, extend 800 m to 1,500 m from the shoreline, and stand approximately 10 m above Lowest Astronomical Tide (LAT);
- LNG Export Jetty; The causeway will be a pile-supported structure (trestle) driven to a depth of 20 to 35 m below LAT. The jetty extends to the LNG berthing area and includes four breasting dolphins, six mooring dolphins, and a 40x30m loading platform;
- Navigation channel;
- Navigation aids; and
- LNG loading facilities.

2.2.3 Onshore Project Component

The Onshore Project is designed to receive, treat, and convert natural gas from the Subsea Production System into a liquid. The Project site includes the LNG Facility, worker housing, construction lay down areas, airstrips, water and waste facilities and buffer zones. The total area granted for the Project is approximately 7,000 ha.
**LNG Facility**: The gas stream is routed to a liquefaction unit to undergo various stages of chilling resulting in the stream being cooled and liquefied provided by the refrigeration cycle. The product will be higher pressure LNG which is then transferred to storage tanks prior to export.

**Figure 2.3: Near-Shore Project Components**

**Figure 2.4: Onshore Project Components**
Supporting onshore components:

- Temporary and permanent facilities and utilities:
  - Fuel gas system,
  - Power generation and distribution,
  - Water desalination plant
  - Water wells and water treatment,
  - Sewage and waste treatment facilities and communication infrastructure;
- Buildings to accommodate: administration, recreation, training facilities, health facilities, control rooms, warehouses, maintenance shops, and security;
- Infrastructure to support logistics including roads and airport; and
- Storage facilities including refrigerants, water, and fuel.

2.3 Updates to Project Description (May 2018)

Further engineering and design occurred after the submission of the LNG ESIA Report in February 2014. The following section presents update of the project as date of May 2018. This update represents the evolution of the technical development of the project which takes into account the environmental and social impacts identified in the ESIA.

2.3.1 Offshore

The pipeline from Golfinho will no longer be directed south before entering the bay between Tecomaji and Rongui Islands. The pipeline will now be routed in a south-westerly direction to enter the bay south of the Cabo Delgado Peninsula. Figure 2.5 provides an indicative alignment (brown pipelines pattern).

Figure 2.5: Updated Offshore Pipeline Routes (Indicative)
2.3.2 Near-Shore

**Materials Offloading Facility:** The MPD is now called the Materials Offloading Facility (MOF) and its shape has changed. The MOF footprint on the beach is smaller than that of the MPD.

**Pioneer Dock:** The Pioneer Dock described is being revised. AMA1 is considering a Rapid Deployment Beach Landing via groundable barges or similar. Thereafter it will morph into an early beach landing which will have a quay or bulkhead for small barges, or similar, to moor. The temporary beach landing will remain in place through construction until the MOF is in place.

**Dredge Disposal:** In the base case project description, dredged material would have been used first to fill in and level onshore areas, and for construction of the MPD. Subsequent studies indicate that there is sufficient material onshore to level the land without needing additional dredged material. Accordingly, some material may be used to construct the MOF while the balance of the dredged material will be disposed offshore. An additional location(s) may be used as the total volume of dredged material may be in excess of the 11.9 million m$^3$ envisaged in the LNG ESIA. The mitigation and monitoring measures remain the same as those identified in the LNG ESIA Report.

**Design of the Jetties:** The base case project description considered a causeway/trestle combination structure. Currently, trestle jetties are being favoured.

**Fiber Optics Cable:** AMA1 is investigating the option of providing internet services to the site via a marine fiber optic cable.

2.3.3 Onshore

The Revised Onshore Project Footprint Area was used by AMA1’s selected EPC Contractor to refine the Project layout. The high level layout in the LNG ESIA Report has been updated.

**Key Layout Changes:** With the exception of the Replacement Village and associated infrastructure (e.g. community roads), all project infrastructure will be located within the Revised Onshore Project Footprint Area.

- The design of the airstrip has been updated and its location has shifted to the west;
- The Pioneer Camp has been constructed as part of the Afungi Site Improvements and is currently operational;
- After extensive consultation with authorities and communities, the location of the Replacement Village has been identified (see RAP summary);
- The construction camp has been moved further west of the LNG Facility;
- The layout of the LNG Facility itself has changed;
- An access road, the Palma-Afungi Road, and power line to supply the Replacement Village has been included in the Project;
- Community roads are being designed to provide access to surrounding areas;
- AMA1 and Area 4 have agreed on the fencing alignment for a perimeter fence and high security fence around the onshore facilities.
3 REGULATORY FRAMEWORK

3.1 Introduction

The regulatory framework is presented in detail in the ESIA 2014 Volume 1 (Chapter 2). This section highlights some of the main points.

This ESIA is being undertaken in terms of the Environmental Law (Law No. 20/97 of 1 October). This Law applies for any activity which could have direct or indirect impacts on the environment. The Project will be in compliance with the applicable Mozambique laws and regulations as well as international treaties to which Mozambique is a signatory. These include various international treaties, conventions and protocols relating to issues such as biodiversity, climate change and marine pollution.

Moreover, the Project will be aligned with the International Finance Corporation (IFC) Social and Environmental Performance Standards and EHS Guidelines, to the extent reasonable, as well as those of the African Development Bank’s Integrated Safeguards System (ISS).

3.2 Mozambican Legal and Regulatory Framework

The Mozambican regulatory framework establishes well-defined requirements and standards for the implementation and ongoing environmental and social management of industrial and civil infrastructure developments. Environmental protection functions are carried out by different authorities at both national and regional level.

3.2.1 Relevant Authorities in Mozambique

The key institutions in relation to environmental protection and the petroleum industry in Mozambique and therefore involved in the Project are:

- Ministry of Land, Environment and Rural Development (Ministério da Terra, Ambiente e Desenvolvimento Rural) MITADER (formerly MICAO in the ESIA 2013) is responsible for the implementation of environmental policy. MITADER is the pertinent competent authority for the ESIA and is represented at provincial level by the Provincial Directorate for the Coordination of Environmental Affairs.
- Ministry of Mineral Resources (Ministério dos Recursos Minerais - MIREM). MIREM is responsible for directing and implementing policies in the context of geological research, the inventory of and exploration for mineral resources including coal and hydrocarbons.
- National Petroleum Institute (Instituto Nacional do Petróleo - INP). The INP is the regulatory entity responsible for administration and promotion of oil and gas operations.

Many other Ministries have commitments to environmental and social components: Agriculture, Ministry of Fishing, Ministry of Tourism, Ministry of Industry and Commerce, National Naval Institute, National Institute of Hydrography and Navigation, Ministry of Health, National Aviation Institute, Mozambique Ports and Railways Company, E.P., National Roads Administration, Regional Water Administrations.
3.2.2 **Environmental and Petroleum Regulations**

The ESIA process for this project complies with the Environmental Regulations for Petroleum Operations (Decree No. 56/2010 of 22 November), as well as the Petroleum Law (Law No. 3/2001 of 21 February) and the Regulations on Petroleum Operations (Decree No. 24/2004 of 20 August). This ESIA is in compliance with the Licensing Regulations for Petroleum Installations and Activities (Ministerial Decree No. 272/2009 of December 30), applicable to concessionaires, operators, their contractors and subcontractors and other individuals or entities involved in petroleum operations and activities in Mozambique.

3.2.3 **Other Mozambican Legal Considerations**

Other legal considerations related to the environmental legal framework, water use, waste, effluent management, air emissions, terrestrial and marine environment, transport, social receptors, protected areas and species and infrastructure relevant to the Project. The Project will take these requirements into consideration in the design, construction and operation of the Project activities.

3.2.4 **Regulations on the Resettlement Process Resulting from Economic Activities**

Regulations on the resettlement process have been approved by Decree No. 31/2012 of 8 August. The regulation establishes the basic rules and principles on the resettlement process for the purpose of providing the opportunity to improve the quality of life of affected households.

3.3 **International Conventions**

The Project is obliged to ensure that its operations comply with international conventions to which the Government of Mozambique is a signatory. These conventions focus on the following points: Air Quality, Habitats and Biological Diversity, Water Resources/Maritime Activity, Archaeology and Cultural Heritage, Hazardous Waste, Hazardous Waste, Aviation, Piracy, etc.

3.4 **Good International Industry Practice**

In planning and implementing the Project, AMA1 will be aligned with good international industry practice, to the extent reasonable, notably the environmental and social performance requirements as defined by the Equator Principles, the International Finance Corporation (IFC) Social and Environmental Performance Standards and the IFC EHS Guidelines.

Good International Industry Practice guidelines and standards have also been produced by a number of marine, conservation and oil and gas industry bodies, in terms of the environmental impacts and impact assessment methods associated with onshore and offshore gas extraction, including the International Association of Drilling Contractors and International Oil & Gas Producers Association.
3.5 **African Development Bank**

The Project has been classified as a Category 1 by the African Development Bank (AfDB) in line with its Integrated Safeguards System (ISS). The following AfDB Operational Safeguards (OS) are triggered:

- **Operational Safeguard 1 – Environmental and social assessment**: This OS is triggered on account of the Project activities’ potential to generate significant environmental and social impacts to identified receptors within the Project’s area of influence, requiring the development of an ESIA;

- **Operational Safeguard 2 – Involuntary resettlement (land acquisition, population displacement and compensation)**: This OS is triggered because the Project entails both physical and economic displacement, requiring the development of a full RAP;

- **Operational Safeguard 3 – Biodiversity, renewable resources and ecosystem services**: This OS is triggered due to the potential effect on biodiversity and ecosystem.

- **Operational Safeguard 4 – Pollution prevention and control, hazardous materials and resource efficiency**: This OS is triggered mainly due to hazardous gas; and

- **Operational Safeguard 5 – Labour conditions, health and safety**: This OS is triggered on account of potential risks to health and safety of workers.

4 **DESCRIPTION OF PROJECT ENVIRONMENT**

4.1 **Introduction and Geographical context**

The proposed LNG Facility will be located on Afungi Peninsula, on the southern shores of Palma Bay, close to the town of Palma. Area 1 extends up to 50 km offshore in the Rovuma Basin, and the Mamba Gas Field located in Area 4, extends approximately 30 km further offshore. Both Area 1 border with Tanzania in the north. The Project’s Areas of Direct and Indirect Influence include elements of the offshore, near shore and onshore environment where Project activities will take place or will potentially impact, either positively or negatively.

The area experiences one wet season and one dry season annually. The average annual temperature and humidity is 25.9 °C and 75.8 % respectively, with peaks during the wet season from December to April. From March to September, wind patterns in the Palma area are predominantly south-south-easterly, while from October to February, they are predominantly north-easterly. Temperatures in northern Mozambique have increased by 1.1 °C during both summer and winter over the period 1960 to 2005. Changes in rainfall patterns in north-eastern Mozambique have been recorded in recent years; rainfall is projected to increase across the country during December to February and March to May, although this may be largely offset by the increase in evapotranspiration rates as a result of warmer temperatures. The Project Area has been classified as an area of low risk for tropical cyclones by the National Institute of Meteorology. Recent models indicate that there will likely be a declining trend in the number of cyclones taking place within the Indian Ocean, but that the intensity of cyclone events will likely increase.
The baseline concentrations of air pollutants onshore, including nitrogen dioxide (NO₂) and nitrogen oxides (NOX), are low. The current offshore air quality is considered to be acceptable and within Mozambican or international standards.

Noise levels at the ocean are relatively steady between daytime and night-time, whereas inland night-time levels are quieter. Dominant sound sources across the Afungi Project Site are from wildlife activities such as birdsong, frogs, insects and daily human activities. In locations where these sources are not present, or are to a lesser extent, noise levels tend to be lower.

Palma Bay is a large distinct natural bay. The wider area includes remote wooded landscapes, located inland of coastal settlements. The islands to the northern extreme of the Quirimbas Archipelago (i.e. Rongui, Tecomaji, Vamizi islands, etc.) form an important part of the overall seascape in the area. There are no gazetted protected areas within the Area of Direct Influence (ADI). However, there are a number of designated and proposed conservation areas in the greater region, both terrestrial and marine, including Quirimbas National Park and Mnazi Bay–Rovuma Estuary Marine Park.

### 4.1.1 Offshore Environment

The offshore gas fields, Golfinho, Prosperidade and Mamba are located in deep oceanic water offshore of the extremely narrow continental shelf, in depths of around 1,000 to 2,300 m. Deep canyons are found within the area, characterised by mostly unconsolidated sediment. Temperature, salinity and dissolved oxygen profiles in the Offshore Study Area show a well-developed upper mixed layer underlaid by a strong thermocline. Water column turbidity levels are mostly low, <0.5 mg/l, with elevated levels in the very near-surface layers and a minor elevation in turbidity at depths corresponding to the base of the upper mixed layer/top of the thermocline. The sediments of the seabed are poorly sorted, indicating multiple sources of sediments and a low-energy environment near the seabed.

Low and high-relief reef structures are present in deep waters, and are likely to be found throughout the area of the offshore gas fields. Biodiversity is highest on the high-relief reefs, although they do not apparently support high densities of fauna.

Pelagic and mesopelagic fish species are widely distributed. In the deep waters, a number of fish and benthic species have been observed appear to be new to science and have not previously been taxonomically described. Megafauna such as whales, dolphins and turtles, together with pelagic seabirds, are present in the region, and include species regarded as Endangered, Vulnerable or Near Threatened according to the IUCN Red List of Threatened Species (IUCN). The distribution ranges of these fauna are truly vast compared to the distance scales of the gas fields that are proposed for development.

### 4.1.2 Near-Shore Environment

The depth of the channel in the central area of Palma Bay extends to 50 m. The islands of Tecomaji and Rongui sit on the edge of the continental shelf, where water depths greater than 350 m occur within 2.5 km from the islands.

Palma Bay is a generally clear water environment with low turbidity levels. Temperatures and salinity are typically around 30 °C and 35 practical salinity units respectively. The surficial sediments are mainly sand or muddy sand. Sediment transport rates are small in the bay, due to the benign wave climate. Heavy metal concentrations observed were low.
The main shoreline types in Palma Bay are intertidal rock, steep supratidal sand beaches, mangroves and intertidal sand/mudflats. The intertidal zone appears to be highly productive and biologically diverse. There are both extensive and minor stands of mangroves located in Palma Bay.

Seagrass beds and meadows, supporting a wide range of fauna including sea urchins, starfish, sea cucumbers, sponges, colonial ascidians and pen shells, are distributed throughout Palma Bay on sandy substrates from the mid-tide level in the intertidal zone from 6 m to 8 m depth. The species present are widely distributed on the East African coast, and particularly in the Quirimbas Archipelago.

Coral reefs in Palma Bay comprise *Porites*-dominated bommies with minor amounts of branching (*Acropora*) and other forms. They are distributed in and among the seagrass beds mainly in the west and south of Palma Bay; in diverse bommies in the bommie fields on the inshore side of Tecomaji, Rongui and Queramimbi islands; and in highly diverse reef and fringing reef at Cabo Delgado Peninsula and to the east of the islands. There are important structural reef features north of Tecomaji, between Tecomaji and Rongui and south of Rongui Island. These are biologically diverse, although evidence of damage (from extreme weather and fishing activities) is evident in each area. There are varying degrees of reef development between Tecomaji and Rongui, and the southern area between the islands has a relatively minor stretch of continuous reef, with more stretches of sand in the centre and on the northern side.

Fish species associated with reefs and seagrass beds are abundant and diverse. Five species of turtle are found in the Quirimbas Archipelago, all of which are protected species. The mainland beaches in Palma Bay are steep and the high tide levels extend to the top of the beach, making them unsuitable for turtle nesting. A number of whale and dolphin species have been recorded in the near shore, and several species are known to enter Palma Bay e.g. humpback whales and bottlenose dolphins.

Palma Bay has been identified as a location with potential for aquaculture; namely, fish farming and seaweed production. In 2011 approximately 10 ha of the bay was declared as a “Marine Reserve” by Decree No. 71/2011 of 30 December. There are currently no known proposed or active aquaculture farms within the bay. This is detailed further in Chapter 9, ESIA 2014.

### 4.1.3 Onshore Environment

A large proportion of the Palma District is currently endowed with habitat of very high conservation value, mostly situated in the central and western parts of the District.

**Geology:** The Afungi Peninsula is located in the Rovuma Sedimentary Basin on the coastal plain and present an undulating topography. Within approximately 5 km of the coast, elevations average 30 m above sea level. Within 10 to 15 km, elevations reach up to 100 m. The stratigraphic development is related to the tectonic activity, including offshore rifting as well as uplift and faulting associated with the East Africa Rift System.

The Afungi Project Site is located on recent to Tertiary age units (fluvial sandstone and conglomerate formation) with the near-coast areas covered with recent unconsolidated deposits that include dunes, low coastal deposits and stream sediment deposits, as well as reef and coral formations, lacustrine and tidal zone sediments and surface soils. A number
of faults (generally normal) are present in the area and the general trend north-south, roughly parallel to the coast.

**Soils:** The soils in the Afungi Project Site comprise two soil units of significance:

- a large area comprising all land outside of the wetland zones (estuaries and marshes). This area comprises deep grey/white sands; that soil and
- areas representing the wetland zones, which include the estuaries, marshes and drainage course zones.

The dominating soil occurring in the Survey Area is deep sand, well drained and low in soil fertility. The average rainfall in the area is very high, and this specific climate and soil combination results in low arable agricultural potential due to low fertility.

**Groundwater:** Regionally, aquifers in the younger littoral deposits are the most productive, and the fractured or weakly cemented sandstones in the northern coastal Mozambique region can provide higher aquifer yields and are suited to large-scale development. Shallower aquifers are typically more mineralised and are considered to be vulnerable to saline water intrusion. The alluvium aquifer has, in places, been exploited for supplies in the coastal areas, especially along the main rivers where the alluvial deposits are better developed and contain significant amounts of groundwater and higher specific capacities can occur.

Relatively shallow groundwater conditions occur beneath the Afungi Project Site with differences in water levels being apparent, which is attributed to the presence of locally developed lenses of silt and clay. Based on the available geological information, indications are that there is no ubiquitous confining layer separating a shallow aquifer from a deeper aquifer.

**Hydrology:** The Project is located in the drainage paths and low-lying areas. High-intensity rainfall events are experienced in the Study Area, but this will be tempered by the deep sandy soils which allow for high infiltration and permeability rates. These factors, combined with the slow velocity flows (due to the relatively flat topography) would reduce the flooding potential due to water infiltration. Therefore, high-intensity rainfall events would need to occur over a long period of time to allow for soil saturation before overland flow would likely occur. Flooding could be managed by appropriate flood mitigation measures such as diversion channels to divert flows around and away from the site.

**Surface Water Ecology:** The Afungi Peninsula is bordered by two major drainage basins: the Rovuma Drainage Basin, 35 km to the north, and the Messalo Drainage Basin, approximately 90 km to the south. Due to the low gradient of the peninsula, the fresh-water systems within the Afungi Project Site are largely interconnected wetland systems ending in estuaries connected to Palma Bay. There are no major rivers draining the immediate area. The rainfall in the area averages above 1,000 mm/year; the highest flows are experienced in February to April, and the lowest flows in August. The local people use the estuaries and wetland systems for subsistence fishing, but not to a large extent.

**Aquatic Ecology:** Based on available literature and fieldwork studies performed, 54 fish species can be expected to occur in the freshwater habitats within the Palma District. Only 9% of the expected species were sampled within the AII, outside of the DUAT area, in comparison to 24% sampled within the DUAT, even though the DUAT provides poorer habitat diversity.
Two species of fish found in the All were not previously encountered while sampling within the DUAT namely a species of Ambassis and of Aplocheilichthys.

Based on the specialist’s current understanding, the larger rivers to the North and the South are considered key to the aquatic biodiversity as they are believed to play an important role in the repopulation of the wetland systems of the All after dry periods. Furthermore, the pan system in the West of the All is considered to be of conservation value.

**Vegetation:** Cabo Delgado Province vegetation structure varies from open grassland, to grassland with thickets, to savannah and woodland. The most recent land-use and land-cover maps of the Survey Area indicate that the vegetation is degraded due to historic land-use and agricultural practices. Therefore, the species composition and structure of the area have been modified. Despite this vegetation type’s highly fragmented nature, a chain of natural forest relics are found within the secondary savannah woodland. However, low-altitude Moist forest, Miombo woodlands, mangroves and vegetation associated with watercourses and rivers are excluded from the defined coastal cry forests.

The Survey Area comprises a diversity of habitats and vegetation types. This system is driven by a moisture regime dependent on subsurface water flow from higher elevations, through a network of wetlands, depressions and mangroves eventually to reach the sea. The spatial arrangement of different vegetation communities is clearly dependent upon the availability of the subsurface water flow. Along this flow gradient, seven distinctly different Vegetation Units (7) have been identified: Short Open Shrubland, Short Closed Marshland, Open Saline Plains, Short Closed Grasslands, Closed Wetlands, Short Open Woodland and Short Closed Woodland.

No Red Data plant species (IUCN 2012) were recorded within the seven Vegetation Units. A number of locally protected plant species such as baobab, white mangroves, black mangrove, Indian mangrove, Tonga mangrove, red mangrove and star-apple mangrove occur in the Afungi Project Site.

**Mammals:** The survey identified 58 species of mammal to be present within the Palma District, representing 28% of the 205 non-marine mammals and 40% of the terrestrial and semi-aquatic mammal species (non-flying) found in Mozambique. Five of the recorded mammal species are IUCN Red Listed in Mozambique and ten species are listed as protected by Mozambican Regulations of Forestry and Wildlife, Decree.

The Rovuma River serves as a vital migratory route for a number of IUCN Vulnerable mammal species, including African elephant and hippopotamus. Finally, the high density of the hippopotamus is seen as a critical attribute as the species is both concentrated within the Rovuma River and represents a nationally important regional population of a species that is in rapid decline in Africa and Mozambique.

The African elephant is considered to be the most important species of conservation concern in the area of indirect influence (All), especially owing to the vastly increased regional pressure on the species as a result of poaching. The upgrades to infrastructure and communication in the area combined with the anticipated in-migration of people into the All is anticipated adding immense pressure to the regional elephant population, which requires urgent monitoring and proactive measures in relation to anti-poaching. Although responsibility of this issue is not solely that of the Project, there is an undeniable link between development expansion, infrastructural upgrading as well as increases of human populations with unsustainable utilisation of wildlife resources. The fact that the antagonists
of the illegal activities (poaching) are both armed and well-resourced raises concerns for project security.

The majority of the Afungi Project Site is of Medium and Low mammalian sensitivity, due to the overwhelming presence of Medium and Low sensitivity mammalian habitat types. Areas of low sensitivity include the mangrove regions and the wetland dambos, which showed forage potential for many of the prevalent mammalian taxonomic groups.

**Herpetofauna:** A combination of fieldwork and literature surveys revealed that 111 reptile and 51 amphibian species can be expected to occur within the Palma District, of which 54% and 73% respectively of the reptile and amphibian species were observed. Fieldwork in the Palma District (including within the DUAT area) revealed 60 reptile and 37 amphibian species, of which 51 and 20 respectively were found outside of the DUAT area. Of these, four reptile and one amphibian species have not previously been recorded in Mozambique, most likely due to limited sampling. Only one species of conservation concern was observed within the Palma District (the southern African python (*Python natalensis*)).

**Avifauna:** Fieldwork in the Palma District (including within the DUAT area) confirmed 321 bird species, 60 species of which have never previously been recorded in the Palma District, including three species which represent new records for Mozambique.

The Palma District supports a high richness of bird species: 64% of the 755 bird species known to occur in Mozambique are present within an area that is less than 1% of the area of Mozambique. In addition, the Palma District is an important area for many biome-restricted (15 species are restricted to the East African Coastal Forest Biome) and near-endemic species (25% are only shared between Mozambique and Tanzania) which qualifies it as a Secondary Area of Bird Endemism.

Twelve bird species in the Palma District are globally threatened and near-threatened, including the Wattled Crane (*Bugeranus carunculatus*), Madagascar Pond Heron (*Ardeola idae*) and East Coast Akalat (*Sheppardia gunningi*).

**Grennhaouse Gas Emissions:** Mozambique’s national GHG emissions are estimated to be 15.9 MtCO2e in 1994. The vast majority of GHG emissions arose from land use, land use change and forestry (LULUCF) (49%) and agriculture (30% percent). The energy sector (which includes gas processing) accounted for 11%. In the absence of actual GHG emissions data, GDP growth has been used as a proxy for emissions growth from 1994 to the present. The historic average growth of 8% per annum has been used to project GHG emissions from 2012 to 2028 (World Bank estimation). In summary, Mozambique’s GHG emissions were low in 1994 but, based on GDP growth rate, they are projected to grow significantly in the coming decades.

### 4.2 Socio-economic and Community Health Baseline

Palma District is located in the north-east of Cabo Delgado Province and comprises four Administrative Posts, six Localities and several villages (Error! Reference source not found.). The Afungi Project Site is located in the Palma Administrative Post and in the Locality of Mute, south-east of Palma town. In 2012, the population in the Mute Locality was an estimated 16,473 and accounts for 32% of the Palma District population. Within the Afungi Project Site, the population is estimated at approximately 2,700, accounting for 5.3% of the Palma District population.
4.2.1 Education and Employment

In 2007\(^2\), the level of education in Cabo Delgado was very low, as 81 % of the economically active population (15 years or older) did not complete any level of education. This was a small improvement compared to 1997, when 87 % percent had not completed any level of education. As in Cabo Delgado Province, the level of education is quite low in Palma District, with 88 % of the economically active population having no level of education. In the Afungi Project Site and Surrounds (including Senga and Maganja), illiteracy is high, especially among women (92 %).

Challenges faced by the education system in the District include a small number of schools; a limited number of teachers, classrooms and materials such as desks and books; lack of Second Level of Primary Education (EP2) and higher-level schools; long travel distances to schools (for both teachers and students); high dropout rate due to food security issues (these forces young people to engage in household farming activities during some periods of the year, e.g. harvesting); and a high dropout rate among young females that may be influenced by early marriages and teenage pregnancy.

In Cabo Delgado Province and Palma District, formal employment is scarce and mostly provided by the State (public officials of local administration, teachers and health professionals). The private sector is almost non-existent, and salaried employment is limited to tourism operators, some small private operators working in commerce and fisheries, temporary employment opportunities associated with recent hydrocarbon exploration projects, and road construction and maintenance contracts. Thus, the population is largely self-employed (85 % in Cabo Delgado and 87 % in Palma District), the great majority in agriculture and fisheries, and therefore highly dependent on natural resources for their livelihoods and income earning.

Waged employment is not common, and is only reported by approximately 4 % of the heads of households in the Afungi Project Site and Surroundings. This is due, among other factors, to lack of investment in employment-generating activities, limited capacity building of human resources due to high-level illiteracy and lack of trained people, and lack of developed infrastructures such as roads, energy and water supply.

4.2.2 Livelihoods (Agriculture, Fishing and Tourism)

Most of the agricultural activities are on a small scale and, in general, agricultural productivity is low. In the Afungi Project Site and Surrounds, subsistence farming is the primary activity for 50 % of the heads of households, followed by fishing, which is carried out by about 24 % of heads of households. Agriculture is practised in highland and lowland areas. Highland areas are usually located in the grasslands and adjacent to riverbanks, or in the high/plateau areas with sandy soils. These areas are usually utilised for crop farming such as cassava, sorghum, maize and peanuts, as well as trees such as cashew, mango and coconut. Lowland areas are located in the floodplain areas where the most productive soils are found. These are usually used to produce rice, sweet potatoes, bananas and sugar cane.

\(^2\) The socio-economic baseline of the ESIA (2014) is base on informations available at that time (2007). Later on (see chapter 6), complementary studies were produced: Community Health Impact Assessment (2014) and Regional Health Assessment (2019) give a recent portrait of the local and regional socio-economic situation.
Tourism and fisheries are also contributors to the provincial economy. This is attributed to Cabo Delgado being a coastal province with numerous islands located along the coast, which have proved to be a base for the establishment of fishing centres and the development of fishing activity. They are also the main attraction for international tourists, and tourism brings in the most revenue. Industrial tuna fishing occurs in the Exclusive Economic Zone close to the territorial waters of Palma District. Industrial and semi-industrial fisheries by Mozambican operators occur far south of Cabo Delgado Province.

In Palma District, some 21% of women are artisanal subsistence fishers, indicating that they already play an important role in ensuring food security for families, as well as generating income. Artisanal fishing is practised by the communities along the coast and along inland waterways, where catches are used for consumption as well as for sale. For a small percentage of residents, fishing is a source of seasonal employment. During fishing season people fish, and during the off season people grow crops.

Figure 4.1: Cabo Delgado Province, Administrative Division and Posts
4.2.3 Transport

The sea not only supports fishing activities but provides a network for the transportation of goods and services along the Mozambican coastline and to Tanzania. This is, in part, due to the limited general development of transportation infrastructure and services in northern Cabo Delgado and the Palma District. There are a limited number of boats operating in the area and, in terms of transportation, local people tend to walk instead of utilising sea-based transport, as it is expensive. Palma Bay experiences little activity in terms of shipping and navigation activities, with mostly fishing vessels (artisanal), local transport boats (small conventional and artisanal boats) and some recreational navigation (small recreational boats) using the bay. Transit shipping routes in the Mozambique Channel pass between 15 and 25 nautical miles offshore (28 and 46 km).

The road network infrastructure in the District is poor and not well developed, covering approximately 256 km. It consists of tertiary roads, feeder roads and non-classified segments. However, District authorities have implemented road construction and maintenance projects that include repairing and paving some roads.

4.2.4 Health

A vast majority of the households in Palma District rely on unprotected water sources like open wells (60 %); surface water like rivers, lakes and lagoons (7 % percent); and other unspecified sources (2 % percent). This reliance on unsafe water sources poses a variety of health risks (e.g. diarrhoea and cholera) for the local population.

There are limited health facilities in the District, with a high number of people in all Administrative Posts living more than 8 km from a health facility. The lack of public transport and poor road infrastructure exacerbate the situation. The nearest hospital is the Rural Hospital of Mocímboa da Praia, located 80 km from Palma town.

Access to health services is also poor in the Afungi Project Site and Surroundings (including Senga and Maganja). With the exception of the Maganja health facility, all health care facilities are located some walking distance away in the Administrative Post centres. However, vaccination services are available for children through First Responders or APEs (Elementary Polyvalent Agents).

4.2.5 Sanitation, Waste and Power

The lack of sanitation facilities is a significant problem facing the communities in Palma District, including in the Afungi Project Site and Surrounds. Some 81 % of the population in the Afungi Project Site and Surrounds do not have access to adequate latrines. This poses significant health problems for people, as urinating and evacuating in the bush may affect water sources.

There are no formal waste disposal systems or sites in the District, and most people burn or dispose of waste outside their houses or on unoccupied land.

Firewood is used as the main energy source for cooking, followed by palm leaves and coconut fibre. Households mainly use petroleum products and battery-operated flashlights/lamps for lighting.
4.2.6 **Heritage and Culture**

Sacred sites include cemeteries, churches and mosques (where different types of worship services are conducted), as well as sites where initiation rites are performed. Ten archaeological sites were recorded in the area of Afungi Peninsula, as well as one abandoned sacred place and several burial sites. Most of these sites have been affected by extensive cultivation, and those closer to the coast have been influenced by sea erosion. The archaeological finds included beads, shells (including pearl oysters), fish bones and potsherds.

A notable cultural ceremony in the Afungi Project Site and Surrounds are the initiation rites (for girls and boys) that mark the entry of children into adulthood.

5 **POTENTIAL E&S IMPACTS**

5.1 **Site Selection**

As a part of the initial project planning in 2011, a high-level analysis of baseline sensitivities (e.g. habitats, fauna, number of people and area of cultivated land) was conducted to identify an appropriate location for the onshore facilities and nearshore infrastructure. After site visits, numerous analysis, interaction with the Engineering Team and the environmental and social team the Afungi site was the preferred alternative.

5.2 **Stakeholder Engagement**

Stakeholder engagement (including communication with local communities) is a critical part of the ESIA process and activities were carried out at key stages of the ESIA process to ensure that stakeholder concerns and comments are addressed in the ESIA. Meetings were held with stakeholders during the EPDA and Impact Assessment Phases. In addition, focus group meetings were held during the Impact Assessment Phase with key stakeholders. The Draft ESIA Report was made available for public comment between 27 August and 31 October 2013. All comments received throughout the engagement process and commenting period were recorded, and responses are provided in a Public Participation Report (Annex A of ESIA Report). The Draft ESIA Report was updated based on comments received prior to submission to MICOA (MITADOR) in February 2014.

The key issues raised during the ESIA relates to:

- Land acquisition (process followed and communication);
- Displacement (physical and economic);
- Job creation and training for local communities;
- Economic benefits and community development;
- Impacts on livelihoods (tourism, fishing and agriculture);
- Impacts on biodiversity and ecosystems (marine and terrestrial);
- Impacts on health, safety and security; and
- Implementation of mitigation and management measures (effectiveness of mitigation or capacity of authorities to monitor).
The stakeholder engagement and consultation process initiated during the LNG ESIA continue after the ESIA as part of the Stakeholder Engagement Plan and Resettlement Plan (see chapter 7). Since the beginning of the Project ESIA study, almost 600 meetings at various levels (community to national level) were held.

5.3 The LNG ESIA Process

The purpose of the LNG ESIA was to predict the significance of the Project’s impacts on the baseline physical, biological, and socio-economic environment; and to identify measures needed to minimize negative impacts and maximize the positive impacts.

Impacts were identified by the ESIA Team with inputs from stakeholders (e.g. local communities, government departments, and local communities). The Project aimed to avoid impacts to the best extent practical. If impacts could not be avoided, they were mitigated using measures that would provide for the least negative impact and most positive impact possible. In cases where these first two strategies were not possible, the Project would remediate impacts where possible and investigate options for compensation or offsets where necessary or required.

The findings of the ESIA include a large number of potential impacts and are summarized below. In the ESIA 2014, only general mitigation measures were presented. Specific mitigation measures were developed during complementary studies (2014–2019) and are included in different ESMPs (see chapter 6) and integrated in the Environmental Licensing Commitments Register (ELCR) which include more than 1300 measures (see chapter 6 for an example).

5.3.1 Offshore Environmental Impacts

The offshore project location is in deep waters up to 2,300 m. This area supports a large number of marine mammals as well as numerous fish species, turtles, and sea birds. Reef structures have also been observed here.

Project activities that could potentially impact the offshore environment include discharge of treated drill cuttings and residual muds, disposal of dredged material, and installation of subsea infrastructures.

Summary of Offshore Impacts

<table>
<thead>
<tr>
<th>Project Impacts</th>
<th>Impact Significance Level Pre-Mitigation</th>
<th>Impact Significance Level Post-Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge of drill cuttings</td>
<td>MINOR</td>
<td>NEGLIGIBLE to MINOR</td>
</tr>
<tr>
<td>Discharge of residual muds</td>
<td>MINOR</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>Discharge of hydrotest water</td>
<td>NEGLIGIBLE</td>
<td>-</td>
</tr>
<tr>
<td>Increased traffic</td>
<td>NEGLIGIBLE TO MODERATE</td>
<td>NEGLIGIBLE</td>
</tr>
</tbody>
</table>
| Habitat modification    | MODERATE                                | NEGLIGIBLE                               

3 Mitigation measures are developed mainly in the Dredging Management Plan (see chapter 6)
Impacts of discharged drill cuttings: Dispersion modelling indicates that the effects to offshore benthic flora and fauna (physical inundation) will be of MINOR significance before and after mitigation. The drilling of offshore production wells has the potential to impact water quality and marine ecology. With mitigation measures in place, the impact significance would be reduced to NEGLIGIBLE to MINOR significance.

Deepwater reef structures and organisms may be subject to more severe impacts. Reef structure growth is a slow process, so any significant impact may prolong their recovery time. Due to this, the impact significance would be MODERATE before mitigation. Most reef communities in this area are comprised of scattered rock and sediment with low numbers of marine life. With mitigation measures in place, this impact significance would be reduced to MINOR.

Impacts of discharged residual muds: Impacts from this activity on marine organisms are expected to be of MINOR significance because the muds from the drill cuttings after treatment are of low toxicity levels. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE.

Impacts of discharged hydrotest water: Impacts from this activity on marine ecology/processes are expected to be of NEGLIGIBLE significance because the hydrotest water will be discharged in a phased approach and at pressures that will allow for the water quality effects to happen in close proximity to the release points.

Impacts of increased traffic: Impacts from this activity (e.g. vessel and helicopter noise, lighting, and movements) on offshore marine ecology, except marine mammals, are expected to be of NEGLIGIBLE significance. Vessel collisions may have a greater impact on whales due to their conservational importance and will be of MODERATE significance. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE.

Impacts of habitat modification: Impacts from this activity (subsea infrastructure being built on the seabed) will result in changes to the composition of the seabed and affect the diversity and structure of the benthic marine community. These impacts will be of MODERATE significance, especially at deep water reef structures. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE as the location of the subsea structures will avoid sensitive marine areas to the extent practical.

5.3.2 Near Shore Environmental Impacts

The nearshore location in Palma Bay has a variety of different benthic habitats and supports sea grass beds and associated organisms close to shore. Coral reefs are also located throughout the bay and around the islands of Tecomaji and Rongui.

Project activities that could affect the environment of the nearshore include dredging, installation of pipelines, and the construction of the jetties and Multi-Purpose Dock.

- Marine Terminal’s Management Plan;
- Materials Offloading Facility Management Plan
- Onshore Construction Management Plan.
### Summary of Near Shore Impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Impact Significance Level Pre-Mitigation</th>
<th>Impact Significance Level Post-Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredging</td>
<td>MAJOR</td>
<td>MINOR to MAJOR</td>
</tr>
<tr>
<td>Modification of the beach</td>
<td>MODERATE</td>
<td>MINOR</td>
</tr>
<tr>
<td>Increased noise</td>
<td>MODERATE</td>
<td>MINOR</td>
</tr>
<tr>
<td>Alien invasive species</td>
<td>MODERATE</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Discharge into the bay</td>
<td>NEGLIGIBLE to MINOR</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>Waste discharges</td>
<td>MODERATE</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>Loss of estuary/mangroves</td>
<td>MODERATE</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Security exclusion zones</td>
<td>MINOR</td>
<td>To be determined</td>
</tr>
</tbody>
</table>

#### Impacts of dredging:
Impacts from this activity (e.g. increased turbidity, cutting a trench, deposition of fine sediment, and modifications of the seabed) on marine life including seagrass, coral, and associated marine communities are expected to be of MAJOR significance. With mitigation measures in place, including changing the activity technique, avoiding highly sensitive areas, and reducing turbidity, the significance of the proposed activities will be largely reduced. The deposition of fine sediment will remain as a MAJOR significance because resuspension of particles will be unavoidable. Dredged material deposited in a dredge placement area (Afungi Canyon in Palma Bay) will result in negative impacts by covering the benthos and will be at a MODERATE significance. With mitigation measures in place, this impact significance would be reduced to MINOR as the benthos will recover within one to three years after the cessation of dredging.

#### Impacts of beach modification:
Impacts from this activity (e.g. installation of infrastructures on the intertidal beaches and extending into the shallow subtidal zone) will result in a loss of parts of the sand beach, subtidal zones, and seagrass meadows. The establishment of hard substrate communities in the intertidal zone along with the corals, sponges, and other associated organisms will take place. Colonization of invasive species may also be of concern. These impacts are expected to be of MODERATE significance. With mitigation measures in place, including design modification, the impact significance of the proposed activities will be reduced to MINOR.

#### Impacts of increased noise:
Impacts from this activity (e.g. pile driving in Palma Bay) on fish, whales, dolphins, and turtles are expected to be of MODERATE significance. With mitigation measures in place, this impact significance would be reduced to MINOR should a “soft start” method be utilized prior to the commencing of construction activities.

#### Impacts of invasive alien species:
Impacts from this activity (transferring of invasive species into Palma Bay via ballast water) on the biodiversity and marine ecology of the area are expected to be of MODERATE significance. With control measures and processing techniques in place as sanctioned by the International Maritime Organization (IMO), this impact significance would be further reduced. Due to the possibility that invasive organisms may become established, the significance of this impact would remain as MODERATE.

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4 Mitigation measures are developed mainly in Dredging Management Plan; Noise and Vibration Management Plan; Marine Terminal’s Management Plan; Materials Offloading Facility Management Plan and Onshore Construction Management Plan (see chapter 6).
Impacts of discharges into the bay: Impacts from this activity (e.g., discharges from the water treatment plants from the LNG Facility) on nearshore water quality and marine organisms in Palma Bay are expected to be of NEGLIGIBLE to MINOR significance. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE.

Impacts of waste charges: Impacts from this activity (e.g., discharges of solid and liquid waste from marine vessels) on marine organisms in Palma Bay are expected to be of MODERATE significance. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE.

Impacts of estuary loss and its mangroves: Impacts from this activity (project construction activities) resulting in the loss of the estuary and associated mangroves to the east of the Project site are expected to be of MODERATE significance on marine ecology. The impact significance will remain MODERATE due to the loss of the multi-species mangrove stand.

Impacts of the security exclusion zones: Impacts from this activity (establishment of security exclusion zones) around the LNG Facility and Near Shore construction are expected to be of MINOR significance. This activity will disrupt the fishing efforts and locally increase pressure on the community outside the exclusions zones. Mitigation measures have yet to be identified.

5.3.3 Onshore Environmental Impacts

The onshore project area includes three main habitat types: marshlands, wetlands, and woodlands. They support important animal and plant life within the Afungi Project Site.

The project activities that could impact the baseline include the clearing of vegetation, infilling of estuaries, and other site prepping activities during the Construction Phase as well as accidental spills, runoff, and sedimentation during the operation phase.

Because of the sensitivity of the area, the footprint of the Onshore Project location has been reduced by 645 ha to reduce negative environmental impacts of highly to very high ecologically sensitive areas.
### Summary of Onshore Impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Impact Significance Level Pre-Mitigation</th>
<th>Impact Significance Level Post-Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Emissions During Operations:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Two-Train LNG Facility</td>
<td>MINOR</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>• Six-Train LNG Facility</td>
<td>MODERATE</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Emissions of Greenhouse Gases</td>
<td>MAJOR</td>
<td>MAJOR</td>
</tr>
<tr>
<td>Noise Generation</td>
<td>MINOR</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>Visual Landscape:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Construction Phase</td>
<td>MODERATE to MAJOR</td>
<td>MINOR</td>
</tr>
<tr>
<td>• Operation Phase</td>
<td>MAJOR</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Clearing of Soil</td>
<td>MODERATE</td>
<td>NEGLIGIBLE to MINOR</td>
</tr>
<tr>
<td>Groundwater Use</td>
<td>NEGLIGIBLE</td>
<td>NEGLIGIBLE</td>
</tr>
<tr>
<td>Construction in Marine Sensitive Habitats</td>
<td>MAJOR</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Clearing of Site:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Vegetation</td>
<td>MODERATE</td>
<td>MINOR</td>
</tr>
<tr>
<td>• Reptiles and Amphibians</td>
<td>MODERATE to MAJOR</td>
<td>MINOR to MODERATE</td>
</tr>
<tr>
<td>• Birds</td>
<td>MODERATE to MAJOR</td>
<td>MINOR to MODERATE</td>
</tr>
<tr>
<td>• Mammals</td>
<td>MAJOR</td>
<td>MINOR to MODERATE</td>
</tr>
</tbody>
</table>

**Impacts of air emissions:** Impacts from this activity (operation phase of the LNG Facility) on human and ecological receptors outside of the Project site are expected to be of NEGLIGIBLE significance with SO₂ levels increasing the impact significance to MINOR. With mitigation measures in place, this impact significance would be reduced to NEGLIGIBLE. If the expansion of the LNG Facility from two trains to six trains occurs, the significance will be raised to MODERATE.

**Impacts of emissions of greenhouse gases (GHG):** Impacts from this activity (construction and operation phases of the LNG Facility) could result in the Project accounting for nearly 10% of Mozambique’s annual national GHG emissions. These impacts are expected to be of MAJOR significance. With good practices in place, this impact significance will remain at MAJOR. Compensation measures will be developed. A specific Management Plan was developed later (see chapter 6).

**Impacts of noise generation:** Impacts from this activity (construction and operation phases of the LNG Facility) are expected to be of NEGLIGIBLE to MINOR significance.

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With noise levels required to remain in compliance with Mozambican and IFC noise limit/standards, this impact significance will remain at NEGLIGIBLE to MINOR.

**Impacts to the visual landscape:** Impacts from this activity (movement of vessels and highly visible equipment) on the visual landscape of the Palma Bay Seascape will have an impact of MODERATE to MAJOR significance during the Construction Phase. This impact will increase to MAJOR during the operation phase with the introduction of long-term presence of the LNG and associated facilities. Locations further from the Project site will have impacts of MINOR significance during the Construction Phase and MODERATE significance during the operation phase of the LNG Facility.

**Impacts of soil clearing:** Impacts from this activity (clearing of the LNG Facility area during construction) causing soil compaction, topsoil loss, soil erosion, and alteration of natural drainage are expected to be of MODERATE significance. With mitigation measures in place, this impact significance will be reduced to NEGLIGIBLE to MINOR.

**Impacts of groundwater use:** Impacts from this activity (groundwater abstraction from the production well, supply wells) causing lowering of groundwater levels in and around abstraction boreholes are expected to be of NEGLIGIBLE significance to the surrounding community water supply and environmental receptors utilizing surface water. This impact significance will remain at NEGLIGIBLE.

**Impacts on surface water ecology:** Impacts from this activity (Construction Phase of the LNG Facility) causing loss of wetland and estuarine habitats are expected to be of MAJOR significance to the ecological functions of the environment. With mitigation measures in place, including the revision of the Project footprint to avoid highly sensitive areas to the extent practical, will reduce the impact significance to MODERATE.

**Impacts of site clearing**

- **On vegetation:** Impacts from site clearing activities on vegetation, causing fragmentation and removal/disturbance of some sensitive vegetation units, are expected to result in an impact of MODERATE significance. With mitigation measures in place, including the revision of the Project footprint, the impact significance will be reduced to MINOR.

- **On reptiles and amphibians:** Impacts associated with site clearing activities on reptiles and amphibians will include the following: loss of habitat due to infilling of wetland areas, increased mortality, and reduced breeding success. These impacts are expected to be of MODERATE to MINOR significance. With mitigation measures in place, including the revision of the Project footprint, the impact significance will be reduced to MINOR.

- **On birds:** Impacts from site clearing activities on birds, causing loss of estuarine salt marshes, freshwater wetlands, large forests and intertidal zone habitats, are expected to result in an impact of MODERATE to MAJOR significance. The introduction of feral animals due to the population influx may also result in a reduction of the habitat quality. With mitigation measures in place, including the revision of the Project footprint, the impact significance will be reduced to MINOR to MODERATE.

- **On mammals:** Impacts from site clearing activities on mammals, including the loss/fragmentation of habitat and the loss of the ability to escape construction equipment, are expected to result in an impact of MAJOR significance. The influx of people into the Project area will also result in indirect impacts to the mammals
and their habitat. With mitigation measures in place, including the revision of the Project footprint, the impact significance will be reduced to MODERATE.

5.3.4 Key Social Impacts

The Project site is located within Palma District. Most people over the age of 15 in the district have received no formal education and illiteracy is high in the area. Formal employment is scarce and almost non-existent within the private sector. The majority of the population in the Project site are therefore highly dependent on natural resources such as fishing and small scale agricultural activities. There are very few health care facilities in Palma District yet communities are regularly at risk of health problems arising from water and sanitation. The communities largely use natural water sources such as open wells and streams. The sanitation in the area is poor with few formal toilets, this puts the water sources at risk with potential for out breaks of diarrhoea and cholera.

The main project activities that could change socio-economic conditions include the removal of access to land on the Afungi Peninsula, removal of access to parts of Palma Bay, an increase in-migrant population within the Project area, training and employment of local people and use of local goods and services.

Summary of Key Social Impacts

<table>
<thead>
<tr>
<th>Impact</th>
<th>Impact Significance Level Pre-Mitigation</th>
<th>Impact Significance Level Post-Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tourism</td>
<td>MAJOR</td>
<td>MODERATE</td>
</tr>
<tr>
<td>In-migration</td>
<td>MAJOR</td>
<td>MODERATE</td>
</tr>
<tr>
<td>Community health</td>
<td>MAJOR</td>
<td>MODERATE to MAJOR</td>
</tr>
<tr>
<td>Local, regional, and national economy</td>
<td>MINOR (positive) to MAJOR (positive)</td>
<td>MINOR (positive) to MAJOR (positive)</td>
</tr>
<tr>
<td>Increase in marine vessel movement</td>
<td>NEGLIGIBLE to MODERATE</td>
<td>NEGLIGIBLE to MINOR</td>
</tr>
<tr>
<td>Archaeology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Onshore</td>
<td>MODERATE</td>
<td>NEGLIGIBLE to MINOR</td>
</tr>
<tr>
<td>• Offshore</td>
<td>MINOR</td>
<td>NEGLIGIBLE to MINOR</td>
</tr>
</tbody>
</table>

Impacts on tourism: Impacts from visual and noise activities associated with Project construction and operations are expected to be of MAJOR significance on tourism. These impacts include disruption and loss of attraction to tourism destinations on the islands of Tecomaji, Rongui, and Queramimbi. With mitigation measures in place, such as revising the Project design to minimize visual intrusion, the impact significance will be reduced to MODERATE.

**Impacts of in-migration:** Impacts from Project-associated in-migration on the socio-economic environment on the local communities are expected to be of MAJOR significance. These include indirect negative environmental, social, and economic impacts on local receptors such as social services, infrastructures, utilities, cultural life, and livelihoods. With mitigation measures in place, including coordination with relevant authorities, the impact significance will be reduced to MODERATE.

**Impacts on community health:** Impacts from the Project workforce and in-migration on community health are expected to be of MAJOR significance. These include communicable diseases, increased demand on health infrastructure, food and nutrition-related issues, and community accidents. With mitigation measures in place, the impact significance will be reduced to MODERATE, but some impacts (e.g. increase in sexually transmitted diseases) will remain as MAJOR. Positive impacts are expected to be of MODERATE to MAJOR significance with the implementation of enhancement measures promoting community health benefits.

**Impacts on local, regional, and national economy:** Impacts from Project activities are expected to be of MINOR positive to MAJOR positive on the surrounding economies. These include income growth (increased employment rate and procurement), capacity development, and increased government revenue. With mitigation measures in place, including enhancing the economic benefits, the impact significance will remain at MINOR positive to MAJOR positive. A potential negative impact of unmet community expectations will be of MODERATE significance and remain as such throughout the Project life.

**Impacts from increased marine vessel movement:** Impacts from Project activities on international maritime traffic and national regional cabotage are expected to be of NEGLIGIBLE to MODERATE significance with the presence of Project vessels and exclusion zones. With mitigation measures in place, the impact significance will be reduced to NEGLIGIBLE to MINOR. Commercial fishing impacts during the Construction Phase of the Project are also expected to be of NEGLIGIBLE to MINOR significance and are primarily located offshore. With mitigation measures in place, the impact significance will be reduced to NEGLIGIBLE.

**Impacts on archaeology:**

- **Onshore:** Impacts to onshore archaeology and cultural heritage are expected to be of MODERATE significance during Project activities (e.g. site clearing and Construction Phase). With mitigation measures in place, the impact significance will be reduced to MINOR and will remain NEGLIGIBLE during the operation phase.

- **Offshore:** Impacts to offshore archaeology and cultural heritage are expected to be of MINOR significance during the construction and operation phases of the Project. With mitigation measures in place, the impact significance will be reduced to NEGLIGIBLE.

### 5.3.5 Cumulative Impacts

Future developments may occur together with the Project which may cumulatively affect the environment. These include the establishment of an Industrial Zone (IDZ) by the Government of Mozambique (potentially incorporating the Project site) as well as future phases of exploration and development of hydrocarbon resources by AMA1, Eni, and others. The cumulative impacts that may occur include economic development of the Cabo
Delgado Province and the country as well changes to habitats and ecosystems as the relatively undeveloped region is transformed. Both biophysical resources and socio-economic receptors in this region may experience positive impacts as a result of the establishment of the IDZ, provided it is managed properly. Spatial planning by the Government of Mozambique will also be of importance to promote sustainable development in the region. Cumulative impacts are further elaborated on in Chapter 7 (ESIA 2014).

5.3.6 Environmental and Social Management System and Environmental and Social Management Plan LNG ESIA 2014

5.3.6.1 Environmental and Social Management System

Chapter 17 of the ESIA 2014 presents the framework for the implementation of the Project Environmental and Social Management System (ESMS). The ESMS provides the structure for the management of environmental and social impacts associated with project delivery. This includes environmental and social monitoring, documenting compliance as required to measure the effectiveness of the mitigation measures, reporting on environmental and social performance, and the process for defining and implementing procedures for corrective action when necessary.

The ESMS framework enables the implementation of the Environmental and Social Management Plan (ESMP), which details the actions that will be taken by the Project to mitigate and manage environmental and social impacts. Implementation of the ESMP provides tools for auditing the Project’s mitigation and monitoring activities, and communicating monitoring outcomes to stakeholders.

The ESMS is supported by annexes:

- **Annex C**: Specialist Methodologies
- **Annex D**: ESMP Tables: Project impacts, associated management and/or mitigation measures as described in this ESIA, and summarises key monitoring requirements and responsibilities for implementation.
- **Annex E**: Waste Management Plan developed to facilitate evaluation and assessment of the Project impacts associated with the generation of waste. The WMP also outlines how waste generated as a result of the Project will be managed in accordance with Mozambican laws and regulations, recognised international good practice and the Project’s general environmental and waste management policies.
- **Annex F**: Decommissioning and Rehabilitation Plan provides a framework, including a set of guidelines and actions, for facilitating decommissioning and rehabilitation activities. The DRP will need to be updated and submitted to MICOA for approval two years before project closure.
- **Annex H**: Emergency Response Plan provides a representative Emergency Response Plan (ERP) which defines an organizational structure and provides a framework for responding to an emergency situation.
- **Annex I**: Initial Resettlement Plan contains the approach, principles and procedures which will be followed in resettlement planning. The IRP provides a framework for the future development of a Resettlement Action Plan (RAP).

Chapter 6 presents the other development methodologies and plans that have since been developed to support the ESMS.
5.3.6.2 Environmental and Social Management Plan (2014)

The 2014 generic ESMP presents the initial framework and an overview of it contain:

- organisation, roles and responsibilities;
- training, education and competency;
- assessment and improvement;
- grievance management;
- incident management;
- reporting; and
- managing changes.

The 2014 ESMP also includes Annex D Tabulated ESMP which presents: Project impacts, associated management and/or mitigation measures as described in this ESIA, and summarises key monitoring requirements and responsibilities for implementation. In the original ESMP no budget estimation was developed for the implementation.

Chapter 6 presents a listing of the detailed plans that have since been developed to complete the ESMP and their integration in the Environmental Licensing Commitments Register (ELCR).

5.4 LNG ESIA Approval

MICOA (now MITADER) approved the LNG ESIA in June 2014 with various requirements in the relevant regulations and responded to issues raised by public and other stakeholders. The ESIA Approval Letter also provided recommended mitigation and management measures beyond those detailed in the LNG ESIA chapters and the appended Tabulated ESMP (Annex D of the LNG ESIA Report).

6 COMPLEMENTARY STUDIES, ESMP, ENVIRONMENTAL LICENSES, STAKEHOLDER ENGAGEMENT

The LNG ESIA (2014) assessed environmental and social impacts on resources and receptors during 2011 through 2013. Since then, the development of the project has been pursued at all levels: technical, environmental, social and economic.

6.1 Complementary Studies

In addition the LNG ESIA Report, the following additional studies have been undertaken in support of the LNG ESIA:

- Alien Invasive Species Risk Assessment (2016);
- Dispersion Modeling (2019);
- Community Health Impact Assessment (2014);
- Critical Habitat Assessment (2016–2019);
• Ecological Evaluation of the Replacement Agricultural Land (2018)
• Ecosystems Services Assessment (2018);
• Palma-Afungi Road Simplified ESIA (2017);
• Project Induced In-Migration Plan (2018);
• Power line best practice plan (2017);
• Regional Health Assessment (2019).
• Replacement Agricultural Land Ecological Avoidance (2018)
• Residual Impact Assessment;
• Resettlement Plan (2016);
• Replacement Village ESIA (2015); and
• Terrestrial and Marine Baseline Studies (2014–2015);
  o DUAT Terrestrial Ecology Baseline
  o Regional Onshore Ecological Baseline
  o Baseline Survey of Near Shore Coral Reef Structure
  o Biodiversity Baseline Survey of Coral Communities at Tecomaji Island
  o Biodiversity Baseline Survey of Coral Communities at Cabo Delgado Peninsula and Rongui Island.

6.2 ESMP

6.2.1 Management Plans

The ESMP is a programme of actions to manage environmental and social risks and impacts, and other performance improvement measures, which have been identified and developed during, and after, the LNG ESIA (2014) into a suite of Management Plans.

Ressource Management
• Soil Erosion, Reinstatement and Landscaping

Pollution Prevention and Control
• Air Emissions and Greenhouse Gas
• Water and Wastewater
• Waste
• Hazardous Materials
• Noise and Vibration
• Dredging

Biodiversity
• Biodiversity Action Plan
• Biodiversity Guidance Note to Contractors
• Biodiversity Strategy
Engagement
- Stakeholder Engagement

Land and Livelihoods
- Resettlement Plan

Community Impacts and Development
- Community Safety
- Community Health
- Social Investment Strategy
- Security
- Emergency Respond
- Project Induced In-migration
- CATALISA Social Investment
- Community Development Fund Project Implementation
- Local Labour Recruitment Procedure

Cultural Heritage
- Cultural Heritage

Industrial Relations
- Project Industrial Relations Handbook - A Guideline for Contractors
- HSE Plan

Monitoring
- Ecology Monitoring Plan
- Marine Mammal Observation Procedure
- Site Environmental and Social Baseline Establishment
- Contractor Verification and Assurance
- ESMP Monitoring Programme

Specific ESMPs have been developed to comply with ESIA approval letter (2014)
- Camps Environmental Management Plan
- Exclusive Facilities Management Plan
- Materials Offloading Facility Management Plan
- Marine Terminal’s Management Plan
- Onshore Construction Management Plan
- Share facilities Management Plan

A plan presents:
- Introduction;
- Objectives;
- Scope;
• Legal and other requirements;
• Mitigation and management measures;
• Roles and responsibilities;
• Training, awareness and competency;
• Performance indicators;
• Reporting and notification; and
• Appendix, example Air emissions limits.

Figure 6.1 summarise the mains components.

**Figure 6.1: Example of the summary table from the Water and Wastewater Management Plan**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Objective</th>
<th>Control Measure</th>
<th>ID</th>
<th>Monitoring</th>
<th>Monitoring Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic tanks and chemical toilets</td>
<td>Objective 2</td>
<td>Ensure that wastewater collected in septic tanks is collected prior to the tank reaching full capacity and transported to a treatment facility capable of treating the sewage to meeting discharge limits.</td>
<td>WW13</td>
<td>Inspection</td>
<td>Ongoing</td>
<td>Contractor</td>
</tr>
<tr>
<td>Oil Contamination</td>
<td>Objective 1 &amp; 2</td>
<td>Treat all discharges and wastewaters so that the oil and grease content is below or equal to 10 mg/l. Waste oils shall be disposed of as per the Waste Management Plan.</td>
<td>WW16</td>
<td>Inspection</td>
<td>Ongoing</td>
<td>Contractor</td>
</tr>
<tr>
<td>Protection of wastewater treatment systems from Oil and Grease</td>
<td>Objective 2</td>
<td>Conduct regular inspections of oil and grease treatment systems and develop a schedule for cleaning and maintenance as appropriate.</td>
<td>WW17</td>
<td>Inspection</td>
<td>Ongoing</td>
<td>Contractor</td>
</tr>
<tr>
<td>Wastewater Reduction</td>
<td>Objective 2</td>
<td>Identify opportunities to prevent or reduce wastewater pollution; this could include but not be limited to: Using water efficiently, and Re-using treated wastewater.</td>
<td>WW18</td>
<td>Inspection</td>
<td>Ongoing</td>
<td>Contractor</td>
</tr>
</tbody>
</table>

**Budget**

As for the ESMP framework (2014), no budget has been estimated for the majority of these plans. However, the Project sponsor has made a commitment to allocate all necessary resources towards the effective implementation of its environmental and social management plans and commitments. The Resettlement Plan presents a budget and some social development plans present a high level budget.

**Environmental Licensing Commitments Register**

AMA1 has developed, as a key tool to support the implementation of the ESMP, an Environmental Licensing Commitments Register (ELCR) that includes all the environmental and social mitigation and management requirements from the various regulatory ESIA, EMPs and Approval Letters from MITADER (more than 1300 measures). Figure 6.2 presents an example of the content of the ELCR.

**Contractors**

Project contractors and subcontractors will develop their own plans and procedures to align with the ESMPs and Environmental Licensing Commitments Register.
### Figure 6.2: Example of the ELCR’s table

<table>
<thead>
<tr>
<th>CR ID</th>
<th>Category</th>
<th>Subcategory</th>
<th>Source Document</th>
<th>Section no.</th>
<th>Mitigation Action/Commitment (2019 EMP)</th>
<th>Notes (Phase)</th>
<th>Responsible for Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME-1</td>
<td>Drilling</td>
<td>Cuttings</td>
<td>LNG EIA Report</td>
<td>11.4.2</td>
<td>Employ a sub-surface discharge chute extending to approximately 10 to 15m depth for the overside disposal of treated drill cuttings and residual muds. This will reduce the size of the deposition footprint that is 1mm threshold is reduced.</td>
<td>Construction</td>
<td>✓</td>
</tr>
<tr>
<td>ME-2</td>
<td>Drilling</td>
<td>Cuttings</td>
<td></td>
<td></td>
<td>Residual discharges of treated drill cuttings and residual muds should be restricted to distances of &gt;175m from deepwater high-relief reefs as determined by Remotely Operated Vehicle (ROV) video surveys.</td>
<td>Construction</td>
<td>✓</td>
</tr>
<tr>
<td>ME-3</td>
<td>Drilling</td>
<td>Cuttings</td>
<td>LNG EIA Approval Letter (June 2014)</td>
<td>10. no.16</td>
<td>Assessment of cumulative effects of discharge of drilling muds and treated sludge on benthic organisms and reefs.</td>
<td>Design</td>
<td>✓</td>
</tr>
<tr>
<td>ME-4</td>
<td>Drilling</td>
<td>Cuttings and Muds</td>
<td>LNG EIA Report</td>
<td>11.5.2</td>
<td>The Mobile Offshore Drilling Unit (MODU) will be outfitted in accordance with Good International Industry Practice (GIP) to have an efficient solids control and mud recirculation system, including shakers, mud cleaners, dryers and centrifuges for the treatment of drill cuttings.</td>
<td>Construction and Operations</td>
<td>✓</td>
</tr>
<tr>
<td>ME-5</td>
<td>Drilling</td>
<td>Cuttings</td>
<td></td>
<td></td>
<td>Water Based Muds (WBM) and low toxicity additives should be used whenever possible (e.g., concentrations of mercury and cadmium in the barite should not exceed 1mg/l and 3mg/l respectively).</td>
<td>Construction and Operations</td>
<td>✓</td>
</tr>
<tr>
<td>ME-6</td>
<td>Drilling</td>
<td>Cuttings and Muds</td>
<td>LNG EIA Report</td>
<td>11.5.2</td>
<td>Synthetic based muds (SBM) that are low in toxicity, biodegradable and do not bioaccumulate will be used (e.g., polyaromatic hydrocarbon (PAH) content of less than 0.001 percent and a total aromatic content of less than 0.5 percent). No oil based muds will be used.</td>
<td>Construction and Operations</td>
<td>✓</td>
</tr>
<tr>
<td>ME-7</td>
<td>Drilling</td>
<td>Cuttings</td>
<td></td>
<td></td>
<td>All chemicals used will conform with Colas’s Offshore Chemical Notification Scheme (CCNS) and OSPARs PlONOR ( pose little or no risk) list of substances.</td>
<td>Construction and Operations</td>
<td>✓</td>
</tr>
<tr>
<td>ME-8</td>
<td>Drilling</td>
<td>Cuttings</td>
<td></td>
<td></td>
<td>Treated cuttings discharged into the sea will have a maximum oil concentration (by weight of dry cuttings) of 0.5% or less, which is in accordance with GIP.</td>
<td>Construction and Operations</td>
<td>✓</td>
</tr>
</tbody>
</table>
6.2.2 ESMP Implementation

Implementation of the ESMP cover:

Roles and Responsibilities

Primary responsibility for management and implementation of this ESMP rests with the AMA1 Project Management team(s). The AMA1 HSE Team, as well as various other functional leads (e.g., social performance, environmental management, resettlement, engagement, industrial relations, etc.) are responsible for providing support which includes coordination, oversight, facilitation and tracking of Key Performance Indicators (KPIs), monitoring and implementation of specified environmental and social mitigation measures.

Contractors will develop environmental and social plans and procedures to ensure alignment with the Project's environmental and social commitments and any other obligations arising are incorporated into work activities. Contractors will ensure that sufficient experience and competent resources are allocated by demonstrating relevant experience and providing a staff organisation chart. Contractor’s plans, procedures and other relevant provisions will be subject to review and approval by AMA1 prior to commencement of construction activities. Subcontractors are required to adopt or be aligned with Project environmental and social standards and minimum requirements.

Competency, Training, and Awareness

All Project personnel, both AMA1 and Contractors, that have responsibility for the execution of tasks and requirements contained within the ESMP and associated plans must have the necessary competencies, skills and experience to perform their work. AMA1 is responsible for ensuring all AMA1 personnel with such responsibilities are adequately skilled and receive the necessary training. Similarly, Contractors have the same responsibilities for their personnel and Subcontractors.

The extent of environmental and social training provided to personnel must be appropriate to the scope of activity and level of responsibility. Training needs assessment will be undertaken by AMA1 and Contractors to determine the level of training required for each member of the organisation, based on job description and level of environmental and social responsibility and involvement.

ESMP training and awareness programmes will be developed by AMA1 and Contractors and will be provided throughout the Construction Phase. At a minimum, programmes to be developed consist of the following:

- Induction and ESMP Awareness;
- ESMP Awareness for Management; and
- Focused ESMP Training

Refresher courses will be provided and will be updated as needed. All personnel training records and matrices will be retained by the relevant AMA1 or Contractor executing the work and will be kept up to date through Project activities.
Monitoring and Evaluation

Both AMA1 and Contractors have responsibilities to monitor and report environmental and social performance. Assessment and improvement processes associated with the ESMP must be followed by AMA1 and Contractors. These processes include monitoring, inspection and verification, validation, and corrective action and improvement of environmental and social performance.

Contractors will also be required to perform field-based environmental and social monitoring such as surveys, sampling, and analysis to ensure the effectiveness of mitigation measures and that compliance requirements are being followed. AMA1 will also perform monitoring activities in addition to that required by Contractors. To ensure the effectiveness of these mitigation measures, inspection programmes will be implemented by the Contractors. AMA1 will routinely inspect that these measures align with requirements and will also review inspection programmes of its own activities.

KPIs will be developed for AMA1 and Contractors to continuously improve Project environmental and social performance and satisfy Anadarko Policies and Core Values. The objective of implementing KPIs is to establish conformance with, and continuously improve Contractor performance. In addition, internal and external audits will be undertaken to evaluate the Project’s environmental and social performance. These audits include internal, private environmental, public environmental, and lender audits.

A system of conformance or non-conformance is part of the assessment and improvement process of the Project which requires corrective action where there is a non-conformance against mitigation or control measure.

Incident Management and Notification

AMA1 has developed an Incident Management Plan (IMP) that defines the requirements for managing incidents: identifying causes, determining corrective actions to prevent or reduce the likelihood of recurrence of similar incidents and communicating corrective actions.

All incidents and near miss events will be investigated in accordance with AMA1 Incident Reporting and Investigation Procedure which comprises the following steps:

- Report, record and communicate the initial incident information as required by HSE-3 (Health, Safety and Environment Incident Reporting) and applicable HSE Programmes;
- Assemble the Investigation Team and resources needed to conduct the investigation;
- Conduct the investigation to identify the causal factors of the incident (Contractors will allow AMA1 to participate in incident investigations);
- Determine, implement, and track corrective actions to completion; and
- Communicate the investigation findings and lessons learned, as needed.

AMA1 also has an Emergency Management Plan, which has been developed to aid the Project mitigate or prevent, as far as practical, injury or loss of life, damage to property, and/or harm to the environment and communities. The Emergency Management Plan is applicable to all AMA1 operations in Mozambique, both onshore and offshore. The Emergency Management Plan defines an organisational structure that will be implemented
with roles and responsibilities assigned to ensure safe, rapid, effective and efficient response to an incident. Specific site information, emergency preparedness actions and procedures, emergency contacts and resources for each site location are documented as attachments to the Emergency Management Plan Core Plan. The following plans also support emergency preparedness and response:

- Medical Emergency Response Plan;
- Oil Spill Contingency Plan;
- Emergency Evacuation Plan (managed by Security Department); and
- Aviation Emergency Response Plan (currently under review).

The Emergency Management Plan operates within a tiered approach in responding to emergency situations. The response level is determined by the complexity of the incident, the risk to personnel and the public, and the impact on the environment, and is further determined by the need for mobilisation of resources.

**Reporting**

The Project will prepare and publish regular reports on its environmental and social performance. Performance will be communicated to Project stakeholders including the Government of Mozambique, Project affected communities, and Lenders. The results of the implementation of the ESMP will be reported internally to capture the performances of AMA1 and Contractors.

Environmental and Social Performance Reports will be submitted to the Government of Mozambique (every 6 months as noted in the LNG Project ESIA approval letter) and Lenders, which will present details on the Project’s environmental and social performance. The Project will also hold public meetings (every 6 months to begin with) in the areas that are directly affected by the Project and provide a platform to raise any comments, concerns, or questions that the public may have. These notes will be reviewed and formally submitted to the relevant entities and made publicly available on the Project’s website.

**ESMP Management of Change Procedure**

Changes in the Project may occur during all phases, including design and construction. Any recommendations or changes that impact the ESMP or any of its supporting plans or procedures are considered a change. Changes may be planned or unplanned, sudden or gradual, and temporary or permanent. AMA1 has established a Change Management Procedure to provide a standardised method to identify, manage, and track change requests through implementation and documentation of the change.

Project Management of Change (MOC) is the responsibility of AMA1. AMA1, Contractors and subcontractors can identify or initiate the MOC process, and will be required to apply the appropriate MOC procedure for all changes or deviations to agreed designs, facilities and operations activities and to approve plans and procedures. AMA1 will also notify and report changes to Lenders in accordance with applicable agreements.

**6.3 Environmental Licenses**

MICOA (now MITADER) approved the LNG ESIA in June 2014 with various requirements. In subsequent discussions with MITADER, the tabulated Environmental and Social Management Plan associated with the LNG ESIA Report was divided in different discrete
EMPVs (ESMPs). The ESMPs were submitted to MITADER on 8 December 2017 and the associated environmental licenses were issued on February 2018.

Licenses obtained for AMA1:

- AMA1 Exclusive Facilities ESMP (issued on 8 February 2018 and valid until 8 February 2023);
- AMA1/EEA Onshore Shared Facilities ESMP (issued on 8 February 2018 and valid until 8 February 2023);
- LNG Marine Terminal ESMP (issued on 8 February 2018 and valid until 8 February 2023);
- Materials Offloading Facility ESMP (issued on 8 February 2018 and valid until 8 February 2023);
- Palma-Afungi Road (issued 16 December 2016 and valid until 16 December 2021);
- Powerline (issued 13 February 2017 and valid until 13 February 2019);
- Resettlement Environmental License (issued on 8 August 2017, no expiration date).

6.4 Stakeholder Engagement and Consultation

The stakeholder engagement and consultation process for the Anadarko LNG project initiated during the LNG ESIA (during the Scoping Phase and Impact Assessment Phase), continued after the ESIA as part of the Stakeholder Engagement Plan (SEP) and Resettlement Plan (RP). In total, almost 600 meetings at various levels (community to national level) were held.

These consultations made it possible, among other things, to adapt the development plans and develop new programs to meet the expectations and needs of the population, such as the Catalisa Social Investment. With Catalisa, AMA1 seeks to diversify the impact it will have on the economy by investing in building capacity and sustainable industries that serve local markets by:

- Establishing sustainable market-led value chains in Cabo Delgado in poultry and horticulture through grants and technical assistance to private sector;
- Building work skills and supporting micro-enterprises targeted at youth in Palma to maximise local benefit from economic opportunities created by project and other investment inflows.

The planned budget is $10 m over 5 years.

7 CONCLUSION

Through the ESIA process, a number of positive and negative potential impacts of the Project have been identified and assessed. An ESMP framework has been prepared and many management plans have been developed to mitigate the negative impacts and to enhance positive impacts.

The offshore impacts are, after the application of mitigation measures, negligible or minor.
For the near shore, there are some major impacts resulting from dredging; with the application of the measures recommended in the specific *Dredging management plan*, the residual impact will be minor to major. Even after the application of the mitigation measures, the impacts will be moderate with respect to the alien invasive species. The construction of nearshore structures will result in a loss of mangroves that cannot be mitigated.

The project activities that could impact the onshore environment include the clearing of vegetation, infilling of estuaries, and other site prepping activities during the Construction Phase as well as accidental spills, runoff, and sedimentation during the operation phase. Because of the sensitivity of the area, the footprint of the Onshore Project location has been reduced by 645 ha to reduce negative environmental impacts of highly to very high ecologically sensitive areas. Even after the application of measures, the emissions of Greenhouse Gases will remain a major impact. Other major impacts will be mitigated by the measures presented in numerous management plans for the ESMP.

The main project activities that could change socio-economic conditions include the removal of access to land on the Afungi Peninsula, removal of access to parts of Palma Bay; resettlement plan addresses involuntary displacement of persons, replacement of lost farmland and assistance to restore adequate living conditions.

Impacts from Project-associated in-migration on the socio-economic environment on the local communities will be moderate after the application of the management plans, including coordination with relevant authorities.

Impacts from the Project workforce and in-migration on community health are expected to be important; with mitigation measures in place, the impact will be reduced, but some impacts (e.g. increase in sexually transmitted diseases) will remain major.

Impacts from Project activities are expected to be positive on the surrounding economies; these include income growth (increased employment rate and procurement), capacity development, and increased government revenue.

The stakeholder engagement and consultation process for the Anadarko LNG project initiated during the LNG ESIA, continued after the ESIA as part of the Stakeholder Engagement Plan and Resettlement Plan. These consultations made it possible, among other things, to adapt the development plans and develop new programs to meet the expectations and needs of the population. In general, the project is very well accepted by the population who have high expectations for the improvement of their living conditions.

The Project represents an economic opportunity that could be transformational for the economy of Mozambique by allowing the country to become one of the world’s leading LNG exporting countries, potentially generating: substantial tax and profit-sharing revenues for Mozambique, infrastructure and quality-of-life improvements, the possibility of long-term technology and knowledge transfer, direct and indirect employment opportunities and significant, long-term foreign direct investment.
8 REFERENCES AND CONTACTS

8.1 References


Anadarko, Moçambique Área 1, Lda (AMA1) May 2018: *ESHIA Executive Summary and Update.*

Anadarko, Moçambique Área 1, Lda (AMA1) April 2019: *Environmental Licensing Commitments Register.*

8.2 Contacts

African Development Bank (AfDB)
Fernando Balderrama, Chief Investment Officer
Email: f.balderrama@afdb.org
Tel.: +27 12 003 6900