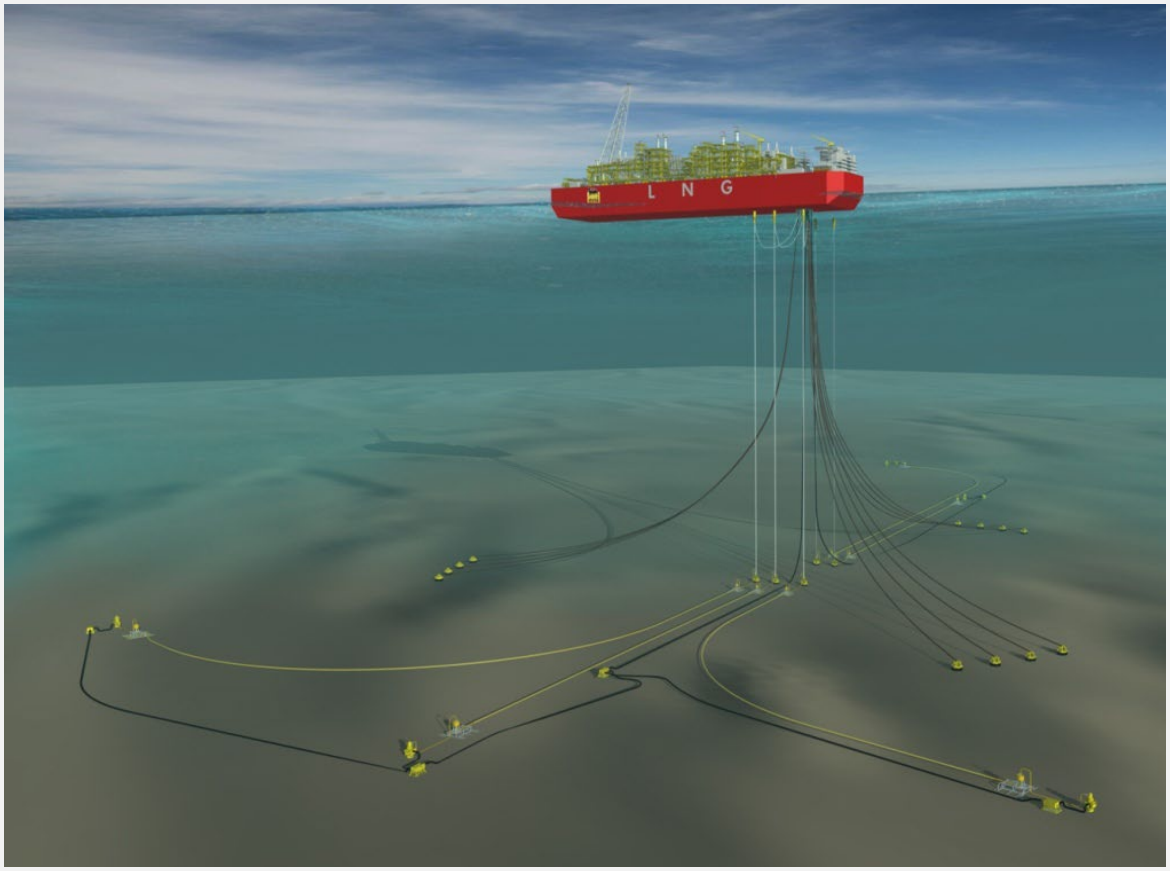
CORAL NORTH DEVELOPMENT PROJECT

ENVIRONMENTAL IMPACT STUDY

FINAL REPORT

VOLUME I – INTRODUCTION, PROJECT DESCRIPTION AND BASELINE ASSESSMENT



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Prepared for:

Mozambique Rovuma Venture

Mozambique Rovuma Venture S.p.A.

Prepared by:

CONSULTEC

Consultec – Consultores Associados, Lda.

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Mozambique Rovuma Venture S.p.A.
Rua dos Desportistas, Nº 918
Edifício JAT V–3, 1º a 4º Andar
Maputo, Mozambique
Tel.: +258-21-344-533
Fax: +258-21-49-7230

Consultec - Consultores Associados, Lda.
Rua Tenente General Oswaldo Tazama, No. 169
Maputo, Mozambique
Phone: +258 21 491 555
Email: consultec@consultec.co.mz

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LIST OF VOLUMES

REVISION HISTORY

Revision	Date	Reason for revision	Originator	Checker	Approver
V00	20 Fev 24	EIS issued for the public participation process	E Viçoso	N Silva	T Dray
V01	24 May 24	Integrates public consultation	E Viçoso	N Silva	T Dray
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Final (Rev 02)	24 Jan 25	Integrates responses to MTA's approval letter comments	E Viçoso	N Silva	T Dray

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LIST OF ACRONYMS AND ABBREVIATIONS

ADI	Area of Direct Influence
ADNAP	National Fisheries Administration (*Administração Nacional de Pescas*)
AII	Area of Indirect Influence
AIS	Automated Information System
ANAC	National Administration for Conservation Areas (*Agência Nacional das Áreas de Conservação*)
ANE	National Roads Administration (*Administração Nacional de Estradas*)
AoI	Area of Influence
AOO	Area of Occupancy
AQUA	National Agency for the Control of Environmental Quality *(Agência Nacional para o Controlo da Qualidade Ambiental*)
ARA	Regional Water Authorities (*Administração Regional de Águas*)
BOD	Biological Oxygen Demand
BOG	Boil-off Gas
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
C_2	Ethane
C_4	Butane
CBD	United Nations Convention on Biological Diversity
CBO	Community Based Organization
CCP	Community Fishing Councils (*Conselhos Comunitários de Pesca*)
CDS-ZC	Centre for Sustainable Development of Coastal Zones (*Centro de Desenvolvimento Sustentável das Zonas Costeiras*)
CFM	Ports and Railways of Mozambique (*Portos e Caminhos de Ferro de Moçambique*)
CH_4	Methane
CHA	Critical Habitat Assessment
CITES	Convention on the International Trade of Endangered Species of Wild Fauna and Flora
CLC	International Convention on Civil Liability for Oil Pollution Damage
CMMS	Computerized Maintenance Management System
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent(s)

COD	Chemical Oxygen Demand
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CP	Fishing Centers (*Centros de Pesca*)
CPI	Corruption Perception Index
CR	Critically Endangered
CTD	Conductivity-Temperature-Depth
dB	Decibel
DINAB	National Directorate of Environment
DMR	Double Mixed Refrigerant
DMU	Discrete Management Unit
DNA	National Water Directorate (*Direcção Nacional de Águas*)
DNPC	National Directorate of Cultural Heritage (*Direcção Nacional do Património Cultural*)
DP	Dynamically Positioned
DPS	Provincial Directorate of Health (*Direcção Provincial de Saúde*)
DUAT	Land Use and Development Right (*Direito de Uso e Aproveitamento da Terra*)
E&P	Exploration and Production
EACC	East Africa Coral Coast
EAME	East African Marine Ecoregion
EBA	Endemic Bird Area
EBSA	Ecologically or Biologically Significant Marine Areas
ECOSOC	United Nations Economic and Social Council
EDG	Essential Diesel Generator
EEZ	Exclusive Economic Zone
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment Process
EIS	Environmental Impact Study
EITI	Extractive Industries Transparency Initiative
EMP	Environmental Management Plan
EN	Endangered
ENH	Empresa Nacional de Hidrocarbonetos, E.P.
EP1	Primary Education First Cycle (*Educação Primária de Nível 1*)
EP2	Primary Education Second Cycle (*Educação Primária de Nível 2*)

EPC	Complete Primary Education (*Educação Primária Completa*)
EPCC	Exploration and Production Concession Contract
EPDA	Environmental Pre-Feasibility and Scope Definition Study (*Estudo de Pré-viabilidade Ambiental e Definição de Âmbito*)
ERB	Eni Rovuma Basin
ESG1	Secondary Education First Cycle (*Educação Secundária de Nível 1*)
ESG2	Secondary Education Second Cycle (*Educação Secundária de Nível 2*)
ESMS	Environmental and Social Management System
EU	European Union
FAO	Food and Agriculture Organization
FDS	Defence and Security Forces
FLNG	Floating Liquefied Natural Gas
FTU	Formazin Turbidity Units
GBV	Gender-Based Violence
GCP	Global Carbon Project
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoM	Government of Mozambique
GTG	Gas Turbine Generator
GTL	Gas-to-Liquids
H_2O	Water
H_2S	Hydrogen Sulphide
HSE	Health, Safety, and Environment
I&APs	Interested and Affected Parties
IADC	International Association of Drilling Contractors
IBA	Important Bird Area
ICC	International Criminal Court
IDEPA	Institute for the Development of Fisheries and Aquaculture (*Instituto de Desenvolvimento da Pesca e Aquacultura*)
IDP	Internally Displaced Persons
IDPPE	National Institute for Development of Small-Scale Fisheries (*Instituto Nacional de Desenvolvimento da Pesca de Pequena Escala*)
IEC	Information, Education and Communication
IFAD	International Fund for Agricultural Development

IFC	International Finance Corporation
IFEPOM	Rail and Port Institute of Mozambique (*Instituto Ferro-portuário de Moçambique*)
IIP	Fisheries Research Institute (*Instituto de Investigação Pesqueira*)
ILO	International Labour Organization
IMO	International Maritime Organization
INAMAR	National Institute of the Sea (*Instituto Nacional do Mar*)
INE	National Institute of Statistics (*Instituto Nacional de Estatística*)
INMARSAT	Convention on the International Maritime Satellite Organization
InOM	Institute of Oceanography of Mozambique
INP	National Petroleum Institute
INSS	National Institute of Social Security (*Instituto Nacional de Segurança Social*)
IOGP	International Association of Oil & Gas Producers
IPIECA	International Oil Industry Environmental Conservation Association
ISO	International Organisation for Standardisation
ISPS	International Ship and Port Facility Security
ITCZ	Intertropical Convergence Zone
ITRANSMAR	Marine Transport Institute (*Instituto de Transporte Marítimo*)
IUCN	International Union for the Conservation of Nature and Natural Resources
JOA	Joint Operating Agreement
JV	Joint Venture
KBA	Key Biodiversity Area
LC	Least Concern
LIFECA	Free of Open Defecation (*Livre de Fecalismo a Céu Aberto*)
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LTOBM	Low Toxicity Oil Based Mud
MAAP	Ministry of Agriculture, Environment and Fisheries (*Ministério da Agricultura, Ambiente e Pescas*)
MARPOL	International Convention for the Prevention of Pollution from Ships
MASC	Civil Society Support Mechanism Foundation (*Fundação Mecanismo de Apoio à Sociedade Civil*)
MD	Medical Doctor
MEG	Mono-Ethylene Glycol
MICOA	Ministry of Coordination of Environmental Affairs

MIMAIP	Ministry of the Sea, Inland Waters, and Fisheries (*Ministério do Mar, Águas Interiores e Pescas*)
MIREME	Ministry of Mineral Resources and Energy (*Ministério dos Recursos Minerais e Energia*)
MISAU	Ministry of Health (*Ministério da Saúde*)
MMO	Marine Mammal Observer
MMT	Million tonnes
MOPHRH	Ministry of Public Works, Housing and Water Resources (*Ministério das Obras Públicas, Habitação e Recursos Hídricos*)
MPA	Marine Protected Area
MPV	Multi-Purpose Vessel
MRV	Mozambique Rovuma Venture
MTA	Ministry of Land and Environment (*Ministério da Terra e Ambiente*)
MTL	Ministry of Transport and Logistics (*Ministério dos Transportes e Logística*)
MTPA	Million Tons per Annum
NGL	Natural Gas Liquids
nm	Nautical Mile
NO	Nitrogen Monoxide
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NOAA	National Oceanic and Atmospheric Administration
NO_X	Nitrogen Oxides (NO + NO_2)
NSR	Noise Sensitive Receptor
NT	Near Threatened
NTS	Non-Technical Summary
O&G	Oil and Gas
OA	Operators with Only Accommodation
OAL	Operators with Accommodation and Leisure Activities
OECD	Organisation for Economic Co-operation and Development
OEBS	Offshore Environmental Baseline Survey
PA	Administrative Post (*Posto Administrativo*)
PAH	Polycyclic Aromatic Hydrocarbons
PCR	Rotating Savings and Credit Groups
PES	Economic and Social Plan (*Plano Económico e Social*)

PM10	Particulate Matter (diameter < 10 mm)
PM2.5	Particulate Matter (diameter < 2.5 mm)
PPE	Personal Protective Equipment
POD	Plan of Development
PPP	Public Participation Process
PRM	National Police Service (*Polícia da República de Moçambique*)
PS	Performance Standard
PSV	Platform Supply Vessel
PTS	Professional and Technical Schools
QNP	Quirimbas National Park
ref	Reference
RM	Mozambique Radio (*Rádio de Moçambique*)
ROV	Remote Operated Vehicles
SADC	Southern African Development Community
SDAE	District Services of Economic Activities (*Serviços Distritais de Actividades Económicas*)
SDSMAS	District Service for Health, Women and Social Action (*Serviços Distritais da Saúde, Mulher e Acção Social*)
SEC	South Equatorial Current
SINAS	National Water and Sanitation Information System (*Sistema de Informação Nacional de Água e Saneamento*)
SO_2	Sulphur Dioxide
SOLAS	International Convention for the Safety of Life at Sea
SPA	Provincial Environmental Service (*Serviço Provincial de Ambiente*)
SPS	Subsea Production System
SSHA	Sea Surface Height Anomaly
SURF	Subsea Umbilicals, Risers, and Flowlines System
SWIR	Seawater Intake Risers
ToR	Terms of Reference
TScf	Trillions of Standard Cubic Feet
TSP	Total Suspended Particles
TSS	Total Suspended Solids
UK	United Kingdom
UN	United Nations

UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN Wider	United Nations University World Institute for Development Economics Research
USA	United States of America
VOCs	Volatile Organic Compounds
VU	Vulnerable
WB	World Bank
WBM	Water Based Mud
WFP	World Food Programme
WHO	World Health Organization
WIO	Western Indian Ocean
WRI	World Resources Institute
WWF	World Wide Fund for Nature
ZTV	Zone of Theoretical Visibility

1 Introduction

1.1 General Considerations

Mozambique Rovuma Venture (MRV) is the Area 4 Operator (with 70% of participative interest) under the Exploration and Production Concession Contract (EPCC) of Area 4 offshore of Rovuma Basin (Figure 1.1), located in the deep waters of the Rovuma Basin off the coast of northern Mozambique near the border with Tanzania. Empresa Nacional de Hidrocarbonetos, E.P. (with 10% of participative interest), Galp Energia (with 10% of participative interest) and KOGAS Mozambique Ltd. (with 10% of participative interest) are joint venture partners.

Significant recoverable natural gas resources have been discovered in the Area 4 concession. As of today, within Area 4 there are two projects with approved Development Plans (POD): the Coral South Floating Liquified Natural Gas (FLNG), in production phase with the first cargo exported in November 2022, is developing the southern part of Coral 441 N/S reservoir, and the Rovuma Liquefied Natural Gas (LNG) Project, suspended in 2021 due to Force Majeure circumstances. Both projects have been granted Environmental Licenses by the former Ministry of Land and Environment (MTA), now the recently created Ministry of Agriculture, Environment and Fisheries (MAAP)[1].

In view of the size of the Coral Reservoir (17.7 Trillion Standard Cubic Feet [TScf] of natural gas in place), a multi-phased development strategy is envisaged, with MRV now proposing the development of a second LNG floating project to develop the resources located in the northern portion of the Coral field – the Coral North Development Project.

MRV is the Area 4 Operator under Area 4 EPCC and the Joint Operating Agreement (JOA).

From a regulatory and legal perspective Coral North Development Project will be implemented pursuant to the comprehensive regime established and applicable in Mozambique for the purpose of enabling the development of the Area 4 and Area 1 projects in the Rovuma Basin.

To obtain the Environmental License as required under the Environmental Law (Law No. 20/1997, of 1 October) for the development described above (hereafter the "Project"), MRV must carry out an Environmental Impact Assessment (EIA) process. Consultec – Consultores Associados, Lda., was appointed by MRV to carry out the EIA process on their behalf.

The EIA Process is initiated through the submission of a Screening Report to the environmental authority to enable Project categorization that indicates the level of assessment required for a project. The Screening Report was submitted to MTA on 12th May 2023. Following MTA's pre-assessment, the Project was classified as Category A on 7th June 2023 (letter ref. 386/SPA/DA-RLA/2020/023 – see Annex II), thus requiring a full EIA Process.

[1] The Ministry of Land and Environment (MTA) was the environmental authority at the time these licenses were issued. MTA has recently been abolished, by Presidential Decree No. 1/2025, and its attributions have been transferred to the newly created Ministry of Agriculture, Environment and Fisheries (MAAP). References to the abolished MTA are maintained in this report, when referring to past events.

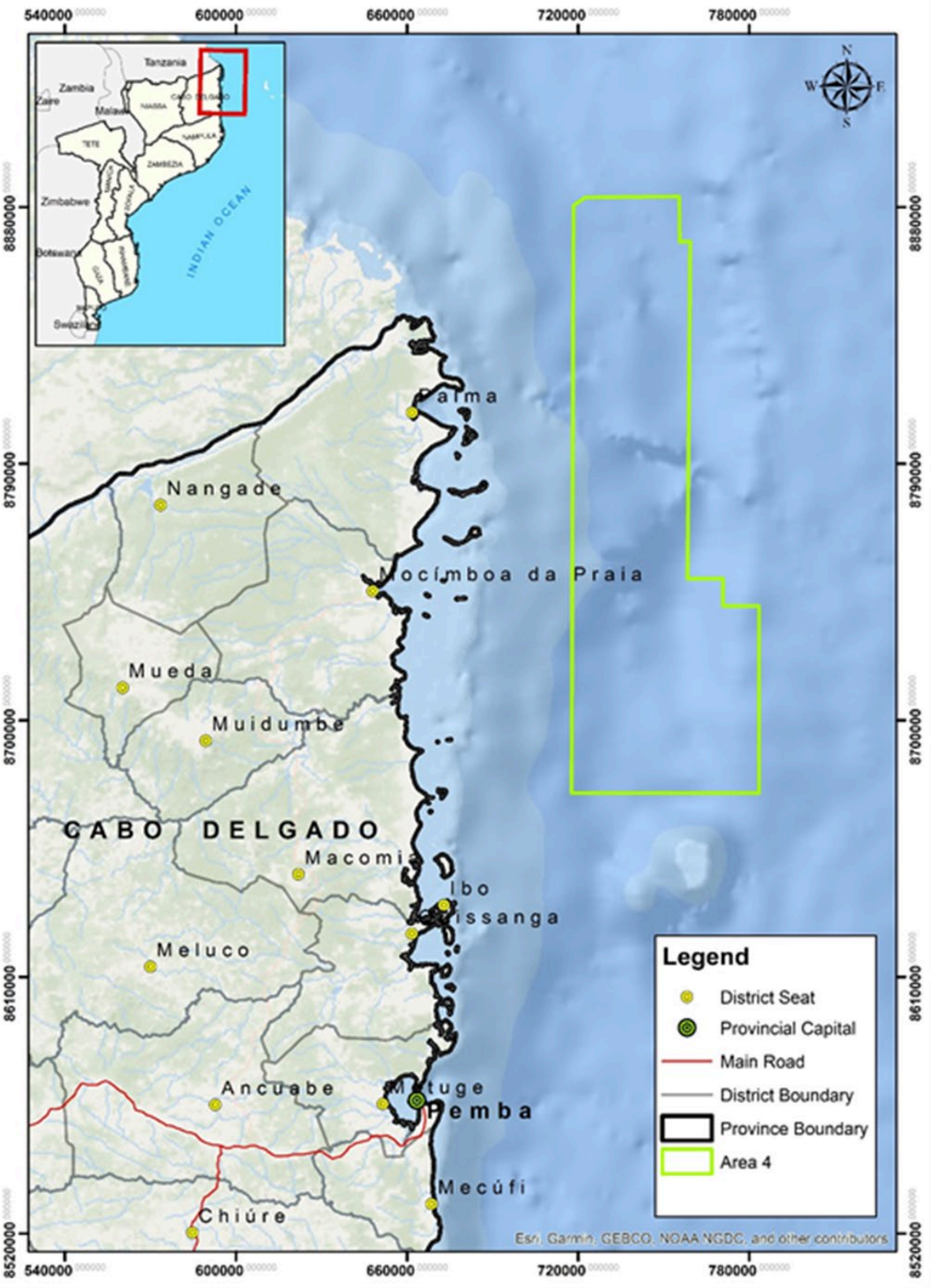


Figure 1.1: Location of the Area 4 exploration and production offshore block

The following step in the EIA process was the submission of an Environmental Pre-Feasibility and Scope Definition Study (EPDA) to MTA. The EPDA's main goals are to *(i)* determine potential fatal flaws associated with the proposed Project and *(ii)* define the Terms of Reference (ToR) of the environmental assessment to be undertaken in the following phase of the EIA process; the Environmental Impact Study (EIS). The EPDA report was submitted to MTA in August 2023. Following MTA's review, the EPDA Report was approved on 26 September 2023 (letter ref. 377/MTA/183/GM/220/23 – see Annex II; Volume IV). Following the EPDA's approval, the next step in the EIA process is the development of the EIS, in compliance with the approved ToR.

This document presents the final EIS Report, which was compiled following the conclusion of the Public Participation Process (PPP) activities of the EIS phase. Revision 01 of the final EIS report integrated a revision to the design of the produced water treatment plan, to include a phenol treatment package, and was submitted for MTA approval in September 2024. In November 2024, MTA communicated their approval of the EIS Report, through letter ref. 399/MTA/183/GM/220/24, dated November 20th, and made several comments to the report and requested its revision. This Revision 02 of the final EIS Report integrates the responses to MTA's approval letter comments.

1.2 Identification of the Proponent

The project proponent is Mozambique Rovuma Venture S.p.A. (MRV), whose contact details are provided in the following table.

Table 1.1: Proponent contacts

MRV	**Project Proponent**	**Mozambique Rovuma Venture (MRV)**
	Address:	Rua dos Desportistas, No. 918 Edifício JAT V-3, 1 a 4º Andar Maputo, Mozambique
	Person of contact:	Marica Calabrese
	E-mail:	marica.calabrese@eni.com

1.3 Identification of the Environmental Consultant

Consultec – Consultores Associados, Lda. (hereinafter designated as Consultec) was appointed by MRV to undertake the EIA process on their behalf. Consultec is a private and independent Mozambican consulting company, established in 1990. Consultec provides engineering, environmental, and social consulting services, and is registered with MAAP as an Environmental Consultant since 2002 (see Annex I; Volume IV).

Consultec contacts regarding this study are presented in the following table.

Table 1.2: Consultec contacts

	EIA Consultant	Consultec – Consultores Associados, Lda.
CONSULTEC Consultores Associados, Lda	Address:	Rua Tenente General Oswaldo Tazama, No.169 Maputo, Moçambique
	Person of contact:	Emanuel Viçoso
	Contact number:	+ 258 21 491 555
	E-mail:	evicoso@consultec.co.mz

Members of the EIA team responsible for drafting this report, their relevant experience and roles within the team are listed in Table 1.3. To develop some of the specialist studies, Consultec subcontracted partner consultancies, including Advisian, Biota, and ERM, as noted in Table 1.3.

Table 1.3: EIA team members responsible for the EIS report

Name	Role	Qualifications and Experience
Tiago Dray	Project director (Consultec)	Honours degree in Biology. Director at Consultec and overall manager of the environmental department.
Emanuel Viçoso	Project manager (Consultec)	Honours degree in Biology. Master's in Environmental Impact Assessment and Environmental Management. Over 20 years of experience in environmental consultancy.
Nuno Silva	Assistant manager (Consultec)	Environmental Engineer with over 20 years of professional experience in Environmental Consultancy.
Susana Rosa	Coordination of the biodiversity team (BIOTA)	Degree in Biology (Lisbon University, Portugal) and PhD in Ecology (University of Lisbon, Portugal). Ecologist with extensive experience in EIA, Biodiversity Monitoring Programs, Experimental design and Statistical Analysis and Biodiversity Action Plans.
Isabel Silva	Tropical ecology (BIOTA)	PhD in marine ecology, and over 20 years' experience as a marine ecologist and scientist.
Helder Araújo	Marine fauna (BIOTA)	Honours degree (*Licenciatura*) in Applied Biology from Minho University, Master's degree in Ecology, Biodiversity and Ecosystems from Aveiro University – Portugal, and a PhD in marine ecology. More than 10 years' experience.
Gelica Inteca	Marine fauna (BIOTA)	Bachelors in Biological Science and a Masters in Natural Resources Management. She is a JNCC trained Marine Fauna Observer with experience of the northern marine ecosystems of Mozambique.
Raquel Fernandes	Marine turtles (BIOTA)	Master's in aquatic biology and coastal ecosystems, with a focus on marine turtles. For the past 10 years she has been involved in conservation efforts for marine turtles in Mozambique.
Daniel Pires	Critical habitat screening and assessment (BIOTA)	Degree, master's, and PhD in biology. More than 20 years' experience in biodiversity consultancy and research. He has significant experience in Critical Habitat Screening and Assessment under IFC PS6
Sónia Malveiro	Habitat and flora (BIOTA)	Degree in Botany, and over 20 years' experience in biodiversity consultancy as a flora and habitat expert, and extensive experience in EIA processes.
Manuel Santiago	Climate and air quality (ADVISIAN)	Chemical Engineer with extensive experience in air quality assessments and air dispersion modelling studies. He completed his doctoral thesis at the Atmospheric Pollution Unit at the Research Center for Energy, Environment and Technology (CIEMAT, Universidad Complutense de Madrid) and the Air Resources Laboratory (ARL) of the American National Oceanic and Atmospheric Administration (NOAA), Maryland, United States of America (USA).

Name	Role	Qualifications and Experience
Tomas Ostolaza	Climate and air quality (ADVISIAN)	Tomás Ostolaza has more than two decades of experience conducting Environmental Assessments worldwide, such as Environmental and Social Impact Assessments, Atmospheric Pollution Studies (Air Dispersion Modelling), Noise Assessments, Marine Modelling, Meteorological studies, Air Pollution Effects on Forests, and Due Diligence for several industry sectors.
Alexander Stephen	Greenhouse Gases (GHG) Assessment (ADVISIAN)	Alex is a Principal Environmental Consultant with Advisian's Energy and Emissions team based in Aberdeen. He has worked in and contributed to a significant number of projects over his time with Advisian. This includes a variety of projects, covering EU ETS eligibility studies, Carbon Management plan development, emission baselines, carbon forecasting and other GHG Related quantification work.
James Assem	Climate change risk assessment (ADVISIAN)	Nearly 20 years' experience and leads a multi-disciplinary team of specialists providing solutions to hydrocarbons, mineral and metals, and infrastructure customers working across Europe, Middle East, Africa, and Central Asia. He has previously been the technical advisor on the Asian Cities Climate Change Resilience Network, looking at adaption measures for a coastal city in Indonesian. James currently manages a climate change adaptation project for an impact investor.
Matthias Thomsen	Climate change risk assessment (ADVISIAN)	Environmental Scientist with a PhD in marine ecology. Matthias's experience ranges from biodiversity loss and ecosystem implications, microplastics, and climate change to environmental impacts and water quality.
Miguel Barra	Atmospheric noise (CONSULTEC)	Graduated in Environmental Engineering, Post-Graduation in Management and Environmental Policies and Post-Graduation in Safety Coordination in Civil Construction. Miguel has 22 years of international experience in the area of environmental monitoring and consultancy.
Peter Ward	Underwater noise (ADVISIAN)	Over 30 years' experience in underwater acoustic propagation studies including over 20 years' experience in environmental impact assessment with reference to the impact of underwater noise on the environment.
Francois Smit	Marine discharges and unplanned events modelling (ADVISIAN)	Francois is a coastal engineer with extensive international marine engineering experience gained on hydrocarbons, petrochemical, power plant and port development projects. He also has extensive experience in coastal and metocean processes modelling, coastal zone management, coastal monitoring, and waterfront and coastal structures design.
Siviwe Mabija	Marine discharges assessment (ADVISIAN)	Senior Coastal Engineer/Project Manager with over 14 years' experience (PrEng) in coastal engineering and maritime engineering field covering concept, feasibility and detailed engineering design, environmental impact, and operational condition studies.
Marcus Kretschmer	Marine discharges assessment (ADVISIAN)	Civil engineer with a Masters' degree in port and coastal engineering. Extensive experience in coastal engineering projects, including coastal modelling.
Annabel Knipe	Illumination assessment (ADVISIAN)	Annabel has over twelve years' experience in environmental management including consultancy, government advisory roles and ecological research in the United Kingdom (UK) and Australia Annabel's research and quantitative skills in applied science provide a solid basis for the interpretation of the scientific literature and modelling reports (underwater noise, oil spill, artificial light) and applying findings to impact assessments in a manner appropriate to both stakeholders and regulators.
Francisco Peño	Illumination assessment (ADVISIAN)	Fifteen (15) years of experience in Geographic Information System (GIS) projects and twenty (20) years in Computer-Aided Design (CAD) projects.

Name	Role	Qualifications and Experience
Aurora Finiguerra	Landscape and visual assessment (ERM)	Landscape and visual specialist with experience in GIS, CAD, 3D models and Photomontages related to Landscape and Visual Assessment. Over 10 years of experience in visual impact assessment.
Rafael Noronha	Socioeconomics and health (Consultec)	Master's in Social Policy and Management from the University of Cape Town, with over 12 years of professional experience. Rafael has been involved in different Social Impact Assessment, Resettlement Action Plans, Monitoring, and evaluation of Social Development Programs.
Horacio Cuna	Fisheries (Consultec)	Degree in Business Administration (Eduardo Mondlane University). Horácio Cuna is an Economic and Financial Analyst, Corporate Auditor, with long years of experience in providing financial costs evaluation, management, inflation estimation, feasibility, market, and socioeconomic studies in Mozambique.
Bram Naidoo	Human rights (Consultec)	Master's in Development Studies specialising in Human Rights and Gender (University of Melbourne) and International Politics (MSc) (University of London). Over 19 years of experience in social development mainly in the Southern African region.
Miguel Nazareth	GIS and mapping (Consultec)	Over 20 years' experience as CAD Technician, GIS Technician and Geology Technician in the main areas of engineering, environment, geology, geotechnic and map production.
Yussufo Adade	GIS and mapping (Consultec)	Experience in GIS and Remote Sensing applied to Integrated Natural Resource Management and Environmental Impact Assessment.

1.4 Purpose of the Report

The EIS's main goal is to assess project risks and impacts, define mitigation to minimize negative impacts and enhance positive impacts and to inform the environmental authority's decision process, regarding the issuance of the environmental license for the proposed activity. The EIS Report must include the following information, as per Article 11 of the EIA Regulation (Decree No. 54/2015, of 31 December):

- A legal framework pertaining to the proposed activity;
- A description of the proposed activity, considering all phases of its life cycle;
- A description and detailed comparison of Project alternatives, when applicable;
- The definition of the activity areas of influence;
- A description of the environmental and social baseline conditions of those areas of influence;
- The identification and assessment of the activity's impacts;
- The definition of the required mitigation measures, in order to avoid, reduce or compensate the negative impacts and optimize the positive ones; and
- An Environmental Management Plan (EMP) for the activity, including monitoring programs, if relevant.

The main tasks in an EIS thus include assessment of baseline conditions in the Project's areas of influence through the specialist studies defined in the EPDA ToR, impact assessment, definition of required mitigation measures and their compilation into an EMP, including monitoring actions.

Further to the tasks described above, the EIS phase also includes a PPP, to provide the opportunity for Interested and Affected Parties (I&APs) to review and comment on the Project and the EIS. In

order to support the public consultation activities of the EIS phase, a Draft EIS Report was compiled and disclosed. The results of the EIS PPP were then integrated into this final EIS Report, which will be submitted to MAAP for review and approval.

1.5 Report Structure

The EIS Report is structured in five Volumes, the content of which is listed in Table 1.4 below.

Table 1.4: EIS report structure

Volume	Chapter	Content
Volume I – EIS Report (Introduction, Project Description and Baseline Assessment)	Chapter 1	**Introduction** Provides a background to the proposed Project and the EIA, as well as information about the Proponent, the EIA consultant team and the report's main goals and structure.
	Chapter 2	**Legal and Regulatory Framework** Outlines the legal framework within which the EIA is being undertaken and identifies other environmental legislation, standards, and guidelines applicable to the Project.
	Chapter 3	**EIA Approach and Methodology** Presents the proposed approach and methodology for the EIA.
	Chapter 4	**Project Description** Discusses the desirability of the Project and provides a description of the Project.
	Chapter 5	**Project Area of Influence** Defines the areas of direct and indirect influence of the Project.
	Chapter 6	**Baseline Assessment** Describes the biophysical and socio-economic baseline of the Project's area of influence.
Volume II – EIS Report (Impact Assessment and Mitigation Measures)	Chapter 7	**Impact Assessment and Mitigation Measures** Identifies and assesses potential Project impacts (biophysical and socioeconomic) and defines relevant mitigation measures to avoid, reduce, compensate, or enhance Project impacts (as applicable).
	Chapter 8	**Public Participation Process** Provides a summary of the PPP activities undertaken in the EIA process up to this point and describes the proposed approach for the EIS PPP activities.
	Chapter 9	**Conclusions** Presents the main findings of the EIS report and recommendations for the following phases of the Project.
	Chapter 10	**References** Provides the references cited throughout the report.
Volume III	**Environmental Management Plan** Presents the Project EMP, organizing all mitigation, management and monitoring requirements set out in the EIS into thematic management programs.	
Volume IV	**Annexes** Provides support information to the EIS, in the form of annexes.	
Volume V	**Public Participation Process Report** Describes and documents the public participation activities undertaken for the EIS.	

2 Legal and Regulatory Framework

2.1 Introduction

The EIA process is being developed in compliance with Mozambique's national legislative requirements and in line with relevant international guidelines. This Chapter presents the national and international development and environmental and social legal frameworks applicable to the proposed Project, including the following:

- National Development Framework: national development and strategic plans with relevance to the proposed Project (see section 2.2);
- Institutional Framework: relevant governmental institutions and authorities with jurisdiction over the Project or over relevant environmental or social aspects (see section 2.3);
- Legislative Framework: legal requirements relevant for the Project's impact assessment (see section 2.4);
- Relevant International Conventions (see section 2.5);
- International Best Practice Guidelines and Policies (see sections 2.6 and 2.7).

2.2 National Development Framework

2.2.1 National Development Strategy (2015-2035)

The National Development Strategy (2015-2035), approved in July 2014 (GoM, 2014), defines the Government of Mozambique's (GoM) main development strategies to achieve the goal of "*raising its people's quality of life through the structural transformation of the economy and the expansion and diversification of the production base*".

The National Development Strategy believes that industrialisation, grounded in an inclusive and sustainable growth model, is the main way to achieve Mozambique's vision of prosperity and competitiveness. To materialise industrialisation, the strategy defines four main development pillars, namely:

- Human capital development;
- Infrastructure development;
- Research, innovation, and technological development;
- Institutional coordination and articulation.

The strategy considers that massive investment in the infrastructure sector is required and is a determinant factor for economic growth. As such, the strategy lists the main infrastructure that should be the focus of investment, including:

- Logistics - transport and storage infrastructure (the latter with a focus on storage of agricultural, fisheries, mineral, and hydrocarbon products);
- Maritime cabotage for cargo transport at long distances;
- Power generation, including alternative energy sources;

- Natural gas supply systems;
- Sustainable management of water resources;
- Social infrastructure;
- Tourism infrastructure.

The National Development Strategy's review process was initiated in 2021 and is currently ongoing.

The Project under assessment is a FLNG project, which will increase national production of natural gas, and is thus fully in line with the infrastructure development strategic goals, as defined in the National Development Strategy for the 2015-2035 period.

2.2.2 Governmental Five-Year Plan (2020-2024)

The main objective of the Government's Five-Year Plan for the current period (2020-2024), approved in April 2020 (GoM, 2020), is the improvement of the well-being and quality of life of the Mozambican people, the reduction of poverty and social inequalities, the creation of an environment of peace, harmony and tranquillity, and a strong focus on job creation. To achieve these goals, the five-year plan defines strategic areas of development the GoM should focus its action, and on which private and public investment should be incentivised.

The promotion of economic growth, productivity, and employment generation is one of these strategic areas for which the five-year plan sets several strategic goals, including the following related to the extraction of minerals and hydrocarbons: "*ensure the implementation of the first natural gas liquefaction units in the Rovuma Basin, on land, and at sea through the floating platform*".

The proposed Project is a natural gas production development in the Rovuma basin, which will increase hydrocarbon exportations, thus contributing to the economic development of Mozambique. The proposed Project is thus fully aligned with the strategic goals of the GoM's Five-Year Plan (2020-2024).

2.2.3 Economic and Social Plan for 2024

The Economic and Social Plan (PES) is an instrument for the implementation of the economic and social objectives defined in the 5 Year Government Program (2020-2024). It defines objectives regarding economic growth, inflation, export, net international reserves, public good production, basic social services, and public finances.

The PES 2024 (approved by the Parliament in December 2023)[2] includes a number of programs for human, social, and economic development translating the GoM's main strategic objectives. With regards to economic development, one of the subprograms pertains to infrastructure development, including the energy sector. The PES 2024 plans a continued effort for expansion of the LNG production and distribution infrastructure, with an expected overall gross domestic product growth

[2] The approval of the 2025 PES is delayed and currently planned for April 2025.

for the extractive industry of 18.6% and the resumption of construction work on the LNG platforms in the Rovuma basin and the expansion of the LNG distribution network in Mozambique.

2.2.4 Mozambique Gas Masterplan

Mozambique's Natural Gas Masterplan was approved by the Council of Ministers on 24 June 2014. The plan establishes a framework of development for the country's natural gas resources, aiming to maximize the benefits of said development for the Mozambican society and thus improve the quality of life of its population.

The plan establishes natural gas development to be achieved up to 2030. One of these main goals is the development of the offshore production of LNG in Rovuma Basin, including for the export of LNG. The Coral North Development Project is fully in line with this main goal of the Mozambique Gas Masterplan.

2.3 Institutional Framework

2.3.1 Petroleum Authorities

The Ministry of Mineral Resources and Energy (MIREME), established by Presidential Decree No. 1/2015, of 16 January, is the Central Body responsible for geological research, exploitation of natural and energy resources, development, and expansion of electricity infrastructure, as well as the supply of natural gas and petroleum products. Presidential Decree No. 11/2015, of 16 March, defines MIREME's attributions and competencies while Resolution No. 14/2015, of 8 July, approves its Organic Statutes. MIREME is organised into different sectors, including a hydrocarbon sector. The responsibilities of the Ministry include, among others: *(i)* promoting private sector participation in the development and exploitation of mineral and energy resources and infrastructure; *(ii)* promoting and controlling geological exploration and research activities, and the rational and sustainable use of mineral resources; *(iii)* promoting and controlling oil production activities and the development of associate transport and logistics infrastructure.

The National Petroleum Institute (INP), created by Decree No. 25/2004, of 20 August, is the government agency under MIREME who oversees regulatory and inspection tasks regarding exploration, production, and transport of petroleum products, as well as the preparation of development policies and rules regarding petroleum operations. INP ensures that all petroleum activities are conducted in accordance with laws, regulations, and international best practice, with special emphasis on optimal resource management, health, safety, and the protection of the environment.

The High Authority of the Extractive Industry was established in 2014 to supervise petroleum operations although is not currently operational.

The GoM has recently created an authority that is responsible for regulating, controlling, and supervising the energy sector in Mozambique, i.e., the Energy Regulatory Authority through the approval of Law No. 11/2017, of 8 September.

In addition to the aforementioned entities that play regulatory and supervisory roles, the State participates in petroleum operations through the national hydrocarbon company - Empresa Nacional de Hidrocarbonetos, E.P (ENH). Any investor wishing to explore Mozambican oil resources must associate with ENH. ENH participates in all phases of petroleum operations, from exploration to production, transportation, storage, and commercialization of oil and gas and their derivatives including LNG and gas to liquids (GTL), both in and out of the country.

2.3.2 Maritime Entities

The maritime governmental entities that are relevant to the activities of the Project are:

- Ministry of Agriculture, Environment and Fisheries (MAAP), newly created by Presidential Decree No. 1/2025, of 16 January, is the central body of the State that, in accordance with the principles, objectives, priorities, and tasks defined by the Government, directs, coordinates, plans, and ensures the implementation of policies, strategies, and plans for activities in the areas of the sea, inland waters, and fisheries. At the provincial level, MAAP is represented by its Provincial Directorates;
- National Sea Institute (INAMAR), created by Decree No. 88/2021, of 28 October, is an organisation with a regulatory role in the marine area. INAMAR's role is to conduct vessel inspections and to issue licenses, certifications, and similar titles associated with the movement of marine vessels;
- Institute of Oceanography of Mozambique (InOM) is responsible for ensuring safety during navigation and contributing to the development of scientific areas and the preservation of the marine environment (Decree No. 87/2021, of 28 October). It is also responsible for promoting national coordination and dissemination of warnings to navigators;
- National Institute for the Development of Fisheries and Aquaculture (IDEPA) is a public institution, endorsed with legal personality and administrative autonomy. Its vision is to ensure an integrated and coordinated development process where progress is made alongside fishing and aquaculture in the communities of fishermen and fish farmers and the quality of their environment. The mission of IDEPA is to promote actions leading to the development of fisheries and aquaculture, contributing to the improvement of the living, and working conditions of fishing and water growers' communities by increasing food production;
- National Directorate of Fisheries (ADNAP) is a public institution subordinated to MAAP whose mission is to contribute to the conservation of living aquatic resources susceptible to fishing through efficient and sustainable management, based on scientific and legal precepts and on the participation of all beneficiaries, with a view to optimizing present and future economic and social benefits for the country. Its attributions include the implementation of fisheries' management policies, strategies, and plans, carrying out the monitoring and control

of the activities of the national and foreign fishing fleet that demand the national ports and ensure fisheries' co-management actions at different levels, including actions by community fishing organizations;

- Ministry of Transport and Logistics (MTL) is the central body of the State, recently created by Presidential Decree No. 1/2025, of 16 January and in accordance with the principles, objectives, priorities, and tasks defined by the Government, directs, coordinates, plans, and ensures the execution of policies, strategies, and activity plans in the areas of transport, road, rail, waterway, air, port and airport infrastructure. At provincial level, MTL is represented by its Provincial Directorates;
- Marine Transport Institute (ITRANSMAR), recently created by Decree No. 83/2021, of 18 October, is the entity responsible for ensuring that all marine transportation activities are developed in compliance with applicable regulations, carrying out inspections of vessels and issuing marine certifications;
- Rail and Port Institute of Mozambique (IFEPOM), recently created by Decree No. 84/2021, of 18 October, is the regulatory entity for the rail and port sectors and is responsible for ensuring that all rail and port activities are developed in compliance with applicable regulations;
- Ports and Railways of Mozambique (CFM) is a public company under MTL that manages Mozambican rail and port systems. The rail system was developed to serve Mozambican ports in Maputo, Beira and Nacala, linking Mozambique to neighbouring countries, with multiple investments in financial holdings.

2.3.3 Environmental Authorities

The Ministry of Agriculture, Environment and Fisheries (MAAP) was recently created by Presidential Decree No. 1/2025, of 16 January. This new Ministry concentrates the responsibilities of the agriculture, environment and sea and fisheries sectors, which were previously under different ministries. MAAP is the central authority that plans, coordinates, controls, and ensures the execution of policies related to the management of land, forests and wildlife, environment, conservation areas, and climate change. At the provincial level, the environmental sector of MAAP is represented by the Provincial Environmental Service (SPA).

The EIA applications are managed by MAAP through the National Directorate of Environment (DINAB) at the national level and through SPA at the provincial level.

The management and monitoring of environmental quality, such as pollution control, water, soils and air quality, noise emissions, and waste management, are also a part of MAAP's responsibilities. The National Agency for the Control of Environmental Quality (AQUA) was created by Decree No. 80/2010, of 31 December, amended by Decree No. 2/2016, of 10 February, and is responsible, among other attributions, to develop and implement strategies for the integrated control of water, air, and soil pollution.

Management of conservation areas falls under the responsibility of the National Administration for Conservation Areas (ANAC), created by Decree No. 11/2011, of 25 of May, amended by Decree No. 8/2016, of 15 of April.

The Centre for Sustainable Development of Coastal Zones (CDS-ZC) focuses on development and coastal management issues and was created specifically to deal with coastal management at the national level through Decree No. 5/2003, of 18 February.

Water management is the responsibility of the National Water Directorate (DNA) and coordinated through Regional Water Authorities (ARA). ARAs are water management authorities organised according to regional hydrographic basins. They were established under Article 18 of the Water Law (Law No. 16/91 of 3 August). The National Water Directorate is under Ministry of Public Works, Housing, and Water Resources (MOPHRH).

The National Directorate of Cultural Heritage (DNPC) is the office in the dependency of the Ministry of Culture and Education that oversees Cultural Heritage.

2.4 Legislative Framework

The Constitution of the Republic of Mozambique defines the right of all citizens to a balanced environment and the duty to protect it (Article 90). Additionally, the State is required to ensure: *(i)* the promotion of initiatives to ensure ecological balance and environmental preservation, and *(ii)* the implementation of policies to prevent and control pollution and integrate environmental concerns in all sectorial policies to guarantee the citizen the right to live in a balanced environment supported by sustainable development (Article 117).

The proposed Project must comply with the legal requirements for environmental licensing taking into consideration the specific EIA regulations and also all the applicable environmental regulation (biophysical and social) that may be relevant to the Project throughout its life cycle (drilling and completion, installation, commissioning, operation, and decommissioning).

The relevance and applicability of this legislation for the Project are briefly discussed in Table 2.1 below. Decrees may be relevant to different matters, e.g., the Environmental Law must be considered for biodiversity conservation as well as waste management.

Table 2.1: Key legislation

Legislation	Description	Relevance
ENVIRONMENTAL ASSESSMENT		
National Environmental Policy - Resolution No. 5/95, of December 6	Establishes the basis for all environmental legislation. According to item 2.1, its main goal is to ensure sustainable development in order to maintain an acceptable balance between socio-economic development and environmental protection. To reach the goal, this Policy requires, among others, the integration of environmental considerations during planning, the management of the country's natural resources and the protection of ecosystems and essential ecological processes.	The project should strive to meet the policy's goals, integrating environmental considerations in its design, thus minimising impacts on natural resources and ecosystems.

Legislation	Description	Relevance
Environmental Law - Law No. 20/97, of October 1	Establishes basic principles for the rational use and management of environmental components in order to ensure the country's sustainable development. The Environmental Law applies to all public and private activities that may directly or indirectly affect the environment.	Any project should strive to meet the sustainable development principle throughout its entire life cycle.
Regulation for Environmental Impact Assessment - Decree No. 54/2015, of December 31	Establishes that one of the fundamental instruments for environmental management is the EIA, which aims to mitigate negative impacts that public and private projects may have on the natural and socio-economic environment, through environmental studies conducted prior to the commencement of said projects. Defines the environmental impact assessment process, the required environmental studies, public participation process, studies review process, project environmental feasibility, decision process and environmental license emission.	Any project should be submitted to a formal EIA process, in accordance with this regulation. An environmental license should be obtained from MAAP, and the issuance of the environmental license precedes any other license or permit required for the Project.
Regulation on the Environmental Audit Process - Decree No. 45/2024, of June 26	Defines environmental audits as documented and objective instruments for the systematic assessment of an environmental management system to ensure environmental protection. Its objective is to assess compliance of work and operational processes with the environmental management plan, including the environmental legal requirements in force, as approved for a particular project.	Throughout the project's lifecycle, the proponent will have to organise for independent environmental audits to be conducted at least once a year, without prejudice to the public environmental audit that may be requested under this decree.
Regulation on Environmental Inspections - Decree No. 51/2024, of July 17	Establishes the procedures for the undertaking of environmental inspections of public and private activities that, directly or indirectly, may negatively influence the environment. Aims to monitor compliance with environmental protection and quality standards at national level.	During the implementation of a project, MAAP may undertake inspections in order to ascertain compliance with environmental legislation and the EMP. The proponent must allow for and facilitate such inspections.
General Guidelines for Environmental Impact Studies - Ministerial Diploma No. 129/2006, of July 19	Provides details on environmental license procedures, as well as the format, general structure, and contents of the EIS report. The objective is to standardise procedures followed by various role-players in the environmental impact assessment process.	The EIS report must conform to the guidelines outlined in this Ministerial Diploma.
Guides the Public Participation Process of the EIA process - Ministerial Diploma No. 130/2006, of July 19	Defines the basic principles related to public participation, including methodologies and procedures. Considers public participation as an interactive process that initiates at the project design stage and continues throughout the lifetime of a project.	The PPP for the EIA must conform to the guidelines provided in this Ministerial Diploma.
PETROLEUM OPERATIONS		
Environmental Regulation for Petroleum Operations - Decree No. 56/2010, of November 22	Defines the EIA Process for Petroleum Operations. Defines categories and level of environmental assessment required for petroleum activities as follows: - Category A: activities related to development and production, construction and operation of oil or gas pipeline systems, decommissioning and any activities in sensitive ecosystems and conservation areas; - Category B: activities related to survey activities, except in conservation areas and sensitive ecosystems; - Category C: activities that, due to their nature, are unlikely to have negative impacts on the environment and public health.	Any project should be submitted to a formal EIA process, in accordance with this regulation. An environmental license should be obtained from MAAP, and the issuance of the environmental license precedes any other license or permit required for the Project.
Petroleum Law - Law No. 21/2014, of August 18	Establishes the regime for granting rights to undertake petroleum operations in the country and includes aspects related to Environmental Security and Protection and disposal of polluted water and petroleum wastes. Article 57 on "Protection of natural resources" establishes that the investor shall guarantee the co-existence of the Project with marine	Any petroleum project must abide by all environmental security and protection measures as set out in this legislation.

Legislation	Description	Relevance
	fauna and other ecosystems, especially in conservation and fishing development activity areas. Article 66 on "Environmental protection and safety" establishes that besides performing petroleum operations in accordance with good petroleum industry practices, the holders of prospecting, exploration and production, construction, installation and operation of infrastructure and systems of oil or gas pipelines, shall perform petroleum operations in accordance with the environmental legislation and other applicable legislation. This is to ensure that no ecological damage or destruction is caused by petroleum-related operations and that, when inevitable, environmental protection measures are in accordance with internationally accepted standards. The latter is achieved by developing and submitting environmental impact studies, including adequate mitigation measures to the responsible entities.	
Regulations on Petroleum Operation - Decree No. 34/2015, of December 31	Establishes operational requirements, including aspects related to safety, health and environmental protection and presents a list of environmental issues to be considered while carrying out petroleum operations.	Any petroleum project must consider safety, health, and environmental protection.
ATMOSPHERIC EMISSIONS AND AIR QUALITY		
Environmental Law - Law No. 20/97, of October 1	Article 9.1 forbids the discharge of any toxic substances into the atmosphere in case these exceed legal standards. The emission standards are defined by Decree No. 18/2004 (see below).	Any project must comply with the ambient air quality standards. This regulation does not set specific emission limits for LNG plants.
Regulation for Environmental Standards and Effluent Emissions - Decree No. 18/2004, of June 2, (as amended by Decree No. 67/2010, of October 31)	Establishes parameters for the maintenance of air quality (Article 7) and standards for emission of gaseous pollutants from various industries (Article 8); and standards for the emission of gaseous pollutants from mobile sources (Article 9) - including light and heavy vehicles.	
Regulation for the Management of Substances which can destroy the Ozone Layer – Decree 24/2008, of July 1	Establishes rules relating to the import, export, transit, and destruction of substances that destroy the ozone layer and equipment containing such substances to prevent or minimise negative impacts on the environment.	Any project must abide by these rules relating to substances which can harm the ozone layer.
Banning the import, export, production, and commercialization of Substances that may destroy the Ozone Layer – Resolution No. 78/2009, of December 22	This Resolution bans the import, export, production, sale, and transit of substances that destroy the ozone layer. The following substances are banned: - Chlorofluorocarbons; - Halogen (Halon - 1211, Halon - Halon 1301 and 2402); - Carbon tetrachloride (CCl4); - Other substances defined in accordance with the terms of the Montreal Protocol on Substances Depleting the Ozone Layer ratified through Resolution No. 8/93.	
WATER RESOURCES AND WATER QUALITY		
Water Policy - Resolution No. 46/2007, of October 30	This Policy includes significant matters not included in the previous policy, such as the improvement of sanitation in urban areas, peri-urban and rural areas, hydrologic networks, development of new hydraulic infrastructure and integrated management of water resources with the participation of interested parties.	
Water Law - Law No. 16/91, of August 3	This law is based on the principle of public water use, water management based on river basins, the principle of user pays, and polluter pays principle. Intends to safeguard the ecological balance and environment. Water uses require either a water concession (permanent or long-term water uses) or a water license (short term	If the Project requires the abstraction of water from natural sources, a water license must be obtained from the competent authority (Northern Regional

Legislation	Description	Relevance
	water uses). Licenses are given for a period of 5 renewable years, while concessions are valid for a period of 50 renewable years. Article 54 of this Law stipulates that any activity with the potential of contaminating or degrading public waters, in particular the discharge of effluent, is subject to a special authorisation to be issued by the Regional Water Administration and payment of a fee.	Administration of Water - ARA-Norte). If the Project requires the discharge of effluents into water bodies, a discharge license must be obtained.
Regulation for Environmental Standards and Effluent Emissions - Decree No. 18/2004, of June 2, (as amended by Decree No. 67/2010, of October 31)	Determines that, when industrial effluent is discharged into the environment, the final effluent discharged must comply with discharge standards established in Annex III of the decree. Onshore discharges of domestic effluent must comply with the discharge standards in Annex IV. Annex III establishes the effluent discharge standards for various industries. Annex V establishes the ambient quality standards for marine waters.	This regulation does not set specific emission limits for liquid effluents of LNG plants. The Project's offshore liquid discharges must not cause the exceedance of the ambient quality standards for marine waters established in this decree.
Regulation for Raw Water Quality Standards and Discharges of Liquid and Solid Effluents - Decree 52/2023, of August 30	Defines quality standards for the discharge of effluents to surface and underground water resources.	Not applicable to the project, as the scope of this regulation does not include discharge of effluents to marine waters.
Regulation on water quality for human consumption approves the Ministerial Diploma No. 180/2004, of September 15	Defines water quality parameters for water quality for human consumption and outlines measures for its control in order to protect human health.	Any project must comply with water quality for human consumption.
POLLUTION AND WASTE MANAGEMENT		
Environmental Law - Law No. 20/97, of October 1	Limits the production and / or disposal into the soil or subsoil and the disposal into water or the atmosphere of any toxic or polluting substances, as well as the practice of activities that accelerate erosion, desertification, deforestation, or any other form of environmental degradation to those limits established by the law (Article 9).	Any project needs to include measures to prevent pollution during and after project implementation. Any project must conform to the requirements outlined in this regulation.
Regulation on Urban Solid Waste Management - Decree No. 94/2014, of December 31	Establishes the legal framework for urban solid waste management. The key objective is to establish rules for the generation, collection, and disposal of urban solid wastes, to minimise their impacts on public health and the environment. Urban solid wastes are to be classified in accordance with the Mozambican Norm NM339 – Solid Wastes – Classification. Waste management is a responsibility of Municipal Councils and District Governments, as applicable.	The Project should implement suitable waste management practices throughout its life cycle, in compliance with the requirements outlined in this regulation.
Regulation on Hazardous Waste Management - Decree No. 83/2014, of December 31	Establishes the legal framework for hazardous waste management. The key objective is to establish rules for the generation, collection, and disposal of hazardous wastes, to minimise their impacts on public health and the environment. Annex IX of this decree provides waste classifications. MAAP is the competent entity to manage hazardous wastes, namely by licensing waste management units. Only entities which are licensed by MAAP can collect and transport hazardous wastes, beyond the limit of the facilities where they were generated.	
Regulation on Biomedical Waste Management - Decree No. 8/2003, of February 18	Aims to establish the rules for the management of biomedical waste in order to safeguard the health and safety of health care facility workers, ancillary workers, and the general public and to minimize the impacts of such waste on the environment.	
Regulation for the Prevention of Pollution	Provides measures to prevent and limit pollution of the marine and coastal environment by illegal discharges from ships, platforms,	The Project must ensure that all measures are in place to prevent

Legislation	Description	Relevance
and Protection of the Marine and Coastal Environment – Decree No. 45/2006, of November 30	and other offshore sources, as well as land-based sources, and the establishment of a legal basis for the protection and conservation of areas that constitute the public maritime domain, including coastal lakes, rivers, beaches, and fragile ecosystems. Establishes that offshore discharges should be compliant with applicable international guidelines, namely MARPOL 73/78.	marine and coastal pollution. This regulation requires the project to have a contingency plan for pollution by oils and other harmful or dangerous substances. This contingency plan must be approved by INAMAR.
BIODIVERSITY		
Environmental Law - Law No. 20/97, of October 1	Articles 12 and 13 state that the planning, implementation, and operation of projects should guarantee the protection of biological resources, particularly of plant or animal species threatened with extinction or that, by their genetic, ecological, cultural, or scientific value require special attention.	The Project must consider protected biodiversity.
Forest and Wildlife Law - Law No. 10/99, of July 7	Establishes the principles and basic rules for the protection, conservation and sustainable use of forest and wildlife resources. Article 10 defines protection zones as territorial delimited areas, representative of the national natural heritage, designated for their biodiversity and fragile ecosystems or the conservation of animal and plant species.	While focused on terrestrial environments, this legislation refers to aquatic animals (such as marine mammals) and should therefore be taken into consideration by the Project.
Regulation on the Forest and Wildlife Law – Decree No. 12/2002, of June 7	This Decree approves the regulation of Law 10/99 and applies to the protection, conservation, use, exploration and production activities of fauna and flora resources. Includes the commerce, transport, storage and primary artisanal or industrial transformation of these resources. Includes a list of protected fauna species, Annex II, for which hunting is prohibited. This list includes all species of gulls and sea turtles.	The proponent must notify MAAP if a species listed in this regulation is captured or disturbed.
Conservation Areas Law – Law No. 16/2014, of June 20 (as amended by Law No. 5/2017, of May 11)	This Law regulates the creation and management of all conservation areas in Mozambique, revoking the Forestry and Wildlife Law competences in this matter. Article 16 states that all activities that could result in changes to vegetation cover, or that could disturb flora, fauna, and ecological processes up to the point of compromising their maintenance, are interdicted within national parks, except if required for scientific reasons or management needs.	No protection or conservation areas are interfered by the Project.
Approves the Regulation of the Conservation Law – Decree No. 89/2017, of December 29	Main purpose is to regulate the Conservation Law and its applicable to the entire national territory including public and private entities who can directly or indirectly influence the country's national conservation system.	
Regulation for the Protection, Conservation and Sustainable Use of Avifauna - Decree 51/2021, of July 19	This decree regulates the protection, conservation, and sustainable use of avifauna, including its natural, continental, marine, lake and river habitats. Art 5 defines as avifauna protection zones the "Key Areas for Biodiversity", and "Important Areas for Birds" and art. 4 prohibits the exercise of any activity or construction of infrastructure capable of disturbing the avifauna or its habitat in the protection areas, as well as any economic or social infrastructure, to be built in sensitive areas for birds, must respect the international standards of good practice, ensuring the placement of signalling devices that prevent collision of birds or any other damage that affects the avifauna. Appendices A and D define the protected species whose exploitation is not permitted; Appendix B defines the species of avifauna in Mozambique included in CITES.	The Project must consider the protected avifauna as well as their habitats. No "Key Areas for Biodiversity" or "Important Areas for Birds" are affected by the Project.
Adoption of the Biodiversity Offsets Directive – Ministerial Diploma No. 55/2022, of May 19	Establishes the principles, methodologies, requirements, and procedures for the correct implementation of Biodiversity Counterbalances, integrated into environmental impact assessment processes.	If Project implementation results in significant residual impacts over key biodiversity areas, critical habitats, or threatened species or ecosystems, them the requirement

Legislation	Description	Relevance
		for biodiversity offsets is triggered and the EMP should integrate a Biodiversity Action Plan.
MARINE ACTIVITIES		
Policy and Strategy of the Sea (POLMAR) - Resolution No. 39/2017, of September 14	T Establishes a policy for the use of the sea, and a strategy for the implementation of that policy, to ensure that the multiple uses for the sea and coastal areas are developed in an ordered and sustainable manner. The proposed strategy is divided into seven pillars, one of which is economic development. Under this pillar, the strategy establishes policy directives for several economic sectors, which the Government of Mozambique should facilitate and promote, including minerals and hydrocarbons. For the minerals and hydrocarbons sector, the adopted policy lines are to ensure the knowledge of the country's potential in terms of minerals and hydrocarbon resources, and to monitor and control mineral and hydrocarbon exploitation activities, to protect human life and the marine and coastal environments. The Policy was drafted due to a growing demand for maritime space for different purposes, such as fishing and aquaculture, maritime transport and naval industry, tourism, energy production, hydrocarbons, research and safeguarding of cultural heritage requires, which requires a holistic and integrated approach. POLMAR therefore aims to address the demand for coastal and marine areas for the development of a blue economy that is both profitable and sustainable.	The project must ensure that it follows the principles outlined under this Policy.
Sea Law - Law No. 20/2019, of November 8	Proceeds to the revision of Law no. 4/96, of 4 January - Law of the Sea. Its purpose is to establish the legal regime applicable to the exercise of powers of sovereignty and jurisdiction over the national maritime space, to the exploitation of living and non-living marine resources, as well as to the use of the maritime public domain. Defines the rights of jurisdiction over the strip of sea along the Mozambican coast and establishes standards for administrative regulations and maritime activities.	This law defines rights in territorial waters and all marine activities must comply with its provisions.
Decree No. 88/2021, of October 28 – Creates INAMAR	Creates INAMAR and defines its attributions and responsibilities, as the marine authority in the maritime, lake, fluvial and coastal jurisdiction areas, as well as in the domains of maritime administration, safety, and protection.	The Proponent will engage with INAMAR, in its role as maritime regulator, and comply with all applicable requirements for all project related marine activities.
Regulates fees payable to INAMAR for public services Ministerial - Diploma No. 218/2013, of December 30 (amended by Ministerial Diploma No. 218/2014, of December 29)	This Diploma regulates fees payable to INAMAR for public services. The regulation is applicable to public and private entities whose activities are subject to authorisation or licensing by INAMAR; to national and international vessels linked to maritime commerce, fishing and other activities who require the use of national ports and waters under Mozambique's jurisdiction; any other floating construction that navigates in waters under Mozambique's jurisdiction.	This diploma establishes some of the fees to be charged for the project's marine component (e.g., vessel inspections and other authorisations).
Regulation establishing the Legal Regime for the Use of the National Maritime Areas - Decree No. 21/2017, of May 24	Establishes mechanisms for the zoning and management of National Maritime Areas, setting rules for the development of marine zoning plans, private use of the sea and coastal areas, taxing of private use of the sea and technical monitoring and evaluation of the marine zoning plans.	No marine zoning plan currently exists for the Project area. If a marine zoning plan for the Project area is developed in the future, the Project's activities will have to comply with the rules of use established in such a plan (e.g., any navigation corridor that might be established).

Legislation	Description	Relevance
Regulation on Commercial Shipping - Decree No. 35/2007, of August 14	Seeks to regulate the Commercial Shipping in its three categories: International Maritime Transport, National Cabotage and Local Traffic.	Since this project entails international marine transport of cargo, MRV must consider and conform to the requirements of this decree.
Regulation of the International Code for Protection of Ships and Port Facilities – Decree 71/2017, of December 20	Establishes the legal regime applicable to the protection of ships and port facilities in Mozambique. Its requirements are applicable to ships undertaking international travels, including drilling vessels, and to the port facilities that service those vessels.	All project vessels, including the drilling ship, will comply with the requirements of this regulation, including the notification and reporting requirements defined in this decree.
Regulation for the Exercise of Ships and Cargo Agency and Complementary Services – Decree No. 40/2024, of June 12	Establishes the requirement for foreign flag ships that call to national ports to obtain a navigation agent, and regulates the activities of navigation agents, in what regards port calls, crew changes, refuelling, cargo handling, and other vessel activities in national ports.	Project vessels will comply with the requirements of this regulation in their interactions with the Pemba port or other national ports.
FISHERIES		
Fisheries Law - Law No. 22/2013, of November 1	Defines areas for the conservation of marine species, which consist of national marine parks, nature reserves and marine protected areas. The Act provides for the establishment of a list of protected species.	The Project must ensure no protected marine species are affected by the proposed activities.
Marine Fisheries Regulation - Decree No. 89/2020, of October 8	Provides a list of aquatic species placed under special protection, in whole or in part and particular conditions applicable to each. In addition to the preservation and protection of marine species, provision is made for the establishment of fishing areas, fishing types, fishing gears, fishing vessels, fishing safety and security.	
Regulation on Recreation and Sports Fishing - Decree No. 82/2021, of October 15	Regulates the practice of recreational and sport fishing in the territorial waters of Mozambique. Annex II of Regulation contains a list of protected species.	The project must aim at ensuring recreational and sport fishing is not affected by the proposed activities.
CULTURAL HERITAGE		
Cultural Heritage Law - Law No. 10/88, of December 22	Aims to legally protect material and non-material assets of the Mozambican cultural heritage. Under this law, cultural heritage is defined as a "group of material and non-material assets created or integrated by the Mozambican people through history, with relevance to the definition of the Mozambican cultural identity". Material cultural assets include monuments, groups of buildings with historic, artistic, or scientific importance, places or locations (with archaeological, historic, aesthetic, ethnologic or anthropologic interest) and natural elements (physical and biological formations with particular interest from an aesthetic or scientific point of view).	The potential presence of cultural heritage on the Project area must be assessed in the EIS. Archaeological objects may be found during drilling, and thus a Chance Finds Procedure needs to be put in place.
Regulation for the Protection of Archaeological Heritage – Decree No. 27/94	All Projects that include works of excavation, earthworks, or removal of buried and submerged objects should include preliminary archaeology survey followed by archaeological monitoring activity during the development of the work. Archaeology monitoring during operations must be followed by rescue activity and mitigation measures, in the event of the detection of archaeological remains. Archaeological work in Mozambique must be conducted under the direction of a qualified archaeologist, duly licensed by the National Directorate of Cultural Heritage (DNPC).	Drilling activities should be monitored through a Chance Finds Procedure. If archaeological remains are found, mitigation measures should be defined and implemented, as required.

Legislation	Description	Relevance
TOURISM		
Tourism Law - Law No. 4/2004, of June 17	Stipulates the legal framework for the promotion and performance of tourism activities. Stipulates the general rule that the development of tourism activities should respect the environment, particularly forest, wildlife, energy and water resources and protected zones. Envisages the creation of Tourism Interest Zones in areas that, due their natural, cultural, and historical value, can produce tourist flows. Establishes that tourism in conservation areas should comply with biodiversity protection and conservation principles.	The project must ensure tourism activities are not negatively affected by the proposed activities.
Tourism Interest Zones Regulation - Decree No. 77/2009, of December 15	Stipulates the legal regime for the declaration of Tourism Interest Zones. There are already several such zones along Mozambique's coastal area, namely Crusse and Jamali Islands, Pemba Bay, Mapanzane and Chipongo, Lumbo and Sancul and Pemba Town. Establishes specific rules for land, environmental, landscape and cultural heritage protection, conservation, and management.	The project must ensure tourism activities are not negatively affected by the proposed activities.
LABOUR		
Labour Law - Law No. 13/2023, of August 25	Defines general principles and establishes the legal framework applicable to individual and collective employment relationships in terms of work rendered to an employer for remuneration. Chapter VI establishes the principles of occupational health and safety for workers.	The project must throughout its entire life cycle abide by Mozambique's labour law.
Regulation on the General Labour Inspectorate - Decree 45/2009, of August 14	This Regulation lays down the rules on inspections, under the control of the legality of work. Paragraph 2 of Article 4 provides for the employer's responsibility for the prevention of occupational health and safety risks for the employee.	The Proponent shall comply with the requirements. In the case of an inspection, the proponent must help to provide all necessary information to the inspectors.
Regulation for the Contracting of Foreign Citizens in the Petroleum and Mining Sectors - Decree No. 63/2011, of December 7	Establishes the legal regime on mechanisms and procedures for contracting foreign citizens for work purposes, under the provisions of the Petroleum Law and Mining Law, provided that the performance of such activities has been approved by the competent entity.	All foreign workers shall be contracted as per this regulation.
HEALTH AND SAFETY		
Legal regime for accidents at work and occupational diseases - Decree 62/2013, of December 4	Establishes the legal regime for accidents at work and occupational diseases and aims to bring the legal in line with the current labour law, introduce new formulas for calculating pensions and indemnities, as well as the possibility of revising pensions as a result of the aggravation or corrosion of the elements that served as the basis for its calculation.	The Proponent shall comply with the requirements.
Law of Protection of People, Workers, and Job Applicants Living with HIV/AIDS - Law 19/2014, of August 27	This law establishes the general principles that aim to ensure that all employees and job applicants are not discriminated against in the workplace or when applying for jobs, for being suspected of having or having HIV / AIDS. It is prohibited testing of HIV / AIDS to workers, job seekers, or candidates to training or promotion, at the request of employers, without the employee's or job seeker consent.	Testing job applicants for HIV / AIDS is prohibited. Testing of workers without the employee's consent is also prohibited. The proponent must train and reorient all HIV positive workers who are able to fulfil their duties at work, with activities compatible with their capabilities.
Mechanisms to protect and promote health and to prevent and control diseases – Law No. 3/2022, of February 10	Establishes mechanisms for the protection and promotion of health, prevention, and control of diseases, as well as threats and risks to public health.	The Project's health and safety procedures will comply with the mechanisms established in this law.

Legislation	Description	Relevance
Law of Private Medicine – Law No. 24/2009, of September 28	Regulates the licensing and practice of private medicine services in Mozambique.	The operation of the FLNG internal clinic will comply with the requirements of this law.
Regulation for the Construction and Maintenance of Technical Accessibility Devices – Decree No. 53/2008	Regulates the establishment of technical devices that allow the accessibility, circulation and use of service systems and public places for people in general and, in particular, for people with disabilities or conditioned mobility.	This decree applies only to public services and spaces, and thus is not applicable to the FLNG facility. However, it is recommended that the project's onshore facilities design takes into consideration the accessibility principles set in this regulation.
Decree No. 5/80, of October 22	Establishes the requirement for workers involved in the preparation and handling of food to obtain and carry a health certificate.	Workers involved in the preparation and handling of food aboard the FLNG will need to comply with this regulation.
UNPLANNED EVENTS		
Legal Framework for Management and Reduction of Disaster Risk, Law No. 10/2020, of August 24	Establishes a framework for risk reduction, disaster management, sustainable recovery for building human, infrastructural and ecosystem resilience, as well as climate change adaptation.	The Project's emergency and risk preparedness and response plans need to take into consideration and comply with this regulation.

2.5 International Conventions

The international conventions Mozambique has joined and are relevant for the Project are briefly discussed in Table 2.2 below.

Table 2.2: Relevant international conventions

Convention	Description
MARINE	
International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78	The International Convention for the Prevention of Pollution from Ships (MARPOL Convention) aims to prevent pollution of the marine environment by ships from operational causes and to minimize accidental discharge of such substances. It is currently ratified by 136 nations, including Mozambique, and contains six annexes that address the prevention of different forms of pollution from ships, namely: - Annex I: Oil: lists the conditions under which vessels are allowed to discharge oil into the sea; - Annex II: Noxious Liquid Substances: details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; - Annex III: Harmful Substances Carried in Packaged Form: contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions, and notifications for preventing pollution by harmful substances; - Annex IV: Sewage: requires vessels to be equipped with either a sewage treatment plant or a sewage holding tank; - Annex V: Garbage: specifies distances from land and the manner in which different types of garbage may be disposed of and imposes a complete ban on the dumping of all forms of plastic into the sea; and - Annex VI: Air Pollution: sets limits on sulphur oxide and nitrogen oxide emissions from vessel exhausts and prohibits deliberate emissions of ozone depleting substances. Mozambique ratified the MARPOL convention by Resolution No. 5/2003 of 18 February and has ratified all annexes, except Annexes IV, V, and VI.

Convention	Description
International Convention for the Prevention of Pollution of the Sea by Oil	The discharge of oil or oily mixtures into the sea from vessels is regulated by the terms of the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL, 1954). While the Convention does not deal with the releases from offshore installations *per se*, it regulates vessels operating in offshore oil fields by prohibiting the deliberate discharge of oil or oily mixtures from nearly all seagoing vessels in specific areas called 'prohibition zones'. Prohibited zones generally extend at least 50 miles (80 km) from all land areas.
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992	An international maritime treaty where the fund is obliged to pay victims of pollution when damages exceed the ship owner's liability, when there is no liable ship-owner, or when the ship-owner is unable to pay its liability. The fund is also required to "indemnify the ship-owner or his insurer" in spills where a ship is in full compliance with international conventions, and no wilful misconduct caused the spill. Mozambique ratified this Convention in 2001, through Resolution no. 53/2001.
United Nations Convention on the Law of the Sea (UNCLOS)	The UNCLOS convention (Montego Bay, 1982) is relevant as many provisions reflect customary international law. Part XII headed "Protection and Preservation of the Environment" includes provisions relating to marine pollution. As per Resolution No. 21/96, of 26 November, the Republic of Mozambique ratified the UNCLOS.
Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972	One of the most important innovations in the 1972 COLREGs was the recognition given to marine traffic separation schemes. Rule 10 gives guidance to determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes. Pursuant to the Resolution No. 11/88, of 28 December, the Republic of Mozambique acceded to the COLREGS.
International Convention for the Safety of Life at Sea (SOLAS), 1974	The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948 and the fourth in 1960. It prescribes numbers of lifeboats, other emergency equipment and safety procedures for merchant ships. Ratified by Mozambique through Resolution No. 25/2004, of 14 July.
International Ship and Port Facility Security Code (ISPS Code)	The ISPS Code is implemented through chapter XI-2 Special measures to enhance maritime security in the SOLAS. The purpose of the Code is to provide a standardized, consistent framework for evaluating risk, enabling Governments to offset changes in threat with changes in vulnerability for ships and port facilities through determination of appropriate security levels and corresponding security measures. The Republic of Mozambique ratified the ISPS Code by way of Resolution No. 26/2004, of 14 July.
Convention on the International Maritime Satellite Organization (INMARSAT), London 1976, 1985, 1989	The purpose of INMARSAT is to improve maritime communications, thereby assisting in improving distress and safety of life at sea communications, the efficiency and management of ships, maritime public correspondence services, and radio determination capabilities. The Republic of Mozambique acceded to INMARSAT and to its 1985 and 1989 amendments by way of Resolution No. 15/89, of 23 November.
International Convention on Load Lines, 1966	It has long been recognized that limitations on the draught a ship may be loaded make a significant contribution to her safety. These limits are given in the form of freeboards, which constitute, besides external weather tight and watertight integrity, the main objective of the Convention. The Republic of Mozambique acceded to the International Convention on Load Lines by way of Resolution No. 12/88, of 28 December.
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention 1972), London, 1972	This Convention regulates the dumping at sea of matter scheduled in the Convention. It contains a list of prohibited substances and substances requiring permits and sets out guidelines in this regard.
International Convention on Civil Liability for Oil Pollution Damage 1992 (1992 CLC Protocol)	This Convention provides for a compensation fund for clean-up costs and environmental damage subject to certain conditions and limits. Pursuant to Resolution Nr. 52/2001, of 6 November 2001, the Republic of Mozambique withdrew from the 1969 CLC Convention and acceded to the 1992 CLC Protocol.
Oil Pollution Preparedness, Response and Co-operation Convention	The Oil Pollution Preparedness, Response and Co-operation Convention (OPRC, 1990) came into force in May 1995 and relates to oil pollution of the marine environment throughout the world from offshore units. Countries or national governments must establish national programs for responding to oil pollution incidents, while operators of offshore units are required to have oil pollution emergency plans in place co-coordinated with the national oil response program. Further sections of the Convention deal with provision of oil pollution combating equipment, reporting, training,

Convention	Description
	salvage, and international cooperation. The Republic of Mozambique acceded to this convention by way of Resolution No. 6/2003, of 18 February.
International Convention for the Control and Management of Ships' Ballast Water and Sediments (IMO, 2004)	Aims to prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms, including alien invasive species, and pathogens through the control and management of ships' ballast water and sediments. Establishes standards and procedures for the management and control of ships' ballast water and sediments. The Republic of Mozambique acceded to this convention by way of Resolution No. 58/2023, of December 29.
BIODIVERSITY	
African Convention on the Conservation of Nature and Natural Resources	The fundamental principle of this Convention consists in the Contracting States undertaking of adopting the measures to ensure conservation, utilization and development of soil, water, flora, and fauna resources in accordance with scientific principles and with due regard to the best interests of the people. Pursuant to Resolution No. 18/81, of 30 December 1981, the Republic of Mozambique acceded to the African Convention on the Conservation of Nature and Natural Resources.
Nairobi Convention	By Resolution No. 17/96 of November 26, Mozambique joined the Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region and its Protocols. This convention aims to assist in the establishment of mechanisms for international cooperation for the prevention of threats to the marine and coastal environment and its ecological balance resulting from marine pollution, whatever its origin. Articles 5 to 10 of the Convention describe the mechanisms that must be implemented for the prevention of pollution from ships, pollution caused by waste disposal, pollution from land-based sources, seabed activities, the atmosphere and in specially protected areas. In addition, Article 13 of the Convention states that members must develop technical guidelines for the planning of major development projects as part of its environmental management policy to prevent or minimize negative impacts on the marine and coastal environment off Eastern Africa.
United Nations Convention on Biological Diversity (CBD) 1993	CBD is an international legally binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; and the fair and equitable sharing of the benefits arising from the use of genetic resources. Its overall objective is to encourage actions which will lead to a sustainable future. Mozambique ratified this convention in 1994, by Resolution No. 2/94.
Convention on the International Trade of Endangered Species of Wild Fauna and Flora (CITES), 1973	CITES aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. It accords varying degrees of protection to more than 33,000 species of animals and plants. CITES was ratified by Mozambique through Resolution No. 20/81.
FISHERIES	
Southern African Development Community (SADC) Protocol on Fisheries	Mozambique ratified the SADC Protocol on Fisheries by Resolution No. 39/2002 of 30 April aimed at promoting the responsible utilization of living aquatic resources and their ecosystems. Article 14 of this Protocol refers to the protection of the marine environment and requires member states to apply the precautionary principle to ensure that activities within their jurisdiction or control do not cause major adverse impacts. In addition, legislative and administrative measures necessary for the prevention of water pollution caused by activities in interior, coastal and marine waters must be implemented.
WASTE AND HAZARDOUS WASTE	
Basel Convention on the control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989	This convention regulates the import, export, and trans-boundary movement of hazardous waste. The Basel Convention was superseded by the Bamako Convention (see below). The Republic of Mozambique ratified the Basel Convention on the control of Trans-boundary Movements of Hazardous Wastes and their Disposal by way of Resolution No. 18/96, of 26 November.
Convention on the Ban of the Import into Africa and the Control of Transboundary Movements and Management of Hazardous Wastes within Africa, Bamako, 1991	During the negotiation of the Basel Convention, the African states represented by the Organization for African Unity adopted the Bamako Convention believing that the Basel Convention was not strict enough. The Bamako Convention totally prohibits the import of hazardous waste into Africa. The Convention came into force on April 22, 1998. The Republic of Mozambique ratified the Bamako Convention by way of Resolution No. 19/96, of 26 November.

Convention	Description
Minamata Convention on Mercury, 2013	The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. Major highlights include a ban on new mercury mines, the phase-out of existing ones, the phase-out and phase-down of mercury use in a number of products and processes, control measures on emissions to air and on releases to land and water, and the regulation of the informal sector of artisanal and small-scale gold mining. The convention also addresses interim storage of mercury and its disposal once it becomes waste, sites contaminated by mercury as well as health issues. Ratified by Mozambique by way of Resolution No. 36/2023, of September 21.
AIR QUALITY AND CLIMATE CHANGE	
The United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, 1992 & 1997	UNFCCC is an international environmental treaty produced with the objective of achieving stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system. The Kyoto Protocol to the UNFCCC was adopted in December 1997, whereby most industrialized nations and some central European economies in transition agreed to legally binding reductions in greenhouse gas emissions of an average of 6 to 8% below 1990 levels between the years 2008-2012, defined as the first emissions budget period. The UNFCCC was ratified by way of Resolution No. 1/94, of 24 August and the Kyoto Protocol acceded to by the Republic of Mozambique by way of Resolution No. 10/2004, of 28 July.
Vienna Convention for the Protection of the Ozone Layer, 1985, London 1990, Copenhagen 1992	As per Article 2.1 of this Convention, the Parties thereto undertook the obligation to take appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer. Pursuant to Resolution No. 8/93, of 8 December, the Republic of Mozambique acceded to the Vienna Convention for the Protection of the Ozone Layer and to its 1990 and 1992 Amendments.
The Montreal Protocol on Substances that deplete the Ozone Layer, 1987	Designed to control the production of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the Earth's fragile ozone layer. Forbids the use of chlorofluorocarbons. Mozambique ratified this convention through Resolution No. 9/2009.
CULTURAL HERITAGE	
United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention Concerning the Protection of the World Cultural and Natural Heritage	Designed to help identify and protect both cultural (monuments, groups of buildings and sites) and natural heritage (natural features, geological and physiographical formations, and natural sites). Mozambique ratified the convention in 1982.
HUMAN RIGHTS	
International Labor Organization (ILO) conventions relating to labour	- Forced Labor Convention, ratified in June 2003: Convention concerning Forced or Compulsory Labor; - Freedom of Association and Protection of the Right to Organize Convention, Dec 1996: Convention concerning Freedom of Association and Protection of the Right to Organize; - Right to Organize and Collective Bargaining Convention, December 1996: Convention concerning the Application of the Principles of the Right to Organize and to Bargain Collectively; - Equal Remuneration Convention, June 1977: Convention concerning the equal remuneration for men and women workers for work of equal value refers to rates of remuneration established without discrimination based on sex; - Abolition of Forced Labor Convention, June 1977: Convention concerning the Abolition of Forced Labor; - Discrimination (Employment and Occupation) Convention, June 1977: Convention concerning Discrimination in Respect of Employment and Occupation; - Minimum age specified: 15 years June 2003: Convention concerning Minimum Age for Admission to Employment; - Worst Forms of Child Labor Convention, June 2003: Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labor.
International Covenant on Civil and Political Rights	Recognizes equal and inalienable rights to all human beings in terms civil and political freedom. Ratified in 1993.

Convention	Description
International Covenant for the Elimination of Racial Discrimination	State Parties "undertake to pursue by all appropriate means and without delay a policy of eliminating racial discrimination in all its forms and promoting understanding among all races". Ratified in 1983
Convention on the Elimination of Discrimination against Women	States have the obligation to ensure the equal rights of men and women to enjoy all economic, social, cultural, civil, and political rights. Ratified in 1997; 2008.
Convention Against Torture	State parties prohibit themselves under any circumstances from committing acts of torture and other cruel, inhuman, or degrading treatments or punishments. Ratified in1999.
Convention on the Rights of the Child	Guarantees protection of children's rights. Signed in 1990 and ratified in 1999.
International Convention on the Rights of Migrant workers	Its primary objective is to protect migrant workers and their families, a particularly vulnerable population, from exploitation and the violation of their human rights. Signed in 2012; ratified in 2013.
International Convention on the Rights of Persons with Disabilities	States have the obligation to protect the rights and dignity of persons with disabilities.; signed in 2007.
African Union related protocols	Several protocols and charters promoting and protecting human rights and basic freedoms, children rights and others on the African continent.

2.6 International Best Practice Standards

MRV is committed to planning and implementing the project not only in line with national standards and regulations, but also in line with international best practice, notably the International Finance Corporation's (IFC) environmental and social performance standards and environmental, health, and safety guidelines. The most important of these international standards and guidelines applicable to this project are described below.

2.6.1 IFC Performance Standards

The IFC Performance Standards (PS) on Environmental and Social Sustainability, published in January 2012, are recognized as being the most comprehensive standards available to international finance institutions working within the private sector. The principles provide a framework for an accepted international approach to the management of social and environmental issues.

The six IFC Performance Standards applicable to the FLNG project include the following:

- PS 1: Assessment and Management of Social and Environmental Risks and Impacts: underscores the importance of managing environmental and social performance throughout the life of a project. PS 1 requires the client to conduct a process of environmental and social assessment and to establish and maintain an Environmental and Social Management System (ESMS) appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts;

- PS 2: Labour and Working Conditions: recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by the protection of the fundamental rights of workers;
- PS 3: Resource Efficiency and Pollution Prevention: recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels;
- PS 4: Community Health, Safety and Security: recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts;
- PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources: recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development;
- PS 8: Cultural Heritage: recognizes the importance of cultural heritage for current and future generations.

PS 5 (Land Acquisition and Involuntary Resettlement) is not applicable to the Project, as Project implementation will not require any type of land acquisition or restriction to land use.

PS 7 (Indigenous People) is not applicable to the Project, as the concept of Indigenous People, as defined in this PS, is not applicable to Mozambique. Under IFC's PS 7, Indigenous Peoples are groups who, by virtue of their economic, social, and legal status, and/or their institutions, custom, culture, and/or language, may be characterized as distinct from mainstream society and that maintain a collective attachment to distinct habitats or ancestral territories. Although Mozambican society is composed of several different ethnolinguistic groups, they are all integrated into one mainstream society and do not have differentiated claims over the territory.

PS 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project.

IFC PS's 2, 3, 4, 6 and 8 present requirements to avoid, reduce, mitigate, or compensate for impacts on people and the environment and to improve conditions where appropriate. Where social or environmental impacts are anticipated, the client is required to manage them through its ESMS consistent with PS 1.

The IFC PSs are further defined with corresponding Guidance Notes that provide guidance on the requirements contained in the standards and on good sustainability practices to assist clients in improving project performance.

2.6.2 IFC Environmental Health and Safety Guidelines

The IFC Environmental Health and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice, as defined in IFC's PS 3 on Resource Efficiency and Pollution Prevention.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to IFC and are generally considered to be achievable in new facilities at reasonable costs by existing technology. For IFC-financed projects, the application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets with an appropriate achievement timetable. The environmental assessment process may recommend alternative (higher or lower) levels or measures to become project- or site-specific requirements, if acceptable to IFC.

The relevant Industry Sector IFC guidelines applicable to the FLNG project include the following:

- EHS Guidelines for Liquefied Natural Gas Facilities;
- EHS Guidelines for Offshore Oil and Gas Development;
- EHS Guidelines for Thermal Power Plants;
- EHS Guidelines for Shipping;
- EHS General Guidelines.

2.6.3 United Nations Guiding Principles on Business and Human Rights

In 2011, the United Nations Human Rights Council endorsed the UN Guiding Principles on Business and Human Rights, a set of guidelines for states and companies to prevent and address human rights abuses committed in business operations.

The Guiding Principles clarify what is expected of business enterprises with regard to human rights and outline the process through which companies can identify their negative human rights impacts and demonstrate that their policies and procedures are adequate to address them.

The Guiding Principles affirm that business enterprises must prevent, mitigate and, where appropriate, remedy human rights abuses that they cause or contribute to. Businesses must seek to prevent or mitigate any adverse impacts related to their operations, products, or services, even if these impacts have been carried out by suppliers or business partners.

The responsibility to respect applies to all internationally recognized human rights expressed in the International Bill of Human Rights and the International Labour Organization Declaration on Fundamental Principles and Rights at Work. To meet the responsibility to respect, business enterprises must have the necessary policies and processes in place. The Guiding Principles identify three components of this responsibility:

- First, companies must institute a policy commitment to meet the responsibility to respect human rights;
- Second, they must undertake ongoing human rights due diligence to identify, prevent, mitigate, and account for their human rights impacts;

- Finally, they must have processes in place to enable remediation for any adverse human rights impacts caused or contributed to by the business.

2.6.4 Extractive Industries Transparency Initiative – Transparency and Reporting

The Extractive Industries Transparency Initiative (EITI) is a global coalition of governments, companies and civil society working together to improve openness and accountable management of revenues from natural resources.

Countries implement the EITI Standard to ensure full disclosure of taxes and other payments made by oil, gas, and mining companies to governments. These payments are disclosed in an annual EITI Report allowing citizens to see how much their government is receiving from their country's natural resources. Mozambique has been an EITI compliant country since October 2012.

2.7 Requirements of International Industry Guidelines

Best 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. This section summarizes key documents, principles and approaches that are relevant to the Project.

2.7.1 International Association of Drilling Contractors Guidelines

The International Association of Drilling Contractors (IADC) Guidelines are designed to supplement company Health, Safety, and Environment (HSE) programs and operating procedures. These safe operating procedures contained in the guidelines have been adopted by many drilling contractors and government regulatory bodies and provides a basis on which the drilling contractors can build a HSE program.

The guidelines outline aspects such as medical evacuation and rough weather procedures, provisions related to the protection of the environment including air emissions, waste management, spill prevention and control, fire prevention and control, Personal Protective Equipment (PPE), and Emergency Action Plans.

2.7.2 International Association for Oil and Gas Producers

The IOGP provides documents and guidelines to assist its members develop best HSE practices. Of special importance for the project are:

- Environmental aspects of the use and disposal of non-aqueous drilling fluids associated with offshore O&G operations – provides a comprehensive synopsis of global information about the environmental impacts of discharges of drilling fluids;
- Environmental management in O&G exploration and production (E&P) – provides an overview of the environmental issues and the technical and management approaches to achieving high environmental performance in the activities necessary for O&G E&P globally;
- Guidelines for the development and application of HSE Management Systems – describes the main elements necessary to develop, implement and maintain a HSE management system by the operators;
- E&P waste management guidelines – provides a general description of waste management principles; an identification and overview of E&P activities and associated wastes; and options of waste reduction, recycling, treatment, and responsible disposal;
- Key questions in managing social issues in O&G projects – provides a tool to help with social planning issues and is targeted to project management, by helping to identify questions that may be important in their leadership role; and business and project teams, by helping in the identification of issues that may be important in project development and management.

2.7.3 International Petroleum Industry Environmental Association

IPIECA is the global oil and gas industry association for environmental and social issues. IPIECA was formed following the launch of the United Nations Environment Program (UNEP) and is still the main channel of communication with the United Nations. IPIECA's membership (including Eni) covers over half of the world's oil production.

IPIECA helps the O&G industry improve its environmental and social performance by: a) developing, sharing, and promoting good practices and solutions; b) enhancing and communicating knowledge and understanding; c) engaging members and others in the industry; d) working in partnership with key stakeholders.

The work of IPIECA is supported by a number of specialist working groups; drawing on the skills and experience of an international membership and operating with support from a secretariat. IPIECA currently has working groups that address the following areas: biodiversity; climate change; health; oil spill preparedness; operations and fuels; reporting; social responsibility, and water.

In particular, the Social Responsibility Working Group provides IPIECA members a unique forum to share information and coordinate responses to some of the social responsibility issues and challenges surrounding the O&G industry. The Social Responsibility Working Group is currently working on human rights, indigenous peoples, local content, sustainable social investment, management systems and responsible security.

3 EIA Approach and Methodology

3.1 General Considerations

The EIA process, as defined in the Environmental Law, is a preventive environmental management tool that aims to identify and assess, both quantitatively and qualitatively, positive and negative environmental effects of a proposed project, and to define the necessary mitigation, to reduce the negative effects and optimize the positive ones.

This chapter briefly outlines the approach to the EIA and the process that has been followed to date for the Coral North Project. The approach to this EIA complies with all applicable Mozambican environmental legal requirements and is in line with relevant international guidelines and policies, as described in the previous chapter.

3.2 Overview of the EIA Process

The EIA Regulation (Decree No. 54/2015, of 31 December) states that every private or public activity that may directly or indirectly affect the environment, must be subject to environmental assessment (Article 3). The level of environmental assessment depends on the sensitivity of the environment and nature of the project, as defined in the Regulation annexes.

Regarding O&G projects, categorization of projects for EIA assessment follows Decree No. 56/2010, of 22 November – the Environmental Regulations for Petroleum Operations. This Decree defines three EIA categories as follows:

- Category A: activities related with O&G development and production, including construction, operation, and demobilization of oil and gas pipeline systems, as well as other activities to be developed in sensible ecosystems and conservation areas;
- Category B: activities related with exploration except in conservation areas and sensitive ecosystems;
- Category C: activities that due to their nature do not result in negative impacts to the environment and public health.

The Coral North Project is a gas production project and was classified as Category A. For Category A projects, the EIA process consists of three phases, namely:

- Screening Phase (Screening Report): the EIA is initiated through the submission to MAAP of a screening report, indicating project characteristics and location, proposed activities, and a brief description of the receiving environment. Based on this information, MAAP formally categorizes the project and defines the level of environmental assessment required;
- Scoping Phase (EPDA Report): the main objectives of the second phase are to identify potential fatal flaws and impacts of the project and to define the ToR for the EIS. The EPDA Phase aims to identify key issues and concerns associated with the proposed development;
- Impact Assessment phase (EIS Report): the main objectives of the third phase are to assess the impacts identified in the EPDA, to define the mitigation measures, and to compile an

EMP. The EIS Report supports the relevant authorities in the decision-making process, resulting in the environmental licensing or rejection of the activity.

Figure 3.1 illustrates an overview of the EIA process for Category A projects, while the main phases of this process are described in detail in the following sections.

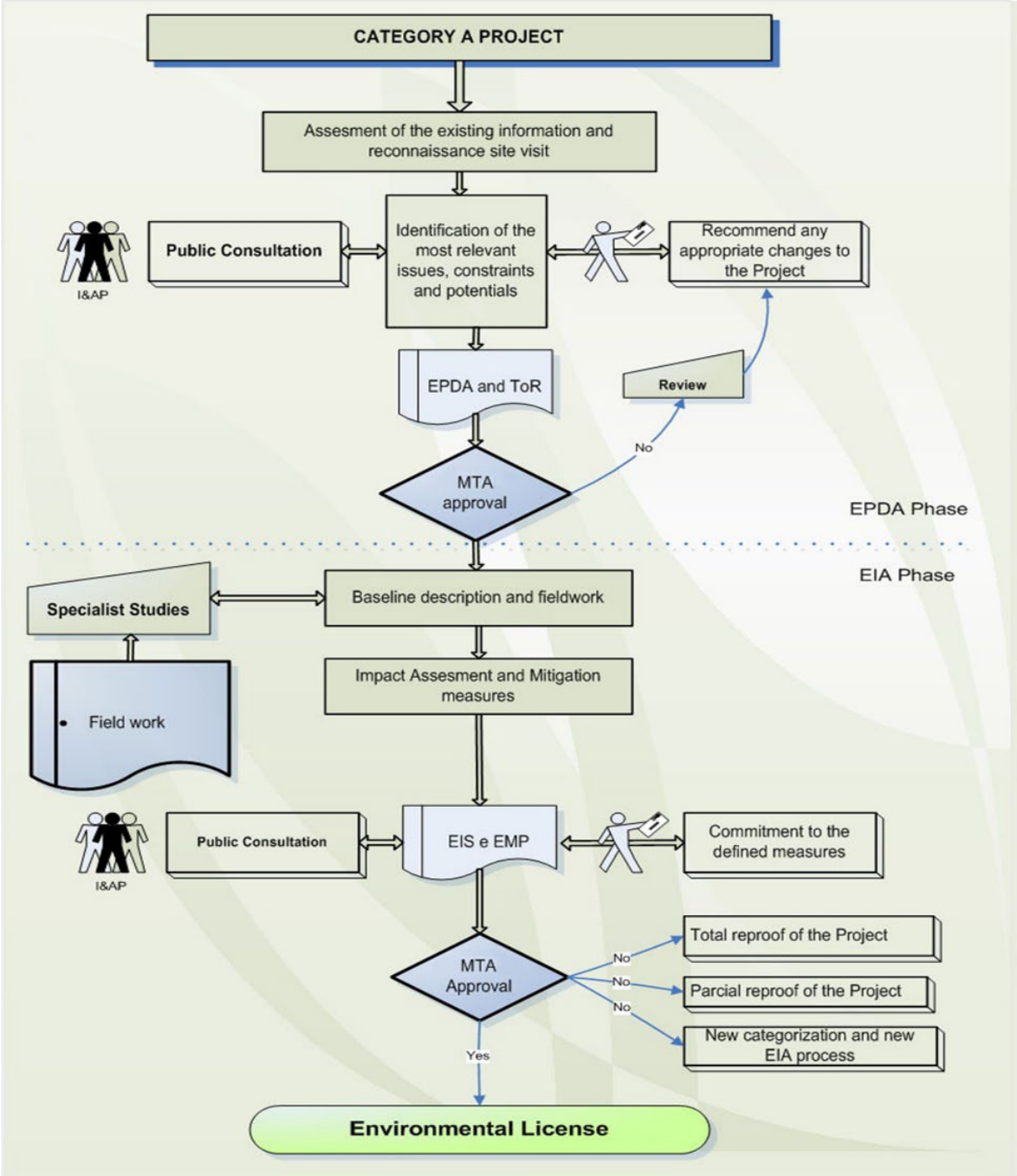


Figure 3.1: Overview of the EIA Process for Category A projects

3.3 Phase 1: Screening Phase

To initiate the EIA Process, a Screening Report was submitted to the former MTA, to assist them in determining the level of environmental assessment required. The Screening Report contained information regarding the proposed Project and a description of the biophysical and socio-economic context of the area. A Preliminary Environmental Information Form was appended to the Screening Report.

The Screening Report and the Preliminary Environmental Information Form were submitted to SPA-Cabo Delgado on May 12th, 2023. SPA-Cabo Delgado classified the Project as Category A on 7th June 2023 (letter ref. 386/SPA/DA-RLA/2020/023 – see Annex II).

3.4 Phase 2: EPDA (Scoping Phase)

Following the Project's categorization, the second step of the ESIA process was the compilation of a scoping report (EPDA) and a ToR for the EIS. As per Article 10 of the EIA regulation, the EPDA's main goals were to *(i)* determine potential fatal flaws associated with the activity and *(ii)* define the scope of the environmental assessment to be undertaken in the EIS Phase.

The EPDA Phase included a PPP (as per Article 15 of the EIA Regulation), aiming to present the proposed Project to all I&APs and identify issues and concerns about the proposed development. The main findings of the EPDA PPP are provided in Chapter 8 of this report.

The EPDA Report was concluded in August 2023. No fatal flaws associated with the Project were identified and the EPDA Report, including the ToR for the EIS, was submitted to MTA on 4 August 2023. Following its review, MTA approved the EPDA and ToR on 26 September 2023 (letter ref. 377/MTA/183/GM/220/23 – see Annex II; Volume IV), and informed that the EIA Process should move forward to the EIS Phase.

3.5 Phase 3: EIS

3.5.1 EIS Objectives

The main goals of the EIS phase include the following:

- Undertake the specialist studies in accordance with the ToR approved in the EPDA phase;
- Assess the environmental and social impacts associated with the Project;
- Define the mitigation measures for adverse impacts and the enhancement measures for positive impacts;
- Integrate those measures in an EMP, as clear, practical measures applicable to the local conditions, based on best practice and relevant legislation.

3.5.2 EIS Report

To support the EIA objectives, the EIS Report provides the following information (as per Article 11 of the EIA Regulation):

- NTS, with the main issues, findings, and recommendations of the Report;
- Information regarding the Proponent of the Project as well as the consulting team responsible for the EIA Process;
- Legal framework of the activity and its context within the existing planning instruments;
- Description of the activities to be carried out under the proposed Project, for all project phases, as well as alternatives considered;
- Definition of the Project areas of influence;
- Baseline assessment of the receiving biophysical and socio-economic environment;
- Identification and assessment of the Project social and environmental impacts;
- Definition of mitigation measures;
- Integration of the mitigation measures in an EMP for the activity, also including monitoring programs and other management tools where relevant;
- PPP report.

Some of the key aspects of the EIS phase, such as the specialist studies, the development of the EMP and the PPP, are further described in the following sections.

3.5.3 Specialist Studies

Several specialist studies were undertaken during the EIS in accordance with the ToR developed and approved in the EPDA Phase. These detailed studies focus on the environmental and social aspects that may potentially be impacted by Project activities. The specialists responsible for each EIS component are presented in Table 1.3 in Section 1.3.

The following specialist studier were developed for the EIS:

- Air Quality Impact Assessment;
- GHG and Energy Assessment;
- Climate Change Risk Assessment;
- Illumination and Visual Impact Assessment;
- Atmospheric Noise Specialist Study;
- Underwater Noise Impact Study;
- Marine Discharges and Unplanned Events;
- Biodiversity and Ecosystem Services Specialist Study; and
- Social, Health and Fisheries Specialist Study.

During the EIS phase, interaction between the specialists was encouraged to fully explore the linkages, commonalities, and inconsistencies among the different aspects of the social and biophysical environment and the assessments thereof.

3.5.4 Environmental Management Plan

The EMP is a fundamental part of the EIA process. External decision-makers will rely on the EIS findings (e.g., significance of residual impact ratings) in the decision-making process. Because an EIS is based on predictions made in advance of an activity taking place, it effectively makes assumptions that the Project will implement controls and mitigation measures. If the controls do not happen, then the EIS is undermined as a tool for I&AP and external decision-makers.

It is important, therefore, that these “assumptions”, i.e., the mitigation measures, are commitments that will be implemented. Thus, once potential impacts have been identified and mitigation measures have been developed, agreed with the Proponent, and described in the EIS, their integration within the Project is required to ensure their future implementation. The EMP is the tool that insures this integration of mitigation within the Project.

The EMP is provided in Volume III of this EIS, integrating the mitigation and monitoring measures of environmental impacts defined in the EIS report into a suite of management and monitoring actions and plans. If the need for additional studies or plans is identified in the EIS, to be developed by the Proponent, the EMP will provide guidelines for their development and implementation.

The implementation of such plans should ensure that any unforeseen impact or issues that may arise will be dealt with in an effective manner in accordance with the relevant laws and regulations of Mozambique and international best practices. In this way, I&APs and external decision-makers will have confidence in the EIS as a tool to aid the decision-making process on the Project.

3.5.5 EIS Phase Public Participation Process

The EIS phase also includes a PPP (Art 15 of the EIA regulation) with the following objectives:

- Update the I&AP database compiled for the EPDA Phase;
- Provide updated information of the proposed project;
- Present the results of the specialist studies, impacts assessed, mitigation measures defined, and the EMP;
- Refer to the issues raised by I&APs APs during the EPDA PPP, and the way they were considered in the EIS phase;
- Provide I&APs with the opportunity to participate effectively in the process and identify any additional issues and concerns associated with the proposed activity, considering the more detailed studies undertaken during the EIS;
- Elicit comments from I&APs with regards to the EIS report and the EMP.

The methodology and main findings of the EIS public consultation are summarized in Chapter 8 of this EIS report. For PPP purposes, a draft EIS Report was compiled and made available at strategic locations for I&APs to access and provide comment. Public meetings were advertised and held in both Pemba, the capital of Cabo Delgado Province, and Maputo, in order to record I&APs issues and concerns. All PPP activities were documented in a PPP report (see Volume V).

3.5.6 EIS Submission to MAAP

Following the PPP, the Final EIS Report was produced, reflecting comments and inputs from I&APs and will be submitted to MAAP for consideration. Subject to approval of the EIS and issuing of the environmental license for the Project, all associated activities shall be governed by the EMP as well as any additional conditions that may be stated in the environmental license.

The EMP will need to be adopted and further developed by the Proponent into an ESMS to ensure that the Project is conducted and managed in a sustainable manner. The Proponent will also need to ensure that its contractors abide by the EMP by making it a part of the contractors' contractual obligations, whenever applicable and pertinent.

4 Project Description

4.1 Introduction

This chapter provides a description of the proposed Project – the Coral North FLNG. The project description does not aim to provide an exhaustive account of the engineering design, rather it focuses on providing a global understanding of the proposed undertaking and describes those activities that could generate potentially significant environmental impacts.

4.2 Project Overview

4.2.1 Project Desirability

Project background

The GoM, through MIREME and INP, awarded several hydrocarbon exploration and production concessions along the coast of Mozambique in 2006, including within the Rovuma Basin (offshore Cabo Delgado Province), to international oil and gas development companies.

MRV has been awarded the Exploration and Production Concession Contract (EPCC) for Area 4 of the Rovuma Basin. Area 4 is located in the deep offshore waters (depth 1700-3000 m) of Mozambique's Exclusive Economic Zone (EEZ); situated approximately 200 km northeast of Pemba and 50 km from the coastline, measured from the western limit of the concession. Figure 1.1 (see page 2) illustrates the location of Area 4.

MRV is the Operator of Area 4. MRV holds a 70% interest in the Area 4 Joint Venture (JV), with the other parties being Galp Energia Rovuma B.V., KG Mozambique Ltd., and ENH, with 10% participation interest each.

Through the EPCC, the Area 4 JV has acquired exclusive rights for surveying, exploring, and producing commercially viable quantities of hydrocarbons in the Area 4 Concession of the Rovuma Basin. The EPCC and the Mozambican legislation provide for a development and production period of 30 years after the GoM approves a Development Plan proposed by the Area 4 JV.

Significant recoverable natural gas resources have been discovered in the Area 4 concession. As of today, within Area 4 there are two approved projects: the Coral South FLNG in the execution phase, which is developing the southern part of Coral 441 N/S reservoir, and the Rovuma LNG facility in concept definition phase. Both projects have been granted Environmental Licenses.

In view of the size of the Coral Reservoir (17.7 TScf of natural gas in place), a multi-phased development strategy is envisaged, with more than one development project required to fully develop this reservoir.

On the basis of concept evaluation and concept selection studies, the Concessionaire of Area 4 proposes, as the most efficient way to maximize the recovery and monetization of the Coral gas resources, a second FLNG project (the Coral North Development Project) comprised of the following components:

- An offshore floating gas treatment, liquefaction, storage, and offloading vessel, a replicate of the Coral South FLNG;
- Subsea wells, subsea production and control systems and risers to the FLNG.

The Coral North FLNG Project will be developed independently from the Coral South development project.

MRV, as the Proponent, will retain the ultimate responsibility for the conduct of the respective petroleum operations and all activities related to Coral North Development Project, including the design, procurement, construction and operation of all liquefaction and upstream facilities.

Advantages of the FLNG approach

LNG is obtained through a process which consists of an initial treatment of natural gas to remove impurities and subsequent conversion into liquid form by cooling. When natural gas is sufficiently cooled, it becomes liquid and occupies about 1/600th of its original volume (US Department of Energy, 2013) for easier storage and transport. Typically, LNG consists of 85% to 99% methane, with the remaining percentages generally comprising small amounts of ethane, propane, butane, pentane, and other inert components.

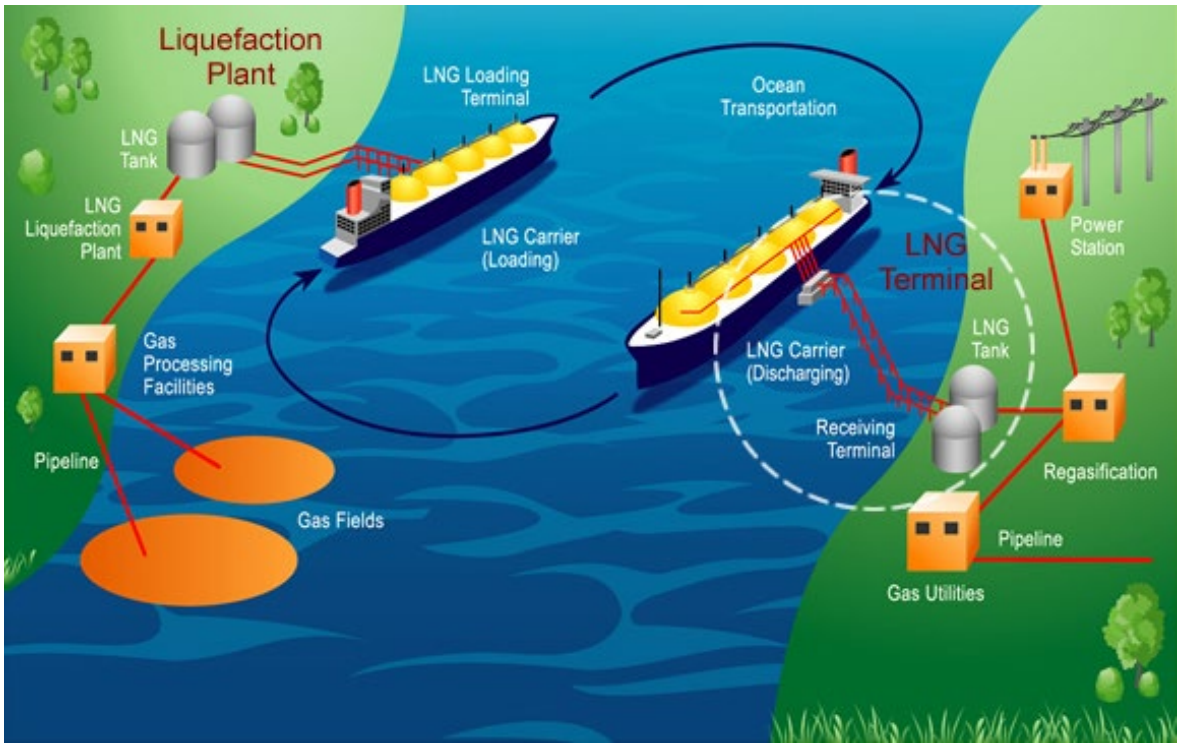
LNG is stored at near atmospheric pressure, reducing the storage hazard compared with pressurized fuels. As such, LNG can be safely and economically transported over long distances to locations beyond the reach of pipelines.

Typically, an LNG supply chain involves (see Figure 4.1 below):

- Extracting the natural gas from the geological strata;
- Transporting the gas through a pipeline to a treatment and liquefaction plant;
- Conditioning and dehydrating the gas to remove impurities (e.g., carbon dioxide and heavier hydrocarbons);
- Liquefying the gas through cooling and storing the liquid in tanks;
- Loading the LNG into carrier vessels for transport;
- Unloading and storing the LNG;
- Converting LNG back to gaseous form by heat exchange; and
- Distributing natural gas through transmission lines.

The FLNG approach follows the overall process described above, with the difference that the treatment and liquefaction facilities are mounted on a converted vessel in order that processing and distribution can be undertaken at the offshore gas field rather than installing pipelines to a shore-based treatment, liquefaction, and export facility. This is particularly advantageous when the gas field is located far from shore and especially when the seabed topography hinders the installation of pipelines, as is the case of the Coral reservoir: it is located more than 50 km from shore and the presence of seabed canyons between the Coral field and the coast presents significant challenges for the placement of pipelines. The FLNG approach also allows the avoidance of land-based impacts, such as loss of habitat and potential resettlement impacts.

Taking into consideration all of the above, MRV is thus proposing the development of a second FLNG project in Area 4 – the Coral North FLNG, which is the scope of this EIA process.



Source: LNGPetro (2013).

Figure 4.1: Typical LNG supply chain

4.2.2 Main Project Components and Activities

The Coral North FLNG Project includes both offshore and onshore components and activities.

The offshore components include the following:

- Producer wells – six (6) subsea wells for the extraction of natural gas from the Coral reservoir;
- Subsea production system with Umbilicals, Risers, Flowlines System (SURF) – subsea infrastructure to supply gas to the FLNG facility;
- FLNG vessel moored offshore more than 50 km off the coast. The FLNG is an offshore floating gas treatment, liquefaction, storage, and offloading vessel, with a production capacity of 3.55 MPTA (million tons per annum).

The offshore activities are related to the production and export of LNG, and supporting activities, including:

- Production of LNG – reception of natural gas from wells through the SURF system; processing, liquefaction, and temporary storage of natural gas aboard the FLNG;
- Export of LNG and condensate – offload of the LNG and condensate onto carrier vessels for export;

- Support and logistic activities – operation of supply vessels coming from the onshore logistic base, operation of tug vessels and multi-purpose vessels in the FLNG proximity and docking and material movements to and from the FLNG and/or supply vessels.

All these offshore components and activities will be located in the offshore Area 4 more than 50 km from the Cabo Delgado mainland.

The onshore Project components are related to onshore personnel and support logistic operations to the offshore FLNG and will be carried out from the following main hubs:

- Port facilities in Pemba Port, namely berthing for supply vessels;
- Facilities of Pemba airport, namely the operation of existing helicopter services;
- Logistics yard in Pemba;
- Offices in Pemba;
- Offices in Maputo.

The onshore activities will include:

- Office activities, both in the Pemba and Maputo offices;
- Operation of the logistics yard in Pemba, which will include reception and temporary storage of materials and goods to be transported to the FLNG;
- Operation of a berthing area in the Pemba Port, including berthing and bunkering of supply vessels, tugs, security, and multi-purpose vessels, and loading of supply vessels with goods and materials to be transported to the FLNG;
- Operation of dedicated helicopter services at the existing facilities of Pemba airport.

Most, if not all, onshore activities will be undertaken within the physical footprint of existing facilities (Maputo and Pemba offices, Pemba port and airport).

4.2.3 Project Location

The proposed Coral North FLNG is located in Area 4, within the deep waters of the Rovuma Basin, in the northern portion of the Coral reservoir, approximately 10 km north of the Coral South FLNG, and more than 50 km from the coastline of Palma District, Cabo Delgado Province. Water depth at the proposed FLNG location is approximately 2,000 m.

The coordinates of the proposed Coral North location, and of the six (6) development wells, are provided in Table 4.1 and its location is illustrated in Figure 4.2. The figure also shows the location of the Coral South FLNG, for context, although only Coral North FLNG is within the scope of this EIA, as the EIA process for the Coral South FLNG was completed in 2015 with the Environmental License issued in September 2015.

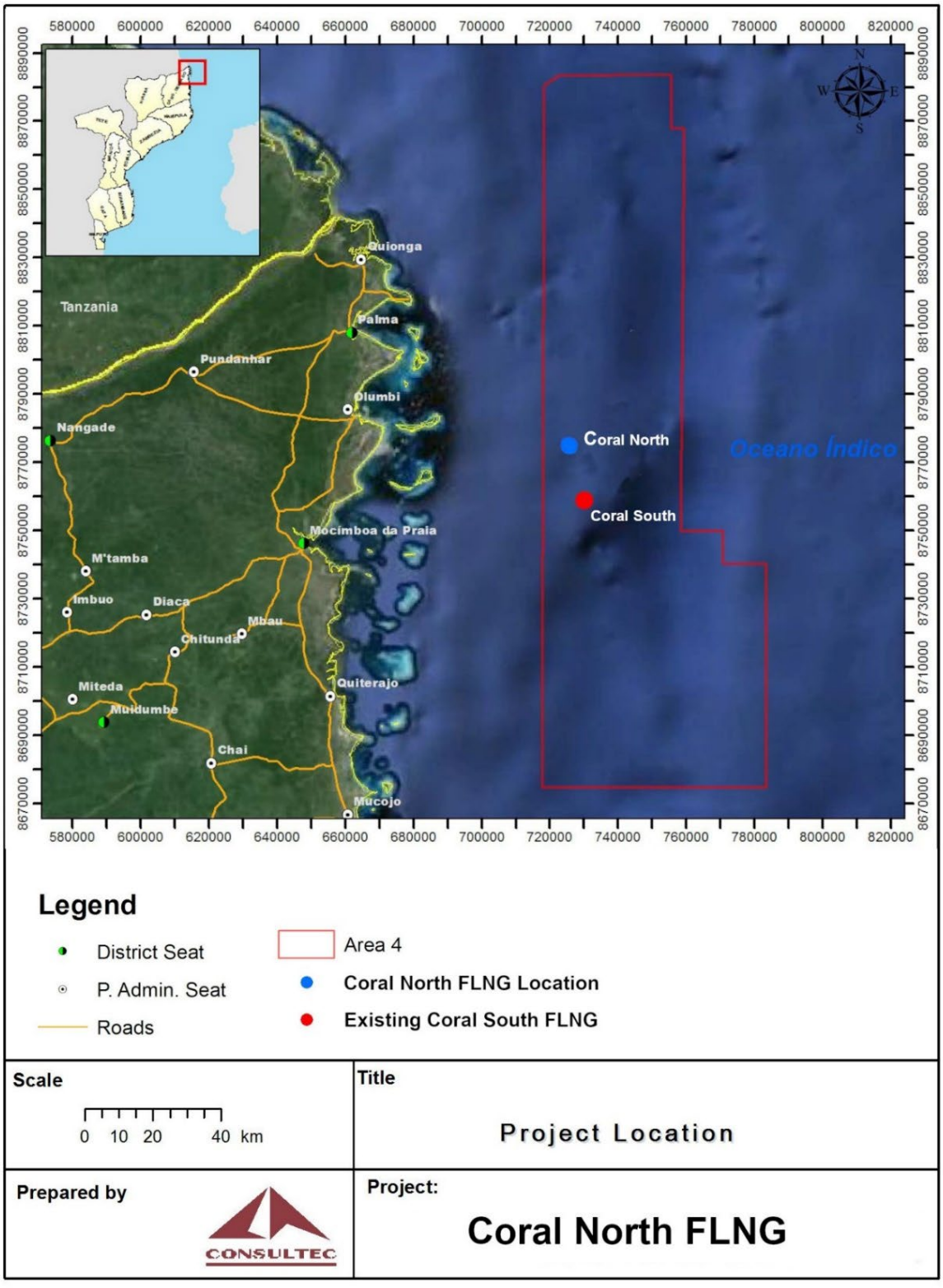


Figure 4.2: Location of the proposed Coral North FLNG

Table 4.1: Coordinates of the Coral North FLNG and development wells

Name	Longitude	Latitude	Depth (m)
Coral North FLNG	41° 7'10.02"E	11° 5'58.50"S	1986
CO-11	41° 7'54.61"E	11° 7'22.62"S	2095
CO-12	41° 7'53.27"E	11° 7'24.48"S	2096
CO-13	41° 6'3.27"E	11° 7'11.40"S	2044
CO-14	41° 6'4.61"E	11° 7'9.53"S	2041
CO-15	41° 6'54.71"E	11°11'18.90"S	1965
CO-16	41° 6'52.43"E	11°11'18.63"S	1964

4.2.4 Project Phases

Project implementation will include the following sequential phases:

- Drilling and completion phase: a drilling ship will be used to drill and complete the six (6) subsea production wells. Two of the six wells may be drilled at a later stage;
- Installation phase: the subsea production system (SPS) will be installed (including subsea items, mooring chains, and anchors) and the FLNG will be towed to the site and hooked up to the SPS. It should be noted that the FLNG vessel itself will be built overseas, in South Korea, as no national shipyard has the capacity to carry out this work;
- Commissioning and start-up phase: the FLNG and all its equipment will be tested, to confirm it is ready to start operations. This includes hydro-testing and dewatering of subsea flowlines and LNG facility pipe work;
- Operation and maintenance: natural gas will be extracted from the wells, treated, condensed, and exported. This includes well, infield flowline, and flexible riser operations, and FLNG facility operation, export shipping, and maintenance activities;
- Decommissioning phase: the SPS will be decommissioned (flushing of subsea flowlines, capping of wells) and the FLNG vessel will be disconnected from the SPS and towed away. After completion of the service life, the FLNG vessel may either be scrapped or assessed to be re-used in another field. The FLNG will be suitably prepared for tow and delivery at Company's designated onshore yard for a future reuse. Due to the size of the FLNG vessel, there may be limitations on the locations to where the FLNG can be towed. However new local facilities may have become available by the time the FLNG is decommissioned in 2052 (approximate year for decommissioning). Given that the deactivation phase will take place at least 25 years in the future, it is not possible at this time to indicate where the FLNG will be towed to, or what the end use will be. The end destination and end-use of the FLNG will be defined in the detailed decommissioning plan to be developed later on in the project's life-cycle, closer to the decommissioning phase.

4.2.5 Project Alternatives

Alternatives refer to site alternatives, technology or process alternatives, and the "no-go" alternative. This section describes the alternatives in terms of both location and technology selection considered during the project development.

4.2.5.1 Location Alternatives

The proposed location of the FLNG vessel is ultimately determined by the location of the reservoir to be explored, and by the location of the gas production wells, which are selected as a result of detailed geotechnical, environmental, and engineering studies. As such, the proposed location is fixed, with no alternative locations under assessment.

4.2.5.2 Technology Alternatives

The alternative technologies considered are primarily associated with the cryogenic liquefaction of the gas and the pre-treatment of the gas prior to the cryogenic liquefaction stage. Please note that the following paragraphs only describe the technology alternatives that were selected. For a detailed description of the project components and activities, please see sections 4.3 and 4.4.

Cryogenic liquefaction stage

The selected liquefaction technology is a Double Mixed Refrigerant (DMR) process, where the mixed refrigerant compositions will be carried out without using propane to limit refrigerant storage and associated boil-off gas (BOG) handling facilities to two components only (ethane and butane). As such, some of the ethane and butane extracted from the feed gas will be used as a refrigerant. Most of these components, along with propane, will be converted into LNG. Please see section 4.4.4.2 for a more detailed description of the LNG production process.

Pre-treatment technologies

There are currently several gas pre-treatment 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. These engineering studies will assess the best available technology options, the most cost-effective approach, and the least environmental and social impacts to determine the appropriate technology for the project.

LNG tanks

The types of LNG tanks include different typology of containment. In addition to type, the size, number, and total storage capacity required will be evaluated by the project team, which will provide recommendations for the project. The amount of space available, markets served, and specific safety studies performed will influence the choice for the project, particularly taking into consideration the size and weight of the FLNG unit. A description of the number and dimensions of the FLNG's storage tanks is provided in section 4.3.1.3.

No-Go alternative

The no-go alternative implies that the proposed Project will not be executed. Assuming that the offshore wells would not be completed and the offshore FLNG Facility would not be developed, the offshore environment would remain in its current state and there would be no negative or positive environmental and social impacts associated with the development.

4.3 Description of Project Components

4.3.1 Offshore Infrastructure

4.3.1.1 Subsea Wells

Six (6) subsea production wells will be drilled and completed in the Coral reservoir to extract natural gas for processing in the Coral North FLNG unit. Preliminary coordinates of these wells are provided in Table 4.1. Two of the six production wells may be drilled at a later phase.

The overall design philosophy is to utilize field proven industry technology and industry accepted "best practices". A conventional 4-string casing scheme with standard specifications has been selected as the basis for development wells. The casing profile foresees the running of 36" conductor pipe, 20" surface casing, and 13 5/8" production casing. A 10 ¾" or 9 7/8" production tubular will be set at top reservoir and an open hole gravel pack is planned for the reservoir interval.

4.3.1.2 Subsea Production System

As indicated above, the subsea facilities include a SPS tied up to umbilicals, risers, and flowlines which will be linked up to the FLNG unit (Figure 4.3).

The subsea distribution unit includes production flowlines and electrical and hydraulic flying leads to each well, with one main umbilical from the manifold to the FLNG, with flexible risers connecting to the FLNG. Subsea umbilicals provide control, chemical injection, and communication service lines.

The operating philosophy driving the design and the architecture of the SURF systems is the following:

- Continuous Mono-Ethylene Glycol (MEG) injection, for hydrate prevention (preserving the system under all pressure and temperature conditions, especially during shutdowns);
- Dual side depressurization, for hydrate remediation;
- System designed to guarantee the overall production rate even in case of shutdown of two (2) wells, for production-loss mitigation;
- Round trip pigging, for flowline inspection and cleaning from topside;
- Full system redundancy, for maximizing availability.

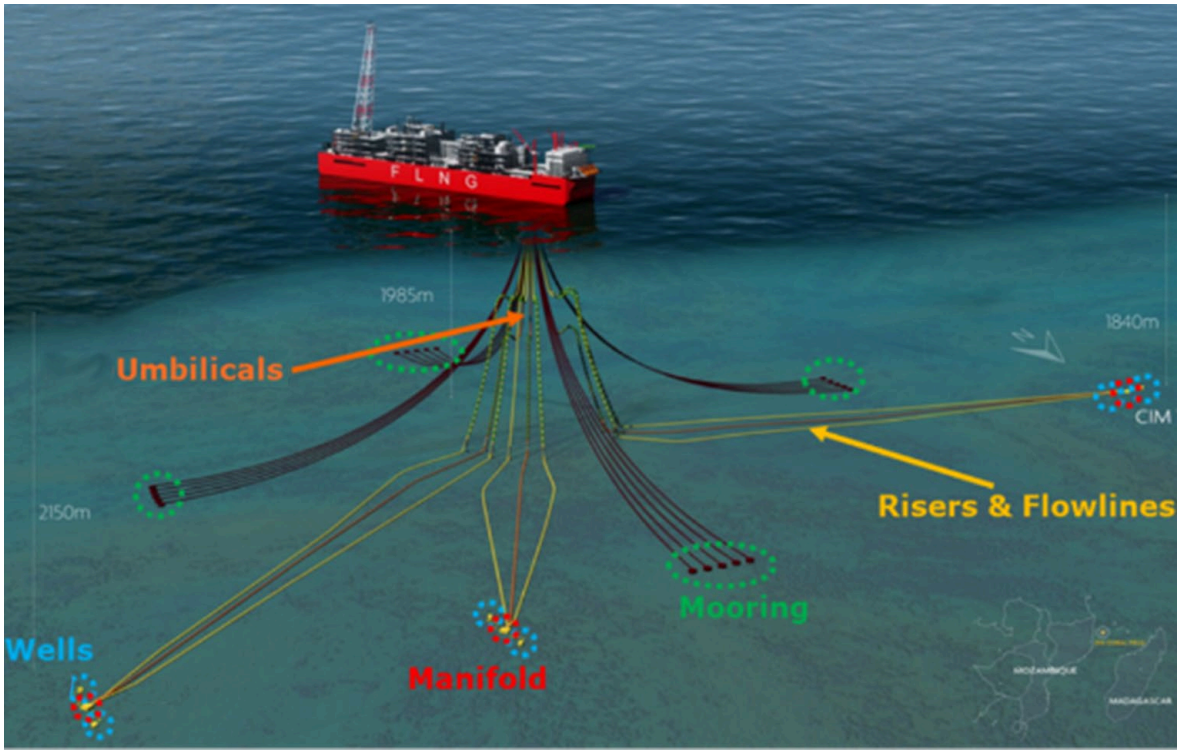


Figure 4.3: Subsea Production System (SPS)

4.3.1.3 FLNG Vessel

FLNG design

The Coral North FLNG vessel will replicate the Coral South FLNG design (see Figure 4.4). It will be a turret moored double hull floating facility, fed by the SURF systems, previously described, with a capacity of 3.55 MTPA.

The vessel is designed to withstand the most severe cyclones (10,000-year return period) and is expected to be on site for at least 25 years without dry-docking. The FLNG vessel will include the following facilities:

- Gas processing (treatment, separation, and liquefaction);
- Topsides control system;
- Storage and off-loading;
- Pigging facilities;
- Produced water treatment package;
- Package and treated bilge and hydrocarbon closed drain system;
- Sanitary sewage treatment package;
- Desalination plant;
- Emergency flaring and flare relief;
- LNG cargo loading in side-by-side configuration with articulated rigid arms;
- Condensate loading in tandem configuration with floating hose;
- Living quarters.

Figure 4.4 shows a very similar FLNG vessel – the Coral South FLNG, and Figure 4.5 shows the general layout of the proposed FLNG vessel.

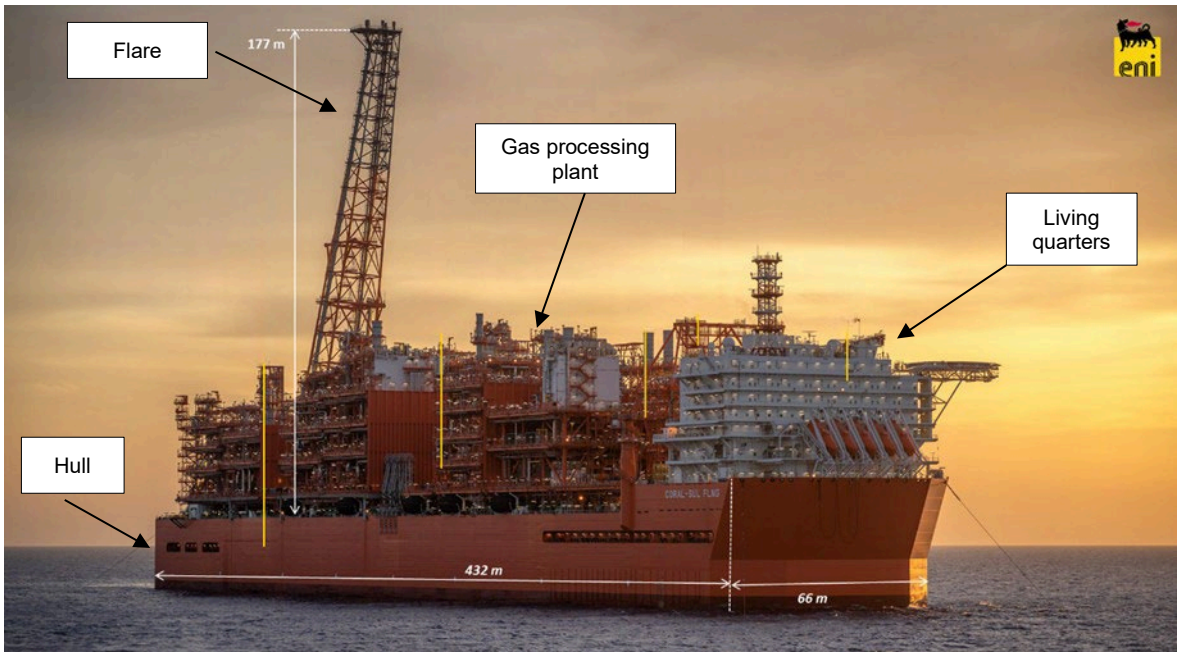


Figure 4.4: View of the Coral South FLNG vessel; the replicate design to be used for Coral North FLNG

FLNG dimensions

Table 4.2 provides the approximate dimensions and other characteristics of the proposed FLNG.

Table 4.2: Approximate dimensions and dry gross weights of the Coral North FLNG

Characteristics of the FLNG vessel	
Main Dimensions	
Overall Hull length	~432 m
Hull Breath	~66 m
Hull depth (moulded)	~37 m
Maximum operating draft	~18 m
Main Dry Gross Weights	
Overall Topside	~59.000 T
Hull	~113.000 T
Internal Turret	~3.000 T
TOTAL Lightship	180.000 T

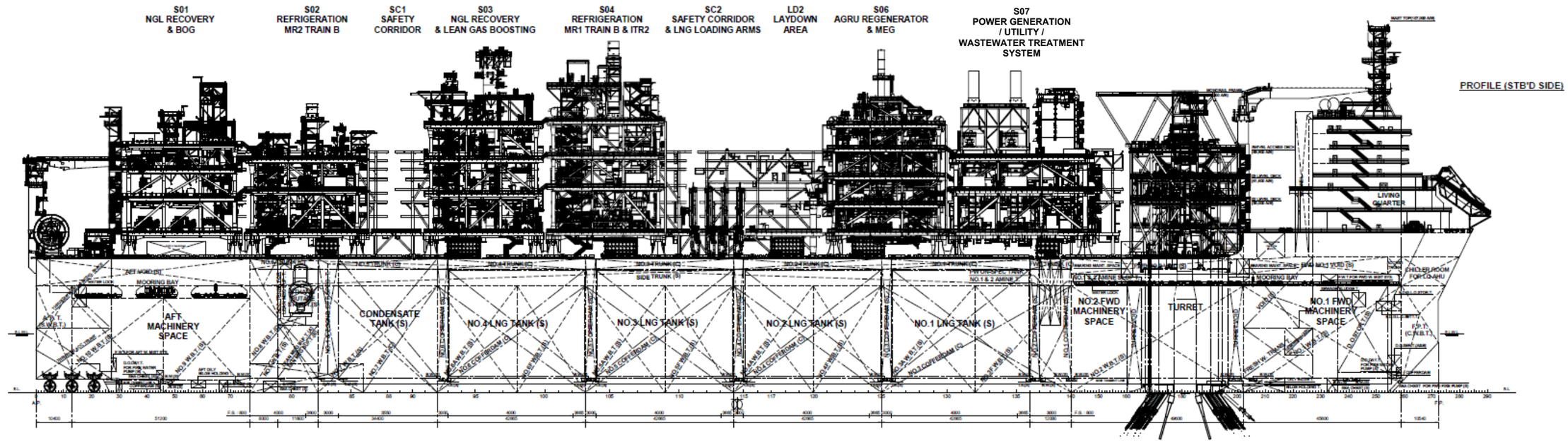


Figure 4.5: General layout of the Coral North FLNG vessel

Hull system

Storage and export facilities include:

- Cargo tank for LNG with offloading in side-by-side configuration with articulated rigid arms;
- Cargo tank for condensate with off-loading in tandem configuration with floating hose.

The hull is designed to accommodate the storage facilities, all the marine systems related to the cargo management and machinery spaces in which part of electrical, instrumentation and mechanical store/room are located.

The storage unit accommodates LNG, ethane (C_2), butane (C_4), and condensate. The LNG cargo is stored in two rows of three tanks each (membrane technology type) located in the central part of the hull with an overall capacity of about 220.000 m^3. LNG storage volume and loading facilities, through a side-by-side configuration, are sized considering an LNG carrier parcel size of about 150.000 m^3. This allows storage of the complete parcel in four (4) tanks, leaving the other two (2) for buffering in case of LNG delay, maintenance operation in one of the tanks, or un-appropriate weather conditions for the offloading.

C_2 and C_4 are located in C-tank type located in forward part, while the condensate tanks (two rows of two tanks) are located in the aft, with a storage capacity of about 1,200 m^3 and 700 m^3 for C_2 and C_4 respectively, and 50,000 m^3 for condensate.

Mooring

The positioning system of the FLNG Facility includes an internal, not disconnectable, turret mooring system, and three mooring line clusters positioned in a 4×5 pattern. The main rationale being that with this configuration, the FLNG will frequently face the wind easing the approach of the LNG carrier and maximizing the overall offloading time. This design also assists in keeping location during storms and cyclones (which is a characteristic of the area).

The turret is the primary interface between the weathervaning FLNG and the geostationary mooring, riser, and subsea systems; in particular, each mooring line is a chain-fibre rope-chain and is designed to get an offset typically no larger than 8% and 10% of water depth in damaged and cyclonic conditions respectively. The turret is able to support up to 8 risers and 5 umbilicals (maximum number of slots, including spares.

Power

The FLNG vessel will be equipped with power generation and distribution systems, including:

- Four (4) gas turbine generators (GTG) as the main power generation units with 30-35 megawatts (MW) power each;
- Two (2) essential diesel generators (EDG) at 6 MW to enable full functionality of system related to life on board and start of one main generator;
- One (1) emergency diesel generator: to allow crew safety, possible floater evacuation, and start of the EDGs. Emergency generation is as per the requirements of SOLAS. This generation is based on a single diesel generator (2 MW) located at the ground level of the

accommodation block, above the flotation line. There are dedicated electrical rooms located close to this generator. These rooms contain all switchboards and associated equipment for emergency distribution. This generation automatically starts on total (normal and essential) loss of power. Start-up can be performed by two different means, electric using batteries or pneumatic.

Living quarters

The living quarters will have nine floors comprising 11 000 m^2 with a total capacity of 350 people on board. During normal operations, the number of personnel on board will mostly vary between 150 and 200. The living quarters include the following areas:

- Accommodation rooms;
- Central control room;
- Emergency control center;
- Off-shore collaboration room;
- Administrative;
- Quite lounge/ coffee bar;
- Catering and dining room;
- Laundry facilities;
- Recreation and leisure center;
- Medical center and emergency hospital;
- Multi faiths room.

The living quarters will be located at the forward of the FLNG vessel, as can be seen above in Figure 4.4.

Onboard clinic

The FLNG field clinic is equipped to provide advanced life support and stabilization of medical emergency conditions. It will work continuously (24 hours per day, 7 days per week).

The medical facilities onboard will be as follows:

- Main medical facilities equipped with:
    - Waiting room;
    - Doctor office;
    - Consultation desk with consultation area
- Hospital room with 4 beds;
- Isolation room with 2 beds;
- Medical store;
- Storage area;
- Mortuary.

Emergency medical evacuation (medevac) will be ensured through suitable equipped helicopter, as specified by local law and international standards.

The health personnel of the onboard clinic will include:

- Two back-to-back highly qualified medical emergency doctors;
- Two back-to-back paramedics;
- Two back-to-back nurses;
- Certified first aiders.

The onboard clinic will treat minor medical illnesses and injuries, including the following:

- Upper respiratory infections (nose, throat);
- Backache, pain, and haemorrhoids;
- Ear infection;
- Headaches and migraines;
- Gastrointestinal upsets;
- Blood pressure monitoring (hypertension);
- Tooth pain and dental emergencies;
- Conjunctivitis;
- Minor skin irritation and infections;
- Sprains and strains;
- Lacerations;
- Eye abrasion;
- Musculoskeletal injuries;
- Nasal bleeding.

Extreme climate events

The FLNG has been designed for a 10,000-year return period survival event including full personnel onboard remaining within the main temporary refuge during and after the event. A number of safety critical elements are included as part of the design such as fire and gas detection, emergency power and lighting, ballasting system, metocean monitoring system, mooring system, and line tension monitoring system.

The mooring system has been designed for several different load cases including extreme cases in accordance with the Classification Society requirements. The risers have also been designed for the survivability of a 10,000-year cyclonic storm with the integrity verified with the certification standard, DNV-OS-F201.

Furthermore, based on the Coral South Cyclone Response Plan, a plan will be developed prior to hookup of the Coral North FLNG in order to formalise the measures necessary to ensure a planned, safe, and orderly down manning of facilities and vessels located in the Coral field.

4.3.2 Onshore Infrastructure

4.3.2.1 Marine Quay

Pemba port

Marine quays in Pemba will be used to support and service the Coral North FLNG drilling, installation, commissioning, and operation activities. This will include vessel berthing, loading, and unloading of materials and equipment during the execution of Coral North project. The Pemba marine quay will be the main quay in service of the Coral North Project where all materials and equipment will be unloaded, with the exception of very specific equipment, such as x-mas trees and wellhead jumpers, where a deep-water quay at Nacala port will be used (see below).

Nacala port

While Pemba will be the main support port, some very specific materials and equipment (e.g., x-mas trees, and wellhead jumpers) will require the use of a deep-water quay. The quays to be used in Nacala Port are illustrated in Figure 4.6. The minimum requirements for the use of those quays are as follows:

- North Quay:
  - Length 400m;
  - Minimum water depth: -8,5 m @ LAT;
  - Bearing capacity >10 ton/m^2.
- South Quay:
  - Length 350m;
  - Minimum water depth: -12 m @ LAT.

Figure 4.6: North and south quay in the Port of Nacala

The Port of Nacala will make available an apron-marshalling area as part of the on-call quay. Such area will be of the same length of the quay and minimum 30 m (preferably 45 m) of width for its entire length and is required for:

- Truck movement and manoeuvring;
- Temporary storage, staging and transshipment of material and equipment;

- Vessel loading and unloading;
- Storage and handling of bulk and liquid materials.

MRV will provide all required navigation aids and oil response equipment for the port area facilities. The area will be adequately fenced and lighted for night operations.

4.3.2.2 Logistic Base

An onshore logistic base in Pemba (~30.000 m^2) will be used to support the Coral North development during drilling and completion, installation, commissioning, and operations. This will be similar to the current Eni Rovuma Basin (ERB) logistic base (Figure 4.7).

The main features required for the Coral North logistic base include:

- Covered warehouse including:
  - Covered storage area;
  - Safety equipment storeroom (i.e., PPE stock);
  - Cold room.
- Open yard including:
  - Open storage area/pipe rack space;
  - Shelter and chemical and/or hazardous stocks;
  - Waste storage area;
  - Parking area.
- Yard/warehouse offices.

Figure 4.7: Existing ERB logistic base in Pemba

During the drilling and installation phase, the onshore support base will be used for the following activities, among others:

- Custom and immigration clearance;
- Transportation and temporary storage of:
  - FLNG mooring spread;
  - Umbilical and flexible ancillary equipment, installation aids, etc.;
  - Material and equipment for commissioning (including fuel, chemicals, etc.);
  - Miscellaneous material to support offshore marine installation spread.

- Waste management.

During FLNG operations, the onshore base will act as the technical and logistics center. The base will be the convenient location for maintenance, fabrication, storage, administration, training, etc. that cannot be carried out on FLNG. The base will also act as a monitoring center dedicated to the remote condition and performance monitoring of the FLNG assets and operations.

4.3.2.3 Helicopter Services

Dedicated helicopter services will be used to enable personnel transportation to and from the FLNG and for medical evacuation. Pemba airport will be used. ERB operates a helicopter service to the Coral South FLNG, and an additional helicopter and expansion of the existing hangar infrastructure will be required to service Coral North. The existing hangar is equipped with the following facilities:

- Helipad for landing and take-off of helicopters;
- Warehouse for parking helicopters and minor maintenance services;
- Offices for check-in services and administrative work.

4.3.2.4 Offices

ERB operates office facilities in Maputo and Pemba, which will also be used to provide onshore administrative support to the Coral North FLNG Project.

4.3.3 Project Vessels

4.3.3.1 Project Fleet

The use of a number of different vessels will be required to undertake and support Project activities throughout its life cycle. Table 4.3 list the main vessels estimated to be required for each project phase, and the following sections provide additional information on these vessels.

Table 4.3: Project marine vessel fleet

Project phase	Vessel	Nº of vessels
Drilling	Drilling vessel (drillship)	1
	Platform Supply Vessel	3
Installation	Installation vessel	2
	Multi-purpose vessel	1
	Tugs	5
	Platform Supply Vessel	3
Commissioning and Operation	Flotel (Commissioning only)	1
	Tugs	3 [(a)]
	Platform Supply Vessel	3
Decommissioning	Installation Vessel	2
	Flotel	1
	Multi-Purpose Vessel	3

Project phase	Vessel	Nº of vessels
	Tugs	5
	Platform Supply Vessel	1

Note: [a] it is understood 6 tugs will be shared between Coral North and South FLNGs, therefore assumed average 3 for Coral North.

In addition to the vessels listed in the table above, during operations LNG carriers and condensate tankers will be used to export the products. These, however, are independently managed and are not part of the Project vessel fleet.

4.3.3.2 Drilling Vessel (Drillship)

A drilling ship will be used to drill and complete the Coral North production wells; the same type of drilling unit that was used for the Coral South FLNG. Drillships are specialized drilling vessels which show advantages over other types of drilling units due to their ultra-deep water drilling capability and easy mobility. They are basically maritime vessels modified to drill wells in oil and gas fields (see Figure 4.8). They are adapted to provide complete offshore drilling solutions. They are equipped with exhaustive mooring and/or dynamic positioning systems and can move from one well to another without outside assistance. Since they are required to work in ultra-deep-water areas ranging up to 3,650 meters, all supplies and equipment are catered by the offshore supply vessels. Drillships have a drilling deck and are equipped with a moon pool. The drilling equipment that passes the moon pool is connected to the 'sub-sea well' via the 'riser pipe' (which is flexible to some extent).

Figure 4.8: Typical drillship

4.3.3.3 Installation Vessel

Specialized installation vessels, equipped with heavy-duty cranes, will be required for the subsea installation of the SPS. A typical installation vessel is illustrated in Figure 4.9.

Figure 4.9: Typical installation vessel

4.3.3.4 Offshore Support Vessels

Offshore support vessels, platform supply vessels (PSV), will be used to support drilling and completion, installation, and operational activities for the Coral North Project. Among other roles, these vessels will be used to transport equipment and materials between the Port of Pemba and the offshore site. A typical PSV is presented in Figure 4.10.

The number of transits between the Pemba Port and the offshore site will vary depending on the project phase and activity but is estimated at two (2) transits / week, during standard operations, with a maximum of one (1) transit / day, during peak activities.

Figure 4.10: Typical platform supply vessel

4.3.3.5 Towing and Maintenance Vessels

Tugboats will be required throughout installation, commissioning, operation, and decommissioning, for several activities (tugging the FLNG to the site, berthing and unberthing of carriers, loading and offloading activities). A typical tugboat is illustrated in Figure 4.11.

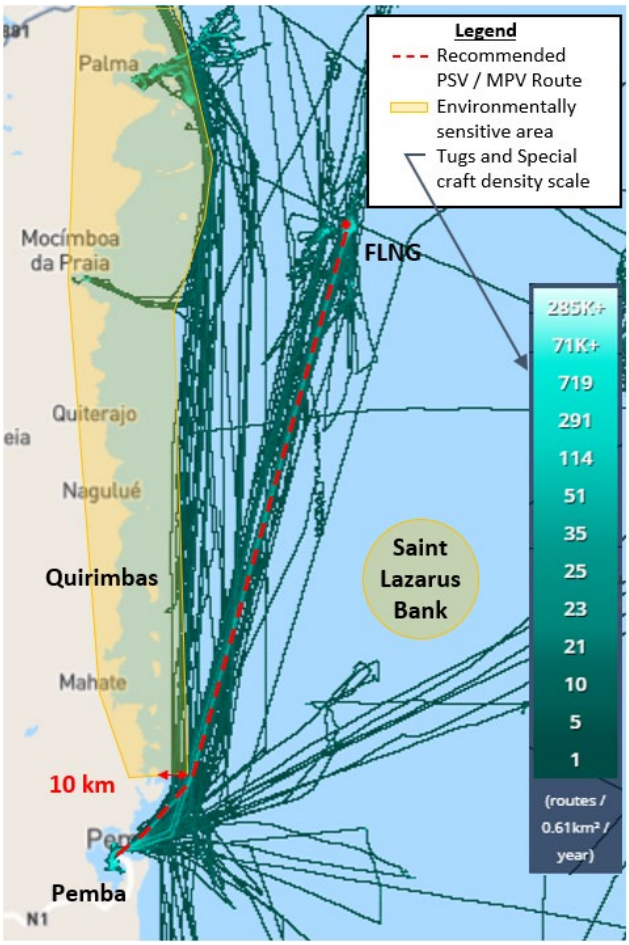
Figure 4.11: Typical tugboat

Additionally, a multi-purpose vessel (MPV) will be used to support marine operations offshore. A typical MPV is illustrated in Figure 4.12.

Figure 4.12: Typical MPV

4.3.3.6 Project Route for Marine Vessels

Project vessels transiting between Pemba port and the Coral North FLNG area of operation will follow the recommended route illustrated in Figure 4.13 below.



Source: MarineTraffic (2021).

Figure 4.13: Project marine vessel route

This is the same route used by the Coral South Project vessels and has been defined to ensure that project traffic avoids two ecologically sensitive areas that have been identified in the region, namely the Quirimbas Archipelago and the Saint Lazarus Bank. All project related vessels will maintain a minimum distance of 10 km from these areas.

4.3.3.7 Project Vessel Effluents

The operation of the project support vessel will generate the following wastewater streams, which are common to all similar marine vessels:

- Stormwater: includes run-off water from the vessel deck;
- Bilge water: oily water that is collected in the lowest space of the vessel;
- Sewage: domestic wastewater.

Ballast water may be taken onboard by ships for stability during a voyage. Ballast water does not contain chemical contaminants, however, it may transport marine species from the place where ballast water was collected with the potential for introduction of alien invasive species.

Project vessels will be compliant with national and international requirements for the treatment and discharge of these effluents and ballast water exchange. Please see section 9.9.2 of the ESMP (Volume II) for a detailed description of these requirements.

4.4 Description of Project Activities

4.4.1 Drilling and Completion Phase

4.4.1.1 Drilling Activities

The drilling and completion activities will be performed using a Dynamically Positioned (DP) drillship, as described in section 4.3.3 above. For safety reasons, a 500 m exclusion zone will be set up around the drillship during drilling operations. The PSV's (see 4.3.3 above) will be used to support the offshore drilling activities.

The drilling scheme will be as follows:

- 36" Conductor pipe: the 36" CP will be set vertical at approximately 60-80 m of penetration below the seabed, in order to guarantee the structural integrity at the mud line. The conductor pipe will be drilled with water-based mud (WBM) and the cuttings returned to the sea;
- 20" Surface casing: the setting depth of this casing (650-700 m below mudline) will guarantee enough fracture gradient to drill the next section. The 24" hole section will be drilled through the unconsolidated formations, riserless with returns to sea using WBM;
- 13 5/8"" casing: this will guarantee enough fracture gradient to drill the next hole section. The relative drilling phase will be performed using Low Toxicity Oil Based Mud (LTOBM) and the cuttings will be collected from the rig through the marine riser and shipped onshore for treatment and disposal;
- 10 ¾" or 9 7/8" production liner: for all the wells the production liner is planned to be set at the top of the reservoir. The relative drilling phase will be performed using LTOBM and the cuttings will be collected from the rig through the marine riser and shipped onshore for treatment and disposal;
- 9 ½" or 8 ½" Open Hole: the reservoir phase will be drilled using LTOBM and the cuttings will be collected from the rig through the marine riser and shipped onshore for treatment and disposal. The section will be completed with screens and open hole gravel pack lower completions.

Table 4.4 below summarizes the proposed drilling scheme for the production wells.

Table 4.4: Proposed drilling scheme and fluids for typical well

Casing Size [in]	Hole Size [in]	Estimated Setting Depth [m TVD]	Estimated Pore Pressure Grad. [kg/cm²/10m]	Estimated mud weight	
				[sg]	TYPE
36"	Jetted	2190	1,030	1.04	WBM
20"	24"	2800	1,030	1.04	WBM
13 ⅝ "	17½ "	3750	1,030	1.10	LTOBM

Casing Size [in]	Hole Size [in]	Estimated Setting Depth [m TVD]	Estimated Pore Pressure Grad. [kg/cm²/10m]	Estimated mud weight	
				[sg]	TYPE
10 ¾"	13 ½"	4450	1,050	1.25	LTOBM
-------	9 ½"	4570	1,080	1.15	LTOBM

4.4.1.2 Management of Drilling Wastes

Drilling activities will generate drilling wastes, including cuttings (rock fragments), and used muds:

- During the drilling of the upper sections of the wells, WBM will be used. All the fluids and cuttings will be dispersed at seabed, as at this stage the riser hasn't been installed yet. It is estimated that roughly 250 m^3 of WBM cuttings and WBM will be dispersed at seabed, per well;
- Once the initial portions of a well have been drilled, a riser will be installed, which allows material (drilling muds and cuttings) to be returned to the drilling rig. All LTOBM and cuttings from the lower sections will be brought up to the drilling vessel and transferred by cutting skips and tanks to shore for treatment and disposal. It is estimated that roughly 250 m^3 of LTOBM cuttings will be recovered to surface, for each well.

As such, all drilling waste produced by the offshore drilling operations will be collected in containers certified for the specific waste typology and shipped to shore. Third-party contractor facilities on land will treat and dispose drilling waste, in compliance with country regulations, MRV's waste management standards, and Good International Industry Practice for waste management.

The treatment and disposal location will be in Pemba. It is envisioned that the drill cuttings will be treated through a thermal desorption unit.

A thermal desorption unit (TDU) is a specialized piece of equipment that uses heat to remove contaminants from a variety of materials, including drill cuttings. The LTOBM drill cuttings are placed in the TDU and heated to a high temperature for a period of time. This process vaporizes the contaminants, leaving the drill cuttings clean and dry. The vapour containing hydrocarbons and water is passed through a primary scrubber and second stage oxidizer where oil is either separated from the water and stored in an oil storage tank or destroyed at temperatures of up to 2,000°F (1,093°C).

The detailed treatment process and final disposal location will be provided in the Waste Management Plan (WMP) that will be submitted to the environmental regulator prior to the drilling operations.

4.4.2 Installation Phase

The installation phase follows the completion of the production wells. In this phase, an installation vessel (see section 4.3.3.3) will be used to set in place the subsea facilities, prior to the arrival of the FLNG vessel. Cranes will be used to lower the subsea equipment to the seabed, and remote-operated vehicles (ROV) will be used to connect the equipment to the wells. No trenching or rock stabilization of the flowlines and umbilicals is required.

The FLNG vessel will be constructed overseas (South Korea), including the fabrication and installation of topside layout and designed modules, which will be performed at the construction shipyard. After the installation of the SPS, the FLNG vessel will be towed to the site, installed, and moored on site. Following this, the risers and umbilicals will be connected into the FLNG turret facility, thus linking the FLNG to the SPS. Figure 4.14 shows similar installation activities: the connection of the flexible lines with the FLNG during the Coral South installation phase.

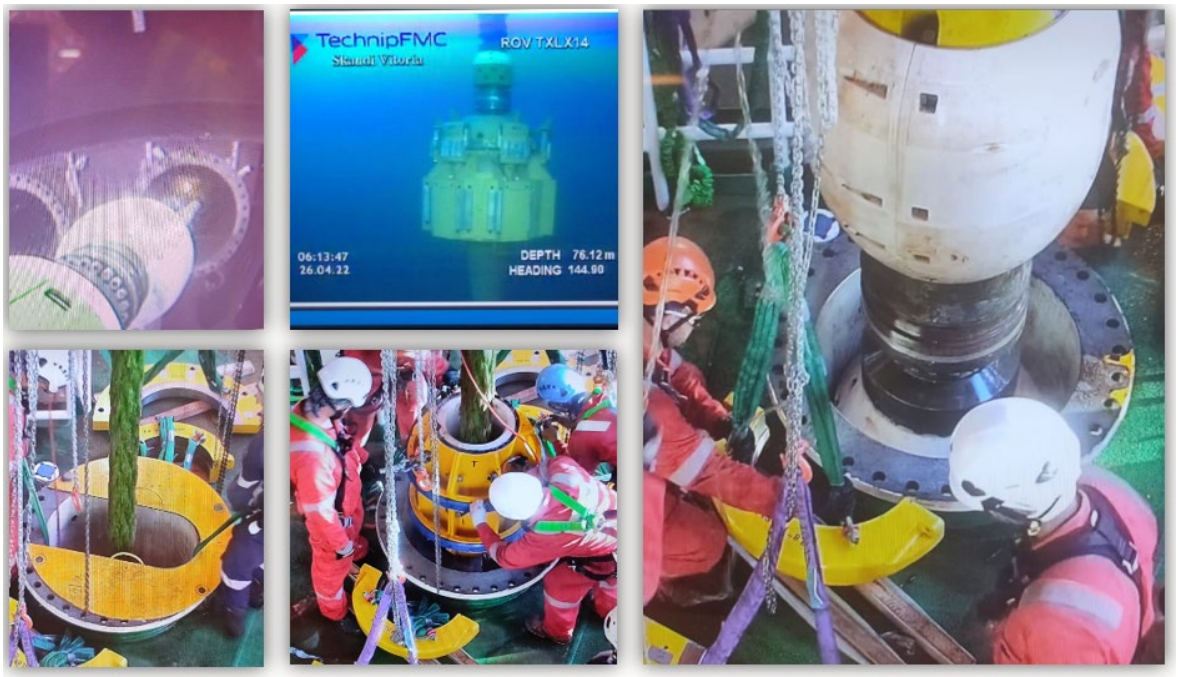


Figure 4.14: SURF installation – flexible lines connection with the Coral South FLNG

4.4.3 Commissioning and Start-up Phase

Following installation of the FLNG, testing, commissioning, and start-up activities will take place, as detailed below:

- Pressure testing, pre-commissioning, and commissioning of the overall production system from the wells to the FLNG facility will be conducted;
- The production system piping will be filled with treated seawater and then pressure tested and dewatered;
- The umbilicals that supply hydraulic and/or chemical and power and/or communications services to the subsea wells and manifolds will be commissioned by displacing fluids into the flowlines. These lines will contain water-based control fluid until discharged to sea during valve operations throughout the FLNG's operational life;
- All topside modules and equipment will be tested and subjected to start-up activities.

4.4.4 Operational Phase

4.4.4.1 FLNG Safety Zones

During the operational phase, the following restricted zones will be established around the FLNG for security reasons:

- Approaching zone is the distance at which the pilot boards the off-take tanker. It should be defined considering the size of the off-take vessels. The pilot boarding area can be placed at one (1) nautical mile (nm, about 1.85 km) from the FLNG in open sea;
- Manoeuvring zone is defined as the area around the facilities needed for the normal manoeuvres of the off-take tankers (approaching, mooring, weathervaning with the assistance of tugs, loading, unmooring, and sailing away) and for emergency withdrawal manoeuvres of the off-take tankers. Distances will be defined on a case-by-case basis. It is reasonable to establish at this preliminary stage a manoeuvring safety area around the floating facilities of 1.5 nm (about 2.77 km), with concurrence of the coastal state authority;
- Safety zone of 500 m around the subsea infra-structure will be considered. Vessel traffic and fishing will be restricted from this safety zone, with concurrence of the coastal state authority.

The PSV and tugboat fleet (see section 4.3.3) will be used to provide support to the offshore operations and to manage and patrol these restricted marine zones around the FLNG.

4.4.4.2 LNG Production Process

This section provides a description of the LNG production process aboard the FLNG facility. A flowchart of the LNG production process is provided in Figure 4.15.

Gas reception

As described in previous section, natural gas will be extracted from the six (6) produced wells and transported to the FLNG through the SPS. Once the feed gas has reached the FLNG facility, processing will commence on the FLNG topside.

Separation of condensate and produced water

The gas from wells is routed to the gas inlet manifold and then to the slug catcher, from which gas condensate and produced water are sent to the condensate stabilization section. The condensate stabilization unit produces stabilized condensate and separates the produced water. To avoid any flaring of flashed gas, this stream is recompressed and routed to the main gas stream going to the pre-treatment; fuel gas is used to assist the incinerator. Production water is treated in a water treatment package before discharge into the sea (see section 4.4.4.4).

MEG will be used to inhibit the formation of hydrates from the well head to the FLNG facility. Hydrates are crystalline structures that form when water and hydrocarbon molecules interact under high pressures and low temperatures, typically in subsea flowlines. The FLNG facility system will be equipped with a MEG regeneration system to provide buffer storage, collection and regeneration of the MEG used to treat the incoming gas from the reservoirs. Any resulting effluent will be conveyed to the existing water treatment system onboard the FLNG (see section 4.4.4.4).

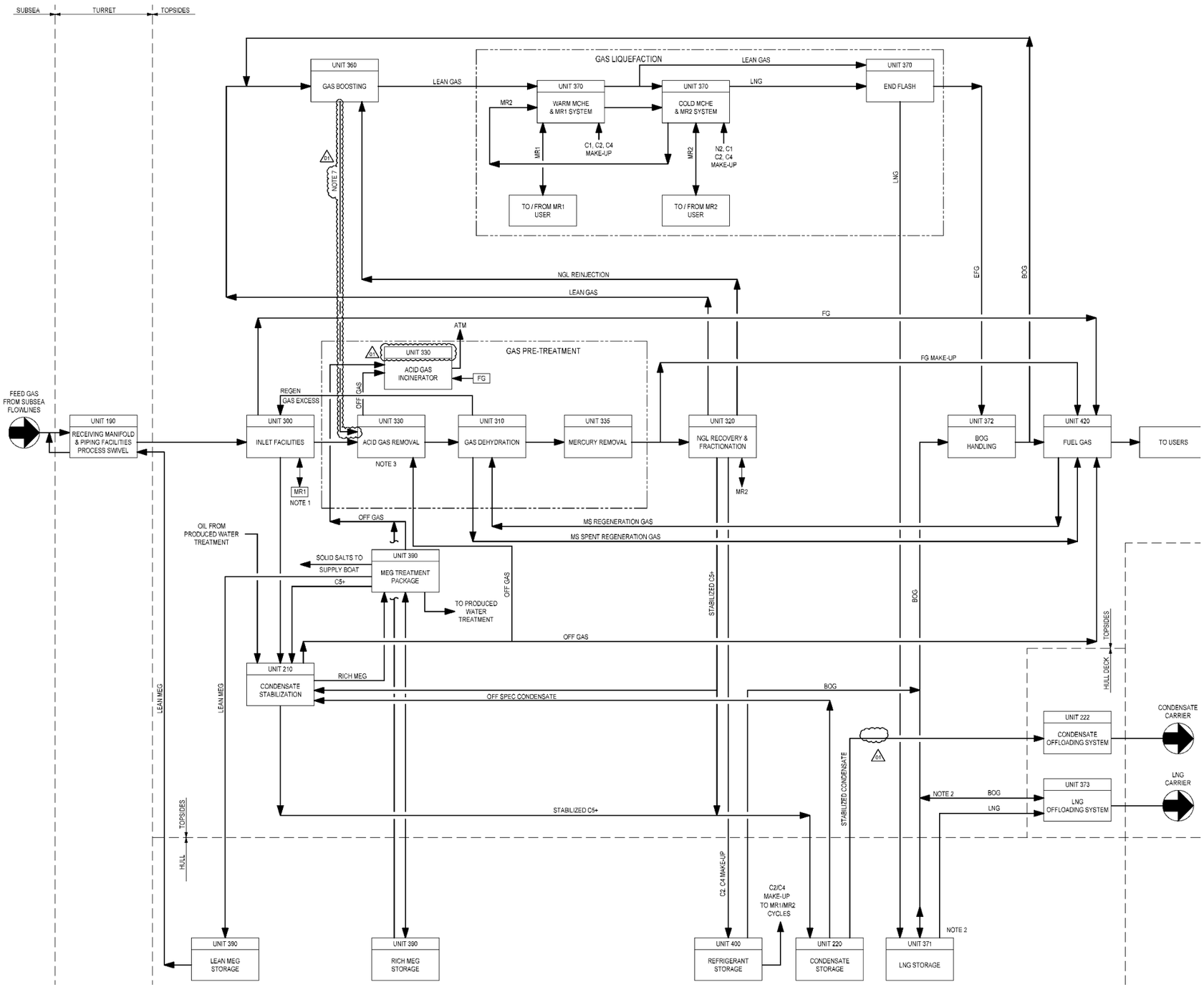


Figure 4.15: LNG production process flowchart

From the slug catcher, the main gas stream is sent to the gas pre-treatment units. The gas is lean but includes some aromatic components. During processing, the condensates are removed from the gas stream and the produced condensate is stored and exported.

Gas pre-treatment

The gas stream is then sent to the gas pre-treatment units for the following processing:

- Acid gas removal to remove carbon dioxide (CO_2) and meet the 50 parts per million (ppm) vol CO_2 content specification;
- Gas dehydration to remove water (H_2O) and meet the 0.5 ppm vol H_2O content specification;
- Mercury removal to meet the 0.01 µg/m^3 mercury content specification.

The following paragraphs detail the pre-treatment procedures.

Acid Gas Removal

This involves the removal of acid gases such as CO_2 from the gas stream to prevent freezing and blockages in the liquefaction unit. This is done via an amine solution which is later recycled to continue absorbing more acid gas while the acid gas is vented to the atmosphere via the flare stack to ensure safe disposal.

Gas Dehydration

After removal of acid gas, the gas becomes saturated with water which must be removed to prevent the freezing of water in the liquefaction unit.

Gas dehydration is performed using molecular sieves technology. The selected process is regenerative; the water is retained by adsorption phenomena on the molecular sieves and when the molecular sieves are saturated with water, the sieves are regenerated (water desorption) by hot regeneration gas.

Mercury Removal

The mercury removal downstream of dehydration is done to prevent corrosion of the aluminium material. The mercury will be absorbed to reduce the mercury level in the gas stream and the waste mercury contaminated material will be sent to shore for appropriate hazardous disposal at a licensed facility. Given the characteristics of the gas, mercury is expected to be present in residual amounts.

Natural Gas Liquids (NGL) extraction and fractionation

Once the gas has passed through the gas treating units, the heavy carbon components will be removed in the NGL extraction unit, prior to liquefaction.

This unit separates a proportion of NGLs from the feed gas, and the latter is compressed while the liquids are fractioned into ethane, propane, butane, and a light condensate product. Ethane, propane, and butane are either spiked into LNG or used as refrigerant or fuel gas. The light condensate is mixed with the stabilized condensate produced.

Liquefaction

The selected liquefaction technology is an independent parallel DMR process; however, the mixed refrigerants compositions will be done without using propane to limit refrigerant storage to two components only (ethane and butane).

The retained MR1/MR2 compression strings configuration is to install four (4) parallel trains (two [2] for MR1 and two [2] for MR2). Each of those compression strings is driven by aeroderivative proven gas turbines with a power in the range from 30 to 35 MW.

The gas is cooled, liquefied, and then flashed (meaning allowed to expand into a drum) to atmospheric pressure, thereby removing excess nitrogen. The resulting LNG, at a temperature of -163°C, is transferred to insulated storage tanks at atmospheric pressure.

After storing, LNG is then offloaded for export as described below.

Offloading

The FLNG is designed to offload both LNG and condensate product by means of shuttle carriers.

The LNG offloading system is a side-by-side offloading through offloading arms located at starboard and amidships. In particular, the system includes four (4) loading arms: two (2) arms for offloading, one (1) arm for gas return from the LNG Carrier to the FLNG vessel and one (1) spare arm for loading or gas return.

The LNG carrier parcel capacity is preliminary considered 150,000 m^3 (slightly more than six [6] days of production), to be offloaded with a 10,000 m^3/h rate. The system is designed to allow the simultaneous loading and unloading of each tank during the offloading operation and to offload four (4) tanks in parallel. In normal operating conditions, one (1) LNG offloading is delivered weekly.

The condensate parcel is offloaded by tandem offloading operation. The operation is carried out using a floating flexible hose connected to a shuttle tanker.

No offloading operations are foreseen in case weather conditions are not favourable.

4.4.4.3 Cooling and Heating Medium

Sea water has been selected as the main cooling medium: due to the thermal duties to be released from the topside process facilities, air cooling would be impractical for footprint and weight. An intermediate freshwater cooling system (closed circuit) has been also foreseen in order to limit the number of items in contact with sea water.

The FLNG facility will require approximately 24,964 to 27,445 t/h of sea water that will be pumped by seawater intake risers (SWIR) at about 150 meters depth. The SWIR will hang below the hull located towards the aft of the vessel to avoid collision with the production risers and mooring lines.

Deep sea water intake hose system is equipped with a sea water filtration screen to avoid any debris carry-over. Water from this depth is colder than surface seawater and therefore reduces energy requirements for cooling.

The seawater will be returned to the sea at an average temperature of 30.64 ºC and comply with national as well as IFC requirements for thermal waters. The seawater cooling discharge depth is estimated at 0.5 – 7.5 m below sea level. The average discharge will be of 6.9 m^3/s.

Hot oil has been selected as heating medium, in close loop arrangement with the waste heat recovery unit on GTGs.

4.4.4.4 Wastewater Treatment

The operation of the FLNG vessel will generate several wastewater streams that will be discharged into the sea[3], namely:

- Stormwater: includes run-off water from both non-process areas (clean effluent) and process areas (potentially contaminated with hydrocarbons);
- Bilge water: oily water that is collected in the lowest space of the vessel;
- Produced water: water separated from the gas during processing potentially containing dispersed and dissolved hydrocarbons;
- Sewage: wastewater from domestic areas (mainly the living quarters), with potentially high organic matter content and possible biological contaminants;
- Cooling water: seawater which is abstracted for cooling purposes and returned to the sea; it may have some inorganic pollutants in residual amounts.

To ensure treatment of these wastewater streams, the FLNG will be equipped with dedicated wastewater treatment units, which are described in the following paragraphs. The wastewater treatment system will be located in unit S07 of the FLNG (see Figure 4.5). All treated wastewater discharged into the sea will comply with applicable national legal requirements and international guidelines for offshore oil and gas developments (such as the IFC guidelines). Effluents which cannot be discharged into the sea in compliance with the environmental regulations and the adopted emission limits will be retained onboard for subsequent transfer to onshore treatment facilities for treatment and disposal.

The exchange of ballast water may introduce AIS from where the ballast water was collected. Ballast water does not contain chemical contaminants. The risk of AIS is only applicable to the FLNG during the first ballast exchange, when the FLNG is towed from foreign waters. To avoid this risk, the FLNG first ballast exchange will be performed outside of Mozambique's EEZ. The FLNG ballast exchanges during the operational phase will only be an exchange of local water (water abstracted and discharged from the FLNG site), with no risk of AIS introduction.

Similarly, all LNG carriers and condensate tankers used for the export of Coral North products will be required to meet the following:

- No ballast activities will take place in the near shore area and over the continental shelf, being limited to deep offshore waters prior entering in country;

[3] This section deals exclusively with effluents from the FLNG vessel itself. For a description of the effluents from project support vessels, please see section 4.3.3.7.

- In compliance with Guidelines for Ballast Water Management and the Development of Ballast Water Management Plans resolution MEPC.127(53) a Ballast Water Management Plan is developed and a Ballast Water Record Book is carried where all ballasting operation are registered.

Sewage treatment system

Raw sewage from the living quarters, medical center, laboratory, and public toilets are collected in sewage mixing tank unit and then routed to sewage treatment package for further treatment and disposal. The treatment system is a two-stage system where the sewage is treated by bacteria at first stage and filtered by a membrane filter at the second stage. Treated sewage is stored inside a tank and discharged to overboard through a disposal caisson. Waste sludge after treatment is collected in sewage sludge tank for offloading to supply vessels for onshore disposal.

National Decree No. 45/2006 (Regulation on Prevention of Marine Pollution) is the national regulation that deals with prevention of marine pollution from sources from ships and platforms. While this decree does not set specific emission limits[4] for offshore sewage discharges[5], or for any other type of offshore effluent, it does state in its Articles 17 and 18 that discharges in national waters are forbidden, except when allowed by international standards. Therefore, to comply with Decree 45/2006, offshore discharges are required to follow international standards.

MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. MARPOL sets emission limits for a number of constituents from sewage discharges from ships or platforms, which are provided in Table 4.5. MARPOL also has additional requirements for sensitive areas, including emission limits for nitrogen and phosphorus. However, to date, only one sensitive area has been defined under this regulation – the Baltic Sea. As such, no nitrogen or phosphorus discharge limits are required under MARPOL for the Indian Ocean, where the Project is located.

The applicability of MARPOL is also reinforced by the IFC EHS Guideline for Offshore Oil and Gas Developments, which advises that treatment of sewage generated at offshore facilities should comply with MARPOL.

Decree No. 18/2004 (as amended by Decree 67/2010), states in clause 3 of its Article 16 that domestic effluents discharged to the ocean should be in compliance with the standards provided in Annex V of that regulation. However, Annex V of this decree does not set emission limits, but instead defines ambient quality standards, that is, maximum admissible concentrations in the receiving oceanic waters. As such, maximum concentrations in the sewage effluent should be such that their discharge into the sea do not cause exceedances of the ambient quality standards (measured in the receiving waters), after the initial mixing. An assessment of this compliance is provided in the impact

[4] Emission limits are maximum acceptable concentrations in an effluent, as established by national laws or international guidelines, for parameters that are considered of interest for the type of discharge in question (i.e., laws and guidelines do not establish emission limits for all parameters that could conceivable be present in a specific type of discharge, only for those that present a risk of harm).

[5] It should be noted that while Decree No. 18/2004 (Regulations on the Standards for Environmental Quality and Effluent Emissions) sets emission limits for sewage waters on its Annex IV, these are interpreted as referring to discharges to surface/interior waters or land only, as indicated by number 3 of Article 16 of this decree.

assessment section, through the application of hydrodynamic modelling (see Impacts WQ2, WQ3, and WQ4; section 7.5.3 of Volume II).

Considering the discussion above, Table 4.5 presents the Project emission limits for offshore sewage discharges, as per MARPOL guidelines (Annex IV - Resolution MEPC.227(64)).

Table 4.5: Treated sewage effluent emission limits

Parameter	Emission limit (1)
pH	6.0 – 8.5
Total Suspended Solids (TSS)	35 mg/l
Biochemical Oxygen Demand (BOD_5)	25 mg/l
Chemical Oxygen Demand (COD)	125 mg/l
Thermotolerant Coliform	100 MPN/100 ml

Reference: (1) MARPOL 73/78 Annex IV - Resolution MEPC.227(64).

Bilge water and deck drainage treatment package

The bilge water treatment system is a dual stage bilge water separation system. The bilge water oil separator is mainly based on the principle of the open pore coalescer in a first stage, and in the second stage the system breaks up the emulsion and removes the oil from the emulsion.

Bilge water is feed in a coalescer filter installed in the suction of an eccentric spiral pump which takes water from the bilge holding tank. This pump type avoids unnecessary additional mixing of oil and water due to reduced turbulences upstream of the gravity oil separator, allowing a more efficient oil droplet separation.

A very open porous coalescer achieves a fine separation of even the smallest oil drops, due to its extremely oleophile surface and oil in water separation is up to 15 ppm.

In case the oil in water spec is above 15 ppm the water is automatically sent to the second stage of the treatment bilge water where two parallel adsorber cartridges are installed. The adsorber elements remove all types of carbon hydrides from the water.

Separated oil is then sent to oily bilge tank and to slop tank for condensate reprocessing.

Table 4.6 presents the Project emission limits for bilge water and deck drainage. MARPOL guidelines apply, as these are vessel effluent streams.

Table 4.6: Treated bilge water and deck drainage effluent emission limits

Parameter	Emission limit*
Oil content	15 ppm

Reference: * MARPOL 73/78 Annex I (additionally IFC EHS Guideline Offshore Oil and Gas Development advises that treatment of Bilge water and Deck Drainage (nonhazardous and hazardous drains) generated at offshore facilities should comply with MARPOL 73/78).

Produced water treatment package

The produced water treatment system treats all the produced water from MEG regeneration unit and includes two main treatment packages:

- A deoiling package, that removes free and dispersed oil and other potential contaminants from the produced water; and
- A phenol package, that removes phenols from the produced water.

After this treatment, the pH of the stream is measured by the pH analyser and caustic is added, if required, to meet the compliance limits for pH. The treated produced water is then discharged to sea at a controlled flow rate.

If the online continuous oil in water (OIW) analyser detects an OIW content that is too high, the produced water is automatically diverted to the off-specification tank, where the produced water is resent to the deoiling package for additional treatment.

Part of the produced water in both the on-specification or off-specification tanks may be used for the operational purposes. The skimmed oil from the deoiling package is recycled to the condensate preflash drum.

The phenol package is designed to reduce phenol concentrations in the produced water up to 0.5 mg/l.

National regulations do not specify emission limits for offshore industrial effluent discharges[6]. The applicable international guideline is the IFC EHS Guidelines for Offshore Oil and Gas Development, which only establishes emission limits for one parameter in offshore discharges of produced water – oil content as per Table 4.7.

Table 4.7 presents the Project emission limits for the treated produced water effluent, as per IFC guidelines.

While no national regulation or international guideline defines an emission limit for phenol, the above referred concentration of 0.5 mg/L will be an internal Company performance target, which will be monitored, as defined in the ESMP.

Table 4.7: Treated produced water effluent emission limits

Parameter	Project Standard
Oil content	42 mg/L (daily maximum) 29 mg/l (monthly average)

Reference: IFC EHS Guidelines for Offshore Oil and Gas Development.

Freshwater system

Potable water, service water and demineralized water are produced from seawater through a reverse osmosis and electrodeionization (EDI) system. The seawater is first filtered on ultrafiltration membranes as a pre-treatment before dechlorinated and desalination on the first pass and second reverse osmosis membranes. The water is then sent to a demineralization and deaeration systems. The produced brine from pretreatment stage is brine with high salinity. Before disposal this brine is mixed with seawater and directed to electrochlorination package where it is used for biocide

[6] The recently published Decree 52/2023, of August 30th, updates the requirements for emission limits for industrial effluents for discharges to superficial or underground waters, but does not apply to effluents discharged to marine waters.

production. The mixed excess brine (slightly above the seawater concentration) will be disposed to seawater.

A second stream of produced diluted brine is then sent to demineralization package which flows (coming from second stage of reverse osmosis treatment and with very low salinity, largely below seawater concentration) to the bilge system.

Cooling water

Table 4.8 presents the Project Standards for cooling water discharge, as per IFC EHS Guidelines for Offshore Oil and Gas Development.

Table 4.8: Cooling water emission limits

Parameter	Emission Limit
Temperature increase	No more than 3ºC difference at the edge of mixing zone [1]

References: [1] IFC EHS Guidelines for offshore Oil and Gas Development.

4.4.4.5 Waste Management

All solid waste generated aboard the FLNG (including hazardous, non-hazardous, and biomedical waste) will be adequately segregated, temporarily stored onboard, and transferred to land, for final treatment and disposal in licensed waste management facilities, in full compliance of national regulations and international guidelines.

A Waste Management Plan has been included in the EMP (see Volume III), defining all waste management procedures, including collection, segregation, temporary storage, transport to land, and final destination.

The only exception is kitchen waste, which will be macerated and discharged to sea in compliance with MARPOL regulations.

4.4.4.6 Flaring

Flaring of hydrocarbons will not occur during routine normal operations. The main purpose of the flare system is to safely and reliably collect and dispose unusable vapor hydrocarbons and liquids, arising from upset and emergency conditions, and from planned non-routine operating conditions, such as start-up, partial/total shutdown, depressurization, and equipment and pipe work purging.

As such, two distinct categories are defined:

- Emergency flaring - depressurization or relief lasting less than 15 minutes; mainly resulting from plant upsets and relief due to failure of plant control systems or plant shut down. This generally involves opening of pressure safety valves or blow down valves;
- Continuous flaring - flare relief lasting 15 minutes or more; mainly resulting from a controlled operational event such as start-up, normal shutdown, venting, upset operation, purging, draining of equipment and pipe work, which occurs as part of the operation of the plant.

During start-up, the facilities have been designed to flare the product until the required specification of gas is reached or to keep part of the unit in operation while downstream units are shutdown or being started up.

In case of upset operation such as failure of equipment or off-spec gas conditions, the facilities have been designed to allow the production to continue flaring some off gases. During this time, the failed equipment can be repaired, or any other problem can be solved, as far as it is acceptable from an operational and environmental point of view.

The flare system will be based on the segregation of wet and warm hydrocarbons (warm flare) from dry and cold hydrocarbons (cold flare) and high-pressure system to very low-pressure system.

The flare stack will be located at the aft of the vessel, at the opposite end from the living quarters shown in Figure 4.4. In order to mitigate the radiation impact from the expected maximum flaring flow rates, a flare stack inclined 20° from vertical towards portside and a stack length of 177 m is foreseen. Radiation shielding will be provided to reduce radiation levels.

4.4.4.7 Maintenance

The maintenance strategy shall ensure that the FLNG meets the standards set forth for cost-effective availability, reliability, operability, maintainability, and mechanical integrity, in a manner that meets/exceeds international standards, relevant flag state and class regime, and HSE regulations, policies and standards. The main principles are listed below:

- Ensuring and optimizing the availability and reliability of the FLNG, in compliance with production needs;
- Protecting and preserving the integrity of the asset, for all field life;
- Regular monitoring of equipment and operating conditions, to prevent unpredicted failures and to improve maintenance activities plan;
- Manage all maintenance activities through a Computerized Maintenance Management System (CMMS) to plan any maintenance activities on all items and to have records and feedback of any action undertaken;
- Move from a planned inspection to a risk-based inspection in particular for the safety critical elements;
- Providing an auditable system of asset maintenance and control to analyse maintenance performance and ensure continuous improvement;
- Minimizing the capital immobilization for spare parts, without compromising the maintenance timeliness and effectiveness;
- All maintenance activities shall be conducted under permit to work conditions at all times;
- Identify a firm set of key performance indicators in order to verify periodically the efficiency and costs of maintenance activities.

All maintenance shall be performed only by competent personnel. Equipment calibration and maintenance is performed by specialists or supervised by specialists contracted on a case-by-case basis. A CMMS shall be utilized to store performance data, generate required equipment and system

reports, trends, and history, manage procurement and inventory, and provide effective work plans and schedules.

Whenever possible, in order to achieve higher equipment/systems availability, the preferred maintenance typology shall be the Condition Based Maintenance or the Predictive. The implementation of these strategies requires suitable set of instrumentation and monitoring systems to be foreseen during the design phase.

4.4.5 Decommissioning Phase

Decommissioning and abandonment will be carried out through a Decommissioning Plan developed in accordance with Article 15 of the Area 4 EPCC, Eni internal standards, and International Codes and Standards relevant to offshore petroleum activities.

A feasibility study shall be carried out during the engineering phase covering the legal and technical aspects, to establish requirements and cost estimation for decommissioning and abandonment of the fixed assets. During the production phase, possible decommissioning alternatives will be analysed according to various factors (such as environmental impact, consumption and/or emission balance, safety, technical feasibility, cost) to inform the Decommissioning and Abandonment Plan. The final aim of this activity is to assure the restoration of the environment to a reasonable condition.

The decommissioning phase will take place at least 25 years in the future. Given the uncertainty associated with predictions so far out in advance, the Decommissioning Plan will be prepared and submitted for approval two years prior to decommissioning.

4.5 Workforce

Workforce requirements will vary during the Coral North FLNG lifecycle.

In the drilling, installation, and commissioning and start-up phases, employed personnel will mostly be that of the offshore marine vessels performing the work, supported by a small number of workers on the onshore logistics base and offices. Most work in these phases will be performed by the marine crews of very specialized international vessels. As such, in these phases the number of direct job opportunities created in Mozambique will be relatively low.

In the operational phase, employment required for the Coral North FLNG project will be structured in three main hubs, namely offshore, onshore logistics base, and home office. The offshore hub will include all personnel aboard the FLNG and marine services personnel, which will include the crew of tug, piloting, and mooring vessels, offshore support vessels, and tankers. While the Project is still in a preliminary phase and workforce requirements may change; it is estimated that the number of direct jobs expected to be created by the Coral North FLNG is likely to be similar to the Coral South Project.

It is anticipated that during the initial phase of the project the national resources will be approximately 25% of the total directly employed workforce (expected to be around 350 employees in the first period of production phase and then stabilize with around 300 employees) increasing to 70% over the duration of the project. Based on the above, a preliminary nationalization plan has been designed and is illustrated in Figure 4.16. The chart shows the estimated needs of personnel and the relevant nationalization plan. This is based on the promotion of national staff onboard the FLNG after demonstration of achieving through professional development the required experience, competencies, and skills. This approach shall remain until the nationals account for about 90% of the entire workforce.

The highest number of national staff will be assigned into the operations organization after successfully completing on the job training.

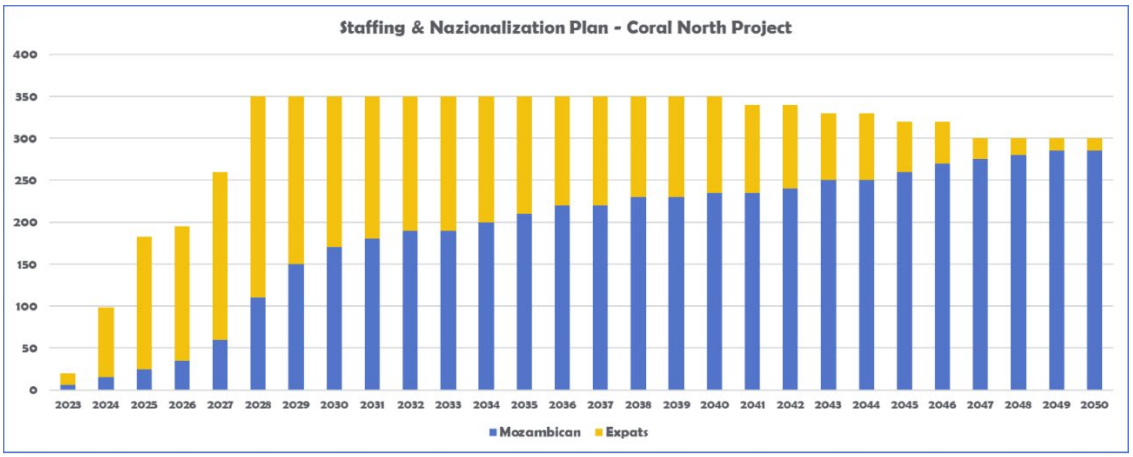


Figure 4.16: Staffing and nationalization plan

In the construction and installation phases, MRV will promote the use of the local resources trained for the Coral South Project including the more critical positions for commissioning and construction activities. Opportunities will also be available for an international Project assignment in France and/or South Korea. Furthermore, it is likely that cumulatively 1,400 Mozambicans will either be directly or indirectly employed including through services required from local companies over the duration of the Project. MRV will encourage its contractors to select, hire, and train national personnel to maximize the local content. The need will be for highly specialized personnel (engineers, technicians) as well as personnel for support activities.

Gender balance is at the core of MRV's strategy from recruitment activities through the development of the resources including the leadership and critical positions within MRV's structure. As such the recruitment process will be considerate of gender.

4.6 Health, Safety, and Environmental Aspects

The project ensures full compliance with all applicable laws and regulations of Mozambique, MRV HSE Policy and standards, and internationally recognized codes and standards.

The project development is supported by an HSE design based on a formal risk-based assessment process, through the following main steps, which will be completed and/or validated based on the Coral South FLNG risk studies during the detailed engineering studies:

- Hazard identification by analysis is performed to ascertain the relevant HSE concerns associated to the project. Where hazards are identified and deemed no-negligible, more detailed quantitative risk assessment and analysis of the hazards will be performed;
- Specific HSE studies to validate the layout and define all necessary measures and protections to put in place (i.e., fire and explosion risk analysis, emission, and gas dispersion studies, such as heat radiation, etc.). A specific blow out analysis for drilling activities will be prepared;
- Verification of the measures to prevent, control or mitigate the consequences of these hazards;
- Identification of changes or additions to the design in order to improve the prevention, control, or mitigation of the consequences of the identified hazards;
- Demonstration that personnel risks are, at worst, as low as reasonably practicable.

Personnel safety is the first priority in decisions involving design options, construction procedures, cost/schedule trade-offs. Project targets for occupational health and safety will include:

- Identification of risks for the health and safety of the personnel working on the project;
- Evaluation of health and safety impacts of the project;
- Definition of protection measures and personal protective equipment necessary for the different tasks.

Appropriate measures will be implemented to intervene immediately in case of injury to personnel, including the provision of medical facilities on the working sites, training of personnel to first aid, emergency actions, medical evacuation, and medical rescue to appropriate facilities.

With respect to environmental protection, the facilities are designed with the aim to:

- Avoid and/or reduce gaseous emissions as far as reasonably practical (apart from commissioning, start-up, re-start after shutdown and emergency situations);
- Meet an efficient management of water, focusing on the most sustainable choices, giving priority to reduction of the consumption of water and generation of wastewater and its possible reuse or recycle, after treatment;
- Assure that all wastes (hazardous and non-hazardous) generated during all phases of the project activities will be managed considering the requirements of applicable legislation, Company and International standards;
- Avoid and/or reduce any potential impact on Biodiversity and Ecosystem Services.

Specific Emergency Response Plans will be prepared to cover all foreseeable emergencies (fire and explosion, spills, uncontrolled blow out, hydrocarbon pollution, man overboard, abandon of the platform, etc.).

4.7 High-Level Project Schedule

A high-level project schedule is provided in Table 4.9. Start-up is estimated in the second semester of 2026 with the start of operations, and LNG production, in 2027. Once operational, the FLNG will operate offshore for at least 25 years without dry-docking. The facility is being designed to withstand cyclones and storms without the need for disconnections.

Table 4.9: High-level project schedule

Project Phase	2023		2024		2025		2026		2027	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
EIA and engineering design										
Drilling and completion*										
Installation										
Commissioning and start-up										
Start of operations										

*Note: two of the six production wells may be drilled at a later stage of the project.

4.8 Investment Budget

Currently, while the cost estimate is still being fine-tuned, in the region of 7 billion USD is expected to be invested by Area 4 partners for the Coral North FLNG development if the project is approved by the GoM.

5 Project Areas of Influence

5.1 General Considerations

The EIA Regulation defines the Area of Influence (AoI) as the geographical space directly or indirectly affected by an activity's environmental impacts. Despite this seemingly straightforward definition, in practice the definition of a project's AoI is not an easy task given that the AoI is a function of many changing and varying degrees of influence on the areas surrounding the project throughout the course of the project's lifecycle.

The AoI can therefore be thought of as the sum of a number of fluctuating factors. The geographical extent of some may be quantified (e.g., the area affected by the project's noise emissions), while the extent of others is very difficult to measure (e.g., direct and indirect economic effects). Project impacts also change over time; a project employing hundreds of workers during construction, and only a small number once operational, has a very different social AoI during those two phases.

A further consideration is the presence of other organizations or developments, each with their own AoI, within the AoI of the proposed project making it very challenging to assign an AoI to each individual development.

Considering the above, determining the AoI therefore requires informed although subjective judgment, based on available information and the knowledge of previous and similar project impacts, combined with practical findings.

The EIA Regulation requires the definition of an Area of Direct Influence (ADI) and an Area of Indirect Influence (AII). The following sections outline the AoI for the proposed Project, in line with the considerations described above, and taking into consideration the specialist assessments developed for this EIS.

5.2 Area of Direct Influence

The Project's ADI is a combination of two different areas:

- Project's footprint;
- Area where drilling, installation, commissioning and/or decommissioning, and operational impacts are likely to be noted.

The footprint includes the area occupied by the FLNG vessel and associated infrastructure such as the production wells and the subsea infrastructure as well as the safety zone established around this infrastructure (see section 4.4.4.1). The footprint is a relatively small area and encompasses the 1.5 nm (2.8 km) manoeuvring zone around the FLNG.

During the drilling, installation, commissioning, and decommissioning phases, the area where direct impacts are likely to be noted include areas where drilling, installation, and commissioning activities will be installed and/or carried out, such as drilling, mooring chains and anchors, installation of the SPS, etc. The area directly affected by these impacts may be slightly larger than the footprint,

although it will still be a relatively small area centred on the FLNG. During these phases, direct impacts may also be observed due to vessel and helicopter activities, thus including the vessel transport corridor to and from Pemba, and the usage of the onshore logistics base in Pemba.

During operations, the same areas described above are likely to be affected by direct impacts from operational activities. In addition, direct impacts are also likely from the FLNG's emissions, including noise, light, and atmospheric and liquid effluents.

Thus, the overall ADI for the FLNG project was determined based on previous experience with similar projects and the findings of the specialist studies developed for this EIA. Table 5.1 below provides the ADI estimates for the environmental components that may potentially be affected (see Volume II for the impact assessment). The estimates in the table below are conservative (i.e., the worst-case scenario was assumed in each case).

Table 5.1: Areas of direct influence for relevant environmental components

Environmental component	ADI	Reasons
Air quality	40 km radius around the FLNG facility	According to the atmospheric dispersion modelling study developed for this EIA, air quality impacts from the FLNG emissions beyond this distance are not noted. Impacts on onshore areas are negligible.
Underwater noise	33 km radius around the FLNG facility	Zone of potential behavioural impacts on marine mammals due to project noise emissions. This distance is informed by the underwater noise modelling study developed for this EIA.
Water quality	100 m radius around each well	The area where water quality is likely to be affected by the release of drill cuttings and muds. This is informed by the results of the marine discharges modelling study developed for this EIA.
	300m radius around the FLNG facility	The area likely to be affected by the discharge of FLNG liquid effluents (produced water and sewage). This is informed by the results of the marine discharges modelling study developed for this EIA, that indicates that no exceedances to water quality guidelines are expected beyond the recommended mixing zone of 300 m
Marine Ecology	500 m around the FLNG facility and 100 m around the well locations	This corresponds to an area where direct impacts on the marine biota are likely to be experienced, such as direct impacts on benthic habitats due to drilling and on marine fauna due to operational activities and light emissions. This is informed by the results of the marine discharges modelling and illumination studies developed for this EIA.
	ADI on underwater noise	Zone of potential behavioural impacts on marine mammals due to project noise emissions.
	Vessel and helicopter routes	Due to the possibility of collision impacts, overhead disturbance from helicopters, as well as due to vessels emissions.
Illumination	70 km radius around the FLNG facility	This is the maximum distance at which a FLNG could be theoretically visible from observers onshore, at night, in perfect atmospheric conditions and while flaring, according to the results of the illumination study developed for this EIA. For biodiversity receptors, the potential area of influence is smaller (20 km for avifauna and within 500 m of the FLNG for other biological groups).

Environmental component	ADI	Reasons
Socioeconomic	2.8 km around the FLNG facility	The area where commercial fishing activities would no longer be viable due to project implementation.
	ADI on illumination	The area where certain socioeconomic activities such as island-based tourism could be affected due to illumination (visibility of FLNG).

Based on the above, the ADI for the Coral North Project is defined as:

- Seventy (70) km radius around the FLNG facility (determined by the greatest distance among the environmental components' specific ADIs);
- Vessel and helicopter route between Pemba port and the FLNG location;
- Pemba City, where the onshore facilities are located.

The ADI is illustrated in Figure 5.1.

5.3 Area of Indirect Influence (AII)

The Project's AII is the geographic area where indirect impacts are likely to occur, those secondary impacts arising from direct effects.

Few or no indirect impacts for the biophysical environment are expected outside of the ADI; while, indirect socioeconomic impacts may occur in Pemba district, as a result of logistic base operations and increased usage of port infrastructure.

As such, the AII includes the following:

- ADI where both direct and indirect impacts may arise;
- Coastline and near-shore area of Palma District and coastal islands, where impacts of emergency events such as accidental hydrocarbon spills, may occur (as per the results of the oil spill modelling study developed for this EIA);
- Pemba District.

The AII is illustrated in Figure 5.2.

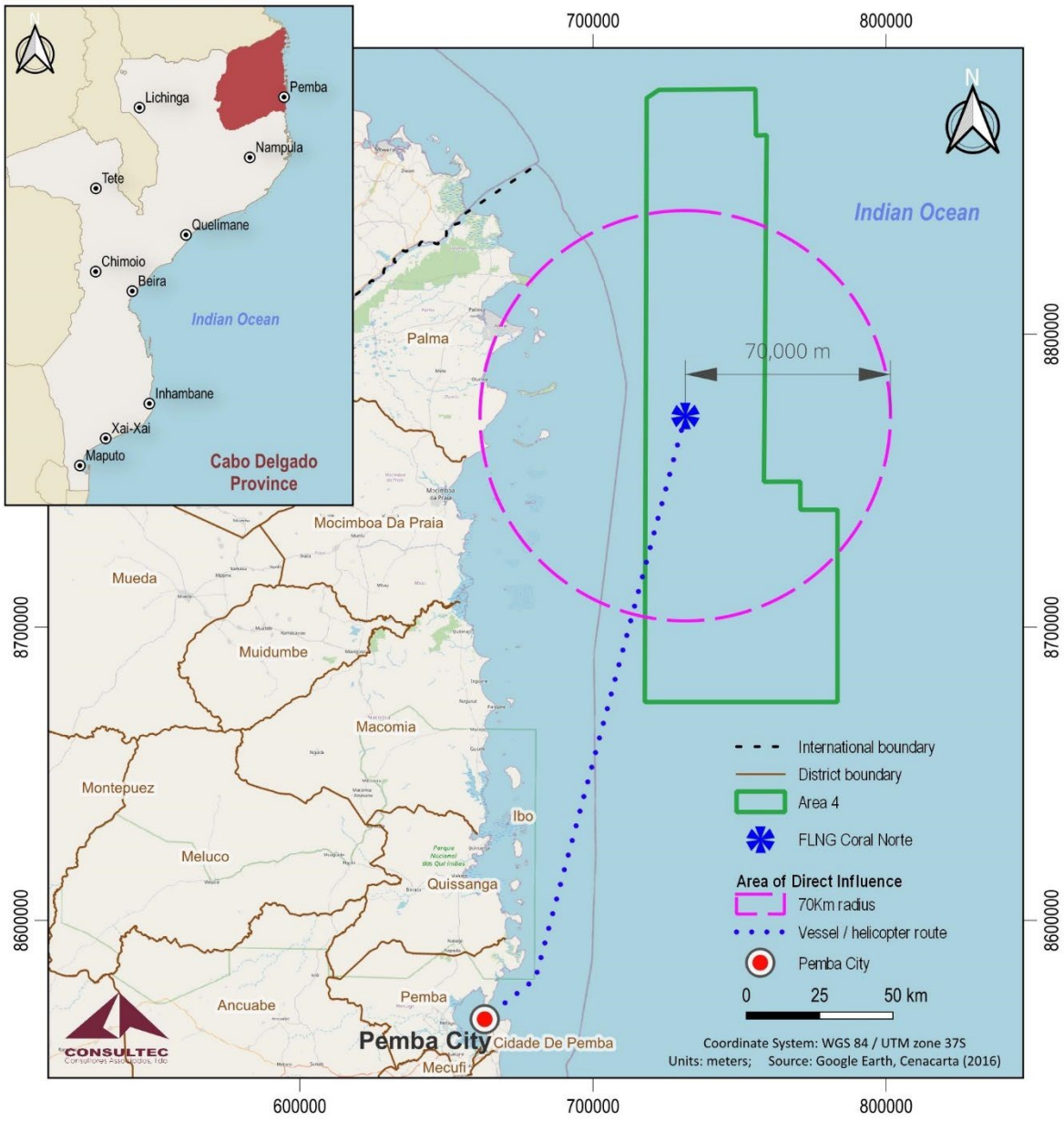


Figure 5.1: Area of Direct Influence

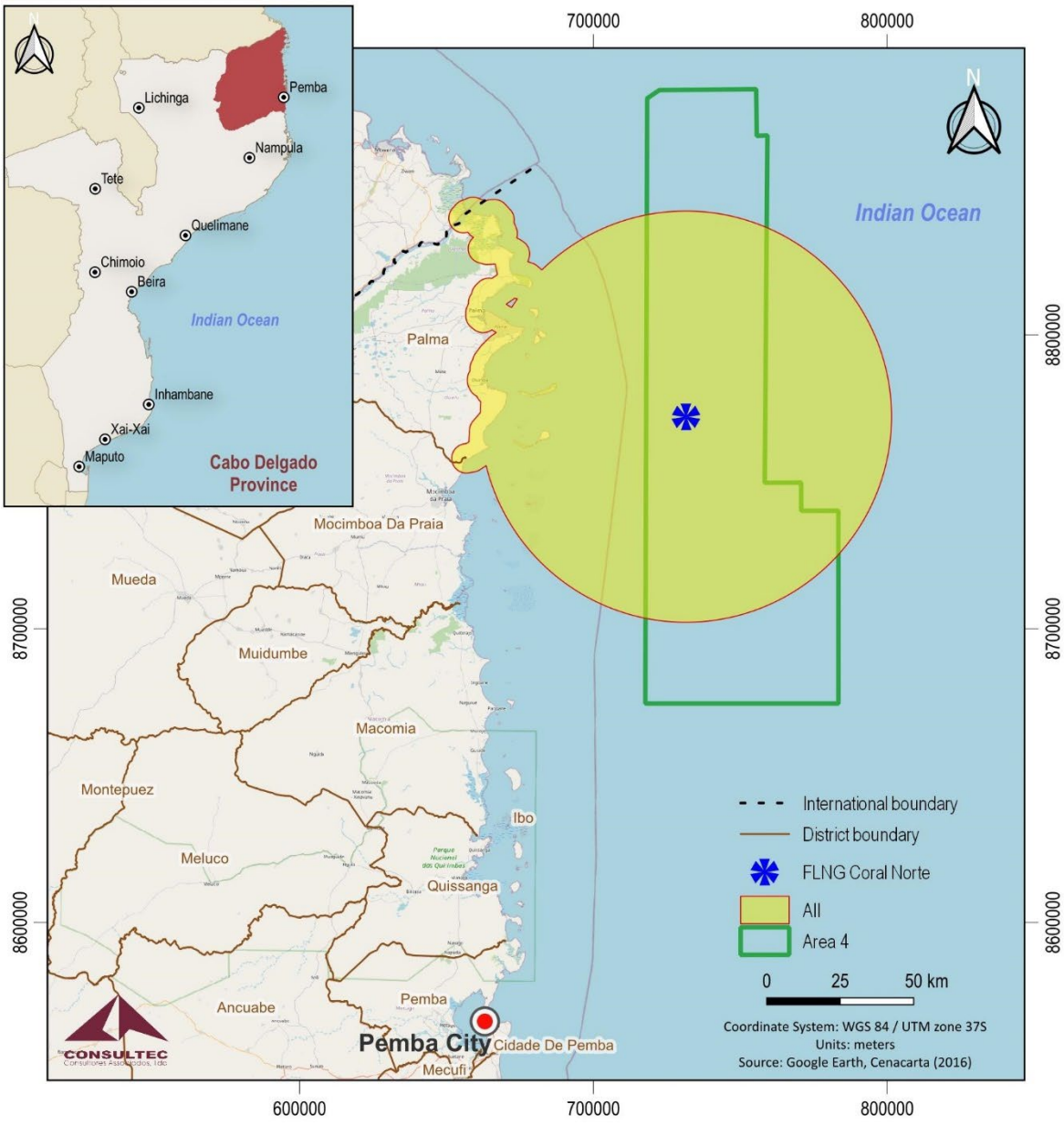


Figure 5.2: Area of Indirect Influence

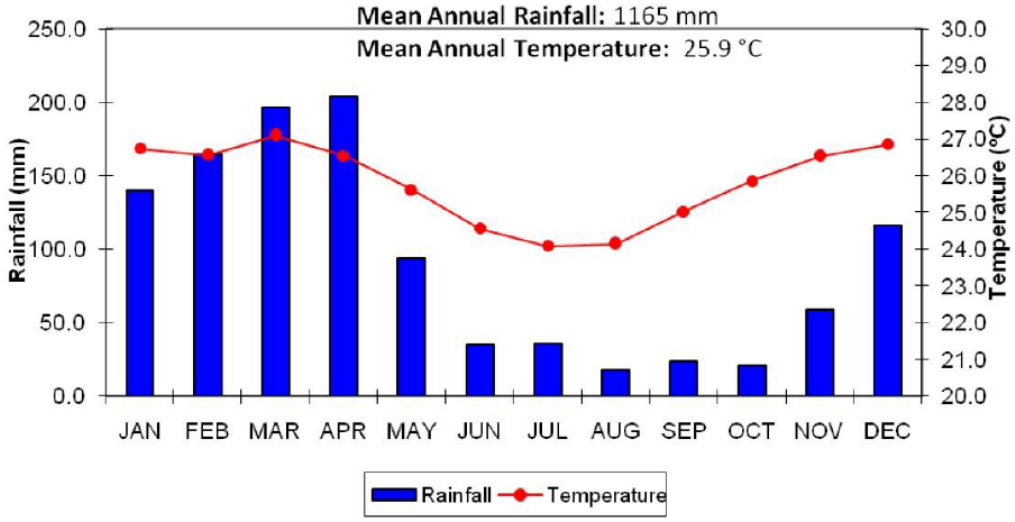
6 Biophysical and Socioeconomic Baseline

This Chapter provides a baseline assessment of the potentially affected environment, within the project's area of influence, as defined in Chapter 5. The scope of the baseline assessment reflects the ToR approved in the EPDA for the specialist studies and the EIS report. The baseline assessment is based on literature review, including all the primary data collected through field assessments and monitoring studies developed for the Coral South Project (located 10 km south of the Coral North location) in recent years, as well as field visits to Pemba and Palma, to collect information on atmospheric noise, socioeconomics, fisheries, and health. The following environmental and social factors are addressed in the baseline assessment:

- Climate (section 6.1);
- Air quality (section 6.2);
- Greenhouse gases (section 6.3);
- Atmospheric noise (section 6.4);
- Underwater noise (section 6.5);
- Oceanography (section 6.6);
- Water quality (section 6.7);
- Landscape and seascape (section 6.8);
- Biodiversity (section 6.9);
- Socioeconomics (section 6.10);
- Marine traffic (section 6.11).

6.1 Climate

Mozambique is situated on the east coast of southern Africa. It has a sub-tropical climate; however, it experiences a tropical savannah and rainy climate in the north of the country. There are two distinct rainfall seasons in the region, a wet season (November to March), and a dry season (April to October). Some 90% of the 800-1 200 mm mean annual precipitation occurs during the wet season (**Figure 6.1**).

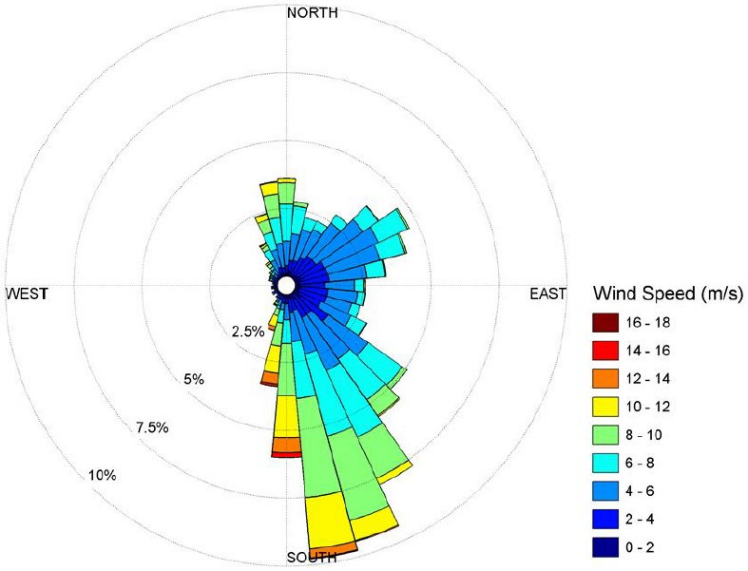


Source: ERM (2019).

Figure 6.1: Monthly rainfall and temperature at Palma

The climate of the Rovuma Basin and Area 4 is influenced by the north and south movements of the Intertropical Convergence Zone (ITCZ) and the Southern Atmospheric Oscillation. The ITCZ is formed when trade winds from the northeast and southeast meet near the equator. Where these winds meet, warm moist air moves upward, causing the water vapor to condense, resulting in large precipitation. The weather phenomenon El Niño and La Niña (Southern Atmospheric Oscillation) results in a shift in water temperature of the Indian and Atlantic Oceans (Consultec, 2015) causing further variability in the area's climate.

The FLNG facility is located in the Southeast Trade Wind Belt, with ERM (2019) reporting a strong season pattern in both wind speed and direction. South–south easterly winds dominate during the end of the wet season and start of the dry season (April to August) and tend to be strongest in July (monthly-averaged wind speed of 8.7 m/s). East–north-easterly winds occur in October and November, at the end of the wet season and start of the dry season (4.1 m/s in March). North–north westerly winds occur in January and February during the wet season (Figure 6.2). March, September, and December are transition months with weaker speeds and a wide range of directions (ERM, 2019).



Source: ERM (2019). Wind data were obtained from the National Centre for Environmental Prediction Climate Forecast System Reanalysis and Climate Forecast System Version 2.

Figure 6.2: Annual wind distribution at the FLNG location (2009 to 2013)

The location of the FLNG is subject to cyclones; typically occurring between December and April. The movement of storms initially is nearly always in a south-west to west direction; most subsequently change direction (re-curve) tracking south or south-east and increasing their speed (ERM, 2019). A few storms reach the Mozambique Channel before changing direction and sometimes cross Madagascar. Between 1980 and 2007, 56 tropical storms and cyclones were recorded, 27 of which were classified as tropical cyclones (wind speed: 17-32 m/s) and the remaining as cyclones (wind speeds >33 m/s) with a storm surge of 1-5.6 m (ERM, 2019).

6.2 Air Quality

6.2.1 General Considerations

The Coral North FLNG will be located in an offshore environment, where no sensitive receptors to air quality exist. The closest sensitive receptors to air quality are located in the onshore areas that fall within the Project's AII (as defined in section 5), namely the human settlements located in the coastline and near-shore area of Palma District and coastal islands within the AII. As such, the air quality baseline is provided for both the offshore AID and the coastal/onshore AII.

The air quality baseline assessment is based on literature review, in particular previous EIA studies and air quality monitoring surveys carried out in the region, including a dedicated offshore air quality survey in 2016 for Area 4. A review of applicable air quality guidelines and legal requirements is also provided.

6.2.2 Air Quality Standards and Guidelines

Ambient air quality standards[7] in Mozambique are established through Decree No. 18/2004, of 2 June (Regulation on Environmental Quality Standards and Effluent Emissions), as amended by Decree No. 67/2010, of 31 December.

Several international air quality guidelines sources were considered during this EIS. The main source was IFC's General EHS Guidelines (IFC, 2007), that refers to the World Health Organization's (WHO) Air Quality Guidelines (WHO, 2005). Additionally, other international standards were considered (e.g., European Union (EU) Directive 50/2008, national and/or jurisdictional environmental protection agencies from other countries and/or jurisdictions as highlighted in Table 6.1).

Table 6.1 lists both the national and international ambient air quality standards.

Table 6.1: Ambient air quality – Mozambican standards and international guidelines

Pollutant		Averaging period	National standard [a] [µg/m³]	International guideline [µg/m³]
SO_2		Annual	40	-
		24 h	100	20 [b]
		1 h	800	-
		10 minutes	500	500 [b]
NO_2		Annual	10	40[b]
		1 h	190	200[b]
TSP		Annual	60	-
		24 h	150	-
PM2.5		Annual	-	10[b]
		24 h	-	25[b]
PM10		Annual	-	20[b]
		24 h	-	50[b]
VOC	1,2Dichloroethane	24 h	-	700[c]
	Formaldehyde	30 min	10	100[c]
	Styrene	1 week	280	260[c]
	1,3-Butadiene	1 week	-	2.4[d]
	Acetaldehyde	1 year	-	30[d]
BTEX	Benzene	1 year	4.4	5[e]
	Toluene	1 week	260	260[c]
H_2S		24 h	-	150[c]
CO		8 h	10000	10000[e]
		1 h	30000	-
		30 min	60000	-
		15 min	100000	-

[7] Ambient quality standards are maximum admissible concentrations of pollutants measured in the receiving environment.

Pollutant		Averaging period	National standard [a] [µg/m³]	International guideline [µg/m³]
Heavy Metals	Lead (Pb)	1 year	0.5	0.5[f]
	Cadmium (Cd)	1 year	-	0.005[f]
	Nickel (Ni)	1 year	0.04	0.02[f]
	Manganese (Mn)	1 year	0.05	0.15[c]
	Mercury (Hg)	1 year	1	1[c]
PAH	Benzo[a]pyrene	1 year	-	0.001[f]

Source: [a] Decree 18/2004, as amended by Decree 67/2010; [b] IFC (2007) / WHO (2005); [c] World Health Organization "Air quality guidelines for Europe" Second edition; [d] New Zealand Ambient Air Quality Guidelines; [e] EU Air Quality Standards, Directive 2008/50/EC; [f] EU, Directive 2004/107/EC of the European Parliament and of the Council relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air, 15 December 2004

6.2.3 Onshore Air Quality Baseline

Impacto & ERM (2014) undertook a baseline air quality survey based on ten monitoring stations distributed along the Afungi Peninsula - located southeast (SE) of Palma Town and in the Palma Town. Monitoring of nitrogen dioxide (NO_2) and nitrogen oxides (NO_x) concentrations was undertaken in these locations for a period of eight months. According to this study, NO_2 average concentrations are equivalent to 1.8 µg/m³, ranging from 0.3 to 0.6 µg/m³ in rural areas to 0.3 to 4.8 µg/m³ in urban areas of Palma. NO_x average concentrations were 6.2 µg/m³, ranging from 3.4 to 12 µg/m³ in rural areas, to 3.9 to 10.8 µg/m³ in urban areas of Palma. These concentrations are substantially below national and international standards (see section 6.2.2), indicating a non-degraded airshed, and reflect the lack of relevant atmospheric emission sources in the area.

Consultec (2014) undertook air quality monitoring in nine sites along the road that connects the coastal districts of Pemba-Metuge, Macomia, Quissanga, and Mocímboa da Praia, south of Palma District. While the areas surveyed in Consultec (2014) are located further south from the AII of the Coral North project, they are still indicative of the general regional airshed quality and are provided in

Table 6.2 below. The results indicate a non-degraded airshed for most analytes, with the exception of particulate matter, where some exceedances were noted from dust mobilized from dirt roads.

Air quality data collected by both Impacto & ERM (2014) and Consultec (2014b) indicate a non-degraded airshed with very low concentrations of most relevant pollutants (NO_2, SO_2, and CO). While it wasn't possible to identify more recent air quality surveys in the AII (and current security conditions in Palma District do not allow the undertaking of *in situ* air quality surveys), it is likely that these values are still indicative of current air quality in the area, as no significant development project was implemented in the area in the intervening years. This is expected given the very low levels of industrialization in the Province and the lack of relevant anthropogenic atmospheric emission sources. Consultec (2014) recorded some locally high concentrations of particulate matter, originating from road traffic along existing dirt roads.

Table 6.2: Summary of air quality parameters measured along the road connecting the districts of Pemba-Metuge, Macomia, Quissanga, and Mocímboa da Praia

Parameter	Average values (µg/m³)	Sampling time	National standard (Decree 67/2010) (µg/m³)	International Guidelines (IFC) (µg/m³) (1)	Notes
Total Suspended Particles (TSP)	143.5	24 hours	150	-	Mostly below national standards, with a few high values linked to the existing dirt road
Particulate matter under 10µm (PM10)	78.9	24 hours	-	20	Guideline exceeded due to existing dirt road as no other relevant sources were identified
NO_2	1.71	7/15 days exposure	10	40 (annual)	All well below applicable standards
Sulphur dioxide (SO_2)	0.23	7/15 days exposure	40	20 (24 hours)	Almost absence of emissions
Carbon monoxide (CO)	< 1,145	Instantaneous	100,000	-	Below the detection limit

Source: Consultec (2014). Note: IFC (2007).

6.2.4 Offshore Air Quality Baseline

6.2.4.1 Data Source

An offshore air quality survey was undertaken by MRV in Area 4, as part of an Offshore Environmental Baseline Survey (OEBS), conducted from December 2015 to March 2016, as reported in ERM (2016). A survey vessel was used to perform air quality measurements at the Coral South FLNG site (specifically at the three manifold locations – CIM1, CIM2 and CIM3), located roughly 10 km south of the Coral North proposed location. The measurements comprised a combination of diffusion sampling methods for gaseous contaminants, use of a particulate sampler, and spot measurements of atmospheric gases using a gas detector. The findings of this study are reported in the following sections.

6.2.4.2 Gaseous Contaminants

Table 6.3 provides the air quality data collected at the Coral South site in the 2016 OEBS for gaseous contaminants, including SO_2, NO_2, hydrogen sulphide (H_2S), CO, methane (CH_4), volatile organic compounds (VOCs), and Polycyclic Aromatic Hydrocarbons (PAH).

As expected, given the distance of the offshore site to any onshore pollution source, most targeted contaminants were present at levels below the detection limits of the methodology used.

SO_2, NO_2 and H_2S were measured by passive diffusion sampling over an approximately 8 h period. NO_2 was consistently detected in samples, with levels that ranged from 2.69 μgm^{-3} to 7.61 μgm^{-3}. These concentrations are consistent with the background atmospheric concentration range for marine environments from literature (0.4 µg/m³ to 9.4 µ/gm³; Seinfeld & Pandis, 2006). Measured concentrations were consistently below both national and international ambient air quality standards,

namely the IFC guideline for NO_2 of 40 μgm^{-3} (1-year averaging period) and the more stringent standard set by the Mozambican regulations of 10 μgm^{-3} (1-year averaging period) (see section 6.2.2).

Table 6.3: Concentrations of gaseous contaminants (µg/m³) measured at the Coral South site

Analyte	Site CIM_1		Site CIM_2		Site CIM_3	
	AQ1	AQ2	AQ1	AQ2	AQ1	AQ2
Atmospheric Gases						
NO_2	6.53	5.31	2.69	5.77	4.45	7.61
SO_2	<3.09	<3.09	<3.41	<3.42	<3.45	<3.43
H_2S	<1.06	<1.06	<1.17	<1.18	<1.19	<1.18
CO	<1.23	<1.23	<1.23	<1.23	<1.23	<1.23
CH_4	<0.71	<0.71	<0.71	<0.71	<0.71	<0.71
VOCs						
Formaldehyde	<1.48	<1.61	<1.61	<1.58	<1.63	<1.48
Acetaldehyde	<4.54	<5.57	<5.57	<4.64	<5.67	<5.15
Styrene	<0.70	<0.70	1.11	<0.70	<0.68	1.52
1,3-Butadiene	<0.65	<0.65	<0.67	<0.66	<0.67	<0.63
1,2-Dichloroethane	<02.49	<0.49	<0.50	<0.48	<0.50	<0.48
BTEX						
Benzene	<1.64	<1.64	<1.67	<1.59	<1.67	<1.61
Toluene	<1.64	<1.64	<1.67	<1.59	<1.67	<1.61
Ethylbenzene	<1.64	<1.64	<1.67	<1.59	<1.67	<1.61
m/p-Xylene	<1.64	5.28	<1.67	<1.59	<1.67	<1.61
o-Xylene	<1.64	1.77	<1.67	1.60	<1.67	<1.61
PAH						
Naphthalene	<1.59	<1.61	<1.64	<1.61	<1.67	<1.52
2-methyl Naphthalene	ND*	ND	ND	<1.61	<1.67	ND
Pyrene	<1.59	<1.61	<1.64	<1.61	<1.67	<1.52
Biphenyl	<1.59	ND	<1.64	<1.61	<1.67	<1.52
Phenanthrene	ND	ND	<1.64	ND	<1.67	<1.52
Fluoranthene	<1.59	<1.61	<1.64	<1.61	<1.67	<1.52

Note: *ND – No Data.

Concentrations of SO_2 and H_2S were undetectable from all samples, with the limits of detection being far lower than the applicable standards.

CO and CH_4 were detected using a high sensitivity gas detector; these gases were measured in part per million (ppm) concentrations, although converted to µg/m³ levels to allow comparison with air quality standards. Both gases were below the instrument's limit of detection during all measurement

events (detection limit for CO = 1 ppm or 1.23 µg/m^3) which is far below the most stringent standard accepted by both national standards and international guidelines (10,000 µg/m^3 over 8 h period).

The VOCs, formaldehyde, acetaldehyde, styrene, 1,3-butadiene and 1,2-dichloroethane were sampled using pumped diffusion samplers (2 h period). The only detectable VOC was styrene, which was detected at concentrations of 1.11 µg/m^3 and 1.52 µg/m^3 at stations CIM_1 and CIM_2. However, it was thought likely that these detectable results may have been due to contamination from the vessel's stack emissions. Despite this potential trace contamination from the survey vessel, levels were far below the IFC standard of 100 µg/m^3 (30 min averaging period), and the national standard of 10 µg/m^3 (30 min averaging period).

Benzene, toluene, ethylbenzene, and xylene (BTEX) were also sampled using pumped diffusion samplers over a 2 h period. The only detectable BTEX compounds were m/p-xylene and o-xylene with both compounds detected at CIM_1 (5.28 µg/m^3 and 1.77 µg/m^3 respectively) while only o-xylene was detected at CIM_2 (1.60 µg/m^3). The level of m/p-xylene at CIM_1 was detected at approximately three times (5.28 µg/m^3) the limit of detection of the method, while the o-xylene concentrations recorded were only marginally above the limit of detection (1.60 and 1.77 µg/m^3). The limits of detection of the analysis allow quantification of BTEX compounds at levels well below the international guidelines and national standards.

PAH were sampled using pumped diffusion samplers over a 2 h period. Although the compounds naphthalene, 2-methyl naphthalene, pyrene, biphenyl, phenanthrene and fluoranthene were detected by the sampling and analytical methods utilised, they were present at such low levels that they could not be quantified. Naphthalene, pyrene and fluoranthene were present at levels of less than 1.67 µg/m^3 from all samples and the remaining compounds were only detected from certain samples.

6.2.4.3 Particulates and Particulate-Borne Metals

Table 6.4 provides a summary of the data for particulates and particulate-borne metals. Concentrations of PM10 particulates were highly variable between samples, ranging from below the detection limit of 0.003 µg/m^3 to 2.878 µg/m^3. All concentrations were much lower than the most stringent of the air quality standards used which was the IFC air quality standard (1-year averaging period) of 20 µgm^{-3}.

Levels of the metals analysed were, except for cadmium from one sample, below the identified international standards. Mercury and nickel concentrations were undetected from all samples. Cadmium concentrations ranged from < 0.3 ngm^{-3} to 9.8 ngm^{-3}; one sample exceeded the EU air quality standard for cadmium, of 5 ngm^{-3}. Manganese concentrations ranged from 1.6 to 11.3 ngm^{-3} while lead levels ranged from <0.4 ngm^{-3} to 167.5 ngm^{-3}, not exceeding the EU air quality standard (1-year averaging period) of 0.5 µgm^{-3} (500 ngm^{-3}). As the maximum levels of both cadmium and lead occurred in the same sample may indicate a common source of contamination, potentially from the survey vessel.

Table 6.4: Concentrations of particulates and particulate-borne metals

Station	Sample	PM10 (µgm^{-3})	Metals (ngm^{-3})				
			Cd	Hg	Mn	Ni	Pb
CIM_1	AQ1A	2.317	<0.3	<0.4	2.9	<0.7	<0.4
	AQ1B	0.003	0.4	<0.4	11.3	<0.7	4.9
	AQ2	0.481	0.4	<0.4	2.0	<0.7	0.8
CIM_2	AQ1A	0.215	0.7	<0.4	2.1	<0.7	1.2
	AQ1B	0.440	<0.3	<0.4	4.8	<0.7	2.2
	AQ2	0.021	0.5	<0.4	11.0	<0.7	3.8
CIM_3	AQ1A	2.878	9.8[3]	<0.4	4.1	<0.7	167.5
	AQ1B	0.007	0.4	<0.4	1.6	<0.7	0.4
	AQ2	0.017	<0.3	<0.4	5.4	<0.7	1.6
Applicable air quality standard		20.0[1]	5.0[2]	1000.0[3]	150.0[3]	20.0[2]	500.0[2]

Notes: Applicable air quality standards: [1] IFC, [2] EU Air Quality Standards, [3] WHO (see section 6.2.2). [3] Concentration above the applicable air quality standard.

6.2.4.4 General Appraisal of Offshore Air Quality Baseline

The data described above is descriptive of a non-degraded airshed, with no relevant presence of any gaseous of particulate contaminant. This was to be expected, given the absence of any relevant anthropogenic emission sources in the offshore environment at the time of the OEBS. While yearly air quality monitoring is required for Coral South FLNG, the first year's data is not available at the time of this EIA. However, it is unlikely that Coral South FLNG has impacted the offshore air quality baseline, as the Coral South EIS (Consultec, 2015) assessed that atmospheric pollution from the Coral Sul FLNG would not be significant.

6.3 Greenhouse Gases

6.3.1 Data Source

This section describes the greenhouse gases (GHG) baseline emissions for Mozambique, against which impacts from the Coral North project will be assessed (see Volume II).

Emissions data for Mozambique have been extracted from the World Resources Institute's (WRI) Climate Watch database (WRI, 2023). The WRI Climate Watch database draws together GHG data from various governmental organisations including the United Nations Framework Convention on Climate Change (UNFCCC), Global Carbon Project (GCP) and USA State Inventory. As such the available data aligns with the reporting and verification cycles of these organisations and therefore the latest available dataset is from 2020.

The WRI Climate Watch databased groups emissions into five activity categories of land-use change and/or forestry; energy; agriculture; industrial process; and waste.

6.3.2 Mozambique GHG Emissions

A breakdown of Mozambique's GHG emissions is illustrated in Figure 6.3 and corresponding quantities given in Table 6.5 below (WRI Climate Watch database, 2019).

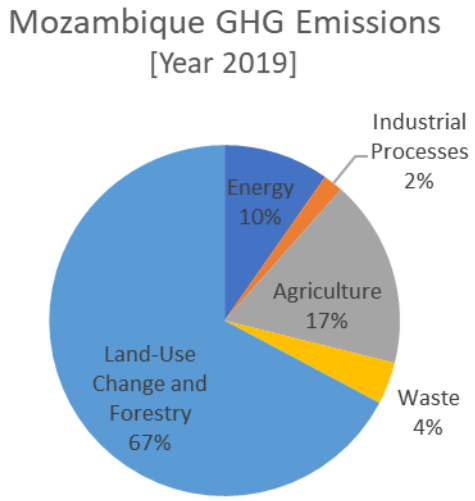


Figure 6.3: Mozambique GHG emissions breakdown by sector

Table 6.5: Mozambique GHG emissions (2019)

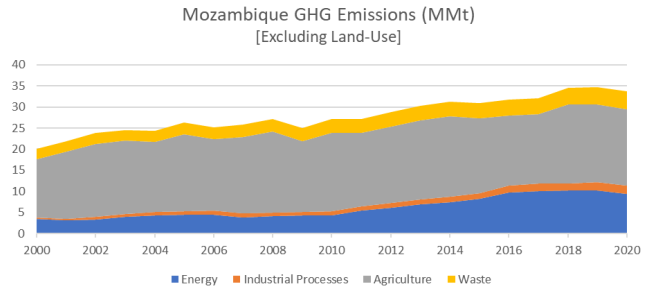
Sector	2019 GHG (Million tonnes)
Energy	10.3
Industrial Processes	1.95
Agriculture	18.37
Waste	4.11
Land-Use Change and Forestry	71.27
TOTAL	**106**

Although the latest dataset is from 2020, the 2019 data is anticipated to be more representative of typical sector contribution as 2020 includes the impact from the global pandemic which resulted in interruption across every industry.

The majority of Mozambique's emissions (circa 71 $MMtCO_{2e}$ or 67%) during 2019 originated from land-use change and forestry related activities, with agriculture the next highest at circa 18 $MMtTCO_{2e}$ or 17%. Energy related activities, which include LNG extraction and processing, accounted for circa 10% of the region's emissions (10 $MMtCO_{2e}$).

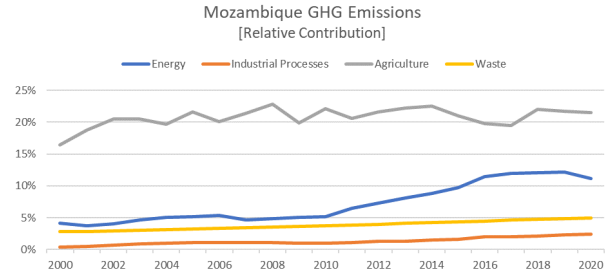
6.3.3 GHG Trend

Historically, Mozambique's GHG emissions have been on an upwards trend over the last two decades (Figure 6.4). This has been primarily driven by the increasing demand for energy (see Figure 6.6) resulting in increasing uptake of new energy projects and correspondingly increased GHG emissions from the sector. Across the period the GHG contribution from the energy sector has roughly trebled (4% to 12%) while the contribution from other sectors has remained relatively flat, as illustrated in Figure 6.5.



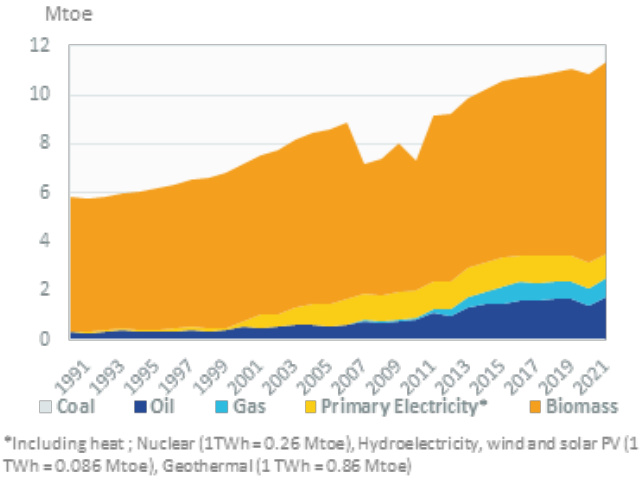
Source: WRI (2023).

Figure 6.4: Mozambique GHG emissions 2000-2020



Source: WRI (2023).

Figure 6.5: Relative sector GHG contribution per year



Source: Enerdata (2023).

Figure 6.6: Mozambique's energy consumption by type

There are some signs of decrease in 2020, however this is considered an artificial shift in trend brought on by the circumstances of the pandemic, which resulted in delays in many projects and/or developments. Therefore, it is not considered indicative of the future emission trends for the region.

Between 2016 to 2020 the emissions contribution from the energy sector was seen to plateau despite energy requirements continuing to rise. This is due to the country's gradual shift from oil dependence to cleaner forms of fuel (i.e., natural gas) and the increased uptake of renewable (i.e., hydro, wind, and solar) electricity generation.

Mozambique has development potential to unlock an abundance of renewable energy, therefore it is not inconceivable that the increase in uptake of greener initiatives will continue. The state's energy company, Electricidade de Moçambique, has set a target of 20% integration of renewable energy in the power grid by 2030 with several large-scale solar projects underway (Borgen Project, 2023). Most recently, Ncondezi Energy has secured the exclusive rights to develop a hybrid solar project which when operating will provide for 300 MW (EnergyCapitalPower, 2023).

It was not possible to locate an official projection of Mozambique's emissions across the Coral North life span (2028-2053). However, as a qualitative approximation, it is anticipated that the GHG

emissions will continue to rise as consequence of further development of the energy sector in response to Mozambique's commitments to enhance availability of energy across the country. The rate of future increase is uncertain and will depend on the rate of uptake of lower emitting solutions over the traditional energy supplies and any upcoming major development projects.

6.4 Atmospheric Noise

6.4.1 General Considerations

This section deals with the atmospheric noise baseline of the onshore areas where Project noise impacts could take place. As such, this section focus exclusively focuses exclusively on Pemba City, where relevant onshore project components, namely the ERB onshore base in Pemba, are located. The Project's offshore components are more than 50 km offshore, and thus too distant from land for any kind of noise impact to be reasonably expected on any onshore sensitive receptor. Atmospheric noise is thus not relevant for the offshore components. The underwater noise baseline is discussed in section 6.5.

6.4.2 Atmospheric Noise Standards and Guidelines

National environmental quality standards are established through Decree No. 18/2004, of 2 June (Regulation on Environmental Quality Standards and Effluent Emissions), as amended by Decree No. 67/2010, of 31 December, which determines the environmental standards and the limits to the emission of effluents, aiming to control and maintain acceptable concentrations of pollutants in the environment. This decree also states that ambient noise guidelines will be established by MAAP. However, to date, these specific guidelines regarding noise have yet to be published. In the absence of national regulation, the WHO and World Bank (WB) ambient noise guidelines are the reference and are therefore adopted as project standards.

WHO's recommended noise guidelines were determined considering noise's potentially negative effects on health and specific environments. Under WHO's noise policy, residential areas, schools, and hospitals are considered to be sensitive receptors and/or land uses. Table 6.6 lists WHO's ambient noise guidelines for such sensitive receptors:

Table 6.6: WHO ambient noise levels guidelines

Land use / Specific Environment	Guideline (L_{Aeq} in dB (A))	Reference Period	Effect on Health
Outdoor of residential areas (daytime)	55 dB(A)	15 hours (07h00 – 22h00)	Serious annoyance
Outdoor of residential areas (night-time)	45 dB(A)	9 hours (22h00 – 07h00)	Sleep disturbance

Source: Berglund et al. (1999).

In 1998, WB developed a pollution management program to ensure that WB financed projects in developing countries were environmentally sustainable (WBG, 1999), including noise. The results were then incorporated into IFC's guidelines, which state that noise impacts from a particular project

should not exceed the levels presented in Table 6.7 or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 6.7: WB and/or IFC noise level guidelines

Receptor	One Hour L_{Aeq} (dB(A))	
	Daytime (07:00 - 22:00)	Night-time (22:00 – 07:00)
Residential; institutional; educational	55 dB(A)	45 dB(A)
Industrial, commercial	70 dB(A)	70 dB(A)

Source: IFC (2007).

As can be seen from the table above, the WHO guidelines for outdoors of residential areas are the same as IFC's guidelines for residential, institutional, or educational receptors, for both the daytime and night-time periods.

6.4.3 Noise Emission Sources

Pemba has a markedly urban character, with an extensive road network, and is also subjected to the influence of several industrial sources. As such, multiple relevant noise sources are included in the Project's direct area of influence (considering the onshore base in Pemba). These can be roughly grouped into four types: road traffic, air traffic, industrial sources, and noise from other everyday human activities. The following paragraphs provide additional information regarding each of these categories of noise sources:

- Road traffic – the onshore base in Pemba is located in a highly urbanized and suburban area, with a well-developed road network, which includes the N1 main road, complemented with secondary and tertiary roads, which distribute traffic within urban areas (see Figure 6.7). Road traffic in the N1 fairway is one of the more relevant sources of noise emissions in the study area;
- Airport traffic – noise from airplane and helicopter movements leaving and arriving in Pemba airport is another significant source of intermittent noise in the onshore base area. This includes the current helicopter traffic for the Coral South Project. It is estimated that the transfer of onshore personnel and contractors and the rotation of offshore personnel for the Coral South FLNG requires 15 to 30 helicopter flights per week;
- Industrial sources – several construction yards and warehouses are located along the N1 road in the vicinity of the onshore base. Vehicle movements along this route are major noise contributors associated with these facilities;
- Human activities – mixed noise emissions from the nearby human settlements such as the noise caused by people talking, children playing, music, etc.

Figure 6.7: Major noise sources in the vicinity of ERB onshore base at Pemba

6.4.4 Sensitive Receptors

The identification of potential noise sensitive receptors areas was based on aerial photographic coverage of the project site and from local observations made during the field survey to ground-truth the desktop assessment. The sensitive receptors mainly include the residential areas located in the vicinity of the ERB warehouse location, as well as the social infrastructure in those settlements, such as schools, health units, and places of worship. Due to the proximity of some of these residential areas to the onshore base, these sensitive receptors may be potentially affected by the noise emissions generated by the project activities.

The definition of sensitive receptor in this study applies only to human receptors, as the noise guidelines against which the project impacts are assessed are defined based on the potential adverse effects of noise on human well-being and public health (as per WHO's Guidelines – Berglund *et al.*, 1998). The noise metrics used in noise impact assessment (dB(A)) are noise levels considering the specific sensitivity of the human hearing system across the frequency spectrum.

Figure 6.8 identifies the nearest sensitive receptors to the project site.

Figure 6.8: Noise sensitive receptors in the vicinity of the Project onshore base in Pemba

6.4.5 Atmospheric Noise Baseline

6.4.5.1 Methodology

The determination of the baseline ambient noise in the onshore project area of influence was based on *in situ* noise level measurements conducted during June 2023 in Pemba. Noise level measurements were recorded in six (6) locations (Figure 6.9), in areas considered to be sensitive to noise in order to:

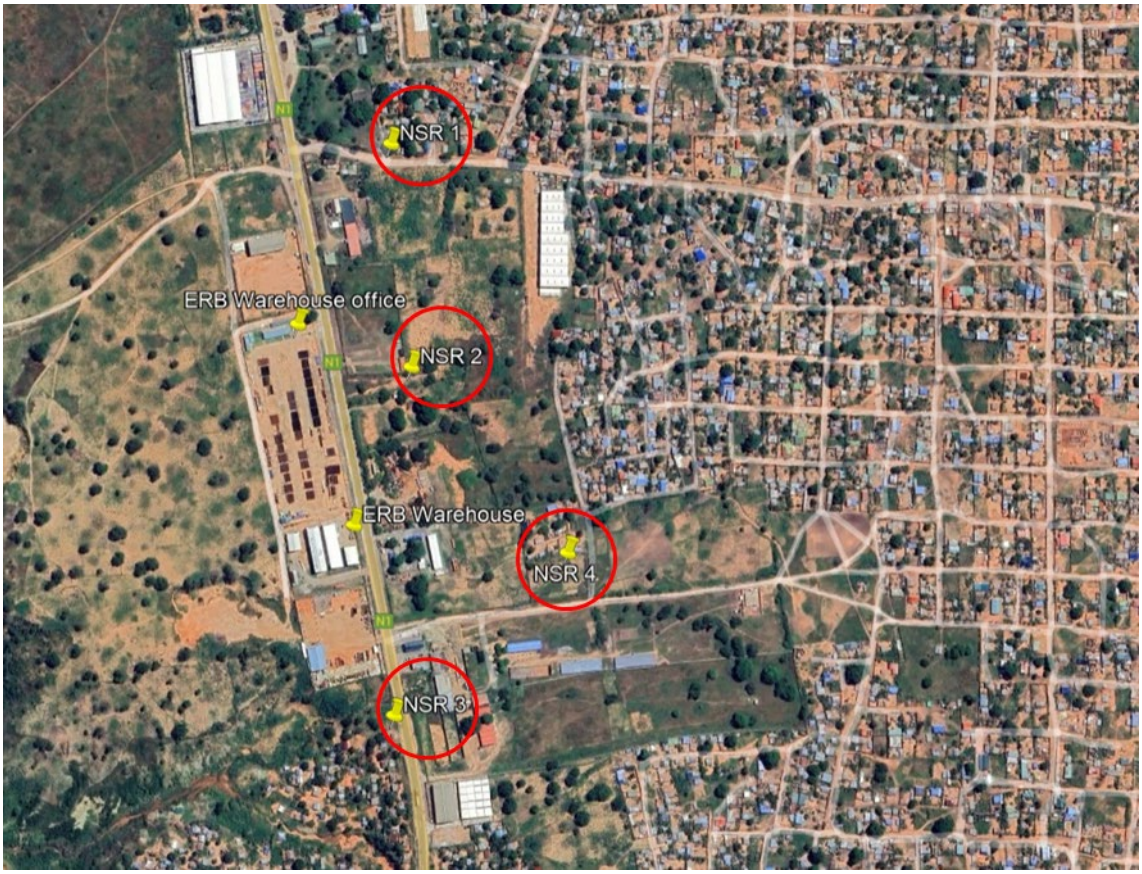
- Determine as rigorously as possible the existing ambient noise levels;
- Obtain a representative perspective of the acoustic environment in the areas that may be potentially affected by the noise emissions generated by the Project.

Noise monitoring locations were selected based on the proximity of the Project's potential noise emissions generated from the Pemba onshore based operations to sensitive receptors (essentially residential areas). These sensitive receptors were preliminarily identified through aerial photographic coverage and were then ground-truthed in the field. The selection of the monitoring locations was based on the following criteria:

- Locations considered to be representative of the current noise levels of the different residential areas surrounding the Project onshore base;
- Locations within dwellings in close proximity to the Project onshore base;
- Easy road access in current conditions;
- Safety and security conditions for undertaking the measurements.

The field survey included a photographic record of the monitoring locations and the measurement of noise level parameters, including the equivalent continuous noise level (LAeq), L_{max}, L_{min} and statistical parameters such as the L_{10} and L_{50} indicators. The background noise was also determined by the use of the L_{90} indicator. The noise sampling procedures followed the recommendations of international standards for noise measurement, namely ISO EN 1996-1:2017 and ISO EN 1996-2: 2018. During the monitoring periods, any external factors that could in any way influence the recorded noise levels were noted and recorded.

Figure 6.9 and Table 6.8 provides information regarding the noise monitoring locations, measured noise indicators, the monitoring equipment, and the duration of the samples.



Legend: NSR – Noise sensitive receptor.

Figure 6.9: Noise monitoring locations

Table 6.8: Noise monitoring: location, parameters, equipment, and sampling duration

Sampling Point	Coordinates (WGS84)	Parameters	Equipment	Sample Duration
NSR1 (residential area)	13° 0'17.54"S 40°31'57.35"E	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs
NSR2 (residential area)	13° 0'27.68"S 40°31'58.51"E	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs
NSR3 (residential area; main road N1)	13° 0'43.40"S 40°31'58.01"E	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs
NSR4 (residential area)	13° 0'35.96"S 40°32'5.86"E	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs
Office Building	13° 0'25.81"S 40°31'53.28"E	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs
Warehouse building	13° 0'34.36"S	LAeq dB(A) Lmin, Lmax, Octave Spectrum	digital integrating D112d CSDVA sonometer	3 independent 10-minutes runs

Legend: NSR – Noise sensitive receptor.

6.4.5.2 Results

Daytime Noise Levels

Table 6.9 presents the recorded daytime ambient noise levels for the six (6) monitoring locations.

Table 6.9: Recorded daytime ambient noise levels

Measurement Point	Coordinates (WGS84)	Daytime Ambient Noise Levels (07h-22h)					
		LAeq dB(A)	Lmin dB(A)	Lmax dB(A)	L10 dB(A)	L50 dB(A)	L90 dB(A)
NSR1	13° 0'17.54"S 40°31'57.35"E	**66.3**	50.6	88.3	75.5	56.3	66.4
NSR2	13° 0'27.68"S 40°31'58.51"E	**49.7**	46.5	74.6	53.5	46.2	49.2
NSR3	13° 0'43.40"S 40°31'58.01"E	**70.1**	51.0	89.4	79.0	60.7	70.4
NSR4	13° 0'35.96"S 40°32'5.86"E	**62.3**	45.1	86.8	73.7	51.4	62.3
Office Building	13° 0'25.81"S 40°31'53.28"E	**65.8**	49.9	89.1	76.4	56.7	64.9
Warehouse building	13° 0'34.36"S 40°31'55.98"E	**65.0**	57.7	86.2	72.3	59.5	64.3

Legend: NSR – Noise sensitive receptor.

The noise levels measured during the daytime period indicate that the baseline acoustic environment already has a relevant degree of disturbance in all the monitored locations, with the exception of NSR2 (residential area). Exceedances to the daytime applicable guideline value for residential areas (i.e., 55 dB(A)) are noted, although current levels are still below the noise guideline for industrial areas (70 dB(A)).

The recorded high noise levels were mostly due to noise emissions from road traffic in N1, which is close to the assessed sampling locations. Helicopter and airplane movements in Pemba Airport also strongly contributed to the noise levels recorded at five out of six locations (NSR1, NSR3, NSR4, ERB Office Building, and Warehouse).

All monitoring sites, except the ERB Office Building and the Warehouse, are in the vicinity of well-established residential areas, and thus are considered to be residential sensitive receptors, subject to road and airport traffic. The recorded ambient noise levels ranged between a minimum of 49.7 dB(A)@NSR2 and 70.1 dB(A)@NSR3 with some locations experiencing levels above the 55 dB(A) daytime guideline for residential areas.

Night-time Noise Levels

Table 6.10 presents the recorded night-time ambient noise levels for the six (6) sampled locations.

Table 6.10: Recorded night-time noise levels

Measurement Point	Coordinates (WGS84)	Night-time Ambient Noise Levels (22h-07h)					
		LAeq dB(A)	Lmin dB(A)	Lmax dB(A)	L10 dB(A)	L50 dB(A)	L90 dB(A)
NSR1	13° 0'17.54"S 40°31'57.35"E	**50.3**	39.5	78.4	62.5	41.9	48.0
NSR2	13° 0'27.68"S 40°31'58.51"E	**44.7**	38.4	57.3	49.9	40.7	44.1
NSR3	13° 0'43.40"S 40°31'58.01"E	**42.8**	37.5	76.3	52.0	38.1	40.4
NSR4	13° 0'35.96"S 40°32'5.86"E	**57.6**	40.7	80.8	69.2	46.0	57.7
Office Building	13° 0'25.81"S 40°31'53.28"E	**55.9**	38.8	76.3	64.6	46.2	55.8
Warehouse building	13° 0'34.36"S 40°31'55.98"E	**43.2**	35.2	69.6	53.7	36.7	41.2

Legend: NSR – Noise sensitive receptor.

The noise levels measured during the night-time period revealed that the baseline acoustic environment also has some degree of acoustic disturbance. Exceedance of the night-time applicable noise guideline (i.e., 45 dB(A)) was verified in NSR1, NSR4 and at the Office Building locations.

The recorded exceedances to the guideline were mostly due to noise emissions from road traffic and from human activities occurring near residential areas (e.g., music playing) and due to nocturnal wildlife, especially insect noise.

The recorded ambient noise levels ranged between a minimum of 42.8 dB(A) at NSR3 and a maximum of 57.6 dB(A) at NSR4, thus some exceedances of the 45 dB(A) night-time guideline were noted.

Findings

Generally, the acoustic environment of the Project area of influence from the onshore operations can be described as presenting some degree of acoustical disturbance, typical of peri-urban areas that are mainly influenced by both road and air traffic, particularly during the daytime period. Exceedances of the WHO and IFC recommended daytime noise guidelines for residential areas (55 dB(A)) were found in five out of six monitoring locations; however, all the results remained lower than the guideline for industrial areas (70 dB(A)). The night-time guideline (45 dB(A)) was exceeded in three of the six monitoring locations. The results of this survey are consistent with the inventory of the current noise sources provided in Section 6.4.3.

6.5 Underwater Noise

Background noise or oceanic ambient noise is considered to be a composite of a number of overlapping components (Wenz, 1962):

- Very low frequencies (1 Hz to 100 Hz) the dominant source is due to earthquake noise from distant activity and from turbulent pressure fluctuations caused by large-scale movements of bodies of water;
- Low frequencies (10 Hz to 1 kHz) vessel noise is dominant;
- Mid-range frequencies (50 Hz to 20 kHz) weather-related noise as prevails while biological activity such as animal vocalisations are also present;
- High frequencies (>20 kHz), thermal noise becomes apparent.

In deep water regions which are generally remote from centres of population, the overarching characteristic of the noise field is that it is isotropic and homogenous, with more or less the same noise level and frequency content regardless of the direction in which the observer is listening. To clarify, vessel noise, for instance, may be heard although it is not significantly louder in one direction than another. In shallow water coastal regions by contrast, background noise levels are very variable being dependent on shipping activity and marine industrial activity as well as wind speed and rainfall (see *e.g.*, Urick, 1983). Shipping activity in particular is denoted by clearly marked shipping lanes inside which noise levels are significantly louder than at locations outside (Neenan *et al.*, 2016; Jalkanan *et al.*, 2018).

In deep water locations, typical noise levels are expected to lie in the range 90-110 dB re 1 μPa over a 1 Hz frequency band.

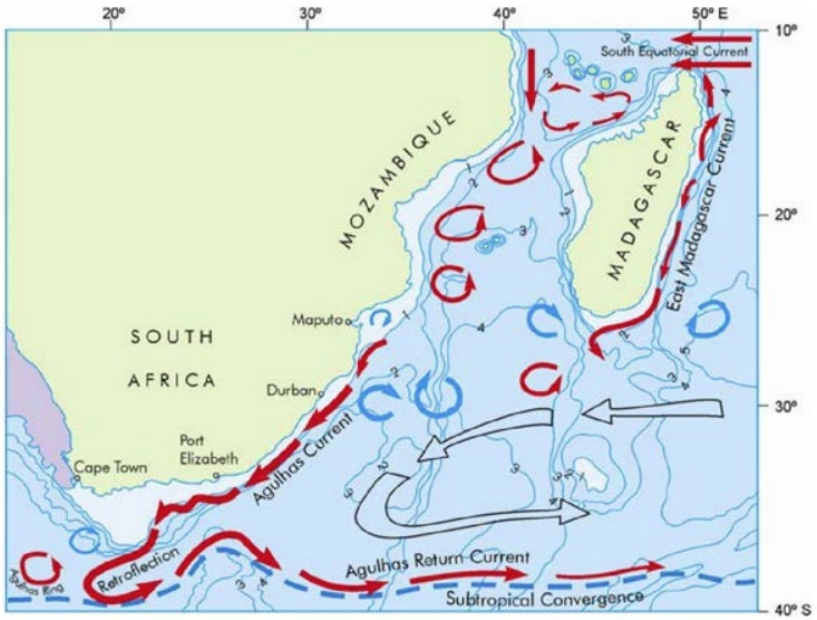
Ambient underwater noise for the offshore Area 4 waters data is available from monitoring surveys conducted in 2016 and 2022. An OEBS was undertaken by MRV in Area 4, from December 2015 to March 2016, as reported in ERM (2016), which included underwater background noise measurements. Analysis of the data indicated that mean spectral noise levels were somewhat lower, lying in the range 55-60 dB re 1 μPa/Hz despite short term (<2 minute) incursions of 70 dB re 1 μPa/Hz. Measured over a frequency range of 10 kHz, this corresponds to noise levels in the range 100-110 dB_{rms} re 1 μPa.

A further background noise survey was undertaken in the Coral South Project Area during a 3-day period in September 2022 (Consultec & Wavec, 2022). Noise levels were found to vary over the range 117.2 to 129.5 dB_{rms} re 1 μPa. This is 7-19 dB higher than the maximum levels recorded during the earlier OEBS. The OEBS was conducted over a 4-month period while the 2022 survey was carried out over a maximum of three days. In the latter case, a 3-day survey period can give only a snapshot of the noise levels likely to arise over a significantly longer period that considers variability in traffic levels and prevailing weather conditions. A longer survey period during the 2022 survey (comparable to the OEBS survey duration) might have given rise to a lower mean background noise level.

6.6 Oceanography

6.6.1 Regional Oceanography and Tides

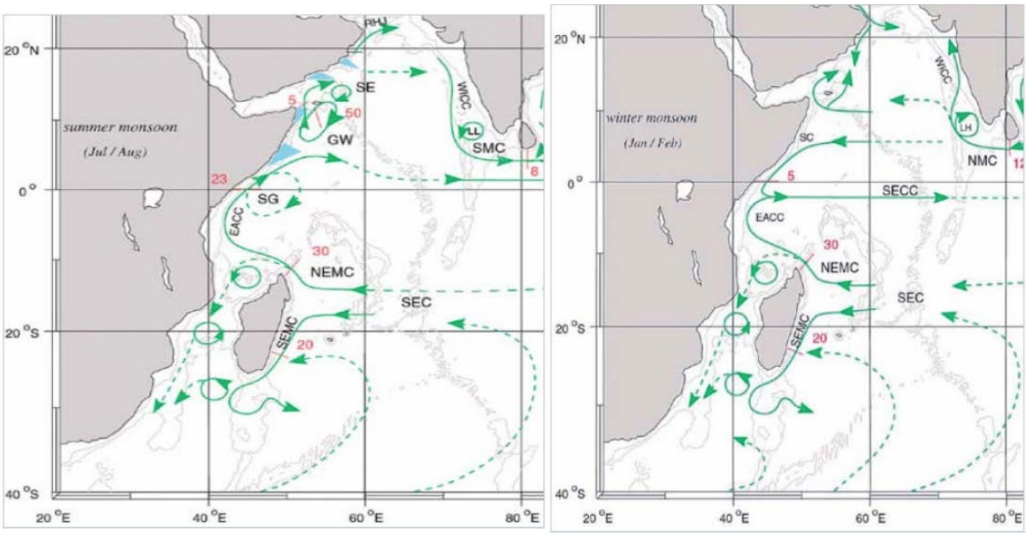
The South Equatorial Current flows continuously westward across the Indian Ocean throughout the year. As the current reaches Madagascar, it splits into north bound and south bound currents. As the north bound current reaches the northern end of Madagascar it further splits, with a southward current flowing past Mozambique via a series of counterclockwise eddies of around 300 km diameter, extending through the water column (De Ruijter *et al*., 2002). The northbound East African Coast Current is between 148-185 km wide and joins the coast slightly north of Cabo Delgado (close to the latitude of the FLNG facility) and flows past Tanzania and Kenya. The Mozambique Channel is characterized by complex and variable surface and sub-surface circulations (Figure 6.10). These are dominated by mesoscale activity, related to the large-scale Indian Ocean circulations. The narrower channels, between the northern and central basins, generally experience eddies that migrate southward (Figure 6.10).



Source: Ansorge & Lutjeharms (2007).

Figure 6.10: Mozambique Channel and Agulhas current system

Eddies forming near Madagascar's southern tip sometimes enter the channel in a northly direction. The prominent surface currents during both monsoon seasons are illustrated in Figure 6.11.

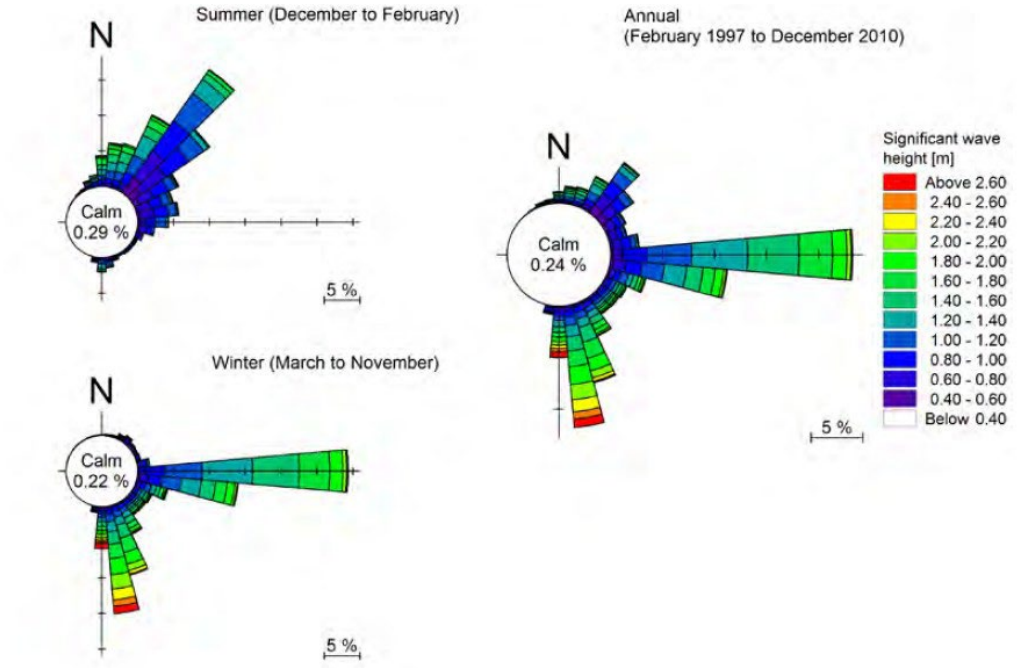


Source: Schott & McCreary (2001).

Figure 6.11: Schematic representation of currents in the Western Indian Ocean during (left) the Summer Southwest Monsoon, and (right) the Winter Northeast Monsoon

Mozambique experiences semi-diurnal tides along its entire coastline, however, the tidal range varies substantially with differences between 2 and 6.5 m. The tidal range at Pemba is 4.0 m at mean high spring tide and 2.8 m at mean high neap tide.

The Area 4 site has a distinct pattern in wave seasonality, with the predominant swell coming from the northeast from December to February, and from the south and the east from March to November (the largest significant wave heights are from the south) (Consultec, 2015) (Figure 6.12).



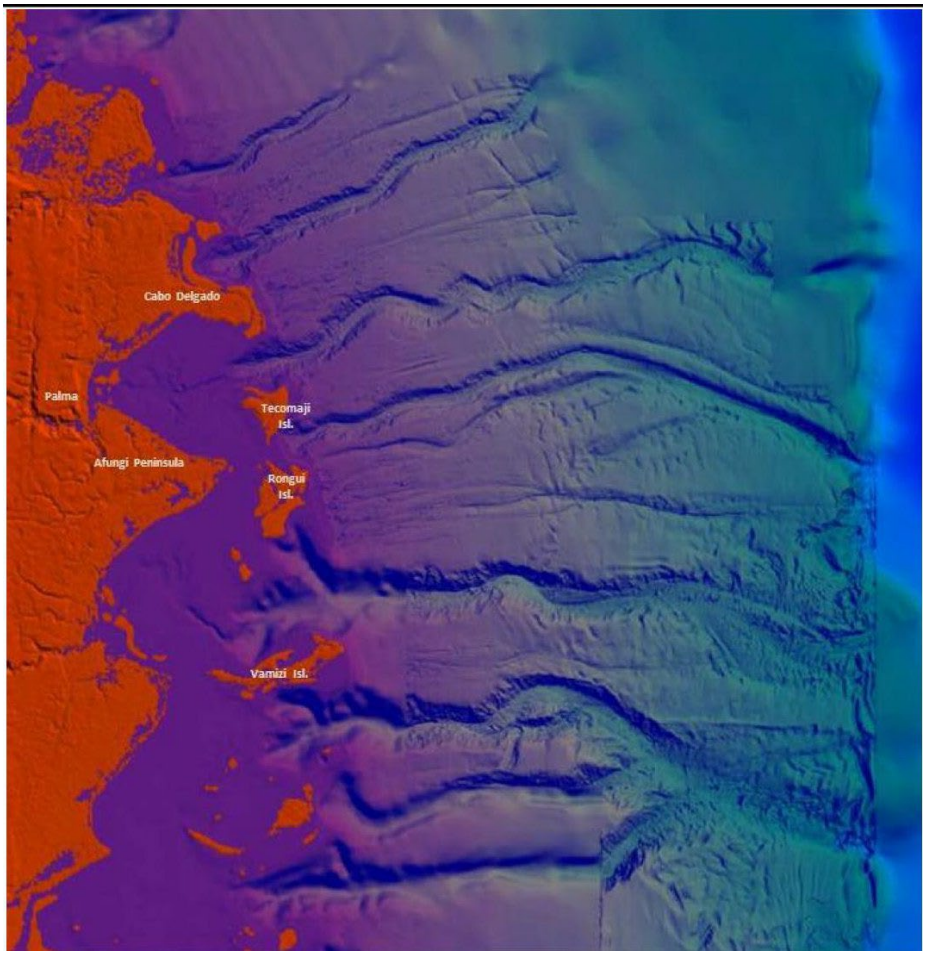
Source: Consultec (2015).

Figure 6.12: Wave climate in Area 4 (11°S, 41.25°E), for the period 1997–2010

Swell is generated by both tropical storms and cyclones, as well as the south-easterly Trade Wind, the generally westerly winds of the Roaring Forties and, to a lesser degree in equatorial waters, the north-eastern Monsoon of the northern hemisphere and its extension into the southern hemisphere, the north-western Monsoon (ERM, 2019). Wave height averages 1-2 m but very occasionally reaches 3-4 m (ERM, 2019).

6.6.2 Local Oceanography

The bathymetry of the Mozambique coastline adjacent to Area 4 drops to 2,000 m depth within 40 km of the shore, with a two-tiered narrow continental shelf along the Palma coastline (2-10 km wide), incised with submarine canyons that run from east to west (Figure 6.13). Detailed bathymetry is presented in Figure 6.14, showing a bathymetry of 1,770 m to 2,300 m depth.



Source: EEA (2013) in Impacto & ERM (2013).

Figure 6.13: Bathymetry within the study area

The Mozambique coast near Area 4 is characterized by clusters of islands surrounded by coral reefs. Notably the Saint Lazarus Banks are situated close to the Area 4 boundary, rising from ~1 000 m below the water surface to a large plateau between 30 and 100 m below the surface. Shallow reefs form along the top of the first tier of the continental shelf (shallows to 30-40m below the surface) and are present along the northern coastal region.

Current measurements for Area 4 were carried out as part of the metocean study developed by ERB (formerly Eni East Africa) in 2013/2014 (Eni Exploration & Production, 2014). The current rose for a station located close to Area 4 at 6 m below the surface is shown in Figure 6.15. At the sea surface, the dominant direction is 210–240°N (ERM, 2014, 2019). In the metocean study, monthly average currents varied between 0.61 m/s in May 2013, and 0.19 m/s in October 2013 (Eni Exploration & Production, 2014; ERM, 2014).

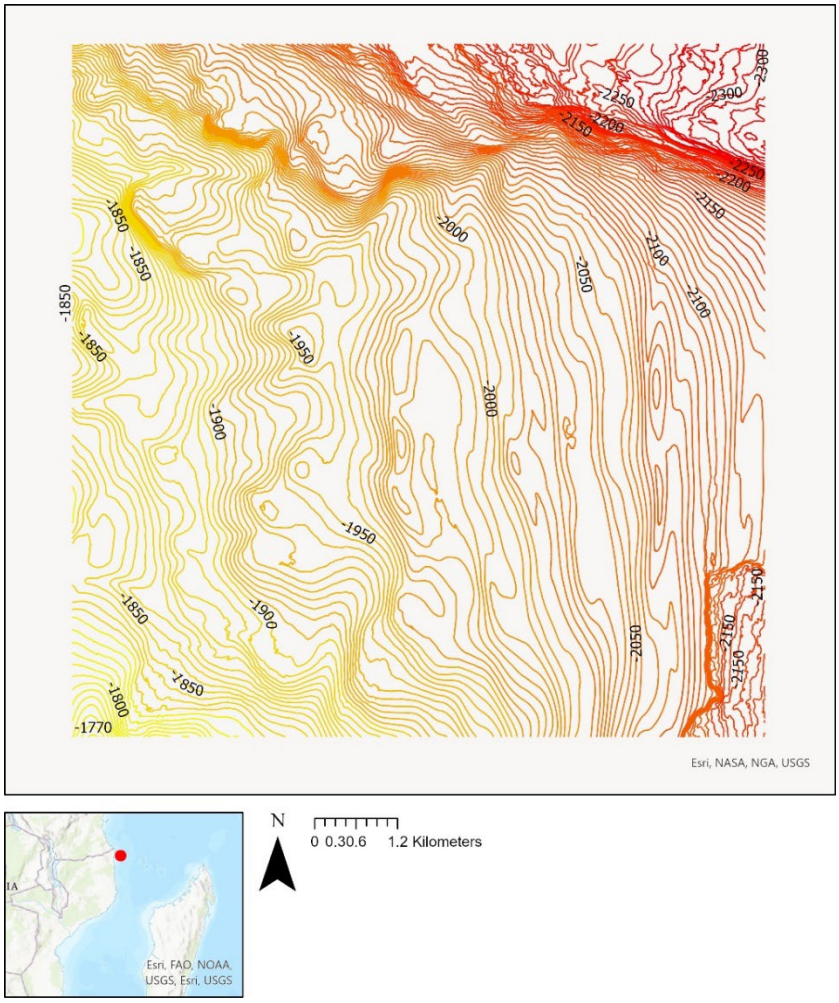
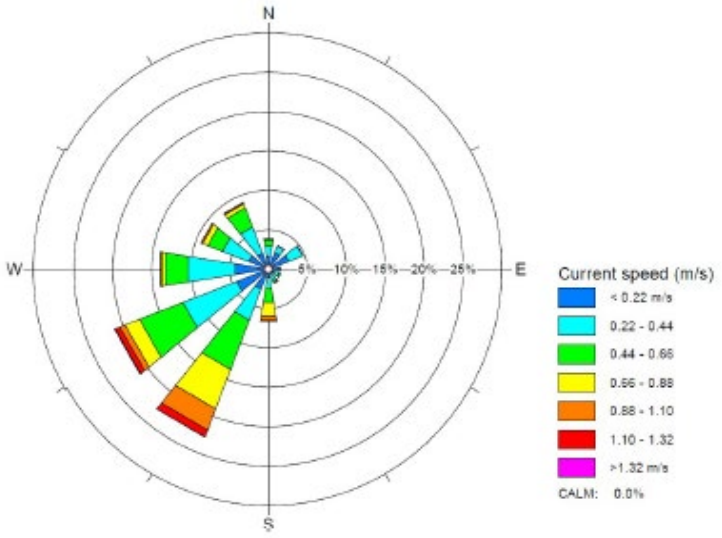


Figure 6.14: Detailed bathymetry in project area



Source: ERM (2014).

Figure 6.15: Current rose for Area 4 at 6 m below the sea

6.7 Water Quality

6.7.1 Seawater Ambient Quality Standards

Ambient marine water quality standards in Mozambique are established through Decree No. 18/2004, of 2 June (Regulation on Environmental Quality Standards and Effluent Emissions), as amended by Decree No. 67/2010, of 31 December, and are listed in Table 6.11.

Table 6.11: Ambient seawater quality standards

Parameter	National Regulation(1)
Floating Material	Virtually absent*
Oil and grease	Virtually absent*
Substances that produce colour, odour, and turbidity	Virtually absent*
Artificial dyes	Virtually absent*
Substances which form undesirable deposits	Virtually absent*
Substances and conditions that favour unwanted aquatic life forms	Virtually absent*
BOD/5 days, 20ºC	≤ 5 mg/l
Dissolved Oxygen	≤ 6 mg/l
pH	6.5-8.5 No changes greater than 0.2
Aluminium	1.5 mg/l
Ammonium	5.0 mg/l
Antimony	0.2 mg/l
Total Arsenic	0.5 mg/l
Barium	5.0 mg/l
Beryllium	1.5 mg/l
Boron	5.0 mg/l
Total Cadmium	0.2 mg/l
Lead	0.5 mg/l
Cyanide	0.2 mg/l
Residual chlorine	0.01 mg/l
Copper	1.0 mg/l
Total Chromium	0.05 mg/l
Tin	4.0 mg/l
Phenols	0.5 mg/l
Soluble Iron	0.3 mg/l
Fluorides	10 mg/l
Manganese	0.1 mg/l
Mercury	0.01 mg/l
Nickel	0.1 mg/l
Nitrates	10 mg/l

Parameter	National Regulation(1)
Nitrites	1.0 mg/l
Silver	0.005 mg/l
Selenium	0.05 mg/l
Surfactants that react to the Methylene Blue	0.5 mg/l
Sulphide, such as H_2S	1.0 mg/l
Thallium	0.1 mg/l
Uranium	0.5 mg/l
Zinc	5.0 mg/l

Source: (1) Annex V, Decree No. 18/2004 (as amended by Decree No. 67/2010). Note: * The term "virtually absent" means that in a visual inspection, no alterations or presence of any substance or objects that alter the quality of receiving environment should be observed or noted.

6.7.2 Offshore Water Quality Baseline

Temperature and salinity were measured through conductivity-temperature-depth (CTD) profiler casts during the 2013/2014 metocean study (ERM, 2014, 2019). CTD profiling data showed a marine environment considered typical for this offshore region of the Western Indian Ocean, with a thermocline at approximately 70 m depth corresponding with a deep chlorophyll maximum and the associated reduction in dissolved oxygen.

The monthly statistics for temperature are given in Table 6.12. The highest monthly average surface temperature was 29.86°C in May 2013 and the lowest was 25.25 °C in August 2013 (Eni Exploration & Production, 2014; ERM, 2019).

Table 6.12: Mean temperature (°C) across water depth per month

Month	Water depth (m)										
	Surface	10	20	50	100	200	400	800	1200	1600	Seabed
1	28.67	28.35*	28.27*	27.35*	24.86*	16.44*	11.6	7.16	4.99	3.45	2.88
2	29.09	28.65*	28.53*	27.77*	22.86*	16.13*	11.62	7.48	5.27	3.72	3.02
3	29.86	28.91*	28.78*	26.62*	21.67*	15.95*	11.12*	7.11	5.79*	-	3.04
4	29.02	28.68*	28.64*	25.48*	20.61*	16.50*	10.90*	7.07	-	-	2.98
5	27.79	27.42*	27.38*	27.16*	23.07*	16.25*	10.36*	7.26	5.13	3.37	2.78
6	26.46	26.63*	26.59*	26.46*	23.45*	15.65*	10.60*	7.41	5.35	3.33	2.91
7	25.66	-	-	-	-	-	-	7.46	5.32	3.49	2.97
8	25.25	25.06*	25.04*	24.90*	24.22*	16.75*	10.82	6.98	5.1	3.6	3.06
9	25.55	25.88*	25.78*	25.15*	23.95*	14.70*	11.1	7.45	5.29	3.46	3.08
10	26.72	25.92*	25.81*	25.37*	24.21*	17.93*	11.62	7.42	5.32	3.6	3.04
11	27.99	27.74*	27.69*	27.34*	22.84*	16.07*	11.24	7.33	5.33	3.59	3.07
12	29.23	28.36*	28.23*	26.37*	22.72*	15.55*	11.38	7.32	5.52	3.62	3.03

Source: ERM (2014, 2019). Note: * - Data extracted from National Oceanic and Atmospheric Administration (NOAA) databases.

More recent water quality monitoring surveys conducted in 2022 and 2023 for Area 4 (Consultec & CLS, 2022; 2023a; 2023b) showed similar temperature ranges. In the 2022 survey, surface

temperatures in June varied between 26.3ºC and 26.6ºC. In the 2023 surveys, surface temperatures in March varied between 28.99˚C and 30.83ºC, and from 26.35ºC to 28.83˚C in May to July.

The monthly statistics for salinity are given in Table 6.13. The highest monthly average surface salinity was 35.36 PSU in December 2013 and the lowest was 34.83 PSU in April 2013 (Eni Exploration & Production, 2014; ERM, 2019).

Table 6.13: Mean salinity (PSU) across water depth per month

Month	Water depth (m)										
	Surface	10	20	50	100	200	400	800	1200	1600	Seabed
1	35.32	35.07*	35.05*	35.06*	35.01*	35.24*	35.01	34.85	34.84	34.93	34.79
2	35.25	34.99*	34.97*	35.05*	35.14*	35.28*	35.01	34.82	34.84	34.93	34.8
3	34.86	34.68*	34.83*	35.02*	35.14*	35.30*	34.99*	34.83	34.90*	-	34.75
4	34.83	-	-	-	-	-	-	34.75	-	-	34.75
5	34.91	-	-	-	-	-	-	34.76	34.88	34.89	34.78
6	35.02	-	-	-	-	-	-	34.88	34.89	34.89	34.79
7	35.09	-	-	-	-	-	-	34.89	34.89	34.89	34.79
8	35.05	35.18*	35.18*	35.18*	35.19*	35.30*	34.92	34.81	34.94	34.82	34.82
9	35.15	35.10*	35.07*	35.04*	35.12*	35.23*	34.95	34.84	34.96	34.81	34.82
10	35.15	35.08*	35.08*	35.08*	35.23*	35.34*	35.01	34.83	34.9	34.88	34.8
11	35.35	-	-	-	-	-	34.97	34.86	34.89	34.9	34.79
12	35.36	35.14*	35.14*	35.07*	35.08*	35.18*	34.99	34.82	34.87	34.93	34.8

Source: ERM (2014, 2019). Note: * - Data extracted from NOAA databases.

Similar ranges of salinity were found in the 2022 and 2023 monitoring surveys (Consultec & CLS, 2022; 2023a; 2023b). In the 2022 survey, salinity varied between 34.8 PSU and 35.4 PSU, while in the 2023 surveys, salinity varied between 34.73 and 35.01 PSU.

In 2016, an OEBS for Area 4 was conducted which involved both physical and chemical water sampling operations (Consultec, 2015; ERM, 2019). Results of the survey showed low BOD levels, below the detection limit (4 mg/L) for all samples. Turbidity measurements were also low, ranging between 0.90 Formazin Turbidity Units (FTU) and 1.69 FTU, with an average of 0.90 FTU. Turbidity levels measured in both the 2022 and 2023 monitoring surveys were even lower, ranging from 0.1 to 0.4 NTU (2022) and 0.04 and 0.64 NTU (2023). These levels of turbidity are typical of a low productivity offshore environment, with little or no allochthonous suspended particles.

Total hydrocarbon concentrations in Area 4 in the 2016 survey ranged from 7.8 to 41.5 µg/L with an average value of 17.4 µg/L. Total polycyclic aromatic hydrocarbons (PAH) in the area ranged from 118 to 272 ng/L with an average concentration of 153 ng/L, consisting mostly of pyrogenic compounds, which is typical of pristine environments with minimal petrogenic hydrocarbon inputs. In the 2022 and 2023 surveys, total PAH concentrations were always below the detection limit – 173 ng/l. The same is true for all individual PAH analytes that were sampled.

The metals analysis from the 2016 survey showed that the presence of heavy metals in the offshore waters is residual with most heavy and trace metals below the detection levels or with very low

concentrations. The results from both the 2022 and 2023 surveys corroborate this with almost all metals being below the detection limit.

Further to the analytes discussed above, the 2022 and 2023 surveys also monitored other constituents including nitrogen species (total nitrogen, nitrates, and nitrites) and phenol. In these surveys, total nitrogen ranged from <0.5 mg/l to 1.6 mg/l, nitrate and nitrite were always below the detection limit, ammoniacal nitrogen ranged from 0.05 mg/l to 0.77 mg/l, and phenol concentrations were always below the detection limit (0.15 mg/l).

In general, all water quality data available for Area 4 are as expected for a well-mixed offshore area with relatively little anthropogenic impact. Most relevant pollutants are below the detection level or present in very low concentrations in compliance with national water quality standards and relevant international guidelines.

6.8 Landscape and Seascape

6.8.1 Area of Influence

The AoI for the landscape baseline assessment was defined based on the main large-scale elements of the proposed Project, including the FLNG vessel. The AoI has been defined taking into consideration the maximum distance at which the FLNG could theoretically be visible. The FLNG vessel, and in particular its flare, is the major visual element of the proposed development. Table 6.14 presents the maximum length of the line of sight for the FLNG vessel range, taking into consideration the design height of the deck, the flare stack, and the top of flare, considering the highest flare possible (i.e., during commissioning and start-up). This Zone of Theoretical Visibility (ZTV) has been determined through computer analysis of topographical mapping to establish the theoretical distance from which the FLNG could be visible in each direction.

Table 6.14: Line of sight (observer height 1.5m)

FLNG height	Distance
146 m deck height	55 km
202 m flare stack height	64 km
262 m top of flare height	72 km

The current visibility within the ZTV will vary depending on the presence of intervening local topography and other features, such as vegetation and buildings. The present view shed analysis has been based solely on topography and did not consider the potential screening granted by the local vegetation patches, which would further reduce the actual view shed. Moreover, it should be highlighted that a typical view shed assessment does not take typical meteorological conditions into account that can result in changes to real visibility. For example, rainfall and other atmospheric conditions will alter the visibility of the Project. The diminution of visual clarity bought about by atmospheric conditions also increases with distance, and cloudy days can result in a natural attenuation of the visibility of the Project.

Figure 6.16 shows the ZTV of the theoretical range of visibility that have been calculated with a GIS based analysis for the flare.

The ZTV shows that from the islands and from the settlements of Maganja and Lalane, it is theoretically possible to see the FLNG, although the FLNG is located more than 40 km from the islands of the Quirimbas archipelago and is approximately 65 km from Maganja and Lalane.

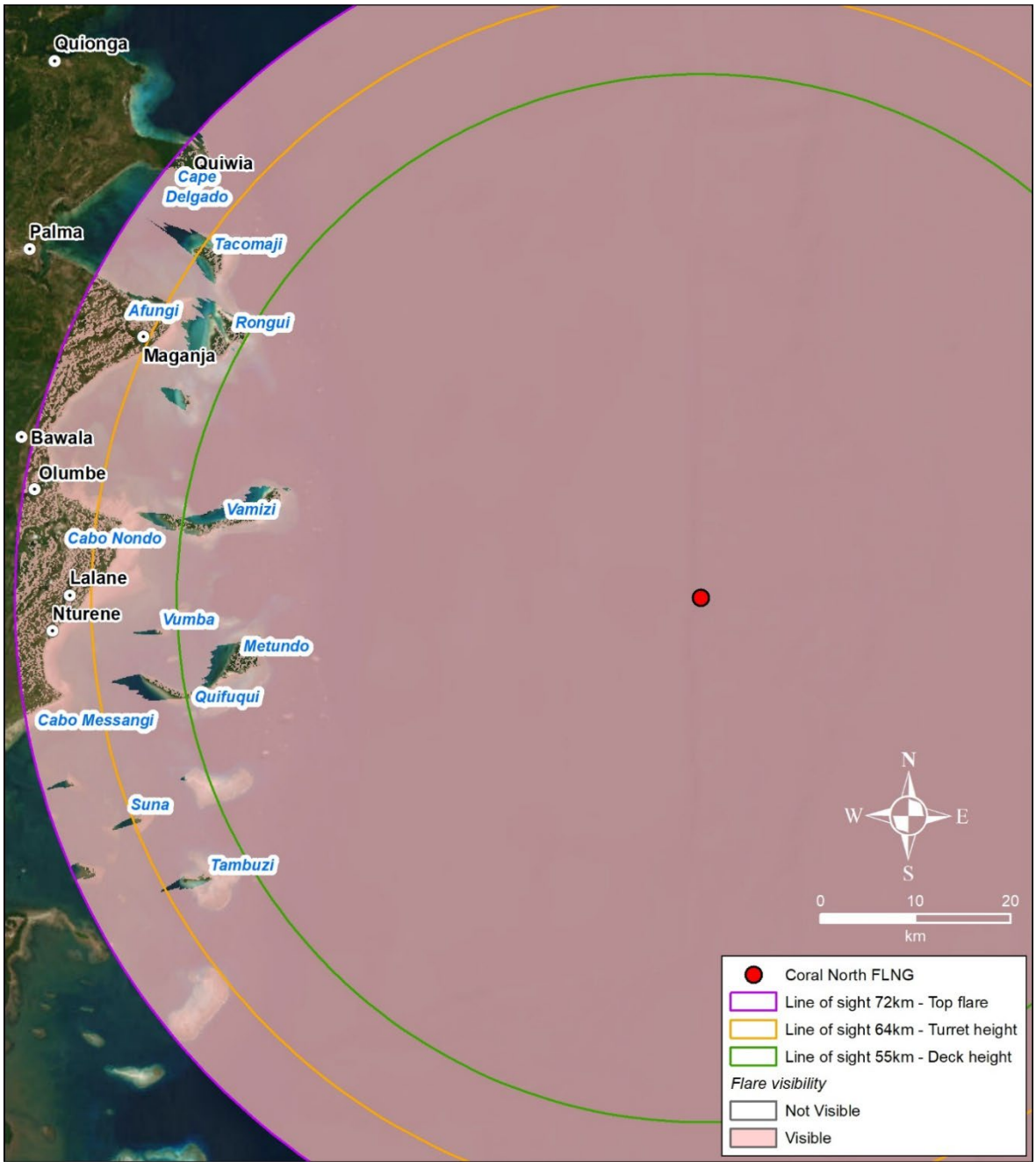


Figure 6.16: Zones of Theoretical Visibility (ZTV)

Given the above, the AoI for the landscape baseline assessment was defined as a radius of ~70 km from the FLNG (see Figure 6.17).

This AoI includes some coastal areas of Palma District, more specifically the Afungi peninsula and part of the Olumbe administrative post, as well as several of the coastal islands of the Quirimbas Archipelago, including Tecomaji, Rongui, Vamizi, Vumba, Metundo, Quifuqui, Suna, and Tambuzi.

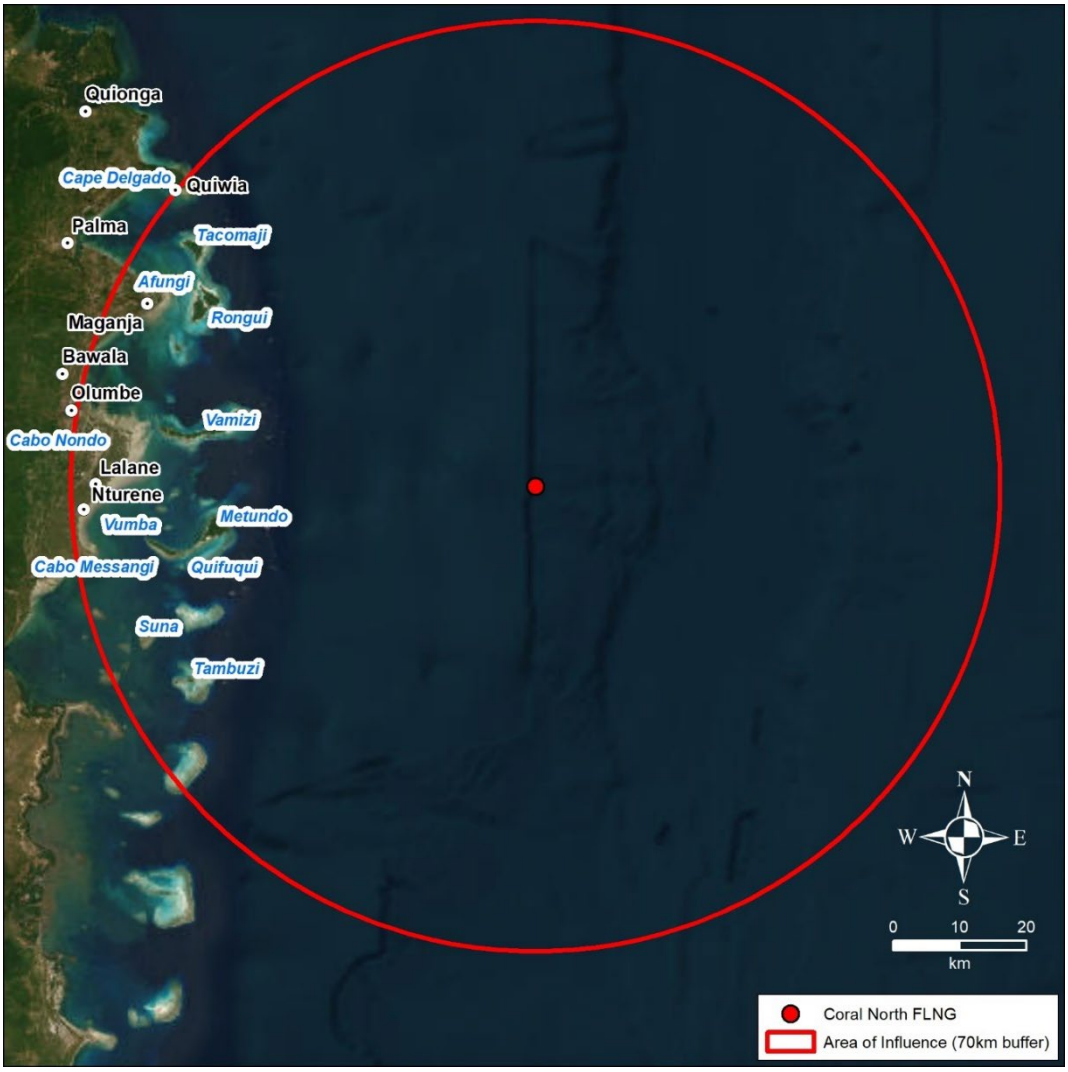


Figure 6.17: Landscape area of influence

6.8.2 Seascape Baseline

6.8.2.1 Seascape Units

This section provides a baseline for the landscape features within the AoI, as defined in the previous section. The local environmental setting was determined through desktop analysis to gain a general understanding of the site visual context and landscape setting. Due to the security situation in Palma District, it was not possible to visit the AoI to capture images of the landscape and seascape.

The AoI extends from the peninsula of Cabo Delgado in the north, approximately 32 km from the Tanzanian border, southwards to include the marine area of the Palma Bay and further south to Cabo Nondo and the northern island of the Quirimbas Archipelago. The AoI includes different areas of

wooded landscapes and forests located inland of the coastal zone. Some settlements and small villages are included in the AoI, mainly in the coastal area of the bays defined by the prominent headlands and peninsulas overlooking the Indian Ocean. The AoI also includes several of the northern islands of the Quirimbas Archipelago (i.e., Tecomaji, Rongui, Vamizi, Vumba, Metundo); these several islands are an important part of the overall seascape in the AoI.

Three seascape character units[8] have been identified within the AoI:

- Peninsulas of Cabo Delgado and of Afungi Seascape Unit;
- Afungi Peninsula to Cabo Messangi Seascape Unit; and
- Quirimbas Archipelago Seascape Unit.

These are illustrated in the following Figure 6.18 and described in the sections that follow.

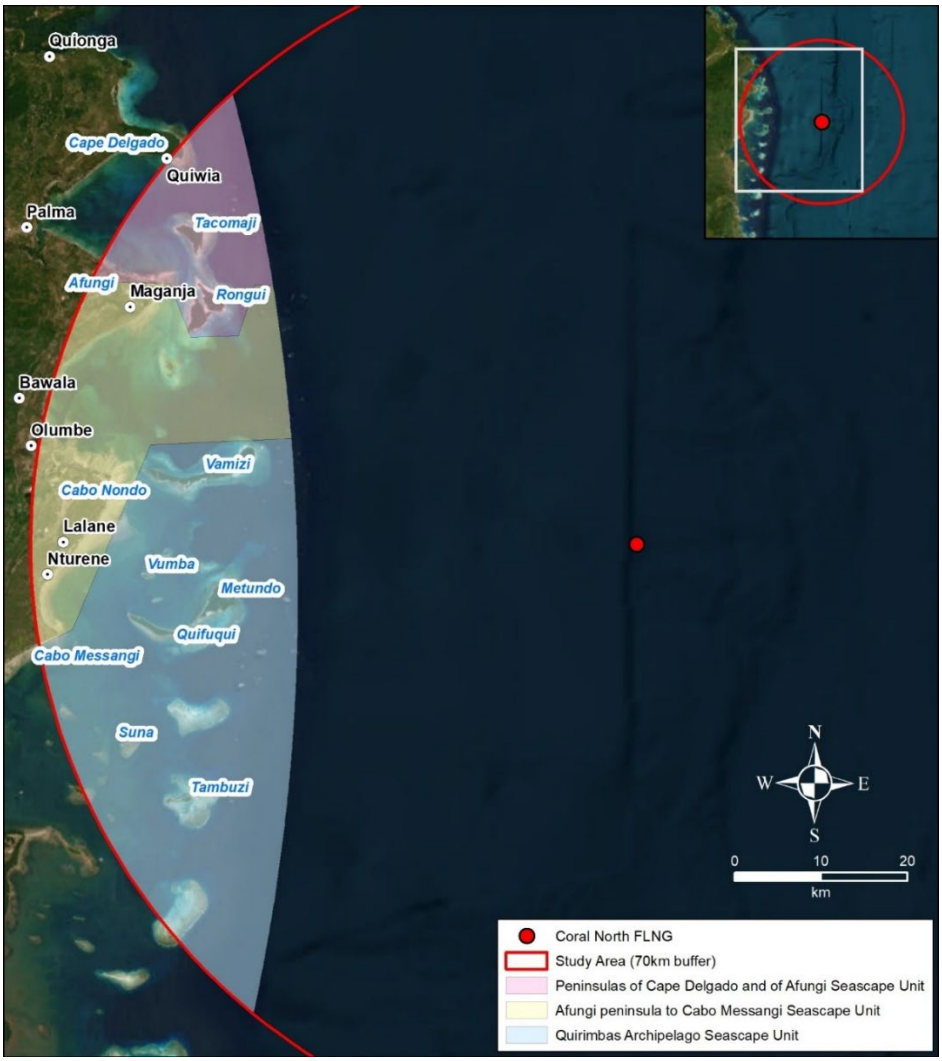


Figure 6.18: Landscape area of influence and seascape units

[8] A seascape unit is the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline. Every seascape unit has three components: an area of sea (the seaward component), a length of coastline (the coastline component) and an area of land (the landward component).

6.8.2.2 Peninsulas of Cabo Delgado and of Afungi Seascape Character Unit

This seascape includes the head of the two peninsulas of Cabo Delgado and of Afungi in the northern part of the AoI that is mainly characterized by the presence of promontories that extend into the Indian Ocean, defining the characteristics of the coastline of this area. These two peninsulas delineate the bay of Palma.

The AoI includes the northern coastal region of the District of Palma, and the biggest islands present in front of the Afungi peninsula: Tecomaji island and Rongui island. The settlement and the harbour of Palma are outside of the AoI.

The northernmost peninsula in this Unit is Cabo Delgado, from which the province gets is name. Quiwia is a small village inside the cape and is characterized by thatched dwellings that blend into the forest vegetation. The Cabo Delgado peninsula is predominantly characterized by dense vegetation that has developed naturally and undisturbed; in this area there are extensive miombo forests with some scattered closed-canopy dry forests. The nearshore area is characterized by a significant coral forest of regional importance. A combination of miombo forest, savannah and cultivation typifies the southern coast of the peninsula towards Palma.

The Afungi peninsula, in the south of this Seascape Unit, is covered by wooded areas with undergrowth of shrub vegetation alternating with open areas of grassland. There are also some areas where subsistence farming is widespread. Clearings alternate throughout the area with the shrub vegetation characteristic of grassland. The topography of the area is gentle and shaped by the watercourses that run east-west along the peninsula. Maganja is the main village of the Afungi peninsula inside the AoI nearby to the smaller villages M'Pala and Nfunzi.

The islands of Tecomaji and Rongui, located in the Indian Ocean, are mainly characterized by a flat topography. They are located about 4 and 5 km from the Afungi peninsula, respectively. Both islands are characterized by dense vegetation consisting mainly of forests and shrub undergrowth. The coasts are characterized by sandy beaches along the northern profile and jagged and rocky beaches in the southern one. There are few settlements and a few minor roads crossing the islands. There is a development plan to improve tourism in the area, with plans to build the Tecomaji Lodge along the north-west coast and a luxury lodge on Rongui Island.

The coastal and landward components of this seascape character area are described below in the context of the main landscape types found therein. These include the coastline, the inland area of Cabo Delgado, and the marine area of Palma Bay.

Coastline

The south coast of the Cabo Delgado Peninsula and the north coast of the Afungi Peninsula consist mainly of gently sloping sandy beaches, characterized along the border with the mainland by neat rows of coconut palm plantations. Continuing inland, the vegetation is woody evergreen. The intertidal areas, often associated with the presence of watercourses or the formation of estuaries, are characterized by the widespread presence of mangroves on sand banks. The more intense currents around the headlands favour the development of coral reefs, resulting in less fine sediment being deposited. At headlands, short reefs form from rocky outcrops.

Inland area of Cabo Delgado

Within the hinterland of the beach, dense forest vegetation is a typical feature. The forest of the Cabo Delgado peninsula is considered unique and comprises an almost impenetrable canopy of dry forest on raised coral rocks. The headland of Cabo Delgado is an important landmark for the entire seascape. The innermost coastline is a gentle, low topography with little variation in relief. At the head of this wooded peninsula is an abandoned Portuguese establishment with a collection of colonial-style buildings and a lighthouse. Nearby are mud houses with thatched roofs associated with a more recent local settlement. The forested promontory overlooks the Indian Ocean, with large areas of beach in the foreground typified by large banks of carbonaceous rock, formed by ancient coral deposits and associated vegetation.

Marine area of Palma Bay

As mentioned above, the town of Palma is not within the AoI, which, however, covers part of the marine area of the opposite bay. This area has a large number of fishing vessels due to the presence of a fishing port. The view from the bay is limited by the presence of the two peninsulas that define its outline. There is regular and continuous fishing activity in the maritime area and several vessels pass through it on their way to the port of Palma. The transport of people and goods by sea usually takes place along the shoreline; the sea is the dominant mode of transport, and it was also used for tourist activities such as transporting visitors and tourists to the nearby islands or for snorkelling, fishing, and diving activities. Currently, however, tourism activities in Palma District are completely absent, due to the continuing unstable security situation caused by terrorist attacks in 2021.

6.8.2.3 Afungi Peninsula to Cabo Messangi Seascape Character Unit

This marine character unit extends from the Afungi Peninsula in the north to Cabo Messangi in the south, including Cabo Nondo. The coastline in this landscape unit evolves gently towards the sea, forming long, sandy beaches. From the tip of Afungi the coastline curves gradually to the innermost part of the “C” bay where Bawala and Olumbe are present and then develops into a new tongue of land towards the Indian Ocean culminating at Cape Nondo. From Cape Nondo the coastline creates a new curvature towards the south-east to Cabo Messangi. In front of this area there are several islands of the Quirimbas Archipelago. The coastal and landward components of this seascape character area are described below in the context of the main landscape types found therein. These include coastline and estuarine salt marsh.

Coastline

To the south of the Afungi peninsula, the coastline consists mainly of wide white sandy beaches. Along the coastline, there are small settlements and occasionally scattered isolated habitations. Predominantly clay houses with thatched roofs can be spotted, which blend into the landscape of the surrounding evergreen vegetation. Maganja and Lalane are the main settlements found on this stretch of the coast. Maganja has a population of around 1900 inhabitants and is located in the northern part of this seascape area near the tip of the Afungi peninsula. Lalane, within the Olumbe administrative post in Palma District, is a remote village of approximately 1150 inhabitants. The

settlements are separated from the coastline by an area with an alternating presence of extensive wetlands, where there are river areas, and intermittent palm plantations.

The main settlement of Olumbe and Bawala are outside of the AoI that includes all the inland areas of Cape Nondo and of Cape Messangi, where white sandy beach followed by dry forests are the dominant landscape. In this coastal area Nturene is the main settlement, which is a small village surrounded by vegetation predominantly of palm trees.

Estuarine Salt Marsh

In this Seascape Unit, there are many areas belonging to the estuarine salt marsh landscape. The most extensive of these is the one formed at the Nonge River mouth near the settlement of Olumbe, where the meeting of the river waters with the marine area has shaped a very wide estuary that typifies the coastline of the entire area. The Nonge River shores are remarkable for the presence of dense vegetation that follows the course of the river until the coastal area of Olumbe. In this area, mangroves are widespread along the coast.

Another of the estuarine saltwater marshes, although smaller in size than the previous one, is present in the northern part of this Seascape Unit near the settlement of Maganja and influences the vegetation and characteristics of the final part of the Afungi Peninsula.

6.8.2.4 Quirimbas Archipelago Seascape Character Unit

The Quirimbas Archipelago in the province of Cabo Delgado in northern Mozambique consists of a complex of more than 30 islands in the Indian Ocean. This Unit Seascape includes the main islands of Vamizi, Metundo, Quifuqui, and some smaller islands such as Vumba, Tamuzi, Suna, Congo and Mechanga. While the Tecomaji and Rongui islands are also part of the Quirimbas Archipelago, for the purpose of this landscape assessment they were not included in this seascape character unit, as they were included in the Peninsulas of Cabo Delgado and of Afungi Seascape Unit.

The islands within Quirimbas Archipelago extend from the coast opposite the city of Palma in the north to Pemba in the south. In 2002, the Quirimbas National Park was established, which, however, does not include the northernmost islands within the Area of Interest.

The islands of the Quirimbas Archipelago are mainly characterized by a flat topography with forests. The coastline is characterized by gentle white beaches, generally along the northern coast, alternate with rocky coasts along the southern borders. These islands are characterized by the presence of coral reefs and are richly vegetated with mangroves and palm trees.

Vamizi Island is narrow and elongated in shape, is only about 4 km from the coast and is visible from Cabo Nondo. The coastline of Vamizi Island is predominantly made up of white sandy beaches with the presence of fringing coral reefs in the intertidal zones. The inland is densely vegetated with indigenous tropical forest and the presence of thick forests of Acacia, Hibiscus and Casuarina. Along the coast palms and mangroves are common. There are few settlements mostly scattered along the coast with mud houses and thatched roofs. The island has a tourist character due to the presence of luxurious touristic accommodation.

Metundo is a private island in the Quirimbas archipelago, consisting of a C-shaped tongue of land. The island is wilderness, the bay with the hotel in the south of the island is the only developed area. The onshore area is densely vegetated with a huge presence of palm near the coastline.

6.8.3 Sensitive Visual Receptors

Sensitive visual receptors are human settlements or activities within the AoI that could be visually impacted by project activities. The AoI is mainly marine, and it was not possible to identify many visual receptors. The receptors considered are highly diversified and differ according to the development and activities that prevail on the coast and islands. They include local inhabitants, tourists, and travellers passing through the area for transport or work activities.

Locals and tourists are mainly shore-based receptors, therefore far away from the FLNG, and consist of the inhabitants of the settlements along the coast or on the islands and the tourists lodging in this area. Offshore receptors are the local workers involved in transport or fishing on private boats and visitors enjoying recreational activities such as snorkelling, sailing, or visiting the islands in the area on boats. However, as stated above, these types of activities are currently not operating in the AoI, due to security concerns.

The main receptors identified to evaluate the visibility and influences of the change proposed by the project are shown in Figure 6.19. The following were considered as possible receptors: inhabited areas, tourist areas, and panoramic spots. The types of receptors and descriptions of existing views are presented in Table 6.15. As stated above, tourism activities are currently not operating from the Palma District, due to security concerns. However, as this assessment is being conducted for the total lifespan of the Coral North FLNG (25 years), it was assumed that within that time period security conditions will normalize, and tourism will return to the district. As such, selected receptors include potential tourist users of the beaches and islands within the district.

Table 6.15: Receptors at selected viewpoints

Viewpoint No.	Description of Viewpoint	Viewer Receptor
1	Cabo Messangi	Tourist users of the beach
2	Lalane Beach	Residents of Lalane, users of the beach, working fishermen at sea. Locals travelling to and from Lalane
3	Metundo Island (beach in the north of the area) is mainly a touristic island where a luxury lodge is present.	Tourist users of the beach
4	Vamizi Island (beach on north)	Tourist users of the beach
5	Vamizi Island (beach on north-eastern tip)	Tourist users of the beach
6	Rongui Island	Tourist users of the beach
7	Cape Delgado (on the eastern tip of the peninsula)	Tourist users of the beach
8	Settlement of Quiwia	Residents of Quiwia

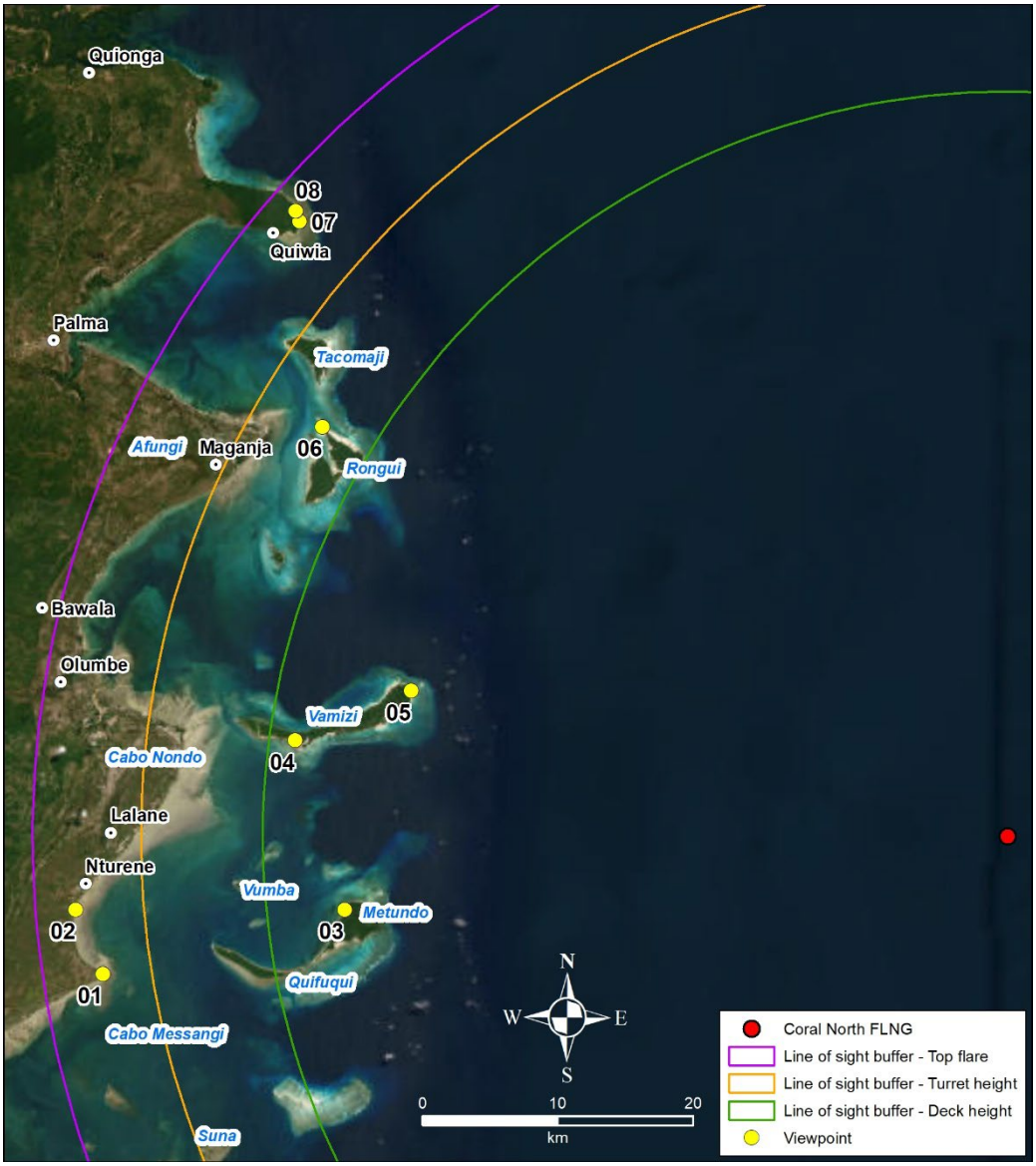


Figure 6.19: Sensitive visual receptors - viewpoint locations

6.9 Biodiversity

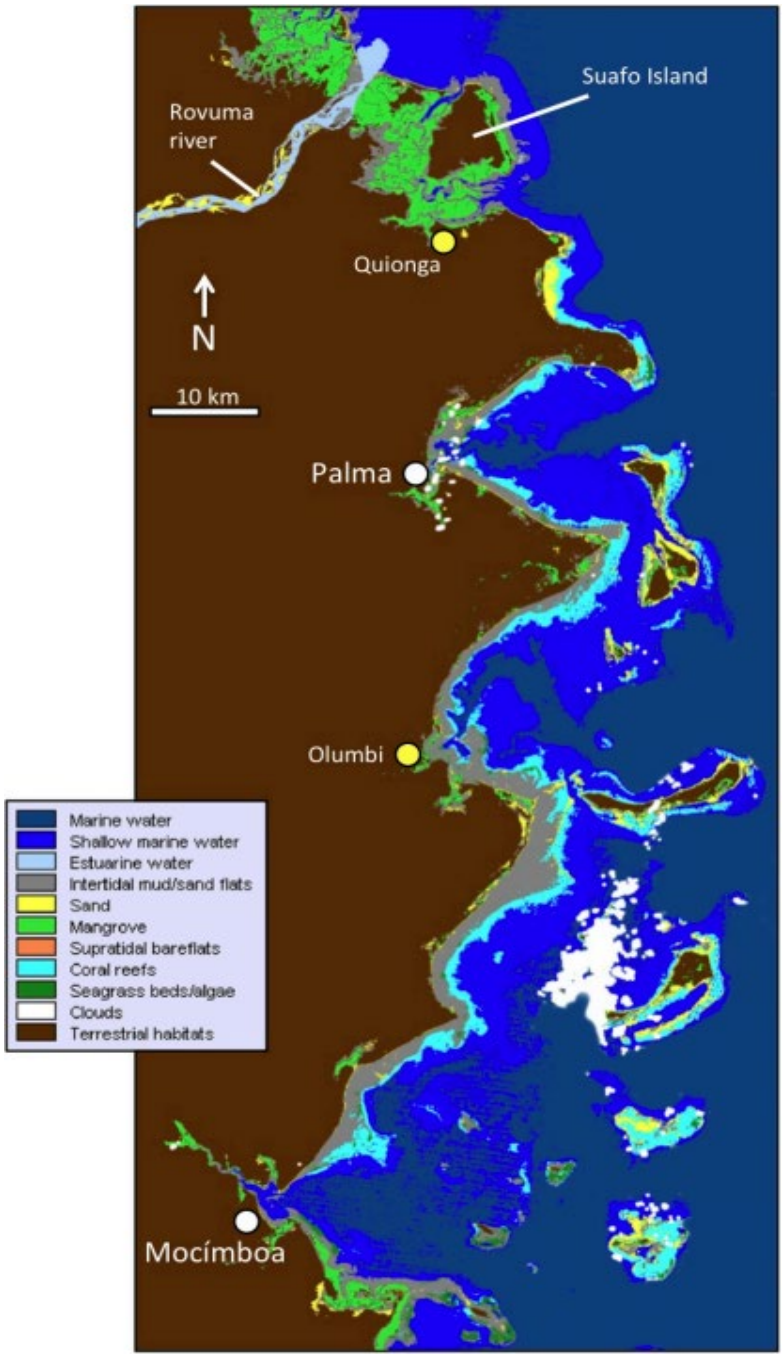
6.9.1 Coastal and Nearshore Environment

6.9.1.1 Regional Framework

Coastal habitats of northern Mozambique form a complex mosaic that follows the coastline's configuration and the sedimentary structure formed by land drainage, including mangrove forests, sandy and rocky shores, estuaries and deltas, coral reefs, seagrass beds, and a dynamic pelagic zone (Figure 6.20).

Coral reefs are denser around the capes, where circulation and currents tend to be higher and thus deposition of fine sediments, adverse to corals, is lower. Coral reefs are also common around the

islands. Mangrove forests on the other hand tend to be concentrated along inner bays where freshwater input is higher, and deposition of fine sediments is maximized. The largest mangrove forests are concentrated around the Rovuma estuary in the northern limit of the district and country, forming a complex structure of channels from the main Rovuma channel to Quionga, including around the island of Suavo. Mixed shores of sand, mud and coral rock debris occur along the large bays of the district. At the capes, rocky outcrops form short cliffs. Figure 6.20 below depicts the coastal habitats of Palma District from satellite imagery.



Source: Consultec (2015); Ferreira *et al*. (2010).

Figure 6.20: Habitat types and cover in the coast and nearshore of Palma District

These coastal habitats are typical of a tropical zone with energy and organic matter shared between ecosystems which high levels of biodiversity depend (McClanahan & Paula, 2009; Paula & Schleyer, 2009). Recent studies have shown that the level of diversity of reef taxa is the second most biodiverse area for coral species in the Indo-Pacific (Obura *et al*., 2012).

The sediment structure formed by currents and land drainage play a large role in the design of this mosaic. Mangrove forests can be found along inner bays where the input of freshwater is higher, depositing high loads of fine sediments. The Rovuma Estuary is home to the largest mangrove forests in the region forming a complex structure of channels from the Rovuma River. Coral reefs are dense around the capes where the circulation and current patterns are greater, resulting in fewer fine sediments being deposited. At the capes, short cliffs are formed from the rocky outcrops.

Biodiversity driven ecological processes depend on the condition of the several key ecosystems and the ways in which they function in an integrated manner. Many of the key marine organisms, such as fish and crustaceans, utilize different habitats (such as coral reefs, seagrass beds and mangroves) for different parts of their life cycle or through migratory processes at even shorter temporal scales, such as seasonal, semi-lunar, daily, or tidal environmental cycles.

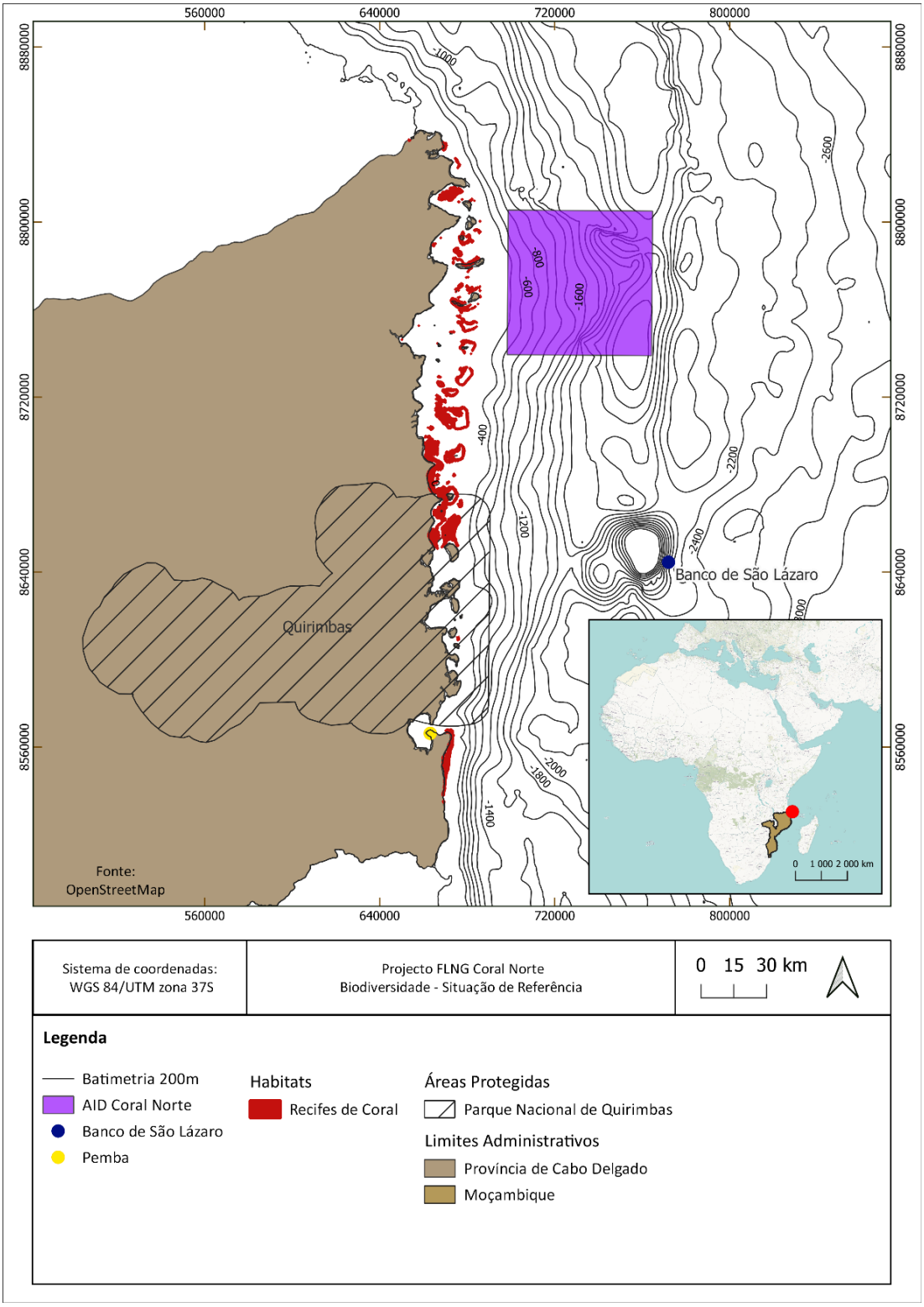
The bathymetry of the study area depicts the limited extent of the continental shelf and the proximity of deep waters to the nearshore environment. For example, at the Cabo Delgado peninsula, the distance from the reef crest and/or flat to the shore is roughly the same as that from the same point to the end of the continental shelf at about 200 m deep (circa 1 km). Local geomorphology dramatically restricts the shelf area and confers the coastal waters an essentially oceanic character. This is also obvious in recent literature data concerning phytoplankton assemblages, which are dominated in the region by picoplankton, mainly comprised of cyanobacteria (Sá *et al*., 2013b).

6.9.1.2 Coral Reefs

Coral reefs are one of the most important ecosystems for supporting marine biodiversity in coastal tropical environments and for the coast's physical protection. The northern Mozambique channel is a very high coral diversity center (Obura *et al*., 2018), forming high-diversity region within the East African Coral Marine Eco-region (Spalding *et al*., 2007). This context makes the northern Mozambique Channel one of the world's globally outstanding marine biodiversity areas and a biological reservoir for the entire coastal East African region. Endemism is marked and overall reef diversity is second only to Southeast Asia's Coral Triangle, with more than 400 hard coral species. The reasons for this high diversity may lie in the oceanographic characteristics of the Western Indian Ocean (WIO) (Saetre & Da Silva, 1984), which connects the area to the central Indian Ocean via the South Equatorial Current (SEC), linking the region via gene flow to the high diversity Eastern Indian Ocean.

The Quirimbas Archipelago comprises some 28 islands and the offshore St. Lazarus Bank. Extensive fringing reefs occur along the mainland coastline, the eastern shorelines of the islands and banks of the Quirimbas Archipelago, including St. Lazarus Bank, which is located 96 kilometres from the ADI of the Coral North FLNG project. The closest island in the Quirimbas Archipelago to the ADI is Vamizi Island, situated 11 kilometres away. These reefs are amongst the most diverse in terms of associated

biodiversity (Obura, 2012). In the Quirimbas Park alone, Rodrigues *et al.* (2000) reported over 50 genera of corals. Figure 6.21 below presents the main coral reefs of northern Cabo Delgado Province in relation to Area 4.



Source: Adapted from Impacto (2009).

Figure 6.21: Main coral reefs along the northern Cabo Delgado Province

The approximately 770 km of coral reefs in northern Mozambique are characterized as a continuous fringing reef along the east coast of the islands and on the exposed areas of the continental coast, being called “coral coast”. It is estimated that coral reefs cover an area of 525 km^2 of the Cabo Delgado Province coastline. Some of 183 coral species in 46 genera from 14 families have been identified in the Vamizi Island region (Guissamulo, A. & Shaw, 2006), 212 species around Metundo Islands (Samoilys *et al*., 2011). The area is considered to be of high importance to fish diversity, with some 373 reef supported fish species were identified around Vamizi Island (ERM, 2019). Vamizi island was designated a key biodiversity area by the International Union for the Conservation of Nature and Natural Resources (IUCN) (WCS, 2021). The spawning aggregation of the giant kingfish (*Caranx ignobilis*), estimated at more than 1,000 individuals by Silva *et al*. (2014) trigger the criteria; however, but is the mass spawning of coral that makes the Vamizi island reefs key for biodiversity. The coral mass spawning events that occur every year on the reefs of Vamizi, and probably extend to the adjacent islands of Metundo, Rongui and Tecomaji, involve the synchronized reproduction of dozens of coral species (Sola *et al*., 2016), especially of the genera Acropora (Sola *et al*., 2015).

In general, the reefs occur within a wide depth range (5-40 m) and are dominated by hard corals (Order Scleractinia) with Acropora, Porites, Pocillopora, Echinopora and Favites as the dominant genera. However, in some locations, soft corals (Order Alcyonacea) are very abundant and dominate the reef benthos (e.g., Benayahu *et al*., 2003; Schleyer *et al*., 1999a; Videira & Pereira, 2007), with Sinularia and Lobophytum (Family Alcyoniidae), nephtids (Family Nephtiidae), and xenids (Family Xenidae) being particularly conspicuous (Pereira *et al*., 2014).

In the Palma region, the estimated live hard coral cover varies between 70-10 % with the highest percentages in Metundo and Tecomaji islands and Quirinde. The more abundant genera are the *Acropora* with large colony sizes, indicating mature community development and high recovery from any past major disturbances (M. Samoilys, Obura, & Osuka, 2015). These numbers are much higher than the ones found in the rest of the country and in previous studies (Pereira *et al*., 2014).

In all regions there are potentially 323 coral species (species included in Class Anthozoa), belonging to the Orders Helioporacea (blue corals, one species) and Scleratinia (stony corals, 322 species), according to IUCN (2023). Helioporacea is represented only by one Family, Helioporidae, with one species, *Heliopora coerulea*, classified as threatened by IUCN, with the status “Vulnerable”.

The most represented Family of Order Scleratinia is Acroporidae with 100 species, followed by Faviidae, with 72 and Poritidae, with 31 (Figure 6.22). Of the 322 potential Scleratinia species in the area, 54 species are threatened, all classified as Vulnerable (IUCN, 2023).

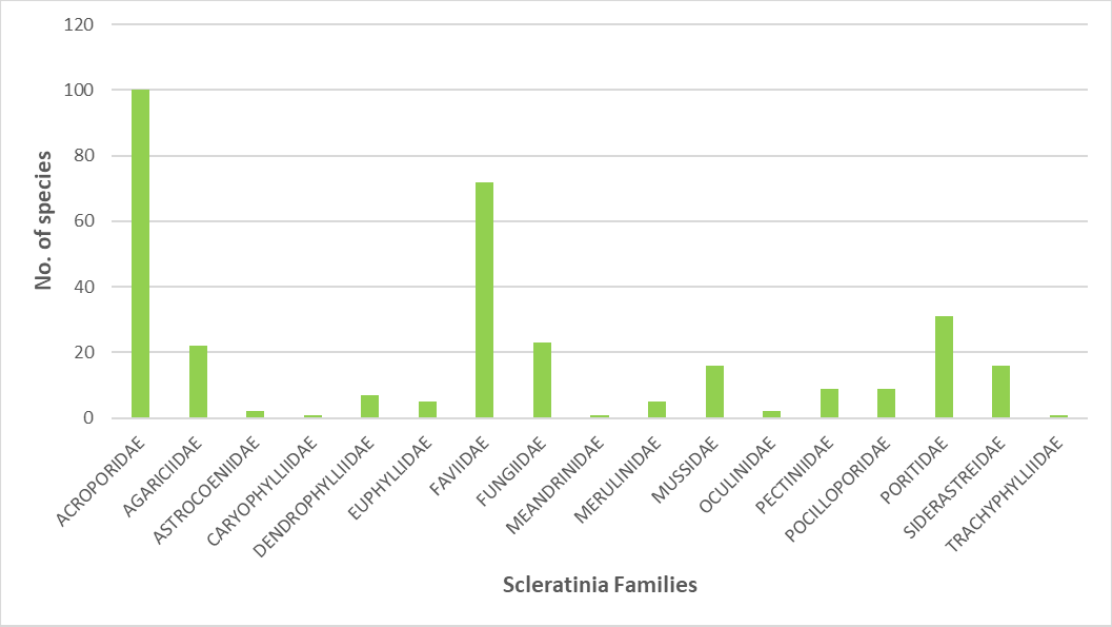


Figure 6.22: Number of potential Scleratinia coral's species per family

From the potential list of Scleratinia corals present in the study area, 309 species are listed in CITES, the convention for animal trade, all in CITES appendix II; and 12 are considered EDGE (Evolutionary Distinct and Globally Endangered Species, as classified by Gumbs *et al*., 2023).

Hydrocorals (Class Hydrozoa) may also form colonies and are frequently associated with corals. There is evidence that corals hosting symbiotic hydrozoans are less susceptible to predation and disease (Montano *et al*., 2017). According to IUCN, there are potentially three species in the study area (*Millepora exaesa*, *M. platyphylla* and *M. tenera*), from the same family, all included in CITES appendix II.

A series of nearshore marine surveys during both the dry and wet seasons were conducted in Tungue Bay around 70 km away from the Coral North FLNG, as part of the habitat and biodiversity assessment preceding the development of an LNG Facility (GeoTeam, 2017a, 2017b).

One hundred and thirty-six taxa of corals were recorded across the three main zones of the coral area; coral bommie (individual coral targets) field, reef flat and fringing reef; 40 are classified as Near Threatened (NT) and 17 classified as Vulnerable (VU). Coral forms included massive, branched, tabular, plate, solitary, and encrusting species. The coral taxa most commonly found included *Acropora, Galaxea* and *Porites*.

The accompanying fish survey in 2017 (GeoTeam, 2017a, 2017b) recorded 186 taxa associated with corals.

6.9.1.3 Mangrove Forests

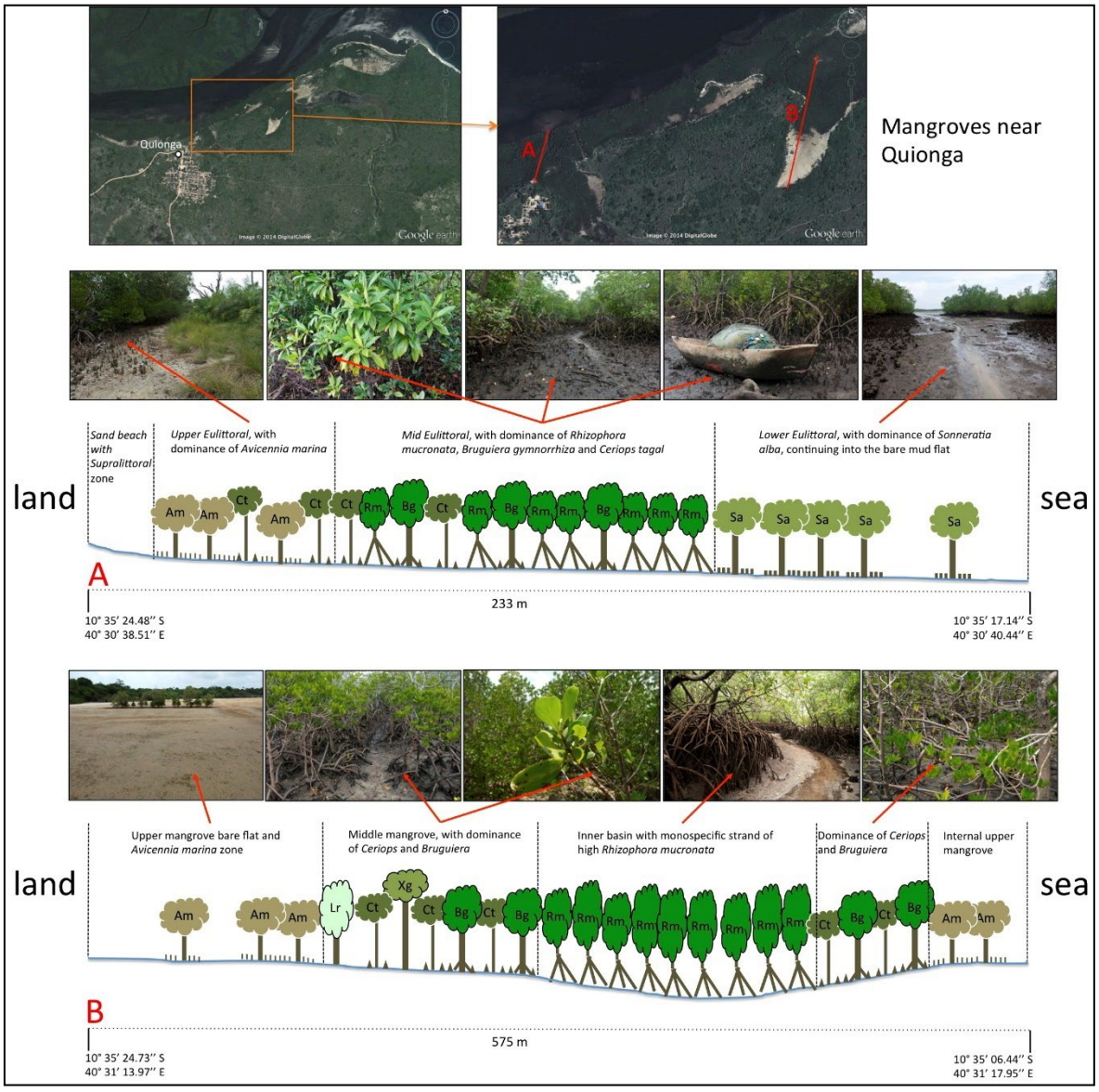
Eight species of mangrove tree species have been identified in Cabo Delgado Province, including Palma District (Beentje & Bandeira, 2007). These include *Rhizophora mucronata*, *Ceriops tagal*, *Bruguiera gymnorhiza*, *Avicennia marina*, *Lumnitzera racemosa*, *Sonneratia alba*, *Xylocarpus granatum* and *Pemphis acidula* (Richmond, 2002; Beentje & Bandeira, 2007). According to IUCN

(2023), two more species are potentially present in the surroundings of the AII: *Acrostichum aureum* and *Heritiera littoralis*. These mangrove species are all considered as Least Concern (IUCN, 2023). The mangrove forests in the region belong to two major types: riverine (which can be marginal or basin type) and oceanic (located in exposed sandy shores). They have a distinct pattern of zonation illustrated in Figure 6.23 and Figure 6.24 (following pages). The mangroves in the district are more abundant near the Rovuma delta bordering Tanzania.

Mangroves are well known for hosting a wide range of invertebrate meiofauna and macrofauna. Among macrofauna, crustaceans and molluscs are the dominant groups. Crustaceans are dominated by crabs typically including ocypodids (fiddler crabs), sesarmids (marsh crabs), Portunids (mud crabs, *Scylla serrata*), and some penaeid shrimps (*Fenneropenaeus indicus*, *Metapenaeus monoceros* and *Penaeus monodon*). Molluscs include mud creepers (*Terebralia palustris),* pencil bait (*Solen capensis)* and mud snails (*Cerithidea decollata)*. Littorinidae are well represented with *Littoraria scabra*, *L. pallescens*, *L. intermedia* and *L. subvittata* all being common or abundant on mudflats associated with mangrove stands. Large bivalves such as oysters (*Saccostrea forskali* and *S. cuculata*) and barnacles (*Balanus amphitrite*) typically attach to mangrove stems, branches or roots and rocks.

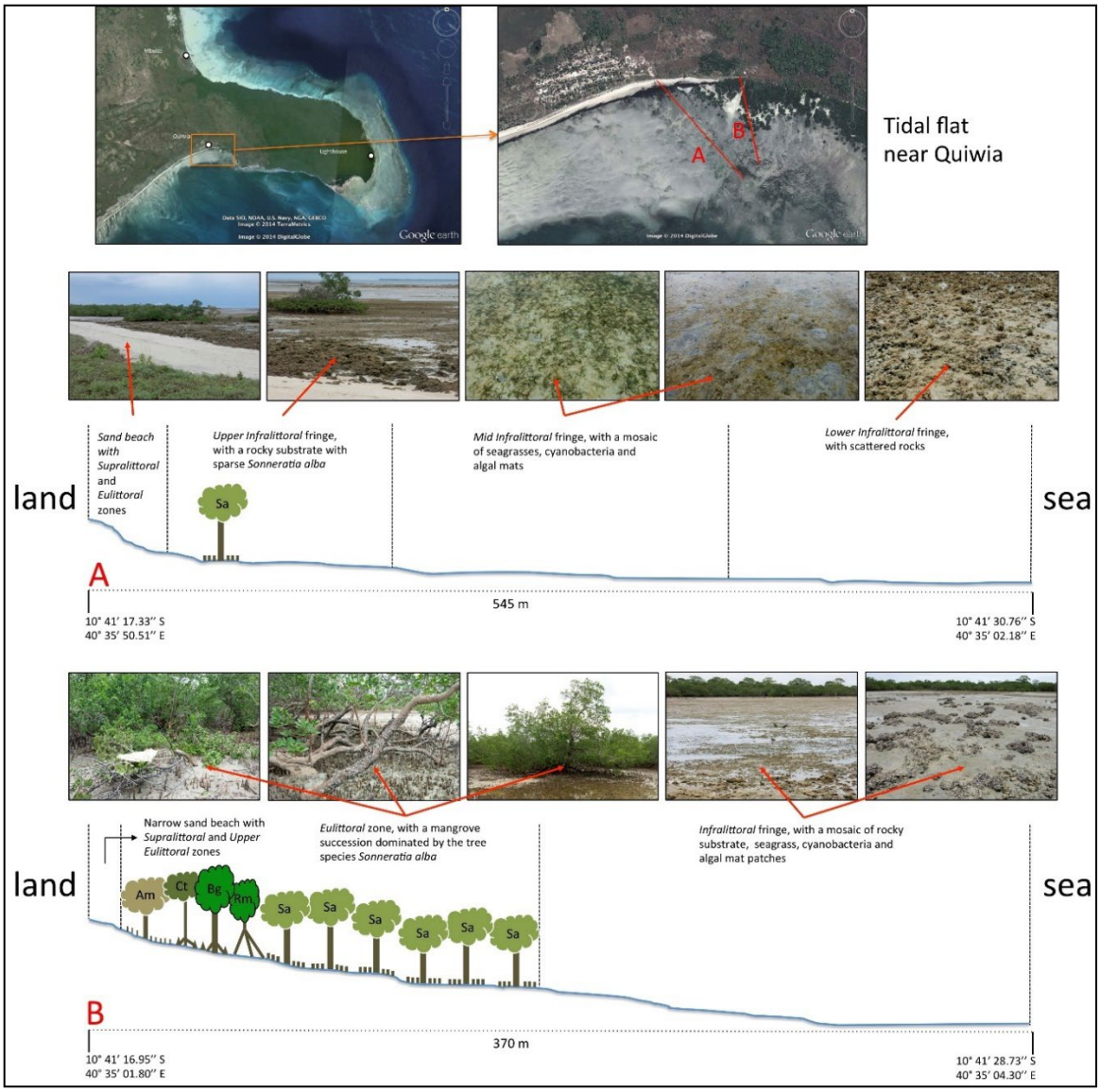
Bandeira *et al*. (2009) studied the condition of mangroves in the region and found that the forests in northern Mozambique are relatively pristine when compared to southern Tanzania, for example. More recent assessments apparently show a degradation in mangrove condition, although the comparison must be cautious as a different methodological approach was used: Pemba and Olumbi mangroves condition was classified as “Moderate” while Vamizi mangroves were considered “Poor” (Macamo *et al*., 2021).

Ferreira *et al.* (2009b) found that the area of mangrove cover in the Mozambican region of the Rovuma increased locally probably due to gains attributed to sedimentation and decreased in other sites probably due to losses attributed to erosion. Overall, there was an increase of 3% between 1995 and 2005. Between 1994 and 2015, the increasing trend in mangrove area in Cabo Delgado was maintained according to Shapiro (2018).



Source: Consultec (2014a). Legend: A – marginal transect near Quionga town, B – transect in the Quionga basin mangrove. Sa – *S. alba*, Am – *A. marina*, Ct – *C. tagal*, Bg – *B. gymnorhiza*, Rm – *R. mucronata*, Lr – *L. racemosa*, Xg – *X. Granatum*.

Figure 6.23: Example of marginal and basin type mangroves in the study area: profile of forests near Quionga



Source: Consultec (2014a). Legend: (A) Bare tidal sedimentary flat, (B) flat with oceanic-type mangrove forest. Vertical axis not to scale. Am – *A. marina*, Ct – *C. tagal*, Bg – *B. gymnorhiza*, Rm – *R. mucronata*, Sa – *S. alba*.

Figure 6.24: Example of oceanic type mangroves in the study area: profile and type of tidal flats near Quiwia

Mozambique's northern coast is predominantly coralline, with coral reefs normally bordering the clear water subtidal areas. Mangroves are common in this region of Mozambique and grow in estuaries, embayments, and some areas protected from direct ocean currents. Extensive mangrove areas occur in Quirimbas Archipelago and in several embayment's nearby (Palma, Olumbe, Mocímboa, Quiterajo; Frontier 1997; GNBR, 2010). Other important mangrove areas are Pemba Bay with 33,600 ha (Ferreira *et al*., 2009) and the coastline of Nampula. In southern areas mangrove cover is patchy (Sitoe *et al*., 2014).

Mangroves are considered as critical habitat in Mozambique, being classified as a highly threatened and unique ecosystem (CEAGRE, 2015).

6.9.1.4 Seagrass Beds

Commonly found in nearshore waters across both tropical and temperate regions, seagrasses marine angiosperms, constitute one of the planet's most productive aquatic ecosystems. In the Western Indian Ocean (WIO) region, where 13 seagrass species have been documented, these ecosystems stretch across extensive areas of near-shore soft seabed along a 12,000-kilometer coastline (Gullström *et al.,* 2002; Nordlund & Gullström, 2013).

Seagrass meadows are versatile, occurring both intertidally and subtidally, often reaching depths of up to 40 meters. They frequently neighbour coral reefs and mangroves, forming interconnected habitats. Due to their capacity for high primary production and their complex structures, seagrass beds provide crucial support by providing food, shelter and serving as breeding and nursery grounds for a diversity of benthic, demersal, and pelagic organisms, including commercially exploited species. The seagrasses are also important feeding grounds for the dugong (*Dugong dugon*) and the green turtle (*Chelonia mydas*).

Fish species assemblages associated with southern Quirimbas seagrass meadows comprised 249 species of fish belonging to 64 families (Gell & Whittington, 2002).

During the 2017 wet season survey carried out in Tungue Bay, nine (9) seagrass species including *T. hemprichii, E. acoroides, T. ciliatum, H. uninervis, H. wrightii, H. ovalis, H. minor, Cymodocea serrulata*, and *Zostera capensis* (GeoTeam, 2017a) were documented. *Syringodium isoetifolium* was also identified during the survey from the drop-down camera observations at select sampling locations. During the dry season survey, only six (6) species were observed, with *Halophila ovalis, Cymodocea serrulata,* and *Zostera capensis* not sighted (GeoTeam, 2017b). *Zostera capensis*, one of the recorded seagrass species, is classified as “Vulnerable” (VU), while all the other seagrass species are categorized as “Least Concern” (LC) (IUCN, 2023).

Massingue & Bandeira (2005) identified 11 seagrass species at Mozambique Island, Nampula province (located approximately 275 kilometres from the Coral North FLNG project). Considering this higher diversity in Nampula province and the challenges associated with accessing remote areas in the northern part of Mozambique, the reported diversity of seagrasses in the province of Cabo Delgado may be underestimated (Massingue & Bandeira, 2005).

Large motile invertebrates associated with the seagrasses were also recorded during the 2017 survey. The seagrass locations exhibited a rich diversity of marine life, with Mollusca, primarily composed of bivalves, accounting for 48% of the total community. Notably, two species of the Pinnidae family, *Atrina vexillum* (flag pen shell) and *Pinna muricata* (prickly pen shell), were prevalent at most sampled places (GeoTeam, 2017a, 2017b). These bivalves are filter feeders and are actively harvested by local artisanal fishermen, as observed by the significant accumulations of empty shells near their village.

Gastropoda were well-represented, featuring Aplysiidae sea hares (*Aplysia* sp. and *Stylocheilus* sp.), *Bulla ampulla*, and various cowrie species. Echinodermata, both abundant and diverse in terms of taxa, accounted for 36% of the total invertebrate community abundance. Asteroidea, including

species such as *Pentaceraster tuberculatus, Pentaceraster mammillatus*, and *Protoreaster linckii*, were the most abundant within this group (GeoTeam, 2017a, 2017b).

6.9.1.5 Sandy and Rocky Shores

The coastline of Palma district is a succession of sandy shores that dominate the shoreline of bays, and rocky outcrops that occur mainly at the capes between embayments.

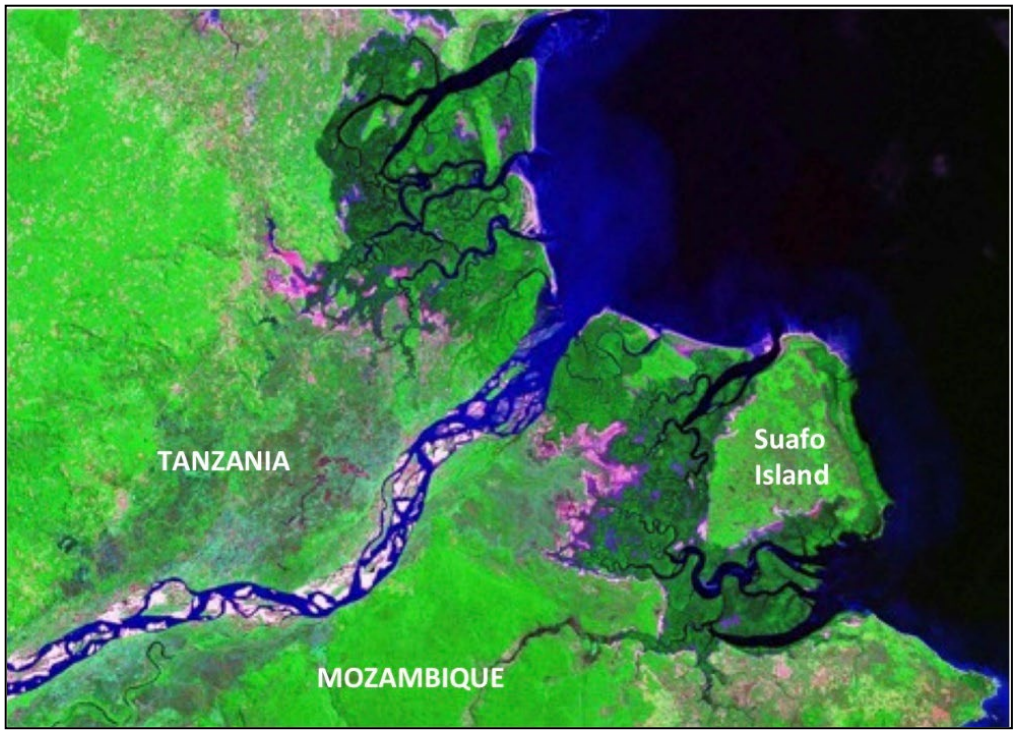
Capes within the study area are essentially carbonate rocky formations of coral reef origin, subject to slow modifications over time and contrasting with sedimentary areas more prone to deposition and erosion processes at much shorter temporal scales. The tidal platforms at the capes are mainly rocky, although deposition of fine white coral sediment occurs in patches related to dispersal by current patterns, and more pronounced near the shore. Between these rocky outcrops, sandy beaches occur. Stretches of oceanic-type mangrove forest develop in parts of the bays that link the bays to the rocky bottoms. In the middle of the bays, it is common for mouths of seasonal rivers to develop more complex mangrove–marsh systems where the tide penetrates during the spring tidal period. In the bays closer to capes, sedimentary bottoms progressively turn rocky and show more typical characteristics of back reef lagoons.

A large proportion of the beach and shallow subtidal bottoms are however of mixed character, with varying types of sediments intermingled with rocky platforms of different types, of difficult character to define.

6.9.1.6 Estuarine Areas

The main estuary in the region is the Rovuma Estuary, located on the border between Mozambique and Tanzania and situated approximately 105 kilometres from the Coral North FLNG project (Figure 6.25). Its discharge affects the adjacent shelf waters and modulates ecological processes in the region, concentrating biodiversity and marine resources. On the other hand, the freshwater it delivers, and the sedimentation of fine materials are the basis for the establishment of the largest mangrove forests in the region.

Other minor estuary discharges also occur in the bays of Mbuize, Palma, and Olumbe, with greater flows to the south of Mocímboa da Praia. These systems are of major importance for the establishment of mangrove forests, and influence adjacent shelf waters through discharge, namely by lowering salinity and carrying nutrients and dissolved and particulate inorganic and organic materials.



Source: LandSat TM5.

Figure 6.25: Satellite view of Rovuma Estuary in the border between Mozambique and Tanzania, showing the extensive associated mangrove areas in both sides (darker green)

6.9.1.7 Conservation Areas

Protected Areas

There are four land-use designations for Marine Protected Areas (MPAs) in Mozambique:

- Partial Reserves (e.g., Ponta do Ouro Partial Marine Reserve);
- National Parks (e.g., Bazaruto Archipelago National Park and the Quirimbas National Park);
- Environmental Protection Areas (Primeiras and Segundas Environmental Protection Area and Palma-Quirimbas Environmental Protection Area);
- Total Protection Zones (Cabo de São Sebastião Total Protection Zone).

Currently, MPAs cover a total area of about 36,720 km^2 of which 23,018 km^2 encompass marine ecosystems. Table 6.16 shows the year of creation of these MPAs, and the areas of protection.

Table 6.16: Existing MPAs in Mozambique

MPA	Year	Total Area (km^2)	Marine ecosystems (km^2)	Distance to Coral North FLNG (km)
Quirimbas National Park	2002	7,506	1,430	110
Primeiras and Segundas Environmental Protection Area	2012	10,409	5,000	565
Cabo de Sao Sebastiao Total Protection Zone	2003	300	80	1,350
Bazaruto Archipelago National Park	1971/2002	1,430	1,295	1,295
Ponta do Ouro Partial Marine Reserve	1965/2009	678	678	1,850

MPA	Year	Total Area (km²)	Marine ecosystems (km²)	Distance to Coral North FLNG (km)
Palma-Quirimbas Environmental Protection Area	2024	16,258	14,385	39

Source: Pereira *et al.*, 2014.

According to the Biodiversity Conservation Law (Law no. 16/2014, of 20 June, as amended and restated by the Law no. 5/2017, of 11 May) conservation areas in Mozambique are classified as:

- Total Conservation Areas (includes Integral Nature Reserves; National Parks and Cultural and Natural Monuments), where the extraction of natural resources is not allowed, and
- Sustainable Use Conservation Areas (includes Special Reserves; Environmental Protection Areas; Official Game Reserves; Community Conservation Areas; Sanctuaries; Game Farms; Municipal Ecological Parks) where a certain level of natural resources extraction is allowed but subject to a Management Plan.

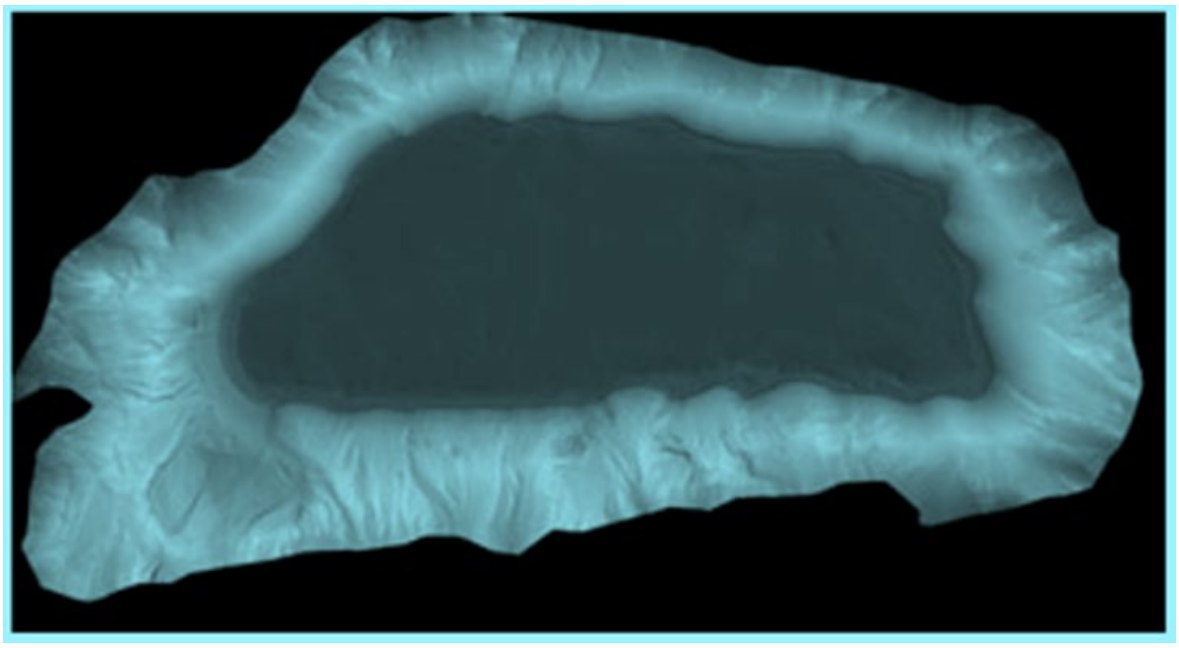
The Quirimbas National Park (QNP) is located 38 km to the southeast of the southern boundary of Area 4, and the closest point to Coral North project area lies at 110 km to the southeast (SE). The marine protected portion of the QNP covers 152,237 km² and is one of the largest protected marine areas in Africa. Important marine and coastal features within the park include mangrove forests and coral reefs, as well as fauna such as the dugong, turtles, and a diversity of fish species (Harari, 2005). Although most of the surface area of the QNP is primarily terrestrial the marine component covers 25-30% of the park and includes the offshore St Lazarus Bank and the 11 southernmost islands of the Quirimbas Archipelago (UNESCO, 2018).

St. Lazarus Bank is a major feature off the coast of Cabo Delgado Province (circa 134 km from the Coral North FLNG site and 30 km from the southern border of Area 4), recognized for its biological importance and high diversity of corals and fish. It bears significant ecological importance, being a biodiversity hotspot, attractive for commercial, sports and recreational fisheries, and also for the known high occurrence of marine mammals (Figure 6.26).

St. Lazarus Bank has coral overgrown on top, close to the surface, being sometimes referred to as an atoll. However, the reefs do not reach the surface and back-reef lagoons typical of atolls are lacking. The central, table-like platform of the seamount has a diameter of around 8 x 4 km, ranging from 6 to about 60 m depth on the margins and falling down rapidly to more than 2000 m on all sides. The currents flowing south hit the bank creating eddies and a circulation system (at a speed of about 1 $m.s^{-1}$) that may contribute to retain pelagic eggs and larvae on the platform. Johnsen *et al.* (2008) noted that a number of larvae or juveniles belonging to at least seven fish species were collected during each of the pelagic trawls, among them also typical reef dwellers.

Large predatory fish species such as snappers (Lutjanidae, e.g. the red snapper *Lutjanus bohar*), jacks (Carangidae, e.g. bigeye trevally, *Caranx sexfasciatus*), or moray eels (Muraenidae, e.g. the laced moray, *Gymnothorax favagineus*) were also observed during the 2007 survey. Nigh-time pelagic trawling resulted in the collection of a considerable number of lanternfish (Myctophidae) over the plateau and on its flanks down to 500 m depth (e.g., *Myctophum spinosum*) with several species

being collected in this area for the second time after the 1978 cruise (Saetre *et al*., 1979). More than 25 species were collected in one deep trawl haul.



Source: Johnsen *et al*. (2008).

Figure 6.26: Birds eye view of the areas of the St. Lazarus Bank mapped with the EM710. The red areas have a depth of <20 m while the maximum depth (dark blue) is around 1500m

In 2007, within the context of the Marine and Coastal Biodiversity Management Project, MTA, financed by the Global Environment Fund, recommended the creation of a new conservation area in Mozambique (proposed name: Rovuma/Palma National Reserve). The study also recommended modifications to the boundaries of the Mnazi Bay Rovuma River Estuary Marine Park (MBREMP), in order to form a Transfrontier Conservation Area contiguous to the conservation area proposed in Mozambique (Bandeira, 2007). In the event the conservation area is created, this new area will be located outside of the concession area, at a minimum distance of 27 km from the western boundary of the concession.

The Quirimbas Archipelago is being considered for UNESCO's category of site of Outstanding Universal Value due to its cultural and natural heritage. The archipelago is comprised of 27 to 30 islands, most of which are uninhabited. Some of these islands, e.g., Vamizi Island, are located about 50 km to the west of the proposed FLNG location. From its extensive complex of reefs with high coral diversity, diverse range of habitats, including mangroves, seagrasses, sandy and rocky shores, the archipelago is of outstanding universal value in terms of its terrestrial and marine biodiversity.

In 2024, the Mozambican government created the Palma-Quirimbas Environmental Protection Area, located in Cabo Delgado Province. This area was established for the preservation and protection of marine, terrestrial, and coastal species and their habitats. The environmental protection area covers a total area of 16,258 km², comprising both terrestrial and marine zones.

The terrestrial area spans 1,873 km² and includes parts of three administrative posts in the Palma District: Palma (including Mute and Palma-Sede localities), Quionga (part of Quirinde locality), and

Pundanhar (entire Pundanhar-Sede locality). The marine-coastal area covers the northern zone of the QNP, and the oceanic area, associated with the St. Lazarus Bank, extends 14,296 km². This oceanic area includes the bank and the coastal corridor between the QNP and the bank, to protect the connectivity of these two areas. Additionally, the Vamizi biodiversity hotspot, which is a key part of the area, covers 88.8 km².

The Project's navigation corridor crosses this new marine area established to connect Saint Lazarus bank to the Quirimbas Archipelago. This area is also crossed by the main regional commercial navigation route. The project navigation corridor was set to avoid traversing near the Saint Lazarus Bank and the Quirimbas archipelago (a minimum of 10 km away from these sensitive areas), and thus no relevant impact is expected on the new protected area.

Protected areas in the broader seascape are shown in Figure 6.27.

Other Important Areas for Biodiversity

The Coral North FLNG site does not interfere with any Important Bird Area (IBA) (BirdLife International, 2019) or Key Biodiversity Area[9] (KBA), although the ADI locates in the close vicinity of the recently classified marine KBA of Vamizi, whose main criteria of classification rely on the fishery community of high importance.

Other than the Vamizi KBA, the nearest KBA's to the Coral North FLNG site are the following, both in Cabo Delgado Province (Figure 6.28):

- Palma, at 55 km west;
- Quiterajo, at 95 km southwest.

The project area and its surroundings do not encompass any Endemic Bird Area (EBA) (BirdLife International, 2019a). The closest EBA is located more than 500 km from the study area.

The ADI is located 10 km from a biodiversity hotspot (Conservation International, 2023) - the Coastal Forests of Eastern Africa, that stretches from Somalia to Gaza Province in Mozambique (Figure 6.28). This biodiversity hotspot also encompasses part of the area covered by Primeiras and Segundas Environmental Protection Area.

Concerning the World Wildlife Fund for Nature (WWF) Global 200 Ecoregions, the AII is completely included in the East African Marine Ecoregion (EAME; Figure 6.29). The Global 200 Ecoregions are large-scale priority areas of uniform ecological features, chosen for the conservation of the most outstanding and representative of the world's habitats (Olson & Dinerstein, 2002). The EAME extends for approximately 4,600 km and includes the territorial waters of Somalia, the coastlines of Kenya, Tanzania, and Mozambique. Its shores and coastal seas harbour a characteristic set of species, habitats, dynamics, and environmental conditions which are similar enough to be considered an ecological unit. In addition, biodiversity conservation sites have been identified along this EAME as priority areas for some species and community groups (EAME, 2004).

[9] All IBA are considered Key Biodiversity Areas.

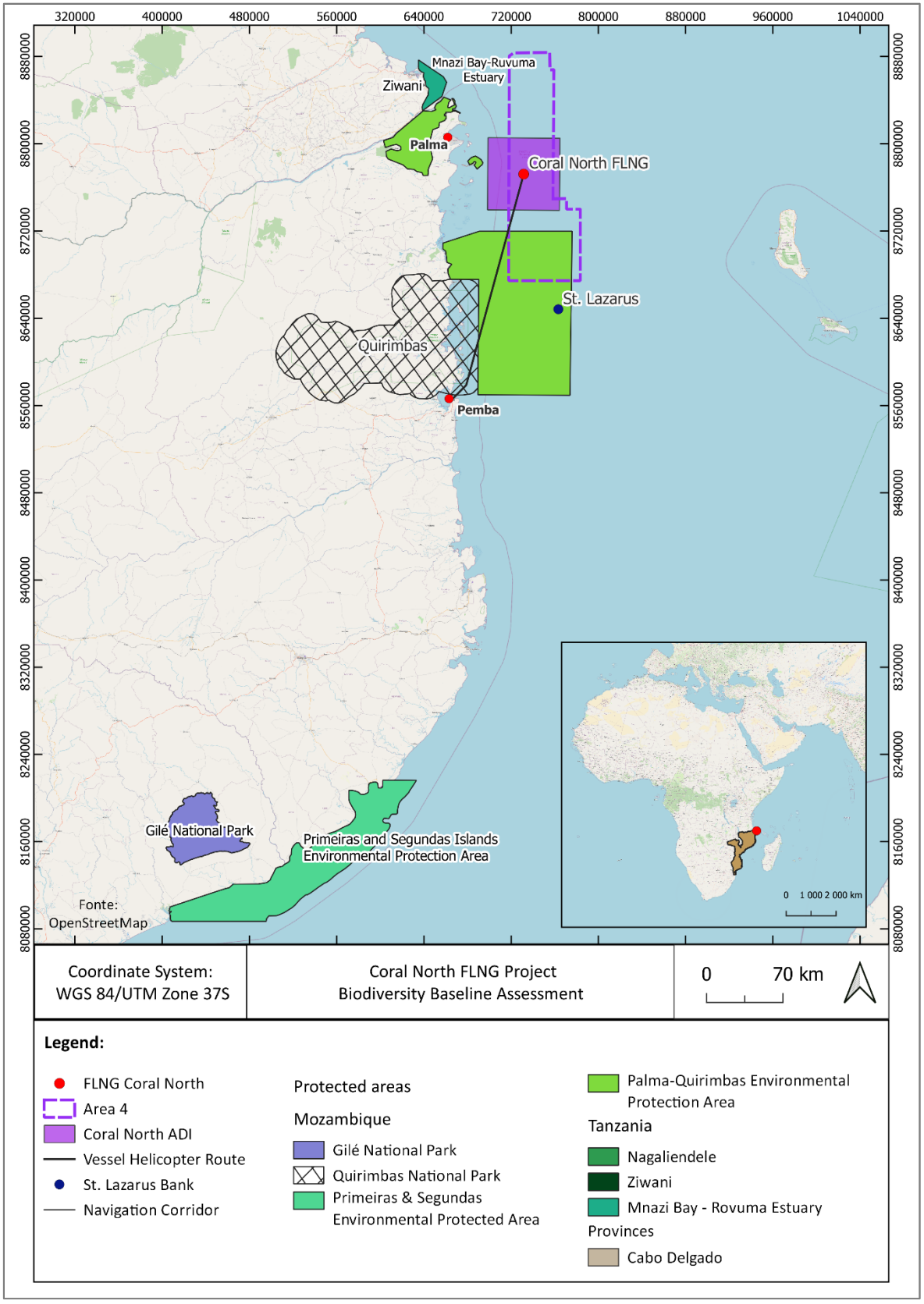


Figure 6.27: Legally protected areas in the surroundings of the ADI

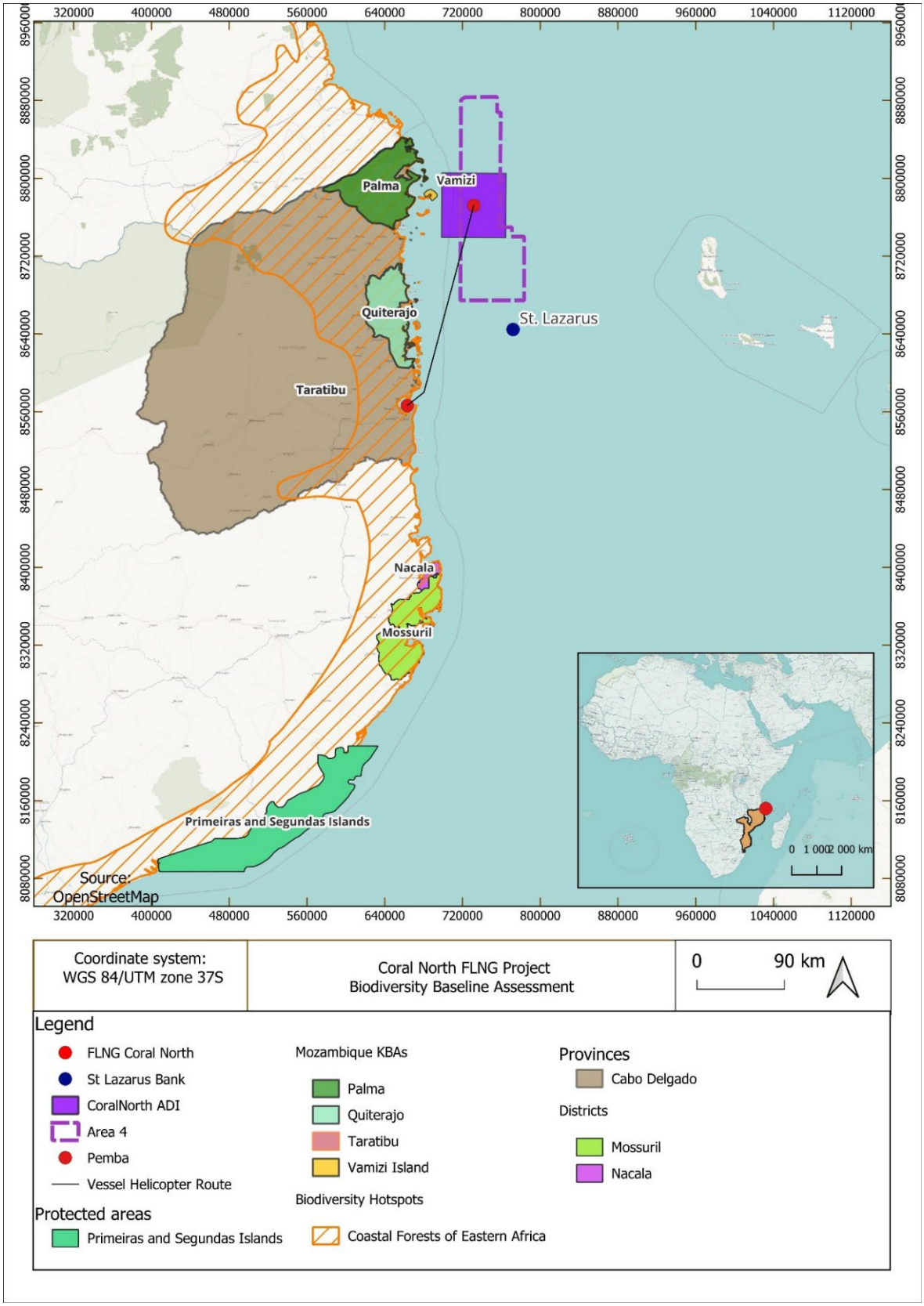


Figure 6.28: Important areas for biodiversity in the broader seascape

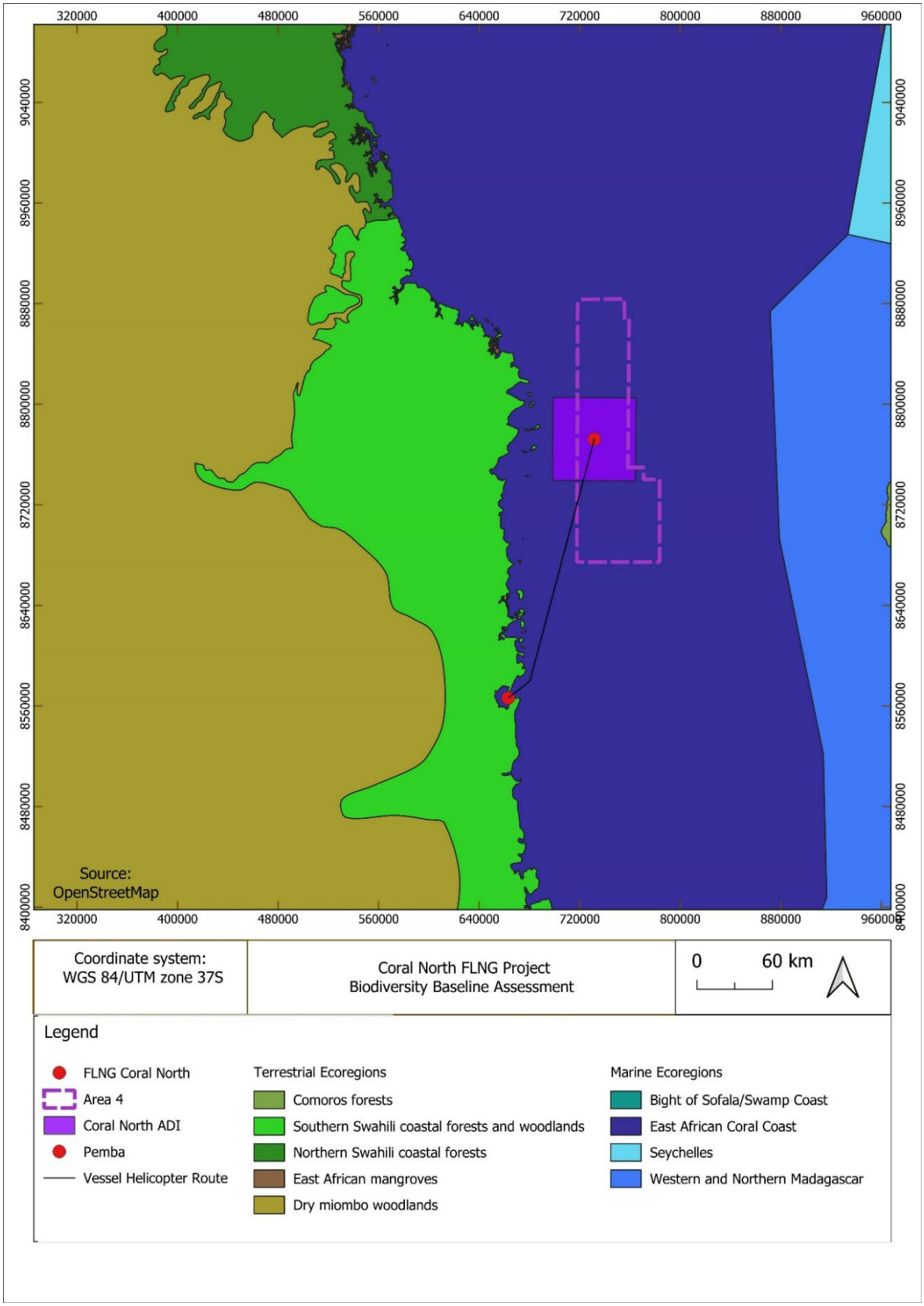


Figure 6.29: Ecoregions in the study area

Near the Project's region, priority sites for biodiversity conservation include the Nacala-Mossuril area and the Primeiras and Segundas islands (Figure 6.28), both classified as important at the ecoregion level. Important habitats in this region include sand beaches, mangroves, forests, river deltas, seagrass beds, rocky shores, mud flats, islands, coral reefs, and open waters. The Nacala-Mossuril area, an area of ecoregional importance, is characterised by a high diversity of habitats, including mangroves of eight different species, sandy beaches, rocky beaches, and coral reefs. The sandy beaches nest two species of marine turtles: green turtle and hawksbill turtle. Whales and dolphins are common in the area and local coral reefs are said to have high diversity of reef fish, gastropods and various macroalgae.

The West Madagascar marine ecoregion is located 145 km east. The Central and Eastern Miombo Woodlands, a terrestrial ecoregion, is located about 200 km west of the Coral North project site (Figure 6.28).

Primeiras e Segundas islands (Baixo Pinda - Pebane) are also considered an EBSA (Ecologically or Biologically Significant Marine Areas), that correspond to the areas described as meeting the EBSA criteria at the CBD Southern Indian Ocean Regional Workshop in Flic-en-Flac, Mauritius, 31 July to 3 August 2012 (Secretariat of the Convention on Biological Diversity, 2016). Baixo Pinda is situated in the Memba district, north of Nacala, and stands as the most exemplary representation of a distinctive coastal region in Mozambique, characterized by intricate lagoons and intertidal zones. This region harbours unique fisheries and is home to an endemic macroalgae species, *Kapaphycus alvereii*. Furthermore, there are several canyons located off Nacala and Ilha de Moçambique.

In addition to the Primeiras and Segundas islands, the project area encompasses the Mozambique Channel, the North Mozambique Channel, and Pemba Bay – Mtwara (all considered an EBSA) (Figure 6.30). The Mozambique Channel is bounded by the oldest coastlines and seabed of the Indian Ocean and marks the first stages in the tectonic movements that created the ocean and the Quirimbas Archipelago, a string of coastal islands extending from Pemba Bay in northern Mozambique, spanning 400 kilometres from the Ruvuma estuary to the Mtwara-Mnazi Bay reef system in southern Tanzania. This archipelago boasts the highest coral diversity (recorded in western Indian ocean along with northern Mozambique) featuring nearly 300 species across 60 genera. It is home to charismatic species such as turtles, dugongs, and elephants, along with numerous rare and endemic plant species.

There are no RAMSAR or UNESCO heritage sites within the study area or in its surroundings (within 100 km of the study area). The Quirimbas National Park is a candidate to Biosphere Reserve, under the regulations of UNESCO.

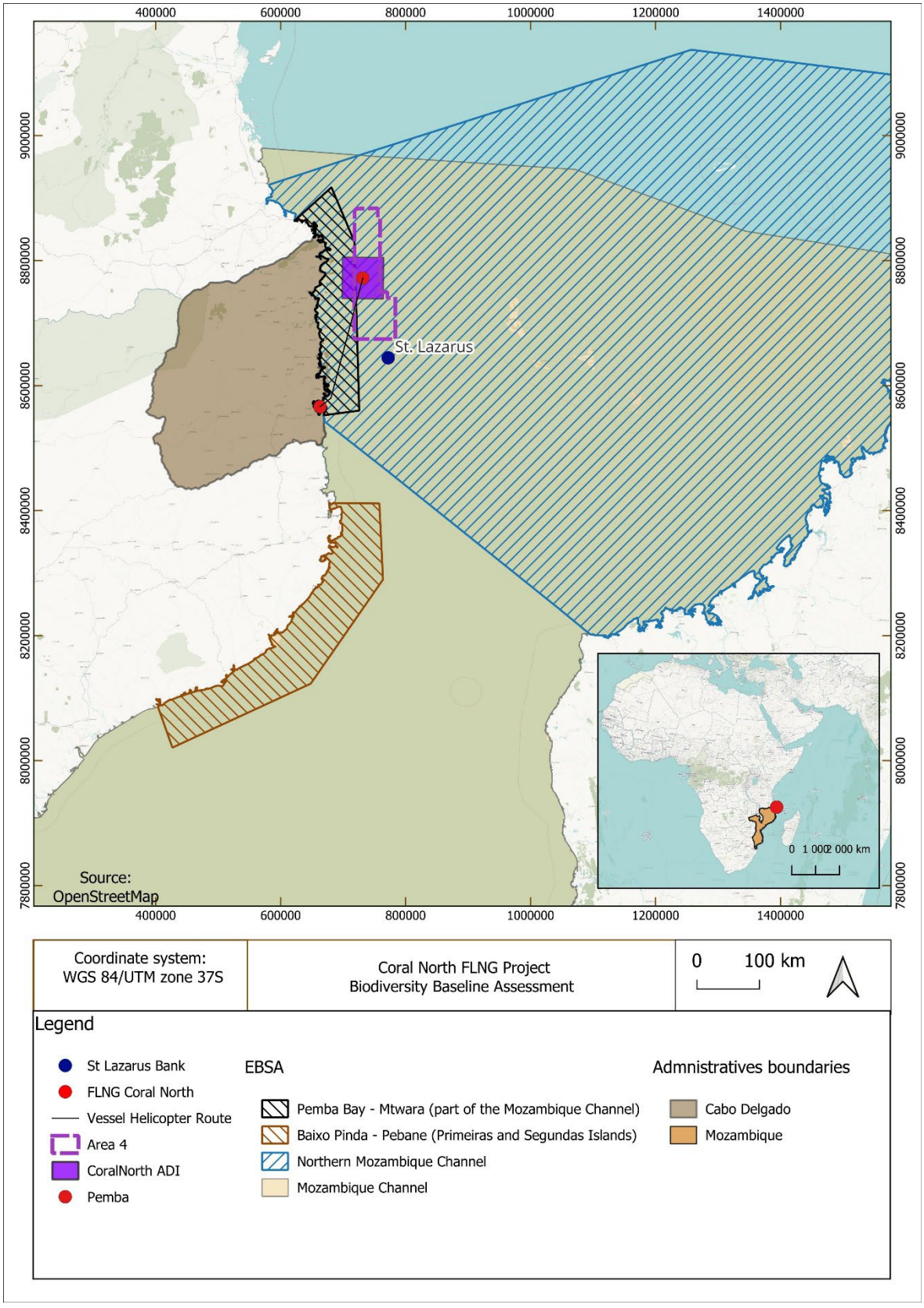
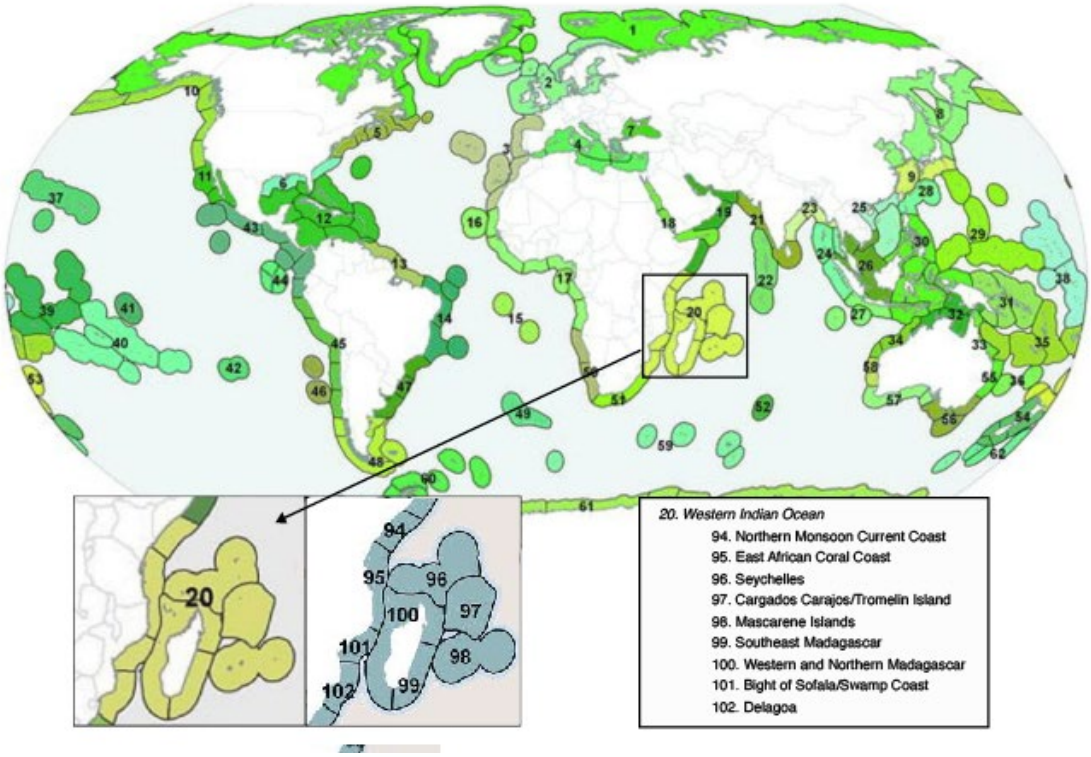


Figure 6.30: EBSAs in the ADI and surroundings

6.9.2 Deepwater Environment

6.9.2.1 Regional Framework

This project site and Area 4 lies within the EAME (WWF, 2004), also known as East Africa Coral Coast (EACC) of the Western Indian Ocean (WIO) Province (Spalding *et al*., 2007), where the South Equatorial Current (SEC) and unique oceanographic features of the Mozambique Channel meet the mainland African coast. Figure 6.31 shows the map of world marine ecoregions and the position of EAME where Area 4 lies. While most of the argument for considering the area as of extraordinary importance for biodiversity and marine ecology lies in features and characteristics of the inshore habitats and the species therein, the offshore environments are also of primary importance.



Source: Adapted from Spalding *et al*. (2007).

Figure 6.31: Map with Provinces and Ecoregions of the world. Highlight is made for Province 20 (WIO) and Ecoregion 95 (EACC)

Firstly, offshore areas host important species such as marine mammals and turtles, as well as deep-sea assemblages such as cold-water corals. Secondly, most inshore species such as fish (vertebrates), corals and other invertebrates have a sensitive dispersive larval phase that is spent in offshore waters, especially where the continental shelf is narrow, as it is the case.

According to Obura *et al.* (2012), the northern Mozambique coast or the "Quirimbas-Mnazi Bay Complex" is unique in the WIO and globally, particularly as it acts as critical node to supplying marine organisms to the East African coast (Kenya, Tanzania, Mozambique, and northern South Africa). Either the entire system, or key locations within the region, could form a potential nomination for World Heritage listing. Other sites in the region either have similar (North Madagascar) or lower-diversity communities of similar types as the Quirimbas-Mnazi Bay Complex. However, its

oceanography and coastline interactions are unique, and biodiversity at the highest level, establishing it as a critical zone for biodiversity conservation.

The potential outstanding universal values for the declaration as a World Heritage include the following criteria (Obura *et al*., 2012):

- Criterion VIII – Geology and oceanography - the northern Mozambique coast experiences extremely high mixing due to cyclonic and anticyclonic eddies generated in the north of the Mozambique Channel, and is defined by breakpoints to the north, where the EACC touches the Tanzania coastline flowing north all year, and to the south where the narrowest part of the Mozambique Channel induces changes in currents and upwelling features on the Mozambique coast;
- Criterion X – Habitats and Conservation – (1) Coral reefs: the Quirimbas – Mnazi Bay complex hosts the highest diversity of corals in the region, together with the upper northwest coast of Madagascar, with over 300 species. (2) Mangroves: the complex hosts some of the best mangrove stands in the WIO in complex bay, channel, and estuarine conditions. (3) Connectivity: the high levels of connectivity make this coastline a critical source and refuge for the dispersal and maintenance of reef diversity to downstream areas to the north and south on the mainland coasts, and to the east side of the Mozambique Channel;
- Criterion IX – Ecology, species, and evolution – (1) Diversity: the complex is a critical node for accumulation and dispersal of marine organisms. (2) Fish: the highest fish diversity in the WIO, with high abundance found in deeper waters such as the St Lazarus bank (3) Turtles: notable nesting site for greens and hawksbills and foraging ground for olive ridleys, loggerheads and leatherbacks. (4) Marine mammals: important humpback whale mother/calf nursing zone. (5) Sharks and Rays: a superlative reef shark site between Vamizi/Metundo islands shows the influence of variable currents in aggregating the sharks, and in protecting them from anthropogenic exploitation. (6) Birds: high densities of migrating crab plovers, and breeding populations of varied birds on remote islands and rocks.

The interest of the area and the international recognition led the Mozambican authorities to address the Quirimbas-Mnazi Bay Complex and proposed the establishment of a transfrontier park encompassing the Palma District and linking it to the Mnazi Bay Ruvuma Estuary Marine Park in Tanzania (Bandeira *et al.*, 2007). This proposal, however, was never formally adopted and it is unclear if it is still being pursued by the Mozambican government.

6.9.2.2 Pelagic Zone

Plankton

Plankton can be broadly described as organisms that float within the water column, although many of them have the ability to swim independently. Phytoplankton, a subset of plankton, are typically characterized as small photosynthetic protists, often ranging in size from 20 µm to 200 µm. However, dinoflagellates and microflagellates also belong to this category, even though some of them are non-photosynthetic (Hoppenrath *et al.,* 2009). In contrast, zooplankton, another vital component of planktonic communities, consists of a diverse array of small to microscopic animals that inhabit the water column. These organisms serve as both primary consumers within the marine food chain and, in the case of meroplankton, as the juvenile life stages of several commercially important species (Sommer, 2012).

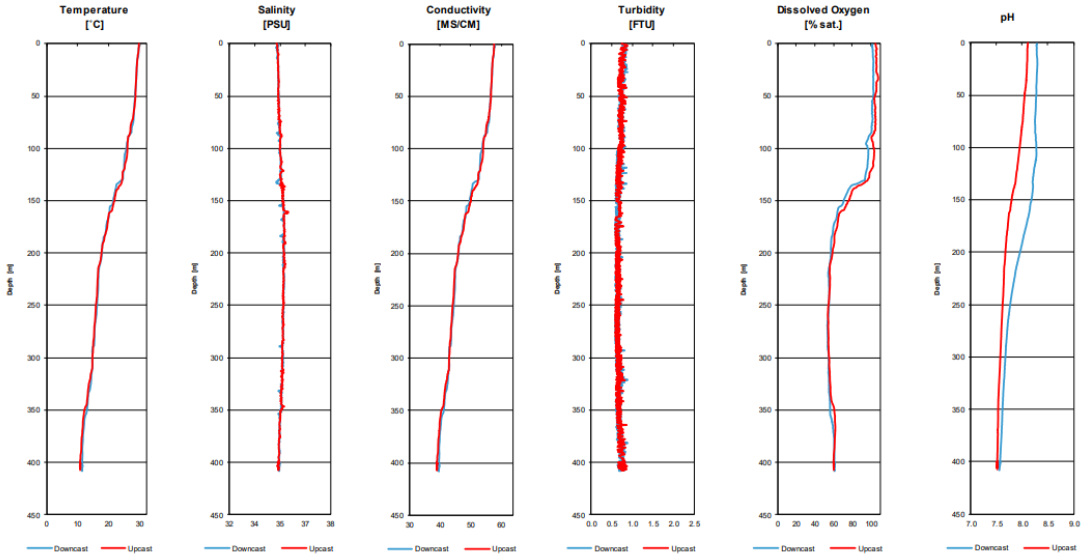
Studies on plankton in the northern Mozambican coast, within the Coral North FLNG region, are relatively scarce. Notably, recent research efforts have primarily focused on potential oil and gas development such as like the Coral South FLNG and the Mamba Field (Fugro, 2016a, 2016b, 2019a).

One of the earliest plankton investigations in the Mozambique region dates to 1979 when Saetre & da Silva conducted acoustic surveys during the Dr. Fridtjof Nansen cruise (Saetre & Silva, 1979). According to their findings, plankton distribution exhibited an irregular pattern with higher plankton abundance in proximity to the continental shelf, particularly around the shelf break, with a gradual decrease in plankton density as the ocean depths increased. Their work suggested that the frequent presence of tuna schools might serve as an indicator of high productivity within the water mass. Subsequent studies have indirectly supported this hypothesis by examining the dietary contents of fish preyed upon by tunas (e.g., Roger, 1994a; 1994b).

The Area 4 specific surveys (Fugro 2016a, 2016b, and 2019a) showed temperature and salinity data similar to the ranges noted in Saetre and Silva's (1979), along with other parameters such as dissolved oxygen, turbidity, and light penetration. Understanding these water profiles is crucial for comprehending the dynamics of the plankton community and its relationship with the surrounding environment.

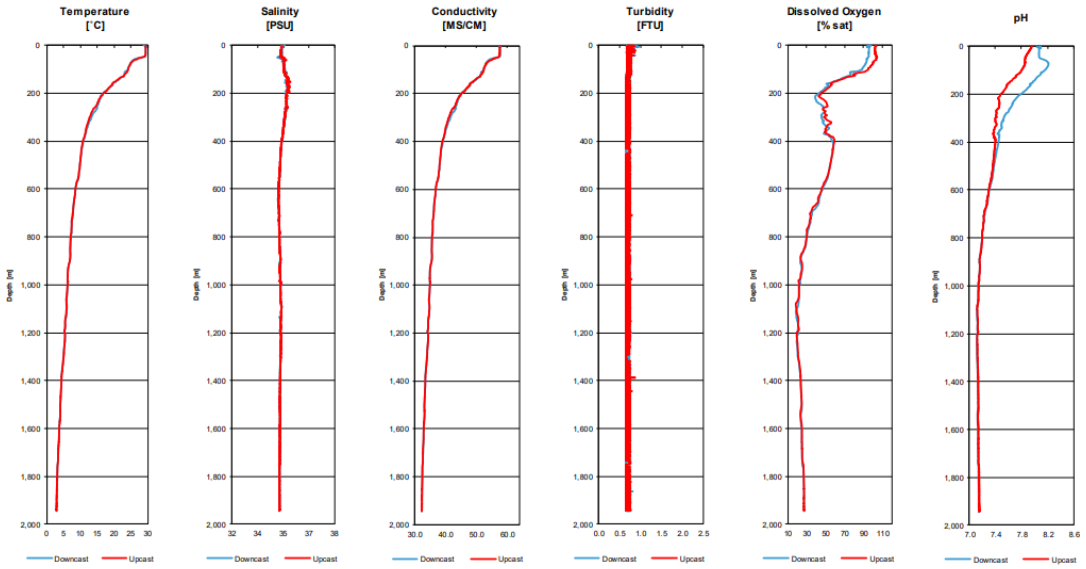
These data highlighted significant trends in water column parameters, linked to the Mozambique Channel's influential water bodies. The 2016 and 2019 wet season survey in Area 4 noted a well-mixed surface water, which extended to approximately 60 m depth during the survey with rapid cooling and decreased salinity due to Sub-Tropical Surface Water (STSW) and Equatorial Surface Water (ESW). Beyond 600 meters, a slower cooling rate and slight salinity increase occurred, influenced by Antarctic Intermediate Water (AIW). Below 1500 meters, stability in temperature and parameters was due to North Atlantic Deep Water (NADW) extending to the seafloor.

The water column profiling revealed stratification in intermediate and deepwater areas from approximately 30ºC in the surface waters to 15ºC at 150 to 200 meters (base) (Figure 6.32 and Figure 6.33). A clear interface appeared between water bodies, especially between the thermocline's base and 400 meters, potentially indicating STSW and ESW mixing.



Source: Fugro (2019a).

Figure 6.32: Vertical water profiles of temperature, salinity, conductivity, turbidity, dissolved O2, and pH at a station in intermediate water depths (< 500 m) of the Environmental Baseline Survey Report of the Coral and Rovuma gas fields in Area 4



Source: Fugro (2019a).

Figure 6.33: Vertical water profiles of temperature, salinity, conductivity, turbidity, dissolved O2, and pH at a station in deepwater depths of the Environmental Baseline Survey Report of the Coral and Rovuma gas fields in Area 4

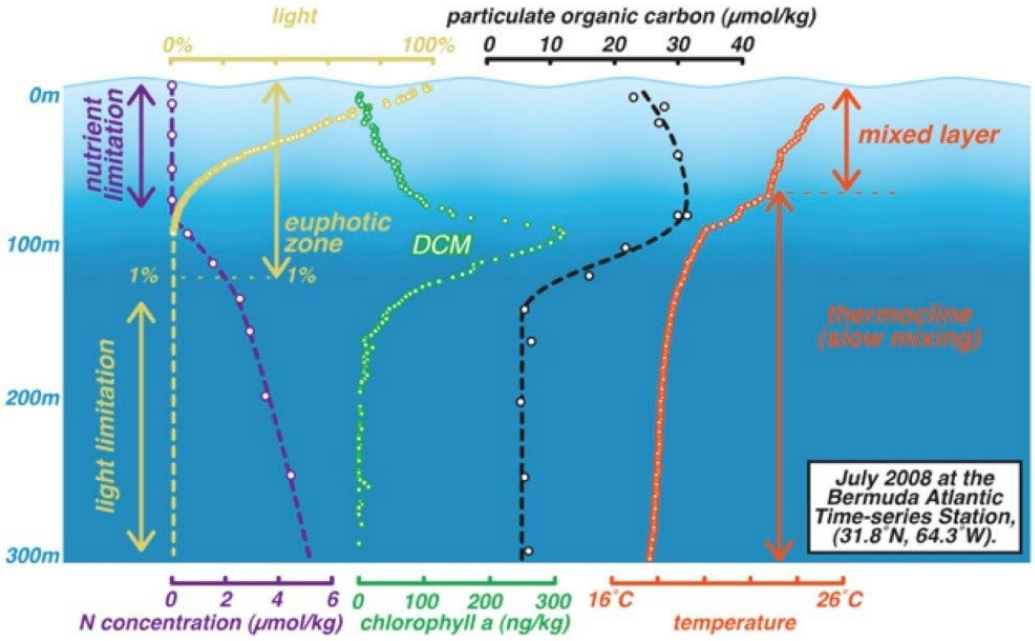
In Mozambique's low-productivity waters, chlorophyll levels typically remained below 0.5 mg/L. Studies indicate that the northern Mozambique Channel experiences a distinct phytoplankton bloom season, occurring from December to March and peaking in July and August. Upwellings associated with gyre systems can also result in variability of chlorophyll concentrations with anti-cyclonic eddies associated with low chlorophyll concentrations (Fugro, 2019a).

The chlorophyll profile aligns with the general model of nutrient-limited surface waters, with a chlorophyll maximum at the base of the thermocline, which is characteristic of subtropical waters.

This pattern is illustrated in Figure 6.34 and has also been observed in similar projects within the region (Olsen et al., 2009). The thermocline, which represents a vertical temperature gradient, plays a significant role in stratifying the upper water column.

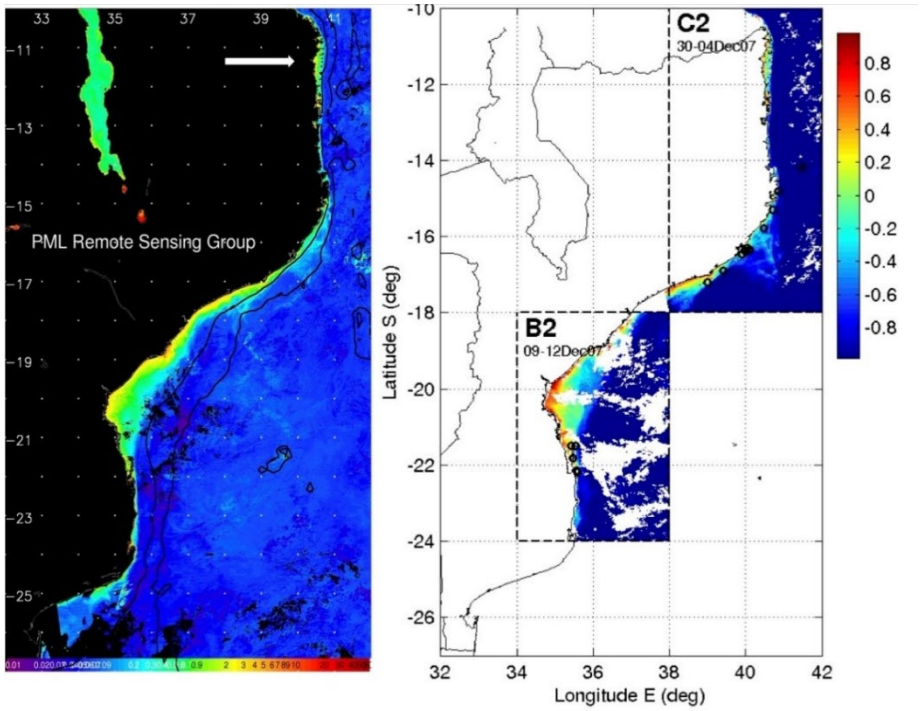
The distribution of primary production along the coast of Mozambique is determined by an interaction of forcing factors, including shelf morphology, land drainage and interaction of offshore eddy systems with the shelf. The largest productive area lies at Sofala Bank in mid-Mozambique, associated with the Zambezi River (Sá *et al.*, 2013). Moving north to the Cabo Delgado Province, primary production remains relatively high in the inshore waters between the coastline and the Quirimbas Islands and experiences a rapid decline due to the narrow continental shelf (Sá *et al.,* 2013) (Figure 6.35).

Moreover, an examination of phytoplankton components using satellite imagery reveals that the prevailing phytoplankton type in north Mozambique is picoplankton (Sá *et al.,* 2013). This fraction, predominantly comprised of Prochlorococcus and Synechococcus, is characteristic of offshore oceanic waters with limited nutrient resources, particularly in tropical and sub-tropical regions featuring warm waters (Figure 6.36).



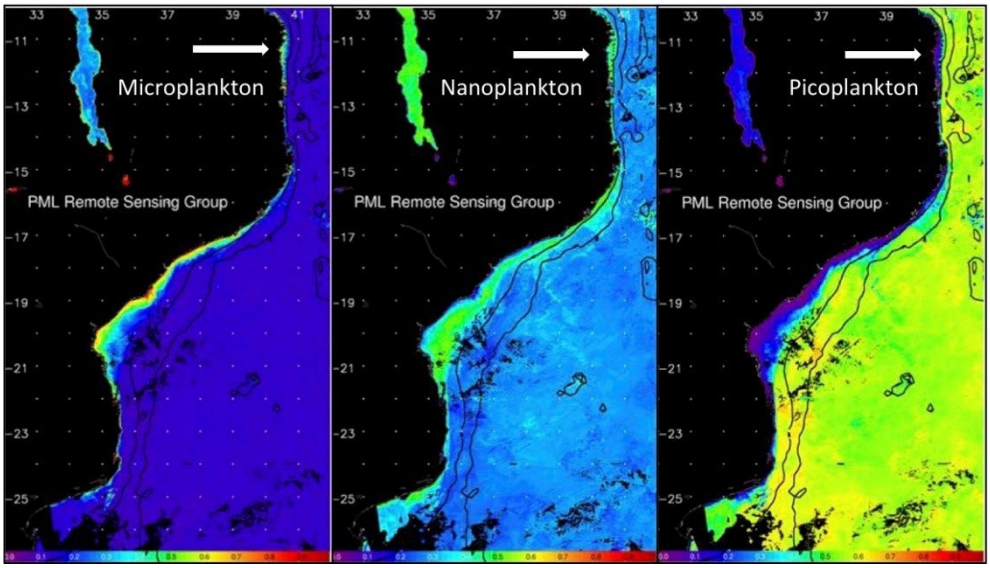
Source: Sigman & Hain (2012). Note: The data shown is made available by the Bermuda Institute of Ocean Sciences (http://bats.bios.edu) and the Bermuda Bio Optics Project (http://www.icess.ucsb.edu/bbop/).

Figure 6.34: Typical conditions in the subtropical ocean, as indicated by data collected at the Bermuda Atlantic Time-series Station in July 2008



Source: Sá *et al*. (2013), adapted from PML Remote Sensing Group.

Figure 6.35: (Left) Total pigments along the Mozambique coast from satellite imagery during the Fridtjof Nansen cruise of 2007, and (right) corresponding to a Moderate Resolution Imaging Spectroradiometer image



Source: Sá *et al*. (2013), adapted from PML Remote Sensing Group.

Figure 6.36: Decomposition of phytoplankton fractions along the Mozambique coast from satellite imagery during the Fridtjof Nansen cruise of 2007

The 2019 *in situ* observations in Area 4 found a phytoplankton composition similar to previously reported inshore communities within the Mozambique Channel (Fugro, 2016a; 2016b; 2019a). Several taxa have also been documented in the region by Sá *et al.* (2013), including diatoms like *Chaetoceros* spp. and *Pseudo-nitzschia* spp. Additionally, six of the top ten most abundant taxa observed in the 2019 survey matched findings from earlier assessments in 2016 (Table 6.17).

Table 6.17: Comparative analysis of phytoplankton taxa abundance in Area 4

Area 4 (Fugro, 2019)	Mamba Field 2016 (Fugro, 2016a)	Coral Field (Fugro, 2016b)
Microflagellates spp.	**Microflagellates spp.**	**Microflagellates spp.**
Cyanobacteria indet.	*Ceratoneis closterium*	Oscillatoriales
***Chaetoceros* (Hyalochaetae)**	***Pseudo-nitzschia*** (< 5 µm)	*Ceratoneis closterium*
***Pseudo-nitzschia* spp.** (4.9 µm)	***Pseudo-nitzschia*** (> 5 µm)	Dinophyceae naked (< 20 µm)
Leptocylindrus cf. danicus	**Other phytoplankton**	Heterocapsa sp.
***Bacteriastrum* spp.**	Oscillatoriales	**Indet. raphiated pennate spp**. (< 20 µm)
Dactyliosolen fragilissimus	**Chaetoceros (Hyalochaetae)**	**Chaetoceros (Hyalochaetae)**
Other unidentified taxa	***Bacteriastrum spp.***	***Pseudo-nitzschia*** (< 5 µm)
Indet. raphiated pennate spp. (< 20 µm)	Dinophyceae armoured (< 20 µm)	**Other phytoplankton**
Phaeocystis spp.	**Indet. raphiated pennate spp.** (< 20 µm)	Gyrodinium sp. (< 20 µm)

Notes: Taxa **in bold** = reported within the top ten most abundant taxa in both the current survey and other surveys in the area

Microflagellates, a diverse group of unicellular, phagotrophic eukaryotes that cannot be differentiated under light microscopy, dominated all surveys. The phytoplankton community displayed significant diversity, with variations in plankton density decreasing with depth in the water column. Notably, near-shore waters featured substantially elevated phytoplankton levels, particularly microflagellates and the centric diatom Chaetoceros (subgenus Hyalochaete), compared to offshore samples. This variation in phytoplankton communities near the coast is likely influenced by coastal slope-upwelling events due to the proximity of these sampling stations to the canyons (Fugro, 2019a).

Zooplankton, as primary consumers within marine ecosystems and, in the case of meroplankton, essential juvenile life stages, play a pivotal role in marine food chains. The zooplankton community exhibited similarities to previously reported communities within the Mozambique Channel (Table 6.18) (Huggett, 2014; Fugro, 2016a; 2016b).

In an earlier study conducted by Huggett (2014), the Mozambique Channel's zooplankton community appeared to be primarily dominated by copepods, as documented in the Area 4 2019 survey, with copepods comprising 76.8% of the observed community (Huggett, 2014; Fugro, 2019a). Copepod crustaceans, widely and globally distributed in aquatic environments, play a predominant role in zooplankton communities, functioning as both herbivores and carnivores, displaying distinct behaviours depending on their taxonomic classification, and exhibiting complex life cycles (Sommer, 2012). The survey identified several copepod groups, including *copepod nauplii* (the larval stage of copepods), calanoid copepods (specifically Calanoida and those from the family Paracalanidae), cyclopoid copepods (particularly those from the family Corycaeidae and genus *Oithona* and *Oncaea*), and harpacticoid copepods of the Microstella genus. These copepod taxa consistently ranked among the top ten most abundant in the area's datasets (Table 6.18) (Fugro, 2019a, 2016a, 2016b).

In addition, solitary, free-swimming tunicates belonging to the class Appendicularia, commonly referred to as larvaceans, were notably prevalent among the top ten most abundant taxa across

datasets. Appendicularians are ubiquitously distributed in the world's oceans and often exist in substantial numbers. They construct gelatinous structures known as 'houses' to filter food particles from the water column. These 'houses,' along with the appendicularians themselves, constitute a significant source of marine snow and play a vital role in the marine food web. They accumulate small particulate matter, which is subsequently consumed by carnivorous zooplankton, contributing to energy transfer within oceanic ecosystems (Gorsky & Fenaux, 1998).

Table 6.18: Comparative analysis of zooplankton taxa abundance in Area 4

Area 4 (Fugro, 2019)	Mamba Field 2016 (Fugro, 2016a)	Coral Field (Fugro, 2016b)
Calanoida	***Oithona* sp.**	*Conchoecia sp.*
Oithona	**Calanoida**	***Oncaea sp.***
Paracalanidae	***Oncaea sp.***	**Calanoida**
Oncaea sp.	**Paracalanidae**	***Oithona sp.***
Copepoda nauplius	***Copepoda nauplius***	**Paracalanidae**
Creseis	*Calocalanus sp.*	**Appendicularia**
Appendicularia	**Gastropoda juvenile**	***Copepoda nauplius***
Gastropoda juvenile	**Appendicularia**	**Corycaeidae**
Corycaeidae	**Corycaeidae**	*Calocalanus sp.*
Microsetella sp.	***Microsetella sp.***	***Microsetella sp.***

Notes: Taxa **in bold** = reported within the top ten most abundant taxa in both the current survey and other surveys in the area.

Similar to the phytoplankton community composition, the zooplankton community in shallower near-shore waters exhibited elevated abundances, notably of copepods and free-swimming tunicates, in contrast to offshore samples (Fugro, 2019a, 2016a, 2016b). This spatial variation in zooplankton diversity can be partially attributed to differences in water depths between the eastern and western regions of the Area 4 survey area, with lower zooplankton densities collected through the larger volumes of water sampled in the eastern region.

Nekton

Nekton (or swimmers) are living organisms that are able to swim and move independently of currents. Nekton are heterotrophic and have a large size range, comprising most pelagic fish and cephalopods, among others. Nekton are usually pelagic, living in the water column, but some are demersal and live close to the bottom, both in the coastal and oceanic habitats (Kress, 2019).

Mesoscale and sub-mesoscale oceanographic features (resulting in enrichment processes through localized upwelling of deeper nutrient-rich waters as well as entrainment of high Chlorophyll-a concentration coastal waters by the eddies in their southward progression; Tew-Kai and Marsac, 2009; Roberts *et al*., 2014) alongside with eddies rotation as well as eddy-eddy interactions were found to affect the occurrence and pattern of aggregation of micronekton (Sabarros *et al.*, 2009; Béhagle *et al.*, 2014) in Mozambique Channel. The exchange mechanisms between the shelf and open water have been suggested to support the production of micronekton organisms, i.e., small fish, cephalopods, and crustaceans which are the main prey of top predators (Roger, 1994; Ménard *et al.*, 2014; Chassot *et al.*, 2019).

A study conducted in the Mozambique Channel reported that eddies running along the coast advect coastal nutrient-rich waters at their edge, supporting the base of the food chain. Moreover, the authors proposed that eddies can shape the distribution and the aggregation patterns of the prey of marine top predators through bottom-up processes (Sabarros *et al.,* 2009).

The Mozambique Channel is of particular importance for top predators with the most abundant species comprising tuna, billfish, and sharks. The Channel is recognized as a key feeding area for tropical tunas and a major spawning area for skipjack tuna (*Katsuwonus pelamis*) (Chassot *et al.*, 2019).

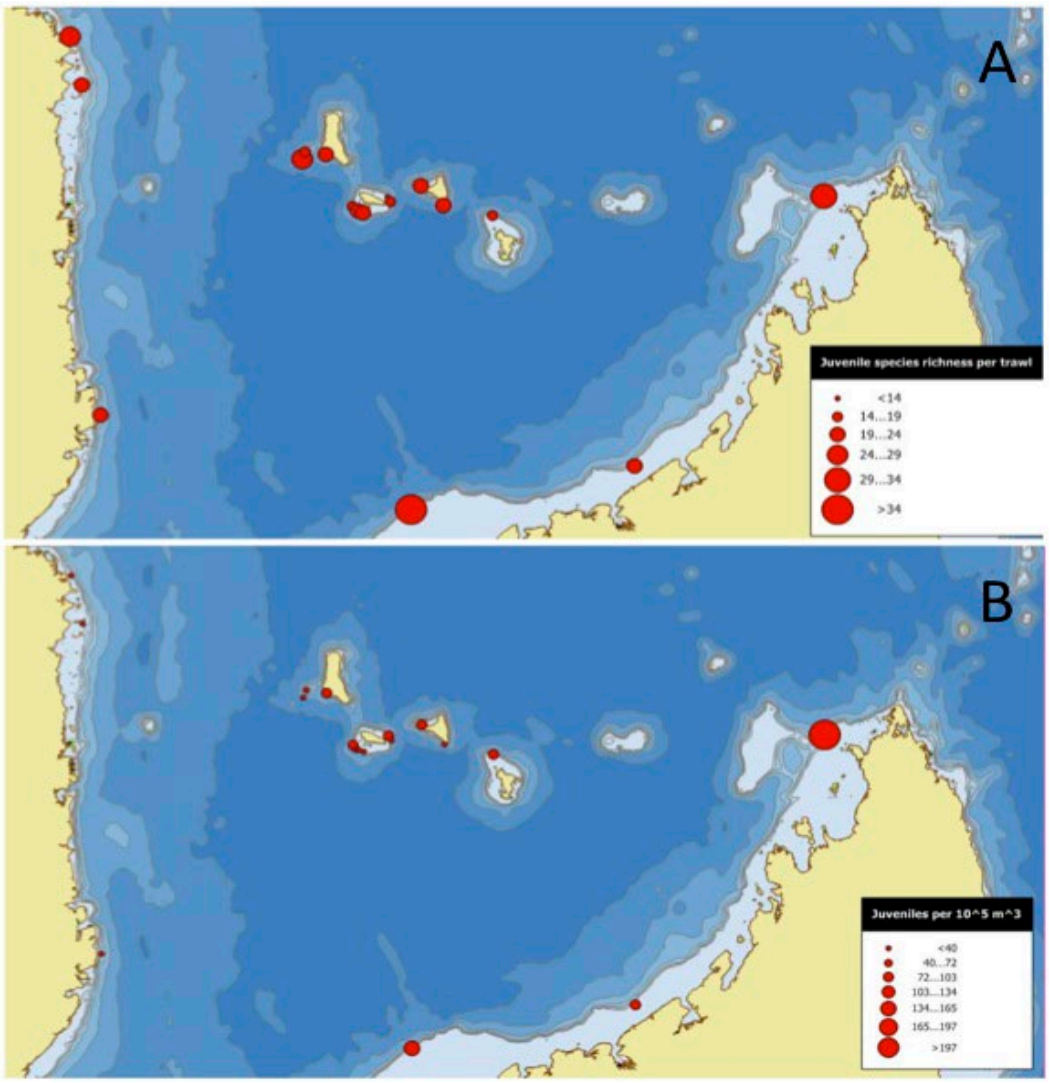
During the pelagic and deep-water trawls carried out in 2009 in northern Mozambique during the cruise of the research vessel Fridjot Nansen, four shark species were recorded, namely (*Carcharhinus falciformes*, *Carcharhinus sorrah*, *Heteronarce garmani* and *Sphyrna lewini*, as well as two species of rays (*Mobula*. sp. and *Raja lanceolata*) (Olsen *et al.*, 2009).

Rays from the Rhinobatidae, Mobulidae, Dasyatidae, Miliiobatidae families and Stomiiformes order have been observed in more coastal waters within the project area. Manta rays (*Manta* spp.) are also known to frequent the pelagic environment in the region.

Carnivorous shark species inhabit the pelagic and mesopelagic environment, as well as the deep areas of the ocean, predating on large fish. Sharks of the Hexanchidae and Heterodontiformes Families (Bullhead sharks) and the Squaliformes (Family Squalidae), Carcharhiniformes and Squatiniformes are common in these environments. Pelagic shark species likely to occur in the study region include the whale shark (*Rhincodon typus*), which is cosmopolitan although tends to frequent highly productive nearshore areas, where good sources of food (i.e., plankton) are found in areas of upwelling.

In 2009, the Comoros Gyre Fridtjof Nansen cruise also analysed the abundance and diversity of juvenile fish in a series of collecting stations from Madagascar to the Comoros and the north Mozambican coast (Roman *et al.,* 2009). Juvenile stages of fish were collected on or near the shelf of the Comoros, Mayotte, Madagascar, and Mozambique. Some 151 taxa were distinguished, photographed, and prepared for bar-coding and identification. The taxa ranged from species with potential commercial importance such as scombrids (2 or 3 tuna species), anchovies and carangids (10 kingfish species) to coral reef inhabitants such as parrotfish, rock cods and surgeon fish.

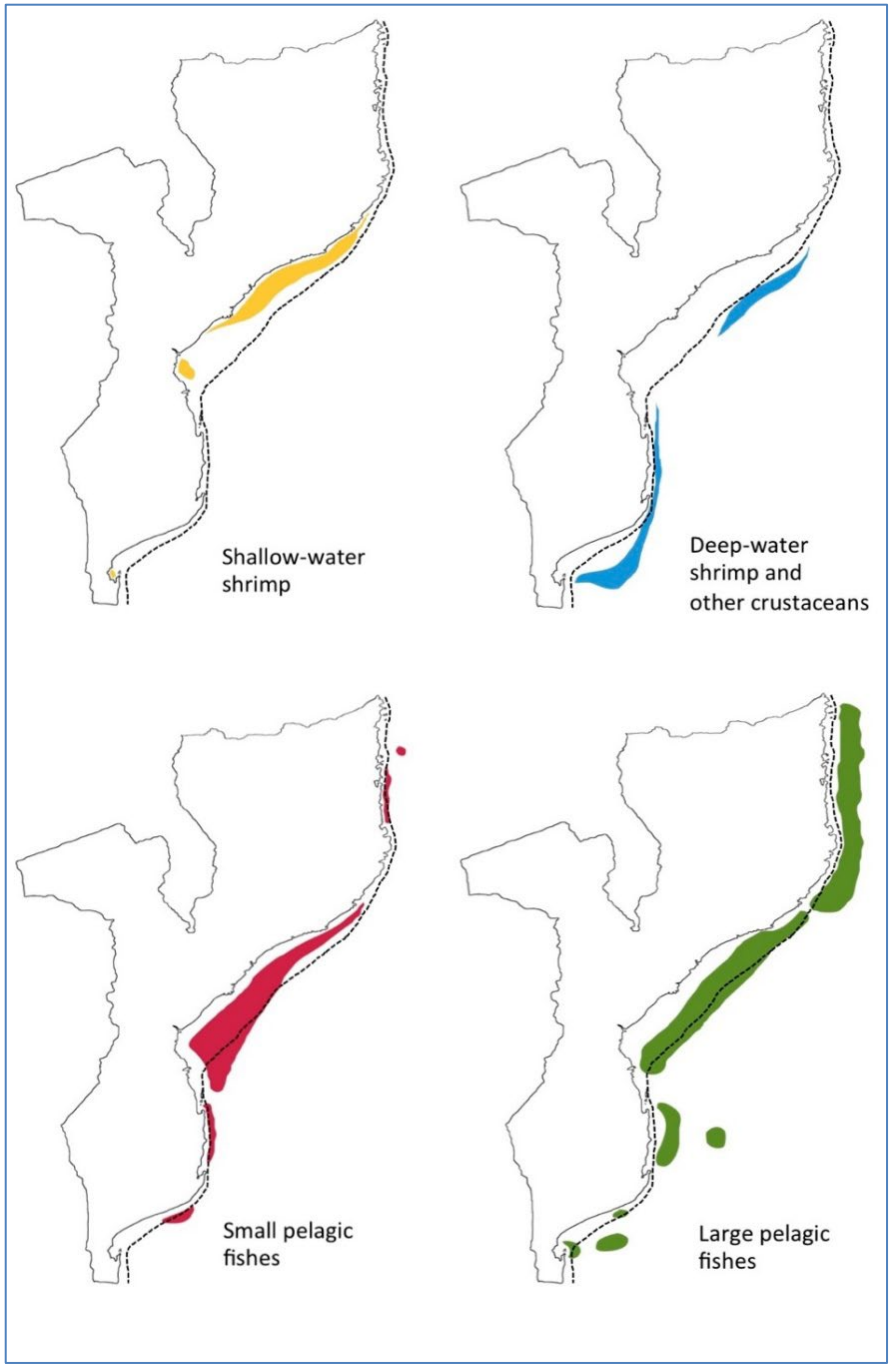
Juvenile species richness, distribution, and abundance data is limited. Nonetheless, the number of species caught in each trawl did not vary dramatically between locations (Figure 6.37), although the number of individuals per unit volume of water varied more dramatically. The highest densities of juveniles were generally caught along the Madagasi shelf, with fewer being observed in the Comoros region and the lowest overall abundances along the northern Mozambique coast. At the time of the cruise, the eastern Comoros Basin was dominated by a cyclonic eddy, while the western part was dominated by a large anti-cyclone. Both physical and nutritional aspects of these features might have affected the survival and distribution of juvenile fish stages.



Source: Roman et al. (2009).

Figure 6.37: Horizontal distribution of diversity and abundance of juvenile fishes during the 2009 Comoros Gyre Fridtjof Nansen cruise

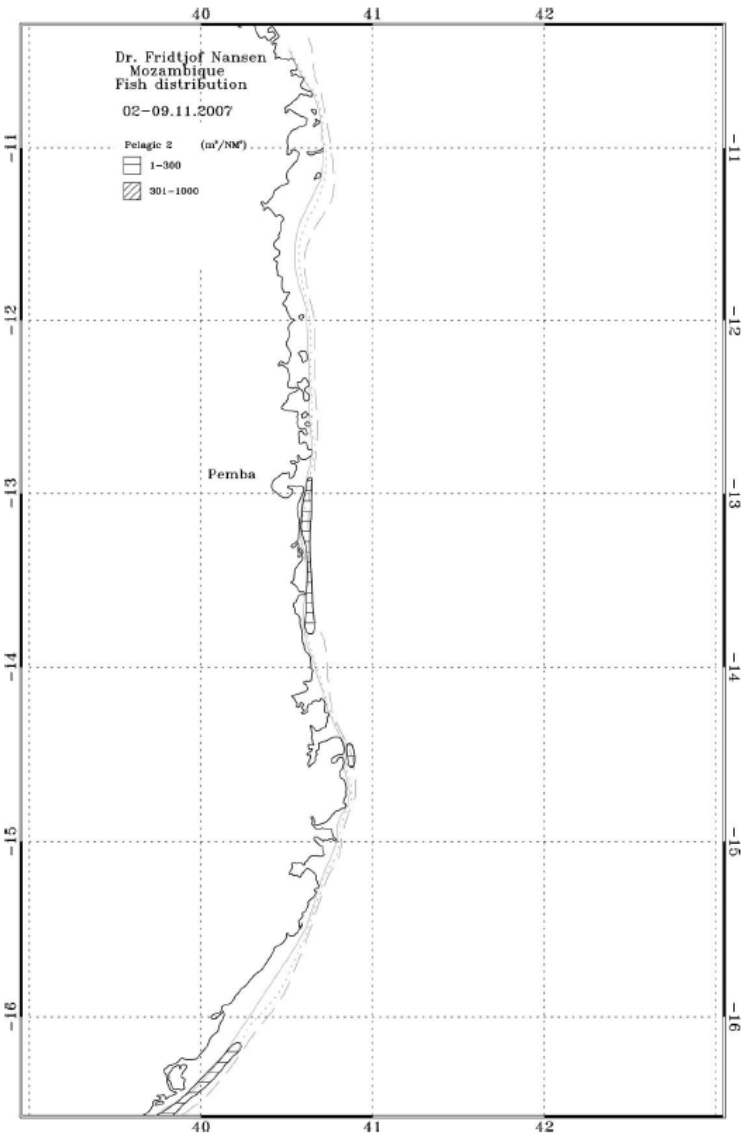
In the northern part of Mozambique, main fish include large species collected by the industrial fisheries sector (Figure 6.38). Small pelagic fish concentrate mainly around the St. Lazarus Bank, otherwise their capture is very limited in other areas of Cabo Delgado Province, according to MICOA (1998, *in* Paula & Cartaxana, 2009).



Source: Paula & Cartaxana (2009, from data by MICOA, 1998).

Figure 6.38: Location of main fishing grounds (including pelagic fish) along the Mozambican coast

A survey conducted in 2007 for living marine resources of North Mozambique (EAF-N2007/848 2007 Cruise) performed investigations on the fish of the area using acoustic methods and trawls. The results on the distribution of major fish families from the Pelagic 2 (PEL 2) acoustic category, which includes the Carangidae, Sphyraenidae, Trichiuridae and Scombridae families shows that these families were not significantly abundant in the northern Cabo Delgado area, only to the south of Pemba (Figure 6.39).



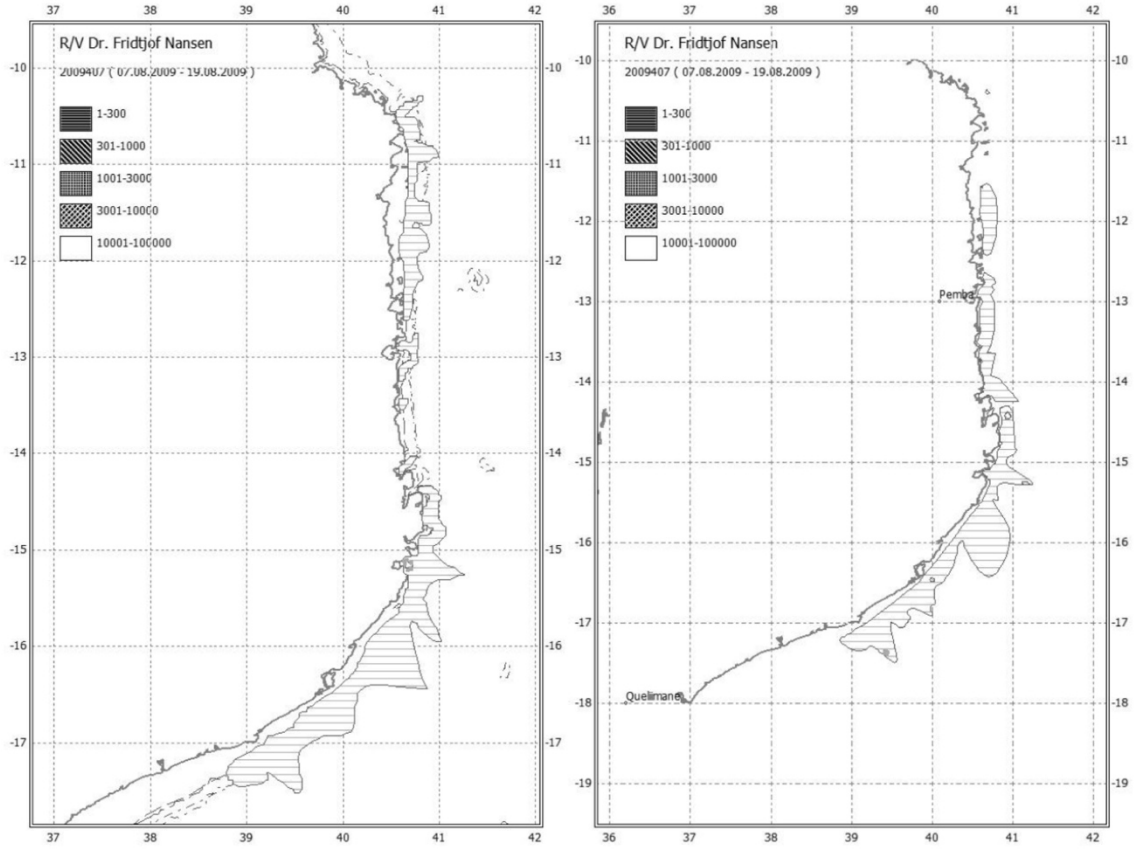
Source: Johnsen et al. (2008).

Figure 6.39: Distribution of the PEL 2 acoustic category (Carangidae, Sphyraenidae, Trichiuridae and Scombridae), during the Fridtjof Nansen cruise of 2007

The results from demersal trawl in the northern region shows that the mean catch rates of pelagic species were 4.7 kg/h or 1.8% of the total catch, while demersal species contributed 26 kg/h and 9.7% of the total catch. Shrimps, cephalopods, sharks, and rays contributed little to the total catch, with 0.1 kg/h, 1.0 kg/h and 1.5 kg/h respectively. Snappers and groupers contributed to 4.2% and 2.8% of the total catch respectively. The average catch rate of snappers was 11.2 kg/h and 7.5 kg/h for groupers. The dominant species group on the inner shelf was carangids, mainly *Decapterus russelli* with an average of 4.6 kg/h. Clupeids and barracudas were only caught in one trawl station, and each group had an average catch of only 0.1 kg/h. Neither scombrids nor hairtails were caught in the northern region.

The survey of marine resources of north Mozambique conducted in 2009 (SWIOFP/ASCLME 2009 Cruise 1) also performed the same type of investigations on the fish of the area, both by acoustic

methods and trawls. The survey results from acoustic categories shows that Clupeids are distributed along the northern Mozambican coast, with maximum concentration on the northern part of Sofala Bank, however also present in the most northern part in front of the Mocímboa and Palma districts. Other families such as Carangidae, Sphyraenidae, Trichiuridae and Scombridae did not present significant abundance in this area, but in any case, were more widely distributed than in 2007 (Figure 6.39).



Source: Olsen et al. (2009).

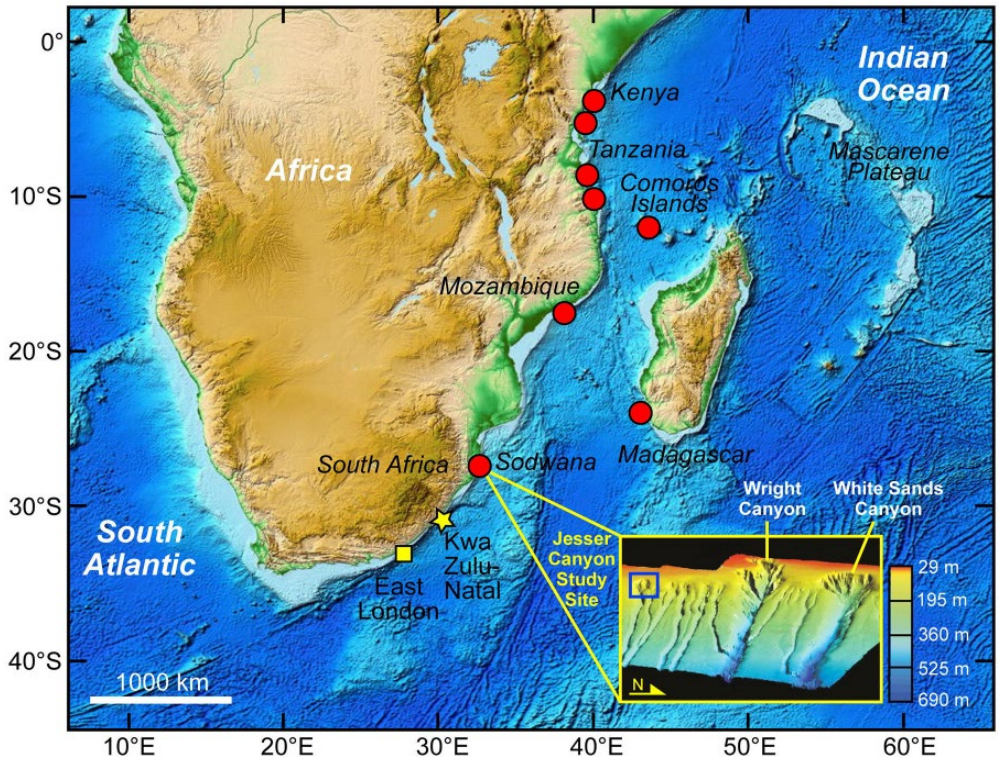
Figure 6.40: (Left) Distribution of the PEL 1 acoustic category (Clupeidae); (right) distribution of the PEL 2 acoustic category (Carangidae, Sphyraenidae, Trichiuridae and Scombridae), during the Fridtjof Nansen cruise of 2009

A more exhaustive list of fish present in the Mozambican waters can be found in Saetre & Paula e Silva (1979), Fisher et al. (1990), Johnsen et al. (2008), Olsen et al. (2009), and the main fishery resources in *the Boletim Estatístico da Pesca e Aquacultura* 2009- 2020.

Iconic Species – Coelacanth

The western Indian Ocean coelacanth (*Latimeria chalumnae*) is classified as Critically Endangered (CR) on the IUCN Red List and listed by CITES to restrict their sale for commercial gain.

The species have been observed by divers or underwater vehicles or caught by fishermen in the western Indian Ocean, including Mozambique waters (Sakaue *et al.*, 2021) although the fish has not been reported for the Cabo Delgado Province (Figure 6.41).



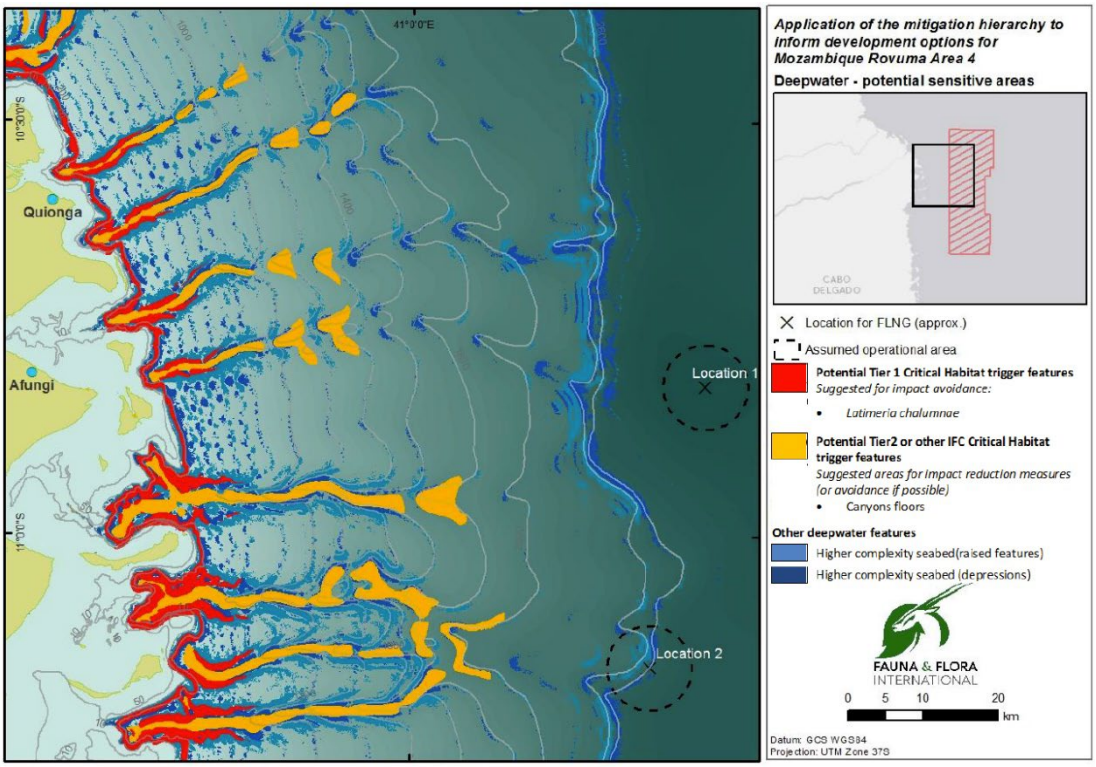
Source: Sakaue et al. 2021.

Figure 6.41: Bathymetric map of the western Indian Ocean region showing the areas where living coelacanths, *Latimeria chalumnae*, have been observed by divers or underwater vehicles or caught by fishermen (red circles)

Coelacanths are most commonly found on sloping continental shelves, below about 100 m depth, where bottom topography such as caves, and canyons and/or fissures leading into deep water provide shelter for them and habitat for their prey. In the East and West Mozambique channel, the species has been found in submarine canyons (Obura *et al.*, 2012).

The coelacanth's typical habitat is canyon walls at less than 700 m depth, together with a general depth range of 100m to 200m (Fauna and Flora International & Eni, 2003; Figure 6.42. Consequently, it is possible to infer that the coelacanth's habitat is much shallower than the 2,000 m water depth where the FLNG facility will be positioned. There is no recent published information on coelacanth distribution.

Since the late 80's when coelacanths were filmed from a submersible in the Comoros Islands (Fricke *et al*., 1987) the species knowledge has considerably increased. Genetic studies suggest there may be two distinct populations of coelacanth, (though this is not fully confirmed): a southern population centred on the Comoros and extending to southern Tanzania, and a northern population in Tanga, northern Tanzania. If true, the patterns show distinct signs of gene flow to the north, although not in the reverse direction, and the ranges of the populations are consistent with high connectivity throughout the Mozambique channel and unidirectional flow northwards in the East African Coastal Current (Obura *et al*., 2012). The genome sequencing of the African coelacanth, suggests that the coelacanth's genes evolved more slowly than those of other studied fishes and vertebrates, including shark's, possibly due to a stable environment and the lack of predation (Amemiya *et al*., 2013).



Source: Fauna and Flora International & ENI (2013).

Figure 6.42: Sensitivity map including the potential habitat for the coelacanth (in red)

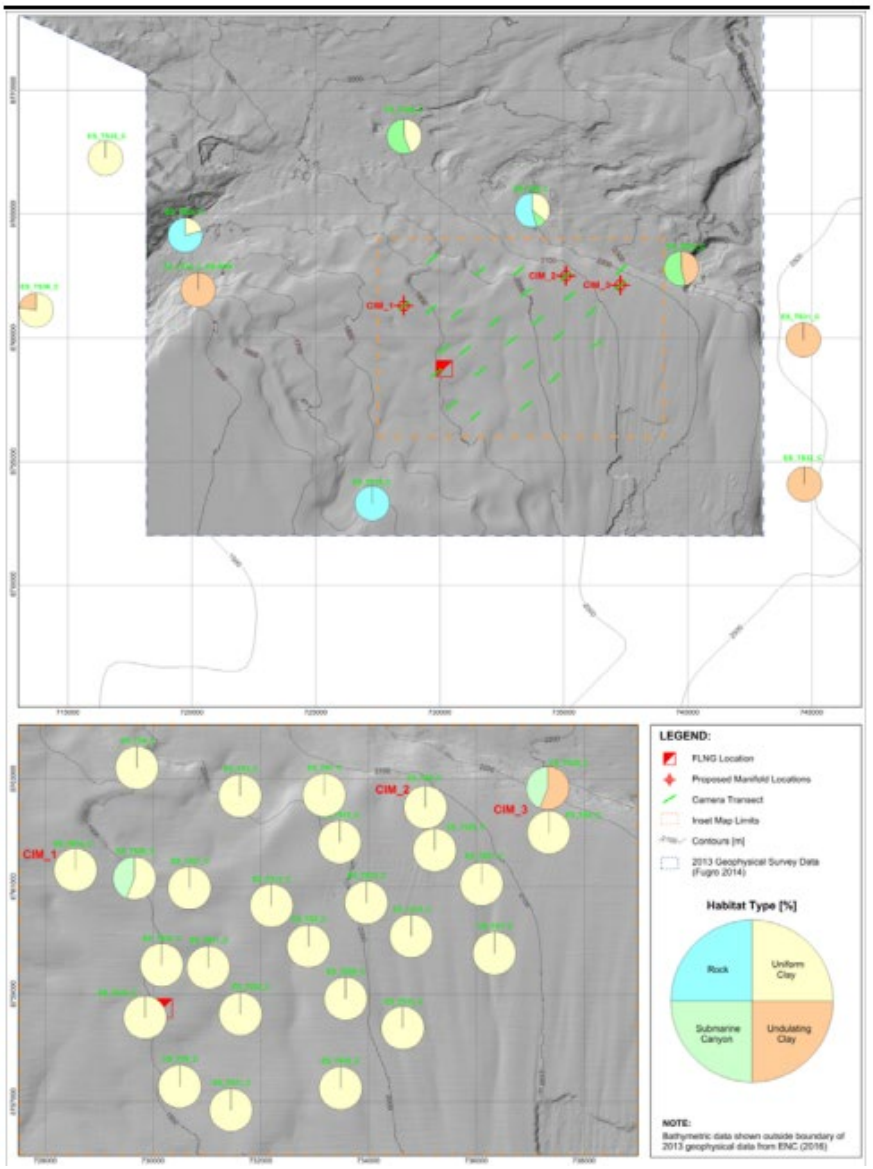
6.9.2.3 Benthos

Benthic Habitats

The Coral South FLNG OEBS included thirty-six camera transects, aimed at providing an extensive characterization of the area's benthic environment (Figure 6.43, Fugro, 2016b).

The survey results showed the presence of four distinct marine habitats within the study area with each habitats exhibiting specific biotope and species complexes based on the UK's Joint Nature Conservation Committee (JNCC) classification system (Connor, *et al*., 2004; Parry, *et al.,* 2015). Abyssal clay was the predominant surface sediment observed, often containing trace amounts of sand and gravel. Three distinct bedforms within clay seabed areas were identified: uniform flat clay habitat, clay habitat with undulating morphology, and a habitat characterized by steep-sided consolidated clay structures and cliffs associated with canyons. These habitats were mainly populated by xenophyophores, sea pens, and burrowing fauna (Fugro, 2016b).

The most prevalent habitat within the Coral survey area was the 'deep sea uniform clay' habitat, covering 71.9% of the total surveyed distance. This habitat was concentrated in the central part of the survey area and extended to proposed manifold locations. The other identified habitats, including 'deep sea undulating clay,' 'deep sea submarine canyon,' and 'deep sea rock,' were less widespread (Fugro, 2016b).



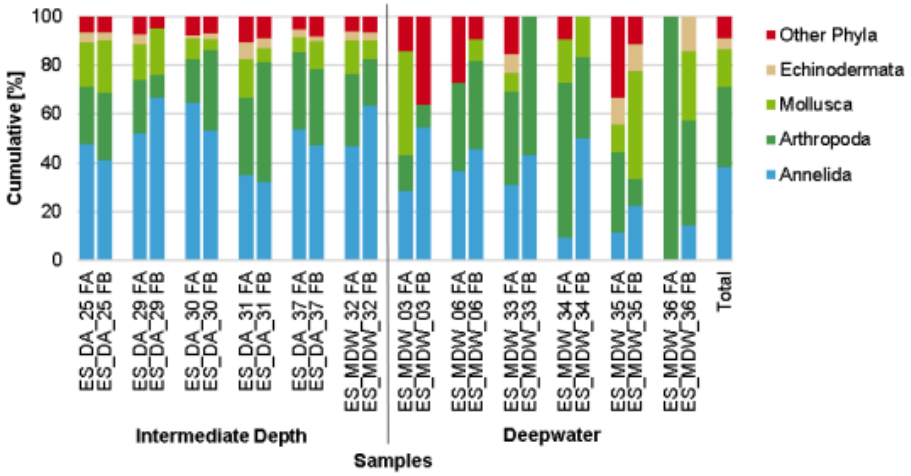
Source: Fugro (2016b).

Figure 6.43: Distribution of benthic habitat types in the Coral Field, with the insert (bottom figure) displaying the benthic habitat types in the immediate vicinity of the Coral South FLNG

Benthic Biota

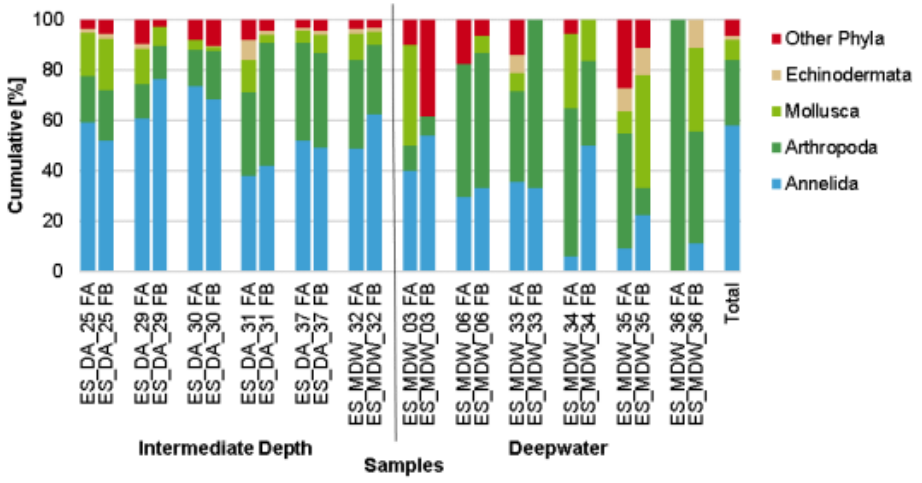
Further north in Area 4, in the shallower depths of the deepwater environment (400 to 1200 m), areas with a richer tapestry of deep-sea environments, encompassing boulders, bedrock outcrops, carbonate structures, mud, and indications of methane seepage were observed (Fugro, 2016a). These habitats hosted a rich diversity of marine species in small aggregates or solitary colonies, including blue sea fan (*Octocorallia* sp.), white sea fan (*Plexauridae* sp.), yellow/white sea fan (*Plexauridae* sp.), curled sea whip (*Stichopathes* sp.), large, irregularly branched pink soft coral (Octocorallia/Antipatharia), black corals (Antipatharia), unidentified shrimp (Caridea), and demersal fish. Additionally, some areas exhibited evidence of methane seepage, adding to the ecological complexity within the AII (Fugro, 2016a). The relic and active 'deep sea carbonate seep' habitats,

recorded during Area 4 site surveys, are comprised of Methane-Derived Authigenic Carbonate (MDAC) concretions and aggregations of mussel shells, *Bathymodiolus sp*. The area of active seepage (presumably of methane) supported dense aggregation of living *Bathymodiolus sp*. Away from the active seep site, this habitat supported a fairly sparse, although diverse community of sea fans (Plexauridae) and whip corals (Octocorallia/Antipatharia); a low number of very small colonies of cold-water coral. The biodiversity recorded from 'deep sea carbonate seeps' appeared high in comparison to other deepwater habitats; despite the habitat's limited extent, 24 of the 72 deepwater taxa identified overall during the surveys were recorded from seep habitat (Figure 6.44 and Figure 6.45).



Source: Fugro (2019a).

Figure 6.44: Phyletic composition of taxa, Mozambique Area 4



Source: Fugro (2019a).

Figure 6.45: Phyletic composition of individuals, Mozambique Area 4

ROV imagery of the sabed, also used for the Coral South Project's impact assessment, showed limited structural complexity (Fugro, 2016a), although some areas showed several habitats of more significant biodiversity value, such as the observed deep-sea carbonate seep. The widespread deep-water undulating mud habitat also contributes to the area's biodiversity, hosting xenophyophores and

sea pens. The deep-sea uniform mud habitat also is inhabited by seapens, sea whips, and brittle stars.

A 550 m long dropdown camera transect within the ADI of the Coral North location (ES_TS26) showed a number of habitat types from silty clay, boulders, steep slope, and ledges. The silty clay habitat hosted Xenophyophore, fan shrimp (*Plesiopenaeus* sp.), sea cucumber (*Benthothuria* sp.), urchin (Echinothuriid), cast, faunal tracks, mounds, tubes, and faecal pellets. Crinoid (*Glyptometra* sp.), Xenophyophore, sea fan (*Schizopathes* sp.), sea pens and whip coral (Octocorallia), Hexacorallia, fan shrimp (*Plesiopenaeus* sp.), brittlestar (Ophiuroidea), urchin (Echinothuriid), cast, faunal tracks, mounds, tubes, and faecal pellets were observed within the harder substrate habitats.

6.9.2.4 Sea Turtles

Five species of sea turtles occur in northern Mozambique: green (*Chelonia mydas*), hawksbill *Eretmochelys imbricata*), olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) (Hughes, 1971).

The IUCN Red List conservation status of these species is shown below in Table 6.19. According to global data, all species have a decreasing population trend. WIO population assessments are only available for loggerhead and leatherback turtles that nest on South Africa and Southern Mozambique.

The Mozambique Channel, bounded by Mozambique and Madagascar, hosts nesting populations of four turtle species - loggerhead, leatherback, green turtle, and hawksbill - with foraging olive ridleys frequenting the east African and west Malagasy seaboard. Along the Mozambique coast, loggerheads and leatherbacks nest in the south, and green turtles and hawksbills nest on central and northern beaches (SWOT, 2016).

Table 6.19: List of Sea turtles recorded in Mozambique, respective IUCN conservation status and nesting sites

Common name	Scientific name	IUCN Conservation status for global population; and population trend	IUCN Conservation Status for Western Indian Ocean population	Nesting in Mozambique
Olive Ridley	*Lepidochelys olivacea*	Vulnerable Decreasing (accessed in 2008)	Assessment not available	North Mozambique in Cabo Delgado Province
Green	*Chelonia mydas*	Endangered Decreasing (accessed in 2004)	Assessment not available	North Mozambique to Bazaruto
Hawksbill	*Eretmochelys imbricata*	Critically Endangered Decreasing (accessed in 2008)	Assessment not available	North Mozambique, to the north of Pebane
Loggerhead	*Caretta caretta*	Vulnerable Decreasing (accessed in 2015)	Near Threatened	South Mozambique only (Ponta do Ouro to Bazaruto)
Leatherback	*Dermochelys coriacea*	Vulnerable Decreasing (accessed in 2015)	Critically Endangered	South Mozambique only (Ponta do Ouro to Bazaruto)

Satellite tracking has shown that Mozambique coastal waters are a critical feeding area for loggerheads and leatherbacks from Southern Africa populations, and for green turtles from all Indian Ocean nesting sites (specially from the Bazaruto and Quirimbas areas). Those same foraging grounds are also important for nesting hawksbill (SWOT, 2016). Sea turtles use a variety of habitats along their complex life cycle. Females are philopatric, and therefore they select nesting sites within the region based on natural cues. Eggs are laid and incubated in sandy burrows. After approximately two months hatchlings emerge. Post-hatchlings are pelagic and inhabit the surface waters of convergence zones and major gyre systems throughout tropical and temperate oceans (e.g. Botha, 2010). Juveniles perform migrations utilizing ocean currents over thousands of kilometres. Most adult turtles also migrate over such distances, though post-nesting hawksbills in the Seychelles do not migrate as far as adult green or loggerhead turtles (Consultec, 2015, van de Greer *et al.* 2022, Garnier 2012).

The feeding grounds of the bottom-feeding sea turtles include seagrass, coral reef, sand and mud flats, and mangrove ecosystems, while the pelagic leatherback feeds in oceanic surface waters of tropical, temperate, and even polar seas. Figure 6.46 below shows known migratory routes and nesting sites in the Western Indian Ocean (Van De Geer *et al.,* 2022).

National monitoring reports summarize the status of sea turtles in Mozambique (Fernandes *et al*., 2021, 2020, 2019, 2018, 2016, 2015, 2014; Louro & Fernandes, 2013; Louro *et al.,* 2012; Videira *et al.,* 2011; 2008; Pereira *at al.,* 2010). However, nesting monitoring programs are scarce in Northern Mozambique, with nesting and occasional sighting reports limited to Vamizi Island, whereas Rongui Island, QNP and Primeiras and Segundas Archipelago have inconsistent monitoring efforts. The latest national monitoring report for 2017/2018 nesting season states that within the QNP, 125 sightings of live and 25 dead marine turtles were reported from June 2017 to May 2018 for the islands of Ibo, Matemo and Quirimba. Most of the identified marine turtles were green or loggerhead turtles; although caution should be adopted as the identification of turtle species may not be accurate. A “marine turtle cemetery” was found in Mefunvo Island, in the southernmost section of the Quirimbas National Park, which clearly indicates that there are significant threats to sea turtles in this area.

The occurrence of sea turtles along Mozambique’s coast suggests that the location of the coast plays an important role in the diversity of foraging grounds used by green turtle populations nesting from Bazaruto Archipelago National Park, in the south, to Palma at Quirimbas Archipelago, in the north. Some of the sea turtle species found along the coastal area of Mozambique seem to exhibit high levels of fidelity to migratory routes and foraging areas, thus strengthening the argument for controlling threats in these areas (Broderick *et al*., 2007). It is believed that the Primeiras and Segundas Archipelago may represent an ideal and safe place for foraging and nesting for the sea turtles and it is known that the Primeiras and Segundas Islands area is a migratory route for marine turtles that nest on the Island of Mayotte (Costa & Sitoe, 2008; Van De Geer *et al*., 2022; Figure 6.46).

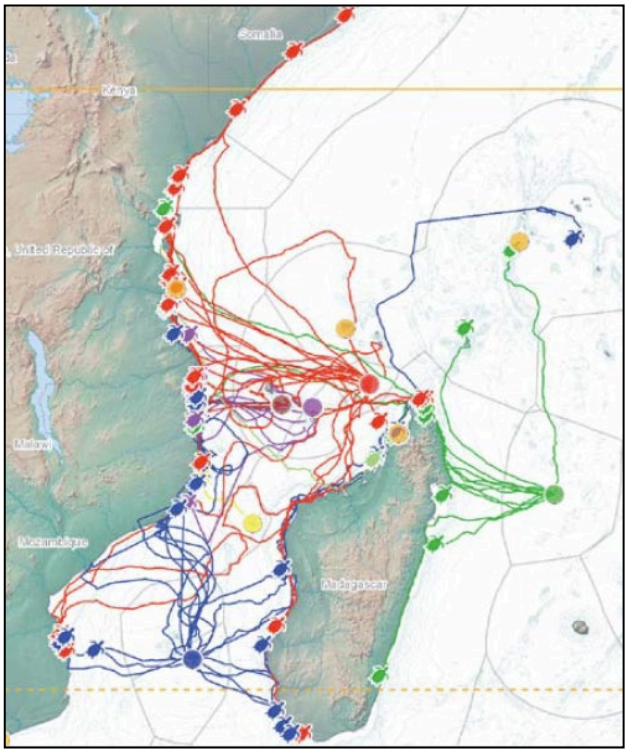
Source: Van De Geer et al., 2022.

Figure 6.46: Nesting locations (green circles) and migratory patterns for (A) green (Cm), (B) hawksbill (Ei), (C) loggerhead (Cc), and (D) leatherback (Dc) turtles along the east coast of continental Africa. Route arrows colour and weight suggests the occurrence probability based on the available data being: Major (>10 recorded migrations), frequent (2−10 recorded migrations), and singular or suspected migration routes

Green turtle

The green turtle is considered the most common sea turtle along the Mozambique coast (Hughes, 1971). Green turtles are widely distributed in tropical and subtropical waters near continental coasts and around islands. Mayotte island, the easternmost island of the Comoros Archipelago, is known to be an important green turtle nesting site with an average of 1 545 nesting turtles per year (±439) from 1998 to 2005, and it is located approximately 465 km from the Coral North FLNG (Bourjea *et al.,* 2007).

Hatchlings green turtles leave the nesting beach to occupy oceanic habitats where their diet is primarily carnivorous (Reich *et al*., 2007). After several or more years living in the open ocean, immature green turtles recruit to neritic habitats, where they shift to a more herbivorous diet (Reich *et al*., 2007), then shifting to coastal habitats as larger juveniles and eventually moving on to adult foraging sites near maturity (Mansfield *et al*., 2021). Adult green turtles occasionally feed together in shallow waters where there are abundant seagrass and algae. Green turtles can migrate several thousand kilometres between feeding grounds and their nesting areas (Figure 6.47).

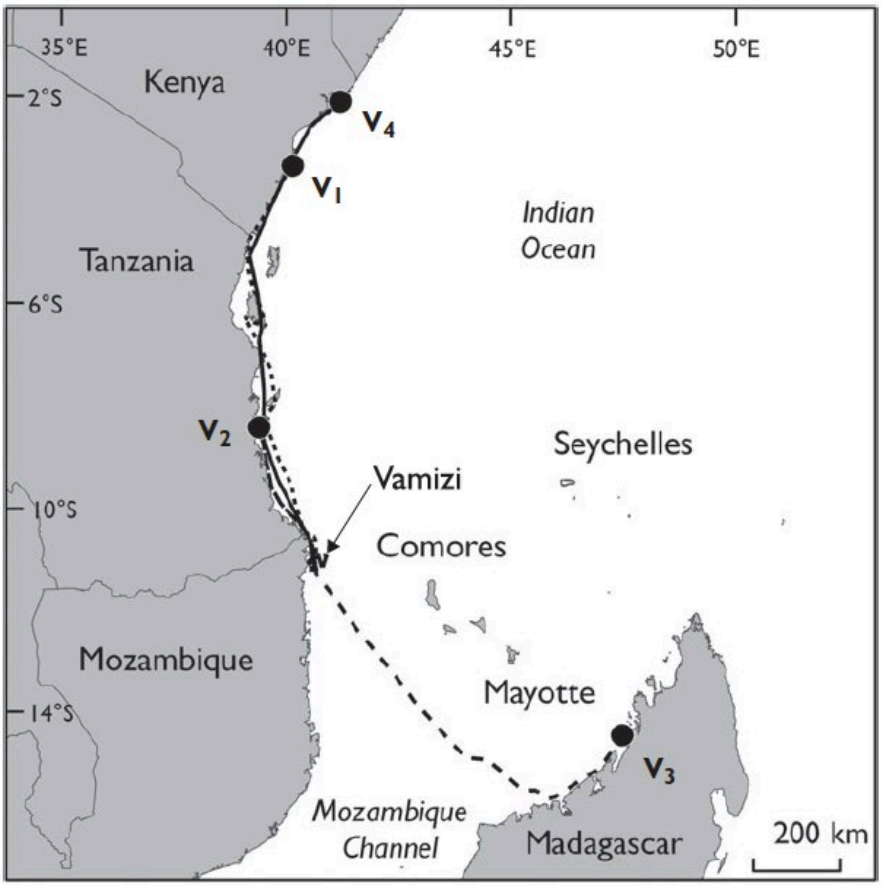


Source: Kelonia (Reunion) in Obura et al. (2012)

Figure 6.47: Green turtle migration routes

Green turtles nest from the Bazaruto Archipelago National Park to the Quirimbas Archipelago. The biggest concentration of nesting sites appeared to be in the Primeiras and Segundas Islands (Hughes, 1971). Gove & Magane (1996) reported that its nesting grounds include the Quirimbas Archipelago, particularly Rongui and Vamizi Islands (Barr & Garnier, 2005). Surveys conducted in 2005 reported green turtle nesting on Rongui Island from January to July and on Vamizi Island from November to July (Barr & Garnier, 2005). The occurrence of hatchling green turtles was reported for all seasons on Vamizi Island (Barr & Garnier, 2005).

Green turtles were tagged (receiving a satellite positioning device) by a team from the Zoological Society of London (ZSL) in collaboration with the Maluane Project in 2007 and 2008 on Vamizi Island. The movements of these turtles showed that the animals travel extensively between their nesting and feeding grounds and ended up as far as at locations in the Kenya and Madagascar coasts (Figure 6.48).



Source: Garnier et al. (2012).

Figure 6.48: Movement of tagged Green Turtles from a dispersal point at Vamizi Island

Regionally, the Vamizi nesting population is much smaller than the large rookeries reported in the South-West Indian Ocean but its proximity to Mayotte (510 km from Vamizi island) and Moheli (347 km) in the Comoros Archipelago, Aldabra Island (629 km) in the Seychelles, and Grande Glorieuse Island (723 km), where green turtle nesting populations are increasing, underlines its contribution to maintaining this species in the region (Bourjea *et al*., 2007a). Furthermore, the Vamizi population contributes to the genetic diversity of the green turtle in this region, which harbours populations from both the Atlantic and the Indo-Pacific (Bourjea *et al*., 2007b). In 2003, it was proposed that the Vamizi, Rongui, and Macaloa area represented a region of regional significance given the declining status of turtle populations in the WIO (Hill & Garnier, 2004).

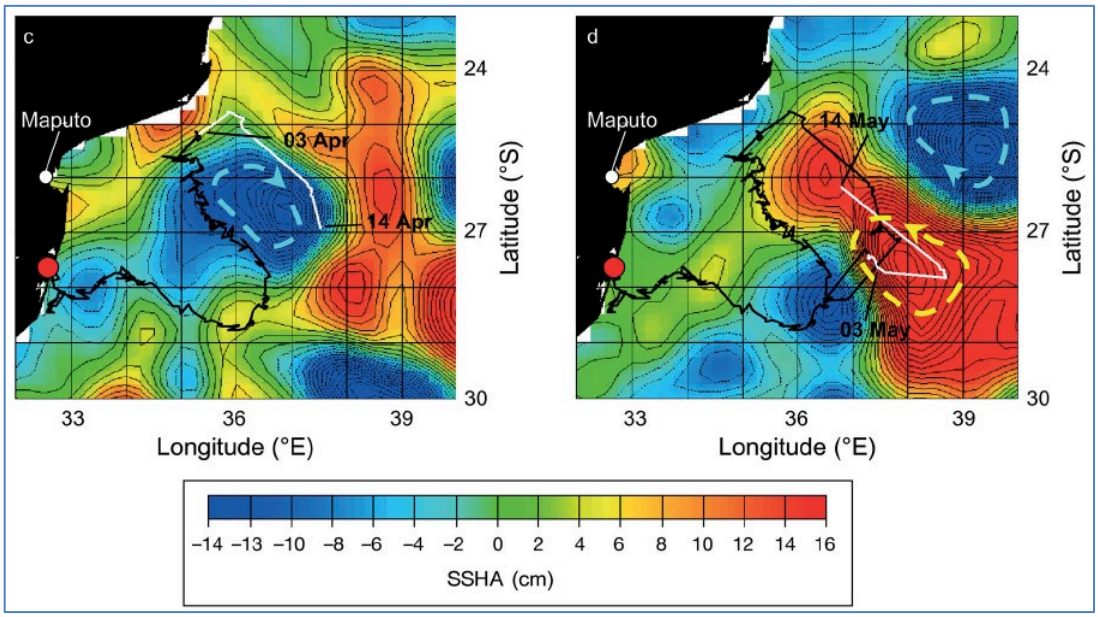
Costa & Sitoe (2008) concluded that Puga Puga, Ndjovo and Mafamede were the three most important islands from Primeiras e Segundas Archipelago, in terms of habitat use, for these species, that forage and nest in this region. According to the same study, Caldeira Island were also a nesting ground. Green turtle is the most abundant species, followed by the hawksbill (Costa & Sitoe, 2008).

Loggerhead and leatherback turtles

Hughes (1971) reported that loggerheads are found along the entire Mozambican coastline, although more common in southern areas. TRANSMAP (2008) also reported offshore sightings of loggerhead and leatherback turtles on Northern Mozambique. Loggerheads nest south of the study area from

the Bazaruto Archipelago to Ponta do Ouro (e.g., Hughes, 1971; Gove & Magane, 1996; Fernandes *et al.,* 2020).

In general, leatherback turtle's telemetry available for the region showed large variations in migration routes and in final destinations, apparently without heading for specific foraging areas (e.g., Lambardi *et al*., 2008). According to Lambardi *et al.* (2008), leatherbacks were greatly influenced by the currents encountered, with their trajectories displaying curves or revolutions in the presence of (and in accordance with) rotating water masses. These results further corroborate the strong influence of oceanic currents and mesoscale features on the movements of marine turtles in the Mozambique Channel and suggest high-quality foraging hotspots for leatherbacks moving in the ocean.



Source: Lambardi et al. (2008).

Figure 6.49: Initial movements of a leatherback turtle upon leaving her nesting beach in 2001 (dates shown), superimposed on sea surface height anomaly (SSHA) maps averaged for successive periods. The white parts of the tracks correspond to the 10 d periods to which the SSHA images refer. The red dot indicates the location of the nesting beach

Hawksbill turtle

The hawksbill turtle is more commonly found close to reefs and also within shallow waters such as coastal lagoons and bays with seagrass beds and algae. Parts of the population (especially juveniles) seem to exhibit residential, non-migratory behaviour in shallow coastal waters (Mortimer *et al*., 2003; Bell & Pike, 2012), however some juveniles travelled more than 1,000 km from the tagging site. There is evidence that upon reaching adulthood, hawksbills in the SWIO may engage in relatively more restricted migrations than they did as juveniles.

Hawksbill turtles are carnivorous and feed on diverse benthic fauna such as corals, tunicates, algae as well as sponges in particular. This species is found along the coastline of Mozambique, though they are most abundant within the northern part of the country to the north of Pebane, nesting most frequently on islands and sporadically on mainland (Louro et al., 2006; Hughes, 1971). Hughes (1971) stated that the islands of Quirimbas, Sencar, and Mefunvo were used as nesting grounds for

this species. Focused monitoring of hawksbill turtles in the Quirimbas Archipelago identifies this area as being of greatest importance for hawksbill turtles, to both nesting and coastal foraging (Consultec, 2022). There are records of hawksbill nesting at the Quirimbas Archipelago, including the Rongui and Vamizi Islands (Hill & Garnier, 2004; Barr & Garnier, 2005). Hawksbill is reported to nest on Rongui Island from December through February and on Vamizi Island from December to March (Barr & Garnier, 2005).

The national monitoring reports indicate that there has been limited recorded nesting activity of hawksbill turtles in Mozambique. In 2008/2009 one nest has been recorded in the QNP and three nests were recorded on the islands of Vamizi and Rongui in 2008/2009. In 2010/2011, one nest was recorded in the QNP. In 2016/2017, one nest was recorded in Cabo São Sebastião in central Mozambique. In 2017/2018, four nests were recorded on Bazaruto Island. In 2019/2020 two nests were detected, one in Vamizi and the other in Santa Carolina Island (Fernandes *et al*., 2021).

Olive ridley turtle

Olive ridley turtles occur in the tropics both in the southern and primarily the northern hemispheres. Olive ridley turtles have been observed travelling in large flotillas between breeding and feeding areas, particularly in the eastern Pacific and Indian Oceans. The turtles travel along the continental shelf and congregate in large numbers at special nesting areas at the beginning of summer. Olive ridley turtles are carnivorous and feed on fish, salps, benthic invertebrates, and algae and are considered common in Mozambican waters north of Pebane (Hughes, 1971). Olive ridley turtles nest on islands and the mainland of the northern part of Mozambique with a similar nesting distribution as the Hawksbill turtle (Hughes, 1971).

Nesting activity peaks from August to October in the Primeiras and Segundas Islands (Costa *et al*., 2007). In Quirimbas Archipelago, and particularly in QNP, mating has been observed in August and September and nesting takes place from January to April with the peak in March (Costa *et al*., 2007).

Cabo Delgado Province

In Northern Mozambique, turtles forage and nest year-round mainly on the sandy beaches of the islands, whereas in southern Mozambique nesting period occurs from October until March (Fernandes et al., 2022; Narane, 2009). Peaking periods may vary, depending on species, population cycles and environmental conditions.

Studies undertaken by the Maluane Group Ltd. In conjunction with the London Zoological Society on Vamizi, Rongui and Macaloé islands, coast of Cabo Delgado Province, confirmed that only two species of turtle nest in the area, namely the green turtle and the hawksbill turtle (e.g. Hill & Garnier, 2004; Barr & Garnier, 2005). A conservation project was in place in the Vamizi-Rongui area through the Maluane Project, with involvement of local communities (Garnier, 2003; Garnier *et al*., 2012). The program was halted for three months in Vamizi after the insurgency situation in 2020 and has continued thereafter. In Rongui annual monitoring activities stopped in 2016 (Fernandes *et al*., 2021).

Vamizi Island is considered a highly important nesting grounds for the green turtle, representing more than >90% of the reported green turtle nests from Mozambique (Van De Geer *et al*., 2022; Fernandes *et al*., 2021). Although marine turtles nest on the sandy beaches of the Cabo Delgado Province,

Vamizi Island is the only site from northern Mozambique with consistent nesting information (ERM, 2019). Vamizi island was considered a nesting stronghold for hawksbill turtles (Garnier *et al*., 2012); however, the data show a negative trend in the number of clutches reported per year (Pereira *et al*., 2009, Garnier *et al*., 2012) and in the 2019 season only a single nest was reported (Fernandes *et al*., 2021).

In Macaloé Island, the turtles have their nesting peak between November and May (Santos 2010).

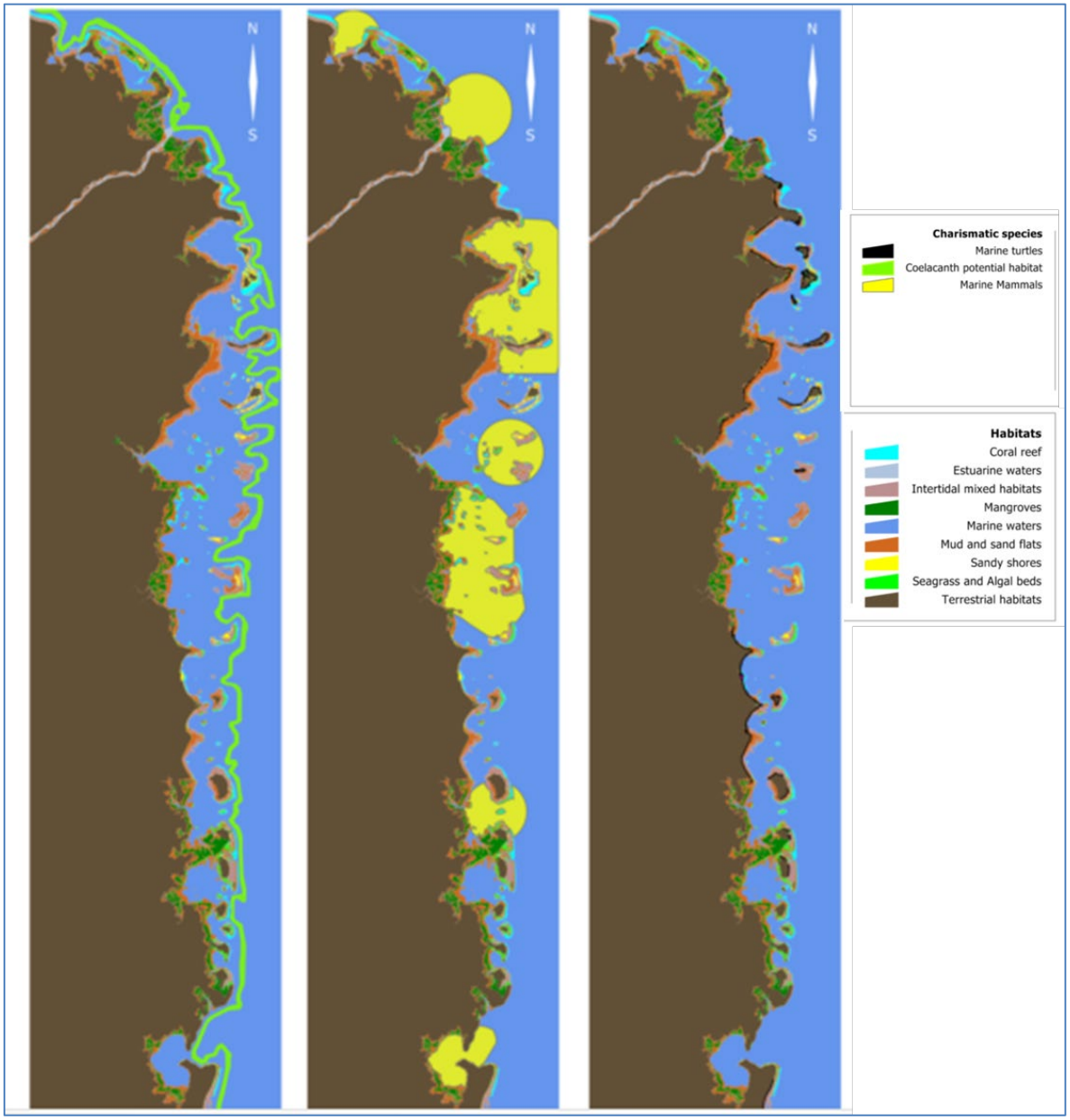
Rongui Island is considered the most important nesting habitat for hawksbill turtles based on historic data (Consultec, 2022); however, due to monitoring efforts constraints only sporadic nesting events have been reported (Barr & Garnier 2005, Borghesio *et al*. 2009, Videira *et al*. 2011).

The results of the aerial surveys performed from 8 to 13 March 2007 by CSA (2007) and, from 19 and 20 November 2007 by TRANSMAP (2008b) show areas of aggregation of marine turtles, although these mappings must be interpreted with caution (see Figure 6.50). The surveys constitute snapshots that may not cover the seasonality and other movements of the animals, and observations in other periods could show different results.

The surveys indicates that marine turtles are scattered along the surveyed area, although higher aggregation seems to be between Medjumbe and Macaloé Islands, where the turtles were seen in large numbers on the offshore side of the islands. A fair number of turtles were observed in front of Mocímboa, around Tambuzi Island and south of Quifuqui. Further north, higher concentrations were seen to the north of Vamizi and around the capes of Cabo Delgado and Nasunga.

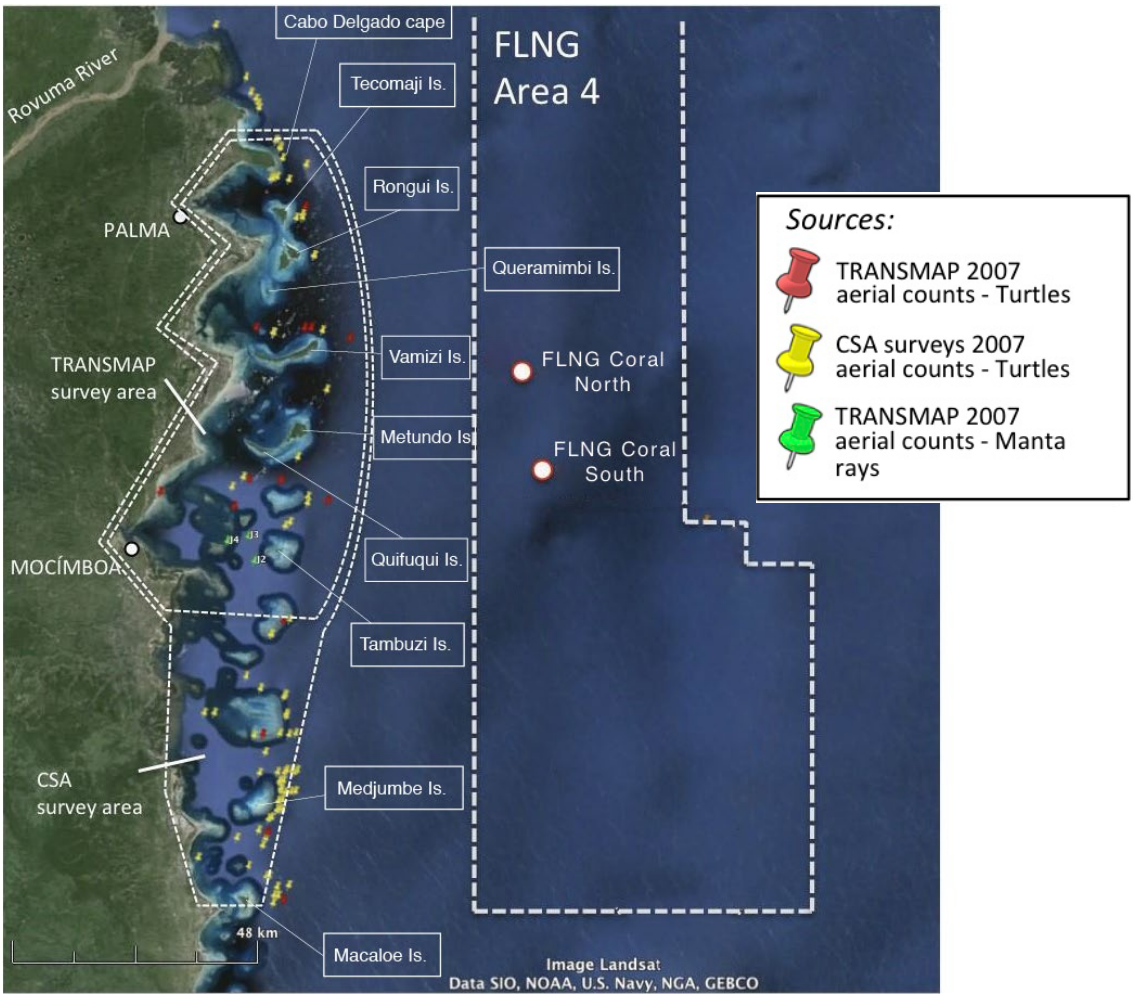
Consultec (2014) provides information on the aerial mapping of sea turtles in northern Mozambique (Figure 6.51). The survey shows turtle aggregations around the islands of the Quirimbas Archipelago with main aggregations in areas where seagrass and coral habitats are present suggesting that these areas are important for the aggregation of hawksbill and green turtles. Occasional sightings of loggerheads feeding on coral reefs were also reported by TRANSMAP (2008). Aerial survey also recorded high aggregations of sea turtles around the islands within the QNP area (CSA, 2007).

The analysis by TRANSMAP (2008a) indicates that there are favourable beach conditions for marine turtle nesting along the whole coast of Cabo Delgado Province (see Figure 6.51). Major gaps are related to absence of sighting surveys in areas of swamp character, where mangroves are particularly developed. However, these sites shouldn't be discarded as potential nesting grounds, as hawksbill turtles also use mangrove estuaries as nesting habitat in other regions. This behaviour has not been reported in Mozambique.



Source: TRANSMAP (2008a).

Figure 6.50: TRANSMAP GIS output on charismatic species occurrence and habitat classification in the northern transboundary area. (A) Potential habitat for the coelacanth, based on the bathymetric range of the species; (B) Areas of highest abundance of dolphins and whales, based on expert and local knowledge; (C) Nesting beaches for marine turtles



Source: CSA (2007); TRANSMAP (2008b).

Figure 6.51: Consolidation of the sightings of marine turtles within transects from shoreline to approximate position of the 200-m bathymetric contour, based on georeferenced data reported by CSA (2007) and TRANSMAP (2008b)

6.9.2.5 Elasmobranchii (Sharks and Rays)

The Northern Mozambique Channel (NMC), a region relatively unexplored by the scientific community until recent years, has emerged as a vital area for elasmobranchs, encompassing a rich tapestry of shark and ray species, earning recognition as an ecologically and biologically significant area (Obura, 2019; CBD, 2012).

The NMC boasts a wide range of typical shallow tropical marine habitats, encompassing coral reefs, mangrove forests, and seagrass beds, in addition to a dynamic pelagic zone. Notably, the northern section of the channel stands out for the remarkable extent and diversity of these habitats (UNEP-Nairobi Convention and WIOMSA, 2015). The exceptional biodiversity observed in the NMC can be attributed to a number of factors such as high connectivity, species retention, and an evolutionary heritage that has preserved unique relict species from the ancient Tethys Sea, dating back 25–40 million years (Obura, 2019).

In recent decades, global shark and ray populations have been severely impacted by overfishing, primarily driven by the high demand for their fins (Clarke *et al*., 2006).

Sharks within the NMC encompass a broad taxonomic range, including the bull shark (*Carcharhinus leucas*), grey reef shark (*Carcharhinus amblyrhynchos*), and sand tiger shark (*Carcharias taurus*). These apex predators are of paramount ecological importance in maintaining the intricate balance of the local marine food web, with many of these species presently classified as endangered or vulnerable by the IUCN Red List.

The Endangered (EN) whale shark (*Rhincodon typus*) is also found in the Mozambique Channel. This species spans the entire east African coast, with a focal point for aggregation in Tofo, southern Mozambique (Bruunschweiler, 2012; Sequeira *et al*., 2012).

Rays are equally significant residents of the NMC. The spinetail devil ray (*Mobula mobular*), coach whipray (*Himantura uarnak*), porcupine ray (*Urogymnus asperrimus*), and oceanic manta ray (*Mobula birostris*) are among the ray species inhabiting these waters. Many of these rays are under threat, with some categorized as vulnerable.

6.9.2.6 Avifauna (Marine Birds)

The avifauna of the Mozambican channel, specifically seabirds, migratory birds, and coastal bird species along Mozambique's northern coast, remains poorly studied. There is a lack of updated species inventories and limited population data, making it challenging to determine the conservation status of most seabirds at the national level according to the IUCN.

To establish a baseline assessment, available information from limited secondary data in the region or broader scales, as well as more recent findings from assessments conducted within the Area 1 and Area 4 oil and gas development projects offshore Cabo Delgado were reviewed. This section of the report combines information on pelagic and nearshore birds, as these species are often evaluated together.

Marine birds in Mozambique

The Mozambique Channel is home to a variety of seabird species, primarily inhabiting the continental shelf, shelf edge, and nearby coastal and inshore habitats. Additionally, the continental slope habitats within the channel support a diverse range of bird species, including albatrosses, petrels, shearwaters, boobies, and gannets. This region serves as a habitat for resident birds, as well as intra-African migratory and Palearctic migratory bird species that rely on marine, coastal, and inshore environments (Newman, 2013; Harrison *et al*., 2021).

Along the shores and open seawaters of Mozambique, birds are distributed among nine families. The most frequent family is Procellariidae, which includes 20 species of petrels and shearwaters. The Diomedeidae family, with six species of albatrosses, is also present in the region. Additionally, the Hydrobatidae family is represented by five species of petrels (Harrison & Cherry, 1997).

Sixteen seabird species can regularly occur within the Mozambique Channel. These species breed in various locations in the region, including the Comoros Archipelago, three coralline oceanic islands

(Glorieuses, Juan de Nova, and Europa), and numerous continental islands along the coasts of Mozambique and Madagascar (Le Corre *et al.*, 2005).

Recent research has provided insights into the distribution of pelagic seabird species in the Mozambique Channel, linking their presence to atmospheric events that influence prey size and availability. The Agreement on the Conservation of Albatrosses and Petrels project in the Mozambique Channel has identified a correlation between lower sea surface temperatures and higher densities of flying and feeding seabirds. Frigatebirds (*Fregata* spp.) are commonly found in frontal zones where strong geostrophic currents are present. These frontal zones are often associated with schools of tuna, which attract the frigatebirds due to the abundance of prey. On the other hand, in divergence zones characterized by low sea level anomalies and high zooplankton biomass near the surface, red-footed boobies (*Sula sula*) tend to concentrate. These areas provide favourable conditions for the presence of zooplankton, which serves as a food source for the Red-footed boobies (Jaquemet *et al*., 2014).

Tropical species within the Mozambique Channel exhibit a preference for cyclonic eddies, frontal zones, and divergence zones, whereas non-tropical species are frequently observed in shelf waters (Jaquemet *et al.,* 2014). The southern part of the Mozambique Channel is recognized as a hotspot region for seabirds, housing several endangered sub-Antarctic migrant species (Jaquemet *et al.*, 2014). The entire coast of Mozambique serves as a crucial migration route for Palearctic birds, which rely on the African coastline during the southern hemisphere summer (winter in their breeding regions) and are commonly observed between October and November (Hayes, 1995). The primary migration route includes birds originating from Europe and Asia, with significant bird groups such as albatrosses, plovers, and gulls. Moreover, the area also encompasses migration routes for intra-African migrants and southern hemisphere migrants, including petrels.

Marine birds in Cabo Delgado Province

The coastal region of Cabo Delgado is home to a diverse array of shoreline aquatic birds (waders) and seabirds, including petrels, albatrosses, gannets, cormorants, gulls, terns, plovers, sandpipers, oystercatchers, egrets, sanderlings, turnstones, and knots (Newman, 2013). While some seabird species, such as albatrosses, petrels, boobies, gannets, and tropic birds, primarily inhabit offshore continental slope habitats, most seabird species in the Mozambique Channel are found in waters of the continental shelf, shelf edge, and adjacent coastal and inshore habitats (Newman, 2013; Sinclair and Ryan, 2003; Harrison *et al.*, 2021).

River estuaries and deltas serve as important habitats for a variety of bird species, attracting significant numbers of wading birds and seabirds due to the high productivity of these areas (Impacto & ERM, 2014). Additionally, exposed coral formations play a crucial role as high tide roosting sites for seabird species in the region.

The Quirimbas Archipelago area in northern Mozambique, located within the EAME, holds global significance as a crucial feeding and migratory bird habitat, particularly for plovers. Designated as a priority conservation area, the EAME encompasses the eastern coast of Africa, including the entire

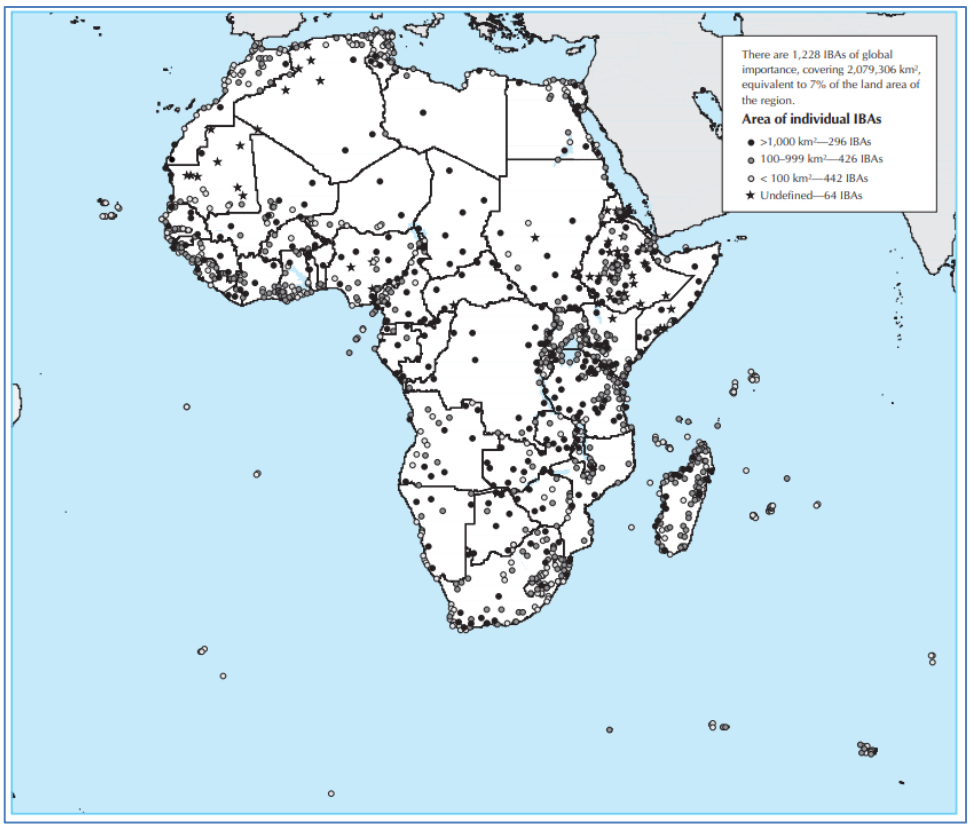
Mozambique coast, stretching approximately 4600 km, and comprising the territorial waters of Somalia, the coastlines of Kenya, Tanzania, and Mozambique.

The EAME (2004) has prioritized the conservation of various species and community groups, recognizing the significance of preserving biodiversity. In particular, the Quirimbas area within the Cabo Delgado Province Coast is included in the EAME due to its vital role as essential feeding grounds and migratory routes for marine and coastal birds. This archipelago has documented over 200 bird species, among which six species represent more than 1% of the global population of these seabird species (Avibase, 2023; UNESCO, 2018).

The AII is situated approximately 200 km west of the Great Comoro Island, which is part of the Comoros Archipelago known for its significance for bird populations. The Saint Lazarus Bank is also a biodiversity hotspot. Important Bird Areas (IBA's; globally important habitats for the conservation of bird populations by BirdLife International) have not been established in Cabo Delgado Province. The nearest IBA's are located in Tanzania, on the opposite side of the Rovuma River, namely:

- Mnazi Bay, located to the north of the Project Area (BirdLife, 2023b);
- Mtwara and Newalla district coastal forests, located approximately 70km north-west of the FLNG Project Site) (BirdLife, 2023c, 2023d).

Within Mozambique's territory, the closest classified IBA is the Netia IBA, situated inland in Nampula Province (Figure 6.52).



Source: Fishpool & Evans (2001).

Figure 6.52: Location of Important Bird Areas in Africa and associated islands

The intertidal beaches are rich in bird diversity, featuring concentrations of plovers, waders, crab plovers, terns, and egrets (Newman, 2013; Sinclair and Ryan, 2003; Harrison et al., 2021). A survey conducted to assess coastal habitats in the district of Palma, including saline wetlands (salt marshes) and intertidal beaches, revealed the presence of a diverse range of bird species. Among them were Kittlitz's plover (*Charadrius pecuarius*), wood sandpiper (*Tringa glareola*), little stint (*Calidris minuta*), marsh sandpiper (*Tringa stagnatilis*), and black-winged stilt (*Himantopus himantopus*) (Impacto & ERM, 2014). The intertidal zone in this area proved highly conducive to supporting numerous shorebirds, with the crab plover (*Dromas ardeola*) population being observed during the winter months (Impacto & ERM, 2014). Meanwhile, inshore regions were dominated by various marine tern species, with notable presence of the greater crested tern (*Thalasseus bergii*), lesser crested tern (*Thalasseus bengalensis*), Little tern (*Sternula albifrons*), and the common tern (*Sterna hirundo*). Several intertidal bird species are migratory and cross offshore regions during their migrations; with some recorded and potentially occurring in the ADI.

Annex V (see Volume IV) contains a comprehensive list of potential seabirds (both shoreline and pelagic, resident, and migrant species) that may occur in the Cabo Delgado Province (Harrison & Cherry, 1997; Sinclair & Ryan, 2003; Impacto & ERM, 2014; Harrison *et al.,* 2021; IUCN, 2023). The distribution areas were reassessed based on the most recent data from IUCN (2023) and the information provided in the guide authored by Harrison *et al*. (2021).

The region is home to several seabird species of conservation concern, with the status of Endangered (EN), Vulnerable (VU), or Near Threatened (NT) according to the IUCN Red List of Threatened Species (IUCN, 2013). Despite this, many of these bird species have wide distribution ranges, some at a global level, and are represented by large populations, as seen in the case of Wilson's Storm-Petrel. Concurrently, most of the bird species in the area are classified as Least Concern (LC) for conservation (IUCN, 2023).

Seabirds

Seabirds predominantly inhabit open seawaters and often visit offshore islands or coastal habitats solely for breeding purposes. Occasionally, certain vagrant species may also be found in coastal areas (Harrison, 2021).

Petrels

Petrels are birds belonging to the order Procellariiformes and are classified into three families: Procellariidae, Hydrobatidae, and Oceanitidae (Harrison, 2021). They are known for their characteristic flight style, hovering above ocean waves with their feet touching the water (Brooke, 2004). Petrels are exclusively found in pelagic environments and only come to land for breeding purposes. These pelagic bird species exhibit a wide range of morphological features and feeding habits (Brooke, 2004).The petrels encompass various bird families, including Hydrobatidae (Northern storm petrels), known as small pelagic petrels often seen following ships; Oceanitidae (Southern storm petrels), the smallest of seabirds that feed on planktonic crustaceans with only ten species assigned to five different genera; and Procellariidae, which ranges a rather diverse assemblage, and is best split into seven (7) groups for ID purposes: fulmarine petrels, blue petrel and the prions, gadfly

petrels, *Procellaria* petrels, shearwaters, *Bulweria*-type petrels and the diving petrels (Harrison *et al.,* 2021; IUCN, 2023).

In the northern part of Mozambique, the following species from the Procellariidae family are potential occurrences: flesh-footed shearwater (*Ardenna carneipes*), sooty shearwater (*Ardenna grisea*), wedge-tailed shearwater (*Ardenna pacifica*), Jouanin's petrel (*Bulweria fallax*), white-chinned petrel (*Procellaria aequinoctialis*), grey petrel (*Procellaria cinerea*), soft-plumaged petrel (*Pterodroma mollis*), tropical shearwater (*Puffinus bailloni* ssp. nicolae), and persian shearwater (*Puffinus persicus*) (Harrison *et al.,* 2021; IUCN, 2023). Additionally, the Oceanitidae family includes petrel species like the black-bellied storm-petrel (*Fregetta tropica*), Wilson's storm-petrel, and white-faced storm-petrel (Consultec, 2015; Harrison *et al.,* 2021; IUCN, 2023).

Source: L–ft - J. J. Harrison (2022); Ri–ht - J. J. Harrison (2012).

Figure 6.53: On the left, white-faced storm-petrel *(Pelagodroma marina)* and on the right, white-chinned petrel *(Procellaria aequinoctialis)*

Albatrosses

Albatrosses are large seabirds belonging to the Diomedeidae family, which is closely related to storm petrels and diving petrels (order Procellariiformes) (Brooke, 2004). These seabirds have a vast distribution across the Southern Oceans. Albatross species are classified into four genera: *Diomedea, Thalassarche, Phoebastria,* and *Phoebetria* (Brooke, 2004; Harrison *et al*., 2023).

Albatrosses are highly skilled fliers capable of covering vast distances, and they have a diverse diet that includes squid, fish, and krill, obtained through scavenging, surface seizing, or diving. These seabirds typically nest in large colonies on remote oceanic islands (Harrison *et al*., 2021; IUCN, 2023). Based on available literature (Harrison *et al*., 2021; IUCN, 2023), six species of albatrosses occur in Mozambican waters, the wandering albatross (*Diomedea exulans*), the sooty albatross (*Phoebetria fusca*), the Indian yellow-nosed albatross (*Thalassarche carteri*), the shy albatross (*Thalassarche cauta*), the black-browed albatross (*Thalassarche melanophrys*) and the white-capped albatross (*Thalassarche steadi*).

Source: Left - J. J. Harrison (2011); Right - Nicolas Olejnik (2015).

Figure 6.54: On the left, wandering albatross *(Diomedea exulans)* and on the right, Indian yellow-nosed albatross *(Thalassarche carteri)*

Gannets and boobies

Gannets (*Morus* spp.) and bobbies (*Sula* spp.) are large seabirds belonging to the Sulidae family. In temperate seas around Southern Africa, one species of Gannets is found – the cape gannet (*Morus capensis*) (Harrison *et al*., 2021; IUCN, 2023). Gannets breed in colonies on islands and coasts, and they are skilled at catching fish by diving from a height into the sea and capturing fish deep underwater, which is a unique hunting behaviour among airborne birds.

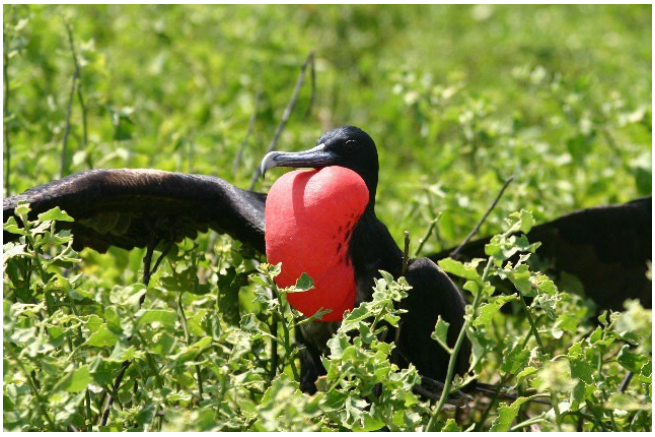
In the northern coast of Mozambique, the masked booby (*Sula dactylatra*) and red-footed booby (*Sula sula*) are present. On the southern coast of Mozambique, the cape gannet occurs, and it likely occurs on the north coast as well, although confirmation is needed (Sinclair & Ryan, 2003; Harrison *et al*., 2021; IUCN, 2023).

Source: Left - Bernard Dupont (1995); Right - Avitopia (2017).

Figure 6.55: On the left, red-footed booby (*Sula sula*), and on the right, cape gannet (*Morus capensis*)

Frigatebirds

Frigatebirds are large seabirds belonging to the order Suliformes and family Fregatidae, typically found in tropical oceans (Harrison *et al*., 2021). These birds are highly adept in flight, boasting one of the largest wingspans among seabirds. Out of the five species occurring globally, two are known to inhabit the waters of Mozambique: the great frigatebird (*Fregata minor*) and the lesser frigatebird (*Fregata ariel*) (Harrison *et al*., 2021; IUCN, 2023).



Source: Charles J. Sharp (2012).

Figure 6.56: Male great frigatebird (*Fregata minor*) displaying

Gulls

Gulls (*Larus* spp.) belong to the family Laridae and are medium to large birds typically found in coastal waters or shoreline areas, rarely staying for extended periods in pelagic zones (Harrison *et al.,* 2021). Gulls have a varied diet, including fish, marine and freshwater invertebrates, terrestrial arthropods and invertebrates, seeds and fruits, and even juvenile birds. They nest in large colonies and have a cosmopolitan distribution, breeding on every continent (Burger and Gochfeld,1996). Most gull species are migratory, moving to warmer habitats during winter. According to Harrison *et al*. (2021), the lesser black-backed gull (*Larus fuscus*), the Grey-headed Gull (*Larus cirrocephalus*), and the sooty gull (*Larus hemprichii*) might occur in the northern coast of Mozambique.

Tropicbirds

Tropicbirds are tropical pelagic seabirds included in the family Phaethontidae. These birds belong to the genus Phaethon, which has three species, two of them occurring in Mozambique, namely the red-tailed tropicbird (*Phaethon rubricauda*) and the white-tailed tropicbird (*Phaethon lepturus*) (Harrison *et al.*, 2021; IUCN, 2023).

Terns

Terns are small seabirds of the family Sternidae with a worldwide distribution, breeding on all continents. Terns' habitat range includes near-sea areas, rivers, or wetlands. In Mozambique and adjacent waters off Cabo Delgado province, the following species may occur: brown noddy (*Anous stolidus*), lesser noddy (*Anous tenuirostris*), whiskered tern (*Chlidonias hybrida*), white-winged tern (*Chlidonias leucopterus*), Caspian tern (*Hydroprogne caspia*), bridled tern (*Onychoprion anaethetus*), sooty tern (*O. fuscatus*), roseate tern (*Sterna dougallii*), common tern (*S. hirundo*), black-naped tern (*S. sumatrana*), little tern (*S. albifrons*), Saunders's tern (*Sternula saundersi*), lesser crested tern (*Thalasseus bengalensis*), and greater crested tern (*T. bergii*) (Harrison *et al.,* 2021; IUCN, 2023).

Source: Left – J. J. Harrison (2008); Right – Charles J. Sharp (2018).

Figure 6.57: On the left, greater crested tern (*Thalasseus bergii*), and on the right, common tern (*Sterna hirundo*)

Shoreline birds

Shoreline birds inhabit the continental coastline or island beaches, intertidal mudflats, wetlands, estuaries, and inlets to the sea throughout the year (resident birds) or during the migratory seasons (Palearctic migratory and Intra-African migratory birds) (Harrison *et al.*, 2021).

Cormorants and shags

Cormorants and shags are fish-eating birds known for their foot-propelled pursuit diving behaviour. They can be found in various aquatic environments, ranging from all major oceans (excluding the central Pacific) to inland waters on every continent except Antarctica, from sea level to altitudes of nearly 5,000 meters in Andean lakes (Kennedy & Spencer, 2014; Harrison *et al.,* 2021).

Waders

Waders are birds typical from coastal wetlands and shorebirds, that includes the plovers (*Charadrius* spp.), which are a widely distributed group of wading birds belonging to the subfamily Charadriinae. They can be found throughout the world, except for the Sahara and the polar regions. Plovers are characterized by relatively short bills and primarily feed on insects, worms, or other invertebrates, depending on their habitat. Along the shoreline of the northern coast of Mozambique, the following plover species can be found: crab plover (*Dromas ardeola*), sand plover (*Charadrius leschenaultii*), and white-fronted plover (*Ch. marginatus*) (Sinclair & Ryan, 2003).

Waders also includes sandpipers (98 species divided into 12 genera), which are shorebirds or nearshore freshwater birds from the Scolopacidae family. Some migratory sandpipers potentially occur on the northern coast of Mozambique, including the curlew sandpiper (*Calidris ferruginea*), little stint (*Calidris minuta*), and green sandpiper (*Tringa ochropus*). They breed in Europe and Asia and winter in tropical Africa and the Indian subcontinent. The IUCN considers them Least Concern (LC) species for conservation as they are common in freshwater habitats worldwide (IUCN, 2023).

Oystercatchers (*Haematopus* spp.) are a group of waders found on coasts worldwide, including the east coast of Africa. They feed on small invertebrates, small fish, and amphibians (IUCN, 2023).

Source: Left – David V. Raju (2020); Right – Wouter van der Ham (2017).

Figure 6.58: On the left, crab plover (*Dromas ardeola*), and on the right, sand plover (*Charadrius leschenaultii*)

Sanderlings (*Calidris* spp.) are birds from the Scolopacidae family, with few migratory species wintering mainly in Africa, as well as in south and southeast Asia. One migratory sanderling, the sanderling (*Calidris alba*), winters on the sandy beaches of northern Mozambique's shorelines (Harrison & Cherry, 1997; Sinclair & Ryan, 2003; IUCN, 2023).

Knots are similar to sanderlings and belong to the same genus, *Calidris* spp. (syn. *Tringa* spp.). These short-legged wading birds are long-distance migrants, traveling from breeding areas in the Arctic to the coasts of Africa and South America (IUCN, 2023). In their wintering and migratory grounds, they feed on a variety of prey such as bivalves, gastropods, and small crabs (Sinclair & Ryan, 2003; IUCN, 2023). Turnstones (*Arenaria* spp.) are wader bird species closely related to calidrids (sandpipers) and belong to the family Scolopacidae. They are medium-sized migratory birds that breed in the Arctic and winter mainly in Africa. The turnstone (*Arenaria interpres*) is said to potentially occur in northern Mozambique (Sinclair & Ryan, 2003).

Egrets

Egrets (including some heron species) are birds from the Ardeidae family, distributed in two genera, *Egretta* and *Ardea* occurring in Mozambique. They are present near water, in salt, brackish, or fresh environments, feeding in wetlands, streams, tidal flats, and other areas (Harrison & Cherry, 1997; Sinclair & Ryan, 2003; IUCN, 2023). In Mozambique's coast of Cabo Delgado province, six species may occur, namely the grey heron (*Ardea cinerea*), great egret (*A. alba*), yellow-billed egret (*Egretta intermedia*), little egret (*E. garzetta*), dimorphic egret (*E. dimorpha*), and black egret (*E. ardesiaca*) (Sinclair & Ryan, 2003).

The entire coast of Mozambique is part of the migration route of Palearctic birds, which depend on the African coastline during the southern hemisphere summer (winter in their breeding regions) (Hayes F. E., 1995). The most important route is that of birds coming from Europe and Asia, followed by bird groups such as albatrosses, plovers, and gulls. Additionally, the area includes migration routes for intra-African migrants and southern hemisphere migrants, such as the petrels.

Bird species conservation status

Although information is very scarce on shorebird and seabird population size and trends in Mozambique, their conservation status was revaluated by IUCN in 2023. It is known that several threatened species of regional and global importance inhabit this area (IUCN, 2023). Among the seabirds and shoreline birds potentially occurring on the coast of Cabo Delgado province, there are five species classified as Endangered (EN), three as Vulnerable (VU), and eleven as Near Threatened, as highlighted below (Table 6.20) (IUCN, 2023).

Table 6.20: Bird species potentially occurring in the Cabo Delgado Region and considered globally threatened (or nearly), and conservation status according to IUCN

Family	Scientific Name	Common Name	Conservation Status as per IUCN
Ardeidae	*Ardeola idae*	Madagascar Pond-heron	EN
Diomedeidae	*Diomedea exulans*	Wandering Albatross	VU
	Phoebetria fusca	Sooty Albatross	EN
	Thalassarche carteri	Indian Yellow-nosed Albatross	EN
	Thalassarche cauta	Shy Albatross	NT
Falconidae	*Falco concolor*	Sooty Falcon	VU
Phoenicopteridae	*Phoeniconaias minor*	Lesser flamingo	NT
Procellariidae	*Ardenna carneipes*	Flesh-footed Shearwater	NT
	Ardenna grisea	Sooty Shearwater	NT
	Bulweria fallax	Jouanin's Petrel	NT
	Procellaria aequinoctialis	White-chinned petrel	VU
	Procellaria cinerea	Grey Petrel	NT
	Pseudobulweria rostrata	Tahiti Petrel	NT
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	NT
	Limosa lapponica	Bar-tailed Godwit	NT
	Numenius arquata	Eurasian curlew	NT
	Thalassarche steadi	White-capped Albatross	NT
	Spheniscus demersus	African Penguin	EN
Sulidae	*Morus capensis*	Cape Gannet	EN

Legend: NT – Near threatened; VU – vulnerable; EN – endangered.

Ten priority seabird species were observed in the 2016, 2019, 2021, and 2022 surveys (Fugro 2016b; 2019; Consultec 2021; 2022): the sooty tern, the common tern, the little tern (*Sternula albifrons*), the roseate tern (*Sterna dougallii*), the bridled tern (*Onychoprion anaethetus*), the sandwich tern (*Thalasseus sandvicensis*), the greater crested tern, the lesser crested tern (*Thalasseus bengalensis*), the lesser black-backed gull (*Laurus fuscus*), and the cape gannet. The lesser black-backed gull was identified as the Heuglin's gull (*Larus heuglini*) by Fugro (2016), although this taxon is not recognized as a species (BirdLife, 2023a) and is a subspecies (Horton *et al.*, 2021) and is known as *Larus fuscus*.

6.9.2.7 Marine Mammals

The Mozambique Channel region is home to diverse marine mammal populations, including species that permanently inhabit the area, such as various dolphin species, as well as those that utilize local habitats as feeding and breeding grounds. Factors such as the availability of food resources, suitable habitats for reproduction, weather conditions, ocean currents, and overall biological productivity strongly influence the distribution, occurrence, and abundance of marine mammals in the Eastern African region (Berggren, 2009; De Boer et al., 2002; Kiszka et al., 2007). Recognized as Important Marine Mammals Areas, Mozambique's coastal zones hold significant ecological value and require conservation efforts to protect these precious habitats (MMPATF, 2019).

Based on the cross-referencing of available literature and the data gathered during surveys conducted at the Coral North and Coral South FLNG fields, 33 marine mammal species were identified as potentially occurring in northern Mozambique (Kiszka *et al.,* 2007; IUCN, 2023; de Boer *et al.,* 2002). Their conservation status, according to IUCN (2023) and their seasonality in the area, are shown in Table 6.21 below.

Table 6.21: Marine mammals potentially present in the Mozambique Channel and species with confirmed presence in the ADI

Common name	Scientific name	IUCN Conservation status	Seasonality	Confirmed presence in the ADI***
Mysticeti Whales				
Common minke whale	*Balaenoptera acutorostrata*	LC	Jul-Nov	
Sei whale	*Balaenoptera borealis*	EN	Jul-Nov	
Bryde's whale	*Balaenoptera edeni*	LC	Unknown	
Blue whale	*Balaenoptera musculus*	EN	Jul-Nov	
Pygmy blue whale	*Balaenoptera musculus ssp. brevicauda*	n. a.	Jul-Nov	
Antarctic blue whale	*Balaenoptera musculus ssp. intermedia*	CR	Unknown	
Fin whale	*Balaenoptera physalus*	VU	Jul-Nov	
Southern right whale	*Eubalaena australis*	LC	Unknown	
Gray whale	*Eschrichtius robustus*	LC	Unknown	
Odontoceti (toothed) whales and dolphins				
Common dolphin	*Delphinus delphis*	LC	All year	
Pygmy killer whale	*Feresa attenuata*	LC	All year	Confirmed
Short-finned pilot whale	*Globicephala macrorhynchus*	LC	All year	Confirmed
Risso's dolphin	*Grampus griseus*	LC	All year	Confirmed
Indo-pacific beaked whale	*Indopacetus pacificus*	LC	Unknown	
Pygmy sperm whale	*Kogia breviceps*	LC	All year	
Dwarf sperm whale	*Kogia sima*	NA	All year	
Fraser's dolphin	*Lagenodelphis hosei*	LC	All year	
Humpback whale	*Megaptera novaeangliae*	LC	Jul-Nov	Confirmed

Common name	Scientific name	IUCN Conservation status	Seasonality	Confirmed presence in the ADI***
Blainville's beaked whale	*Mesoplodon densirostris*	LC	All year	
Ginkgo-toothed beaked whale	*Mesoplodon ginkgodens*	DD	Unknown	
Killer whale	*Orcinus orca*	DD	Seasonal	Confirmed
Melon-headed whale	*Peponocephala electra*	LC	All year	Confirmed
Sperm whale	*Physeter macrocephalus*	VU	All year (males migratory)	Confirmed
False killer whale	*Pseudorca crassidens*	NT	All year	Confirmed
Indian Ocean Humpback dolphin	*Sousa plumbea*	EN	All year	Confirmed
Pantropical spotted dolphin	*Stenella attenuata*	LC	All year	Confirmed
Striped Dolphin	*Stenella coeruleoalba*	LC	All year	
Spinner dolphin	*Stenella longirostris*	LC	All year	Confirmed
Rough-toothed dolphin	*Steno bredanensis*	LC	All year	
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	NT	All year	
Common bottlenose dolphin	*Tursiops truncatus*	LC	All year	Confirmed
Cuvier's beaked whale	*Ziphius cavirostris*	LC	All year	Confirmed
Sirenia				
Dugong	*Dugong dugon*	VU / CR*	All year	Confirmed**

Legend: IUCN: CR – Critically Endangered; EN – Endangered; VU – Vulnerable; LC- Least concern. Red list: Cat – Category; Ex- Extinct; AEx – Endangered; Vul. – Vulnerable. * While the global status of the Dugong is Vulnerable, the Eastern Africa subpopulation is classified as Critically Endangered. ** Reports from local fishermen around Vamizi and Rongui Islands (Quirimbas Archipelago) indicate that dugongs used to occur in the area (Consultec, 2015a). *** Observed during Area 4 surveys and from recent secondary data sources.

Among the 33 marine mammal species potentially present in northern Mozambique, eight (8) are classified as having an unfavourable conservation status according to the IUCN. False killer whale and Indo-pacific bottlenose dolphin are categorized as Near Threatened, while fin whale, dugong, sperm whale, and are classified as Vulnerable. Blue and Sei whales as well as the Indian Ocean humpback dolphin are listed as Endangered (IUCN, 2023).

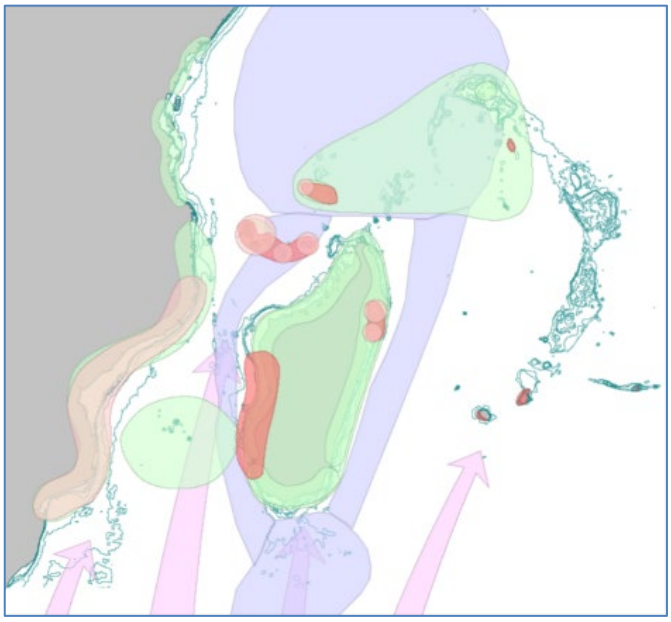
The Mozambique Channel region, encompassing the project's area of influence, holds great importance for marine mammals, particularly during their reproductive and migration periods from the Antarctic Ocean. The presence of protected areas, such as lagoons and coral reefs, enhances the diversity of these species by providing optimal habitats for breeding and feeding (Obura *et al*., 2012). The combination of suitable habitats and abundant food resources contributes to the relatively high number of marine mammal species found in the area (Roberts *et al*., 2002). Among the cetacean species observed in the study area, four large migratory cetacean species can be regularly seen along the coastline from June to September:

- Common minke whale (*Balaenoptera acutorostrata*);
- Humpback whale (*Megaptera novaeangliae*);
- Sperm whale (*Physeter macrocephalus*);

- Southern right whale (*Eubalaena australis*).

During winter, humpback whales (*Megaptera novaeangliae*) and minke whales (*Balaenoptera acutorostrata*) are commonly sighted along the coast. Humpback whales migrate from their feeding grounds in the Antarctic during the austral summer to breed in the coastal tropical waters of the western Indian Ocean, including the shallow waters of Mozambique, Madagascar, and the central Mozambique Channel Islands (Fleming & Jackson, 2011). These whales inhabit the continental shelf and can be found at depths between 10 and 200 meters, utilizing the coast and continental shelf of Mozambique as important wintering and breeding sites. The proportion of females with calves increases from south to north in Mozambique, emphasizing the significance of the continental shelf and nearshore waters for breeding. Mothers and calves are often observed between late October and December, highlighting the critical role of warm coastal waters in the survival of newborns (Kiszka *et al*., 2009).

Figure 6.59 provides an overview of cetacean zones in the WIO, displaying the distribution of different cetacean species. It highlights areas where cetaceans are frequently sighted, including primary sighting zones, blue whale sighting zones, primary feeding grounds, wintering grounds for humpback whales, and migration routes of humpback whales.



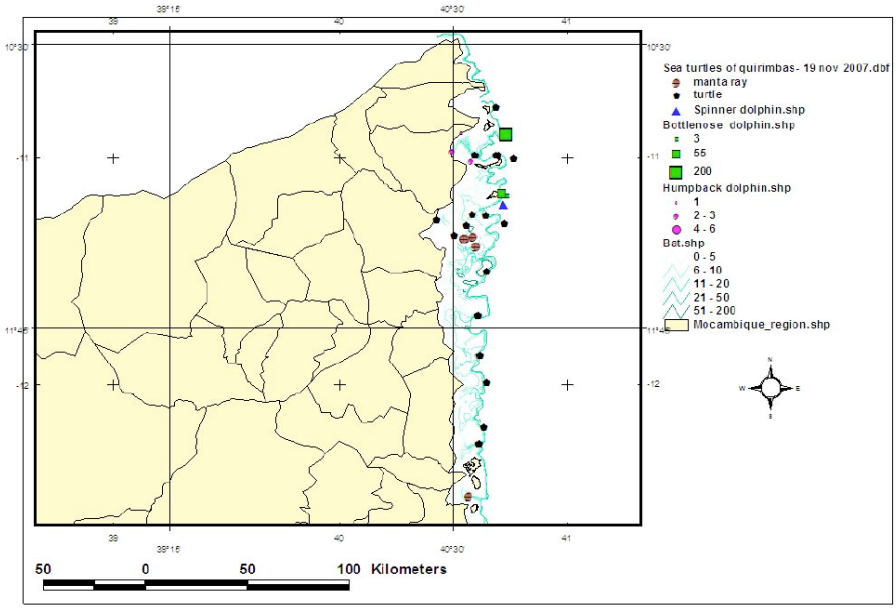
Source: RAMP-COI in Obura *et al*. (2012).

Figure 6.59: Cetacean zones in the West Indian Ocean (WIO), emphasizing the primary zones of cetacean sightings (green), blue whale sighting zones (blue), primary feeding grounds (pink), wintering grounds (red) for humpback whales and migration routes (arrows) for humpback whales

Toothed whales inhabit the continental shelf and the abyssal zones (at depths of between 200 and 2,000 meters), feeding mainly on large pelagic mesocephalopods (squid). These species are known for their long diving periods, lasting between 30 and 45 minutes. Dolphins, on the other hand, are more conspicuous and primarily prey on pelagic fishes. These marine species tend to congregate around underwater mountains, near pits, and other areas of high primary productivity, where prey is

abundant (Whitehead & Weilgart, 2000). Sperm whales are social creatures, with females forming groups that cover vital areas of about 1,000 km. However, they can occasionally embark on journeys spanning thousands of kilometres across the ocean (Whitehead & Weilgart, 2000). Male whales undertake longer migrations between feeding areas in high latitudes and tropical regions where reproducing females are present (Weilgart & Whitehead, 2000).

The surveys conducted during the TRANSMAP project revealed the presence of a diverse range of marine mammal species along the northern coast of Mozambique. In addition to inshore species such as the Indian Ocean humpback dolphin (Sousa *plumbea*) and the common bottlenose dolphin (*Tursiops truncatus*) that inhabit the areas around the islands and the inshore sea, offshore species like spinner dolphins (*Stenella longirostris*) and spotted dolphins (*S. attenuata*) were observed in deeper waters beyond the 200-meter isobath. Occasional sightings of common dolphins (*Delphinus delphis*) were also recorded. Notably, humpback whales and minke whales (*Balaenoptera acutorostrata*) were frequently observed along the coast during the winter season. These findings highlight the rich marine mammal diversity in the region (Figure 6.60) (TRANSMAP, 2008).

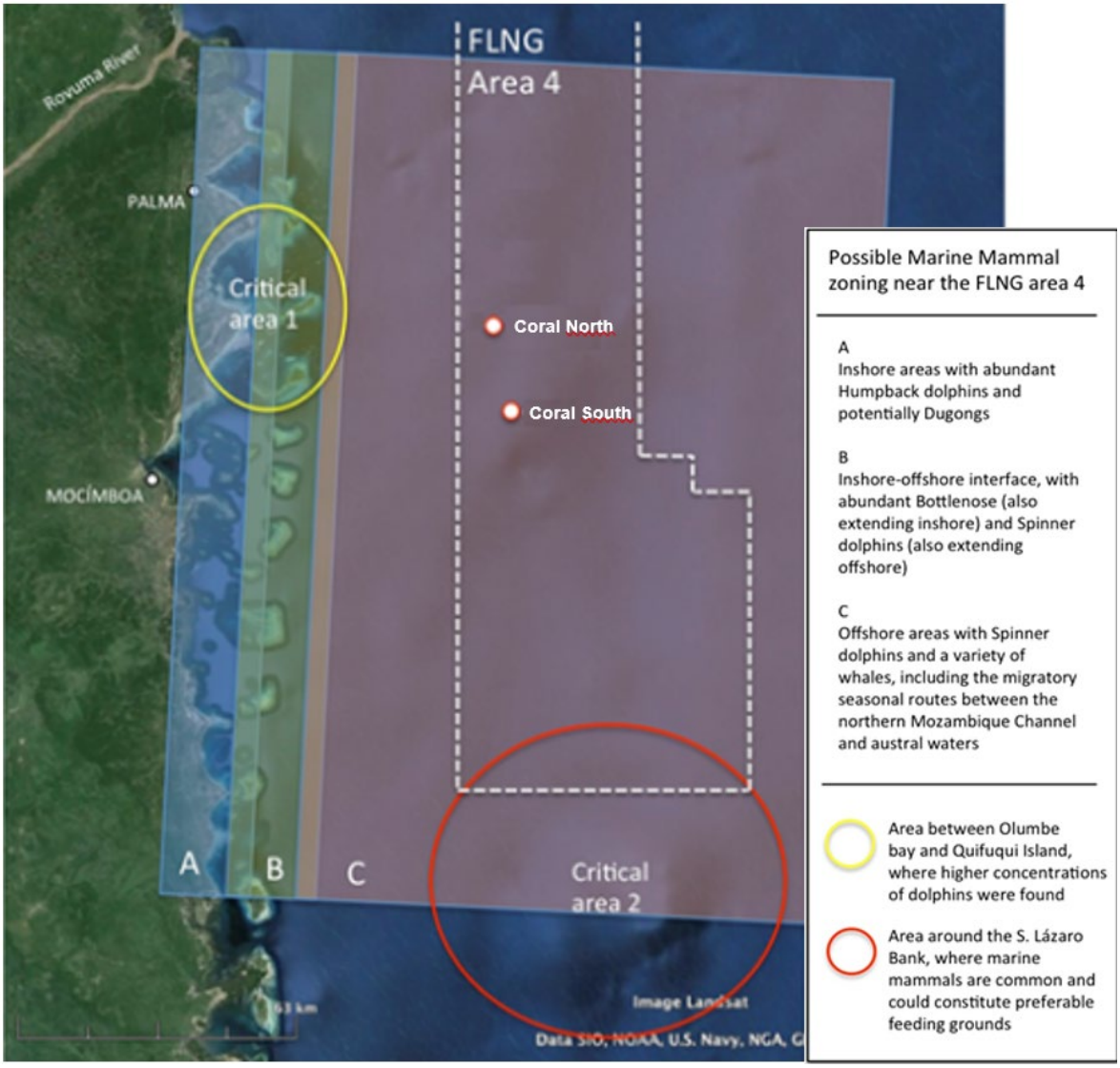


Source: TRANSMAP (2008a).

Figure 6.60: Sightings of marine mammals, manta rays and turtles from the aerial surveys conducted by the TRANSMAP in November 2007

During the 2013/2014 3D seismic survey in Area 4, mammal monitoring conducted by Fennelly *et al*. (2014) resulted in 18 sightings of 206 marine mammals. The most abundant species observed were the melon headed whale and unidentified dolphins, likely belonging to the prevalent spinner and bottlenose dolphin species. The sightings were concentrated in the southern part of the study area, closer to St. Lazarus Bank. This is likely influenced by the presence of St. Lazarus Bank, a well-known fishing site for both industrial and recreational purposes. The abundance of food around the coral bank may attract marine mammal species, highlighting its importance for biodiversity and fisheries resources in the northern Mozambique area (Fennelly *et al.,* 2014).

Figure 6.61 provides a diagrammatic overview of the zonation, including the most probable critical areas for this faunal group.



Source: Adapted from Consultec (2015a).

Figure 6.61: Diagrammatic and preliminary view of inshore-offshore distribution of marine mammals and probable critical areas for their support

The following subsections provide greater details on the species listed as globally threatened, including their behaviour, reproductive patterns, and conservation status.

Blue whale (Balaenoptera musculus)

Antarctic blue whales (*Balaenoptera musculus intermedia*) classified as CR, and pygmy blue whales (*B. m. brevicauda*) classified as EN are both known to occur in the offshore waters of the Mozambique channel during the austral summer (TRANSMAP, 2008; IUCN, 2023). Considering the presence of Antarctic blue whale song off the northwest coast of Madagascar during the austral winter, it is likely that the species migrates through the Mozambique Channel. Based upon the bimodal presence of Southwest Indian Ocean pygmy blue whale song off the northwest coast of

Madagascar during the austral spring and autumn it is certain that the species migrates through the Mozambique Channel area (IUCN- Marine Mammal Protected Areas Task Force, 2021 and references there in). Therefore, it is likely that both Antarctic blue whales, and pygmy blue whales can be found in Area 4.

Humpback whale (Megaptera novaeangliae)

The humpback whale, although listed as LC by the IUCN is included in Appendix II of the Bern Convention, Appendix I of the Bona Convention, and Appendix I of CITES, has been confirmed to inhabit Mozambican waters, particularly during the austral winter, with an estimated population abundance of nearly 6,000 animals (Pereira *et al*., 2014; Kiszka, 2015; IUCN, 2023). Humpback whales have been observed during the Area 4 specific baseline surveys in 2016 and 2021.

These iconic large whales, reaching up to 15 meters in length, are present in the region between June and October, with regular observations along the coast from June to September (Kiszka *et al*., 2007). The annual migrations of Southern Hemisphere humpback whales from their summer feeding grounds in the Antarctic or Southern Ocean to their winter breeding grounds in shallow tropical and sub-tropical waters are well-documented through whaling catches and satellite telemetry studies (Findlay *et al*., 2020). These whales utilize the coastal waters of Southern Hemisphere continents as migratory corridors en route between their breeding and feeding grounds, making them particularly vulnerable to land-based whaling operations (Findlay *et al*., 2020). Populations of Southern Hemisphere humpback whales experienced significant declines during the 20th century due to intensive whaling in both the Antarctic feeding grounds and tropical breeding grounds (Findlay *et al*., 2020).

Migrations in the southwestern Indian Ocean, as suggested by Best *et al*. (1998), involve three principal migratory streams:

- East African corridor, which takes whales to and from the coastal waters of Mozambique, referred to as the C1 ground by the International Whaling Commission (IWC, 1998);
- Madagascar Ridge corridor, guiding animals through Walters Shoal to and from the coastal waters of Madagascar, known as the C3 ground;
- Central Mozambique Current corridor, leading whales to and from the coastal waters of the central Mozambique Channel Islands such as Aldabra, the Comores Islands, and Mayotte, or to the coastal waters of Mozambique to the north of 18°S.

While limited mating activity, such as competitive groups and singing, has been observed in the region, the waters of Northern Mozambique may serve as a critical wintering habitat or resting point for mother/calf pairs along their migration route (Obura *et al.,* 2012). The humpback whale behaviours observed during the 2016 Area 4 survey suggested that the groups of whales were wintering rather than migrating through the area. The observed behaviours included milling by several groups and the mixed directions that many groups were travelling versus in one direction; social behaviours by adult whales as fin and tail slapping to breaching clear of the water; the presence of juveniles and calves along with adults and the active, flamboyant behaviour of some adult groups (Fugro, 2017).

Killer whale (Orcinus orca)

The killer whale or orca (*Orcinus orca*), listed as Data Deficient (DD) by the IUCN and included in Appendix II of the Bern Convention and Appendix II of CITES has been confirmed to be present in the northern Mozambique region (TRANSMAP, 2008; IUCN, 2023).

Killer whales are apex marine predators known for their wide range of prey, which includes marine mammals, elasmobranchs, teleosts, sea turtles, and sea birds (Best et al., 2010). They tend to inhabit circumpolar regions but can roam during the summer months, lacking defined migratory patterns. The diet of killer whales in tropical waters (25° N to 25° S) is poorly understood, and information on their presence and diet is scarce (Baird *et al.*, 2006). It has been reported that killer whales in low latitudes primarily prey on humpback whale calves, even in their breeding grounds where they receive protection from their mothers (Baird *et al.,* 2006).

Due to limited research and rare sightings of killer whales in tropical waters, their ecology and behaviour in these regions remain largely unknown.

Sperm whale (Physeter macrocephalus)

The sperm whale listed as VU by the IUCN and included in Appendix III of the Bern Convention and Appendix II of CITES has been confirmed to be present in the northern Mozambique region (Fennelly *et al*., 2014; IUCN, 2023).

Sperm whales, the largest of the toothed whales (Odontoceti), have a unique biology. Males can reach lengths of up to 20 meters (65 feet), although individuals larger than 18 meters (60 feet) are rare nowadays. Female sperm whales have a maximum length of 12 meters (40 feet) (Berzin, 1971). They exhibit a schooling instinct, forming groups consisting of females and young individuals, young males, and mixed ages and sexes. Older adult males tend to be solitary and migrate to higher latitudes compared to females and younger individuals, limited by their intolerance to low water temperatures. Sperm whales are known for their ability to make prolonged deep dives, with large adult males capable of remaining submerged for over an hour, while females and younger animals typically surface after 15-20 minutes (Kawakami, 1980).

Sperm whales can be found in all oceans worldwide, with their distribution influenced by the availability of food and suitable conditions for breeding. It varies depending on the composition of sex and age groups (Kawakami, 1980). These whales typically inhabit offshore waters, and they are often associated with areas where there is a sharp drop in depth, indicating upwelling and high organic production. These areas provide a good food supply for the whales (Berzin, 1971). Sightings of sperm whales were concentrated in offshore waters, further supporting the understanding that these whales prefer these habitats (Fennelly *et al.,* 2014).

False killer whale (Pseudorca crassidens)

The false killer whale (*Pseudorca crassidens*), listed as NT by the IUCN and included in Appendix II of the Bern Convention and Appendix II of CITES has been confirmed to be present in the northern Mozambique region (TRANSMAP, 2008; IUCN, 2023).

These whales feed on fish species targeted by major high-value fisheries, such as tunas and billfishes. They are known to engage in depredation on both catch and bait in hook-and-line fisheries, making them more vulnerable to bycatch and prey reduction compared to other cetacean species with similar distributions (Baird, 2018a).

False killer whales are typically found in tropical to warm temperate zones, primarily in relatively deep offshore waters across the Atlantic, Pacific, and Indian Oceans. They exhibit higher densities in tropical regions, and their movements into higher latitudes may be associated with warmer currents or seasonal factors. Generally, false killer whales do not range into latitudes higher than 50° in either hemisphere (Zaeschmar, 2014).

Indian Ocean humpback dolphin (Sousa plumbea)

The Indian Ocean humpback dolphin (*Sousa plumbea*), listed as EN by the IUCN and included in Appendix III of the Bern Convention and Appendix I of CITES, has been confirmed to inhabit the coastal waters of the Mozambique region (TRANSMAP, 2008).

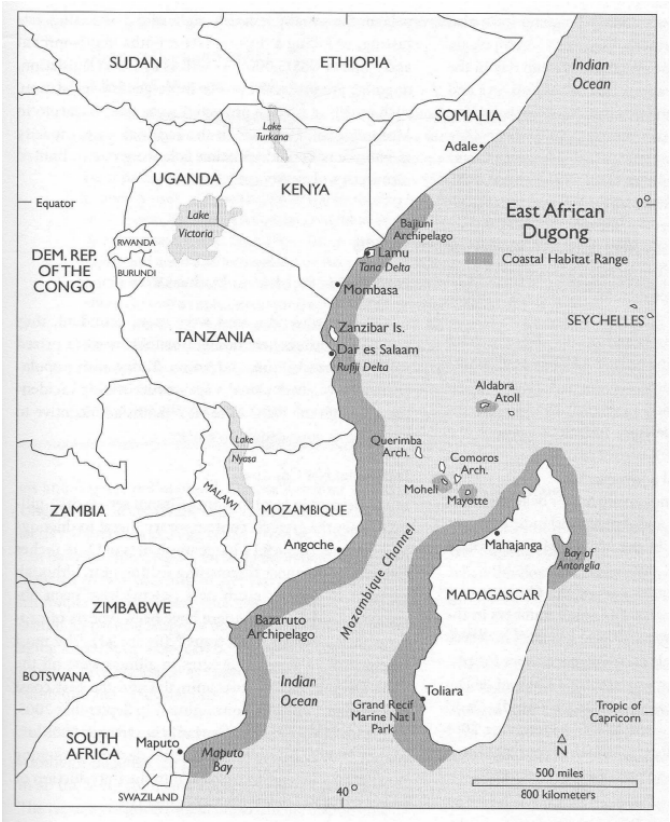
These dolphins are present year-round, typically in coastal areas near islands and the mainland. They are associated with reefs and mangrove channels, often found in shallow waters less than 10 meters deep (Kiszka et al., 2007). The Indian Ocean humpback dolphin's distribution extends from coastal waters off False Bay, South Africa in the west, through the coastal waters of South, East and North Africa, as well as the Middle East to approximately the southern tip of India and possibly further east (Braulik *et al*., 2017).

Due to their coastal range, life history, and habits, the Indian Ocean humpback dolphin is vulnerable to human activities. Coastal habitats expose them to risks such as by-catch in coastal artisanal fisheries and gill net entanglement (Kiszka *et al.,* 2007). Their presence and vulnerability make them valuable as an indicator species, reflecting the impacts of human activities in the coastal marine environment (Obura *et al*., 2012).

Dugong (Dugong dugon)

The dugong, listed as Vulnerable (VU) by the IUCN and included in Appendix III of the Bern Convention and Appendix II of CITES, has been documented to inhabit the northern Mozambique region (Guissamulo, 1996; CDBTP, 2003; IUCN, 2023). While the global population of dugongs is classified as Vulnerable, the Eastern Africa subpopulation, including the individuals in Mozambique, is classified as Critically Endangered (IUCN, 2023).

Dugongs inhabit nearshore tropical and subtropical coastal and island waters of the Indo-Pacific, ranging from southern Mozambique to Vanuatu and Japan, between latitudes approximately 27° north and south, in waters warmer than about 18°C (Obura et al., 2012). The eastern coast of Africa marks the westernmost boundary of the dugong's global range, with known occurrences in waters off Somalia, Kenya, Tanzania, and Mozambique (Figure 6.62) (Muir *et al*., 2012).



Source: Muir *et al*. (2012).

Figure 6.62: East Africa dugong distribution

Local fishermen's reports, around Vamizi and Rongui Islands (Quirimbas Archipelago), suggest a previous abundance of dugongs in the area; however, their population has significantly declined due to hunting pressure (Consultec, 2014b). While extensive seagrass meadows in northern Mozambique indicate suitable habitats for dugongs, aerial surveys conducted in April and November 2007, specifically focusing on marine mammals, did not observe any dugongs (CSA, 2007).

The WIO region serves as an important feeding and calving ground for dugongs. However, like many other areas within their range, dugongs in the WIO are severely depleted (Muir *et al*., 2012). Their future survival is threatened by incidental catch in fishing nets, habitat loss and degradation, fishing pressure, hunting, and pollution. Population declines have raised significant concerns about their survival, particularly in the WIO, where dugongs are considered critically endangered. Studies indicate that populations are small, isolated, and face threats from gillnets and habitat disturbance. These factors highlight the critical conservation status of dugongs in the region.

6.9.2.8 Marine Megafauna – Coral Field Site Specific Results

Marine biodiversity monitoring surveys for Coral South and the broader area were carried out in 2019 (Fugro, 2019), 2021 and 2022 (in the dry season; Consultec, 2021, 2022) and in 2023 (in the wet season, Consultec, 2023), with the general objective of obtaining data on presence, distribution and abundance estimates for target species (seabird, cetaceans, fishes and turtles) thereby verifying the Critical Habitat Screening and Assessment (CHSA's) results carried out for Coral South, as well as

to evaluate possible Coral South Project impacts such as attraction and avoidance effects. These results, presented in this section, are directly applicable for the marine megafauna characterisation and impact assessment of the Coral North area.

Sampling methodology followed the Biodiversity Monitoring and Evaluation Program (BMEP) established for Coral South Project (Consultec, 2019, 2022), and included transect sampling on vessels and "point" sampling while stationed on the supply vessel, near the Coral South FLNG site. All methodological details may be found in Consultec (2019, 2022). These sampling regions are shown in Figure 6.63. Sampling effort is presented in Table 6.22.

Table 6.22: Sampling effort conducted in the 2019, 2021, 2022, and 2023 transect surveys

Region	2019		2021		2022		2023	
	Distance (km)	Hours	Distance (km)	Hours	Distance (km)	Hours	Distance (km)	Hours
1	35	02:03	52	02:25	89.3	13:59	44.8	03:31
2	120	07:39	134	15:37	238.5	33:15	347.3	21:49
3	173	11:48	184	10:33	226.2	10:58	346.2	22:55
4	75	03:08	-	-	-	-	152.8	10:15

The 2023 survey was conducted in the wet season (March) differing from the previous baseline and annual (2021 and 2022) campaigns, performed in the months of May and June (dry season; Fugro 2019, Consultec 2021 and Consultec 2022). In the survey area, the wet season (austral summer) is of particular importance for several avifauna species such as most of the Sternidae and Laridae species and some tuna fish. On the other hand, baleen whales are mostly present (e.g., humpback whale) and turtles spawn on the Mozambique beaches (particularly between October and February) during the dry season (see Consultec 2014a, 2014b).

Data collected in the monitoring surveys was used to map the spatial distribution of the species.

Observations obtained by transect data were converted to Individuals Per Unit of Effort (IPUE), number of individuals per Km (density) and per hour to compare spatial and temporal patterns of sightings among sampling regions in the 2019 baseline and the 2021, 2022 and 2023 surveys.

Overall, the transect survey effort in the 2023 was higher than in the 2021 and 2022 surveys, both in terms of kilometres and in total hours of observation (Table 6.22). The exceptions included Region 1, regarding the distance covered and time expended, and Region 2, regarding time expended. The 2023 survey was a dedicated survey sampling, covering all the four regions with transects, whereas the 2021 and 2022 surveys followed predetermined linear vessel routes to and from the operational area. The effort performed in the 2023 survey was more than double (2.2 times) that of the 2019 baseline survey (Consultec, 2022).

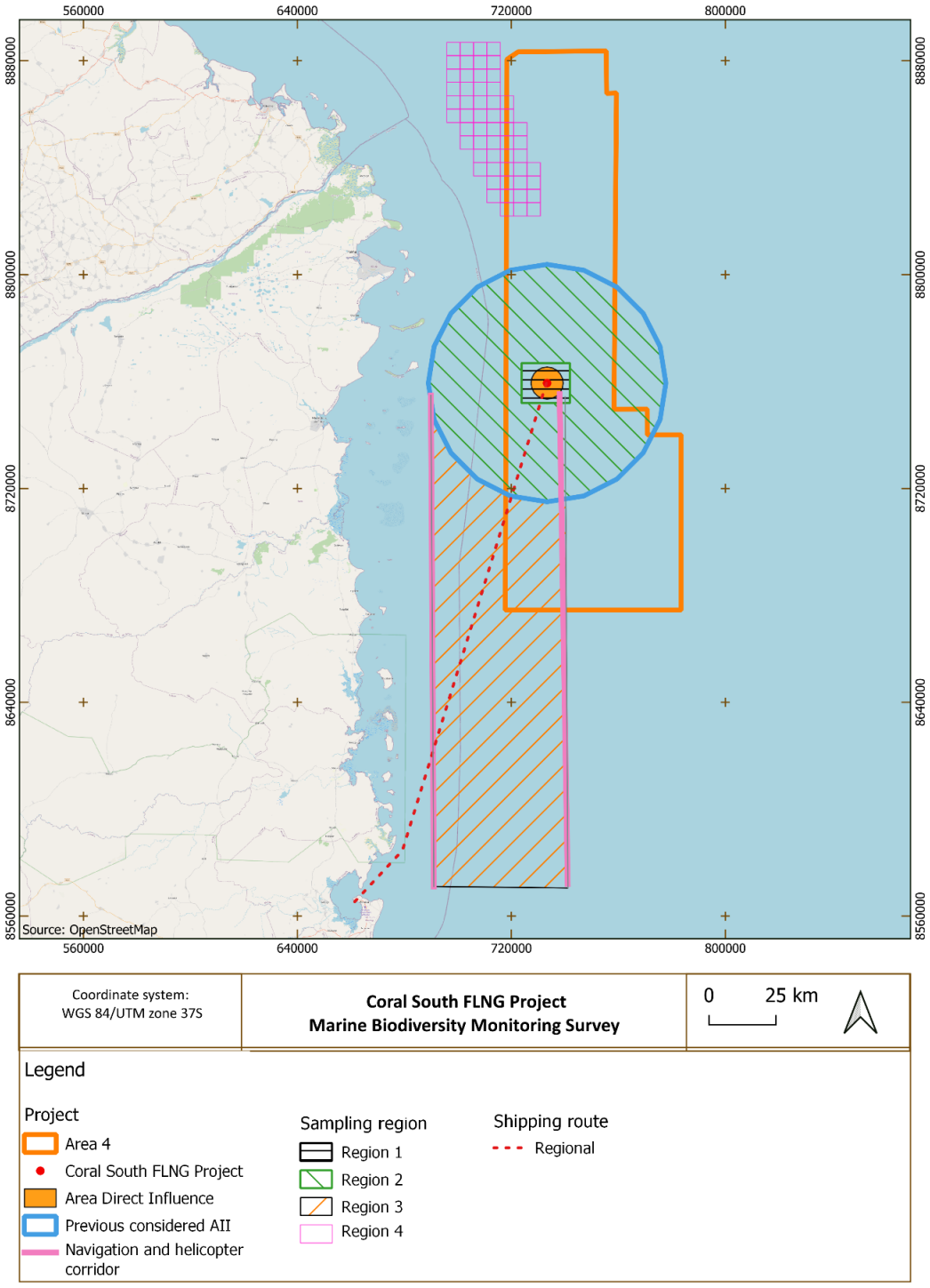


Figure 6.63: Coral South BMEP sampling regions

Table 6.23 shows the number of individuals of marine megafauna per unity of effort.

Table 6.23: Absolute and relative (IPUE) number of individuals of marine fauna observed in the 2019, 2021, 2022, and 2023 surveys

Region	2019			2021			2022			2023		
	Nº ind.	IPUE		Nº ind.	IPUE		Nº ind.	IPUE		Nº ind.	IPUE	
		Nº ind. /km	Nº ind./ hour		Nº ind./ km	Nº ind./ hour		Nº ind./ km	Nº ind./ hour		Nº ind. /km	Nº ind./ hour
1	1	0.03	0.49	21	0.40	8.69	98	1.10	7.01	411	9.17	116.87
2	0	0.00	0.00	37	0.28	2.37	472	1.98	14.20	669	1.96	31.12
3	0	0.00	0.00	17	0.09	1.61	197	0.87	17.96	757	2.19	33.03
4	3	0.04	0.62	-	-	-	-	-	-	323	2.11	31.51

A greater number of individuals were observed in the 2022 and 2023 surveys. The 2022 survey noted unidentified tuna with large school sizes and the 2023 survey observed high numbers of yellowfin tuna and unidentified tuna in large schools in Region 1.

The highest IPUE for avifauna was found in Region 2, due to the presence of sooty terns and unidentified terns in large flocks.

Priority fauna species were defined in the CHSA (ERM, 2016) and in the EIA Gap Analysis and Action Plan for the Coral South Project (Consultec, 2018). Table 6.24 presents a compilation of the observation of these species for all monitoring campaigns carried out (Consultec & BIOTA, 2023).

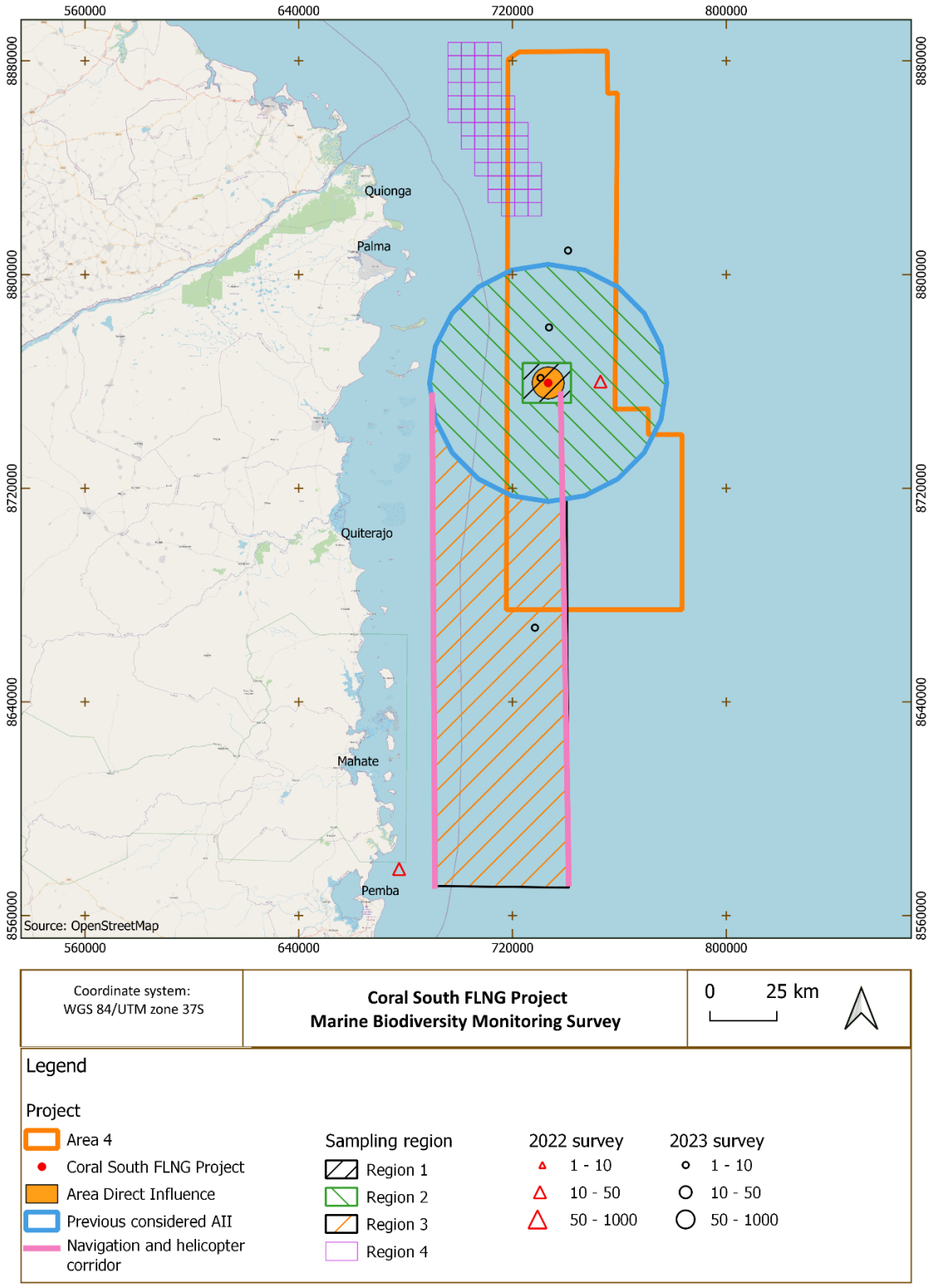
Table 6.24: Priority fauna observed (x) in the marine baseline study conducted in 2015-2016 (Fugro, 2016), in the monitoring baseline (Fugro 2019), and in the 2021, 2022 and 2023 monitoring surveys (Consultec & Biota, 2021; 2022; 2023)

Class/Species	Common name	2016	2019	2021	2022	2023
Mammalia						
Balaenoptera borealis	Sei whale					
Balaenoptera musculus brevicauda	Pygmy blue whale					
Balaenoptera physalus	Fin whale					
Megaptera novaeangliae	Humpback whale			X		
Physeter macrocephalus	Sperm whale	X				
Reptilia						
Caretta caretta	Loggerhead turtle					
Chelonia mydas	Green turtle					
Dermochelys coriacea	Leatherback turtle					
Eretmochelys imbricata	Hawksbill turtle					
Lepidochelys olivacea	Olive ridley					
Aves						
Morus capensis	Cape gannet	X	X			
Hydroprogne caspia	Caspian tern					
Onychoprion fuscatus	Sooty tern	X		X	?	X
Onychoprion anaethetus	Bridled tern	X				

Class/Species	Common name	2016	2019	2021	2022	2023
Sterna albifrons	Little tern	X				
Sterna dougallii	Roseate tern	X				X
Sterna hirundo	Common tern	X		X		
Thalasseus bengalensis	Lesser crested tern					
Thalasseus bergii	Greater crested tern	X		X	X	X
Thalasseus sandvicensis	Sandwich tern	X				
Larus hemprichii	Sooty gull					
Larus dominicanus	Kelp gull					
Larus fuscus	Lesser black-backed gull	X				
Larus cirrocephalus	Grey-headed gull					
Chondrichthyes						
Carcharhinus longimanu	Oceanic white tipped shark	X				
Rhincodon typus	Whale shark					
Sphyrna lewini	Scalloped hammerhead					
Sphyrna mokarran	Squat-headed Hammerhead Shark					
Sarcopterygii						
Latimeria chalumnae	Coelacanth					
Actinopterygii						
Katsuwonus pelamis	Skipjack Tuna					X
Thunnus alalunga	Albacore Tuna					
Thunnus obesus	Bigeye Tuna			X		

Marine Mammals

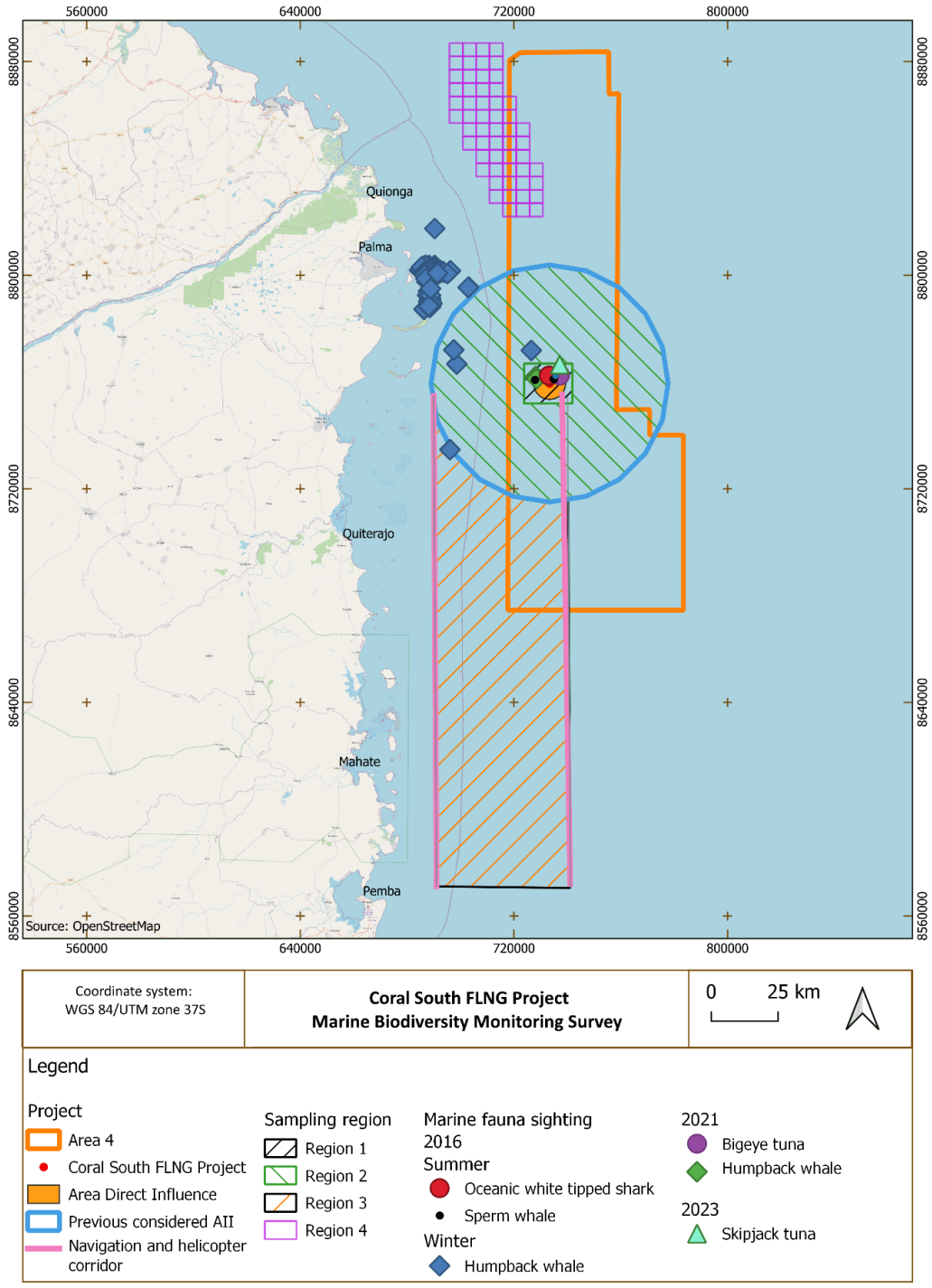
Figure 6.64 shows the sightings of cetaceans in the sampling regions for all the monitoring surveys.



Source: Consultec & Biota (2023).

Figure 6.64: Observations of cetaceans in the 2002 and 2023 monitoring surveys. There were no mammal observations in transects sampling in the 2019 and 2021 surveys

Figure 6.65 shows the sightings of the priority cetaceans and fish, likely to meet criteria 1 to 3 of IFC PS6, per sampling regions for all monitoring surveys (Table 6.30, section 6.9.4) are shown.

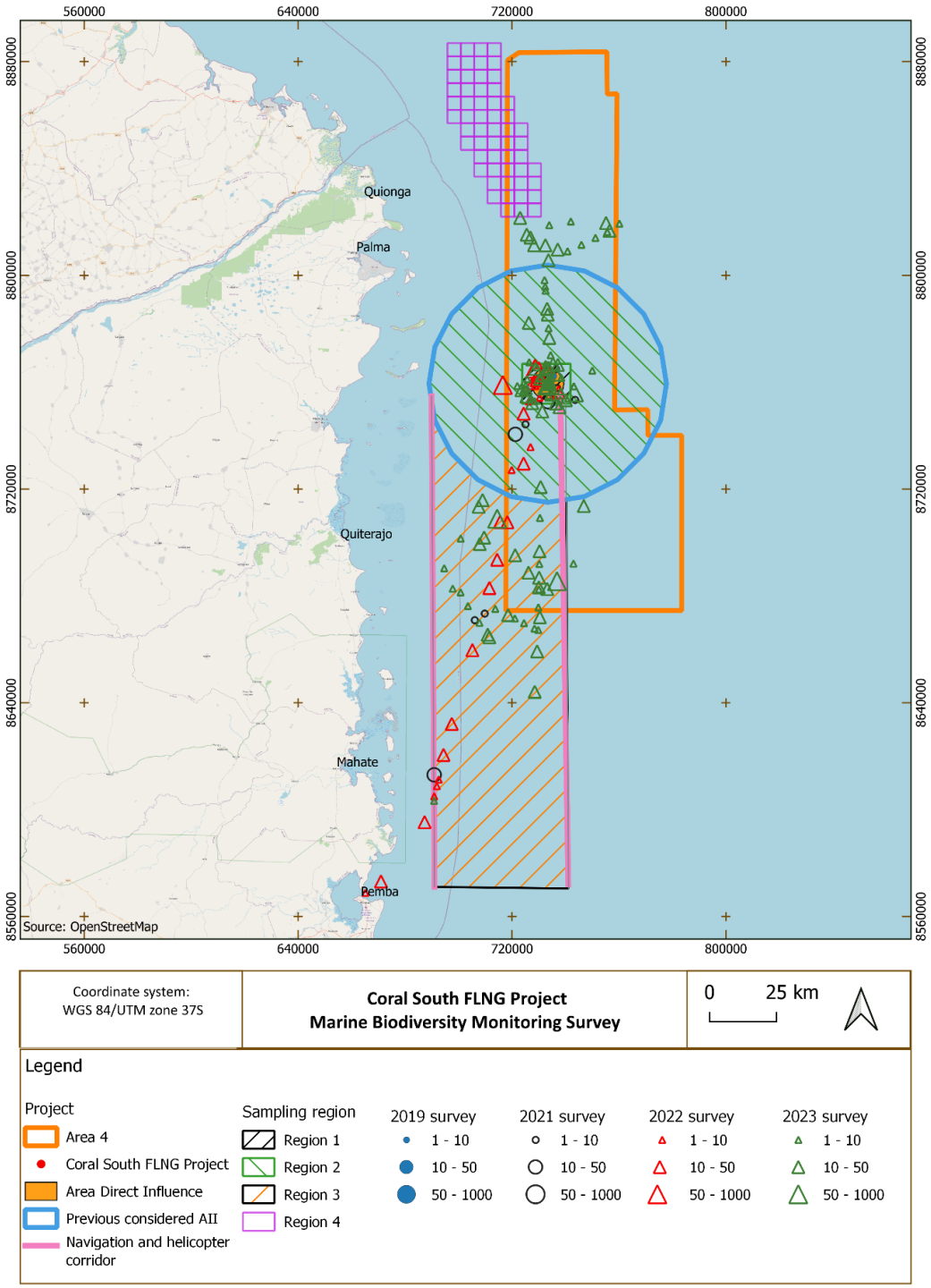


Source: Consultec & Biota (2023).

Figure 6.65: Sightings of priority marine mammals and fishes in the 2016 study and in the 2021 and 2023 monitoring surveys. None of the priority marine fauna species were observed in 2022

Fish

Figure 6.66 shows the sightings of fishes in sampling regions for all the monitoring surveys (Consultec & BIOTA, 2023). Yellowfin tuna species were observed during the previous Coral South FLNG annual monitoring campaigns in 2021, 2022 and 2023. Skipjack tuna was observed during the 2023 monitoring campaign and bigeye tuna was recorded in the 2021 monitoring campaign.



Source: Consultec & Biota (2023).

Figure 6.66: Observations of fish in the 2019, 2021, 2022, and 2023 monitoring surveys

6.9.2.9 Turtles

During the Coral Field surveys, six unidentified turtle individuals were registered in 2019, and one in 2021. In the 2022 and 2023 surveys no sea turtle species were observed. It is likely that data is too scarce to infer trends on these species' presence at the marine area around the project site.

6.9.2.10 Birds

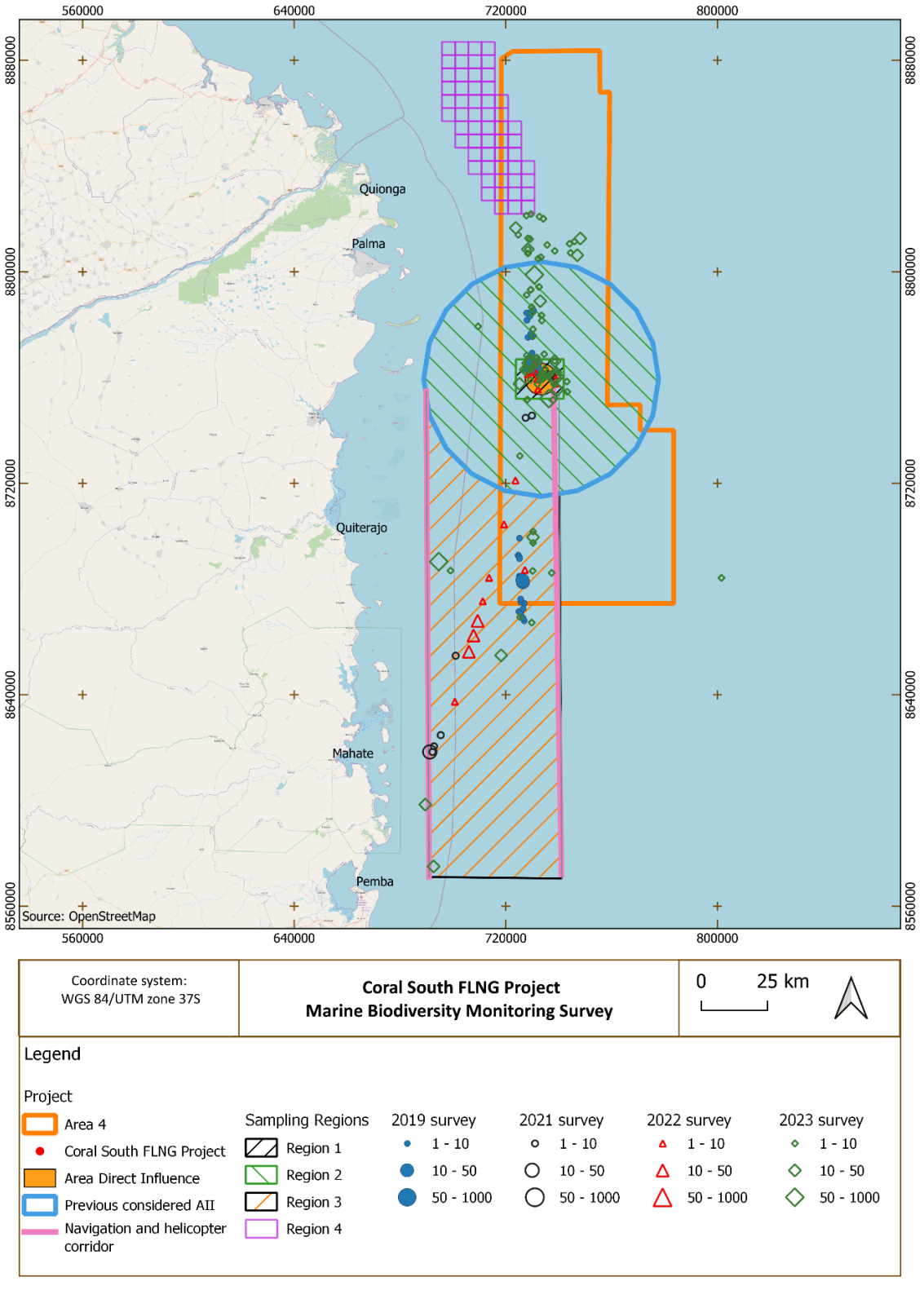
Figure 6.67 shows the sightings of birds in sampling regions for all the monitoring surveys, while Table 6.25 shows the number of individuals of avifauna observed during the surveys, an intermediate taxonomic richness of seabirds in the AII.

Table 6.25: Absolute and relative (IPUE) number of individuals of avifauna observed in the 2019, 2021, 2022 and 2023 transect surveys

Region	2019			2021			2022			2023		
	Nº ind.	IPUE		Nº ind.	IPUE		Nº ind.	IPUE		Nº ind.	IPUE	
		Nº ind. /km	Nº ind./ hour		Nº ind./ km	Nº ind./ hour		Nº ind./ km	Nº ind./ hour		Nº ind. /km	Nº ind./ hour
1	1	0.03	0.49	5	0.10	2.07	5	0.06	0.36	79	1.76	22.46
2	113	0.94	14.64	3	0.02	0.19	7	0.03	0.21	716	2.06	32.82
3	122	0.71	10.34	42	0.23	3.98	70	0.31	6.38	194	0.56	8.47
4	3	0.04	0.62	-	-	-	-	-	-	165	1.08	16.10

During the monitoring surveys conducted in the Area 4 between 2019 and 2023, the following bird species were recorded in the vicinity of the FLNG installation and operational area: pond-heron (*Ardeola idae*), cattle egret (*Bubulcus ibis*), whistling yellowbill (*Ceuthmochares australis*), great frigatebird (*Fregata minor*), Wilson's storm-petrel (*Oceanites oceanicus*), white-faced storm-petrel (*Pelagodroma marina*), white-tailed tropicbird (*Phaethon lepturus*), red-tailed tropicbird (*Phaethon rubricauda*), tropical shearwater (*Puffinus bailloni* ssp. *nicolae*), roseate tern (*Sterna dougallii*), sooty tern, common tern, masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), and greater crested tern.

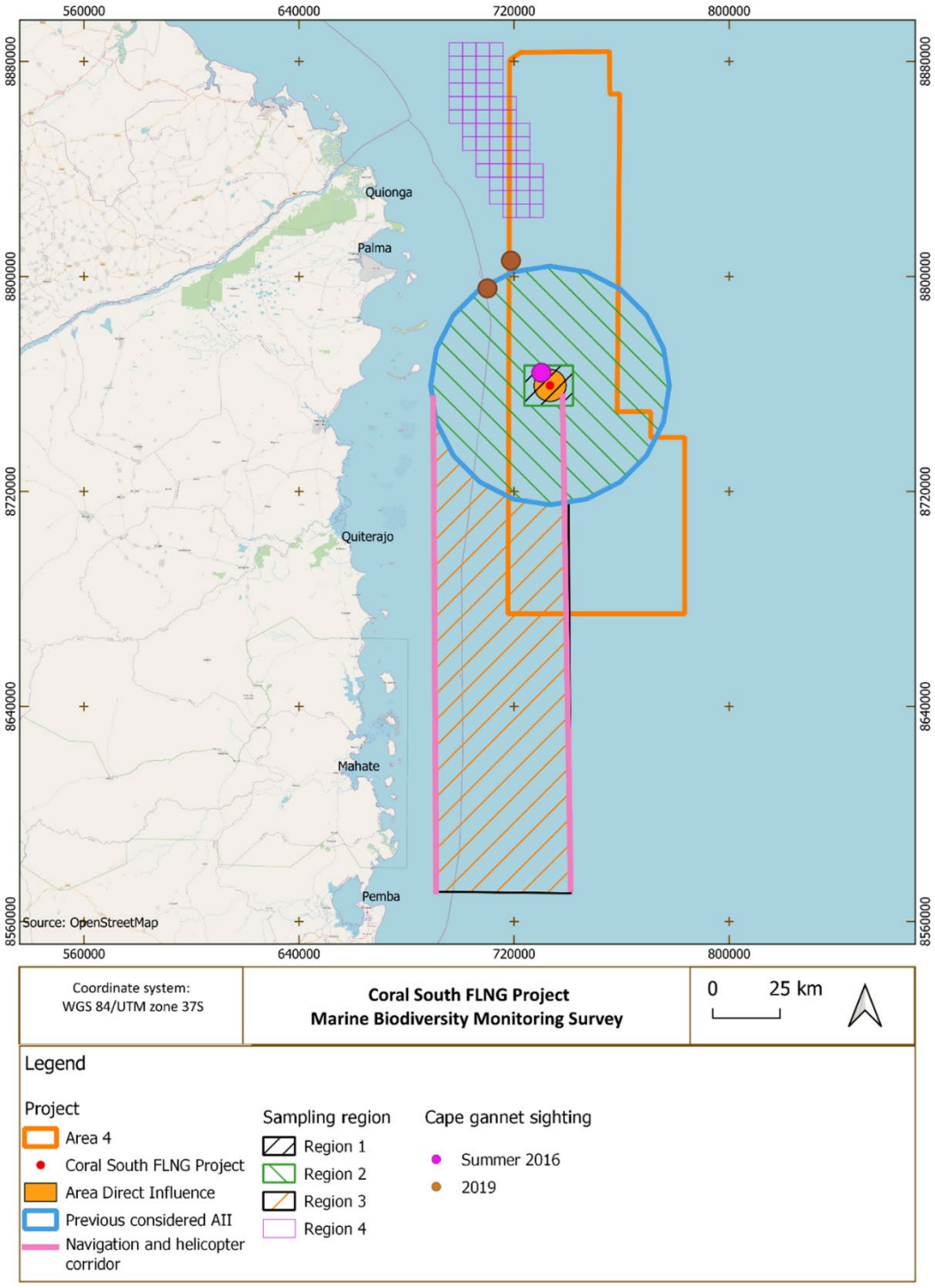
During two of the three years of sampling, the presence of the Madagascar pond-heron, a species classified as EN (Consultec & BIOTA, 2023; IUCN, 2023), was recorded (Figure 6.67). Sooty tern was observed in previous studies conducted under the project framework (in 2016 and 2021); also, in 2022, the observed *Onychoprion* sp. were probably sooty tern. Sooty tern breeds in the Mozambique Channel, in the French Southern Ocean Territories (Le Corre & Safford, 2001) and in northern Mozambique. It is more frequent in the Mozambique channel in the austral Summer (Allport, 2018).



Source: Consultec & Biota (2023).

Figure 6.67: Observations of birds in the 2019, 2021, 2022, and 2023 monitoring surveys

Figure 6.68 shows the sightings of Cape gannet, a priority bird species likely to meet criteria 1 to 2 of IFC PS6, per sampling regions (Table 6.30, section 6.9.4).



Source: Consultec & Biota (2023).

Figure 6.68: Sightings of Cape gannet (priority bird species) in the 2016 study and in the 2019 monitoring survey. The species was not observed in 2021, 2022 and 2023 monitoring surveys

6.9.3 Ecosystem Services

6.9.3.1 Methodology

The characterization of the ecosystem services of the marine habitats in the project area of influence was based on the typology of ecosystems and the classification of their services developed by Bordt & Saner (2019). This classification results from a meta-analysis of ecosystem assessments and frameworks, such as the Millennial Ecosystem Assessment (MA, 2005), The UK National Ecosystem Assessment (DEFRA, 2011), and the work developed by The Economics of Ecosystems and Biodiversity (TEEB, 2010), that evaluated the consensus between studies in linking ecosystems and ecosystem services. In this report, consensus level 4 linkage was used, where a service is linked to an ecosystem when at least four denote an important linkage between them.

The nomenclature and definition of services from the Common International Classification of Ecosystem Services (CICES) (Haines-Young & Potschin, 2018) was used. CICES adopts a hierarchical structure for classifying ecosystem services at four levels, section, division, group, class, and class type, detailing the type of service as it moves down the hierarchy (Figure 6.69). This study used the characterization at the division level of the CICES hierarchical structure of ecosystem services.

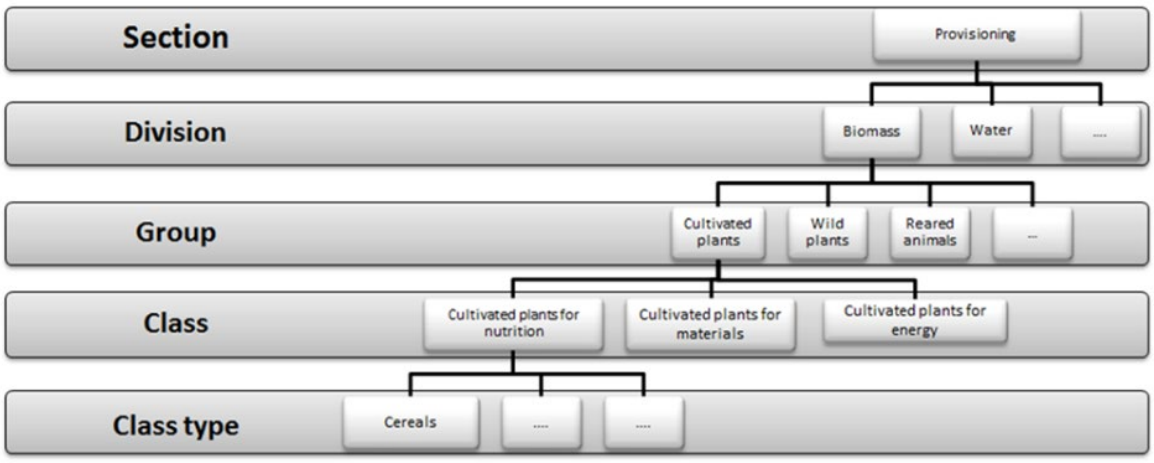


Figure 6.69: Illustration of the hierarchical structure for classifying ecosystem services used by the CICES

Under the CICES framework, the biophysical structure, processes, and functions of ecosystems include the supporting or intermediate services that promote the final service, a service that is appreciated, consumed, or used to generate human well-being. CICES focuses on defining the final ecosystem services, "components of nature, directly enjoyed, consumed, or used to produce human well-being". These services are final because they are still connected to the ecosystem structures and processes that originate them, being the output of the ecosystem, in the sense that they contribute directly to some goods and benefits that are valued by humans, being the link between ecosystems, and the socio-economic system.

CICES considers three sections of ecosystem services, supply services, regulation and maintenance services, and cultural value services, that are briefly descripted in Table 6.26. CICES does not include support or intermediate services, that are considered in some frameworks, such as the Millennial Ecosystem Assessment (MA, 2005), mainly to avoid double valuing the processes or components of the ecosystem that support the final services, where their value is already incorporated. A detailed description of the services covered by each of the sections can be found at www.cices.eu.

Table 6.26: General description of the ecosystem services sections used by CICES

Section	Description
Provisioning	All nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs (including water).
Regulation & Maintenance	All the ways in which living organisms can mediate or moderate the ambient environment that affects human health, safety, or comfort, together with abiotic equivalents.
Cultural	All the non-material and normally non-rival and non-consumptive outputs of ecosystems (biotic and abiotic) that affect physical and mental states of people.

6.9.3.2 Ecosystem Services Baseline

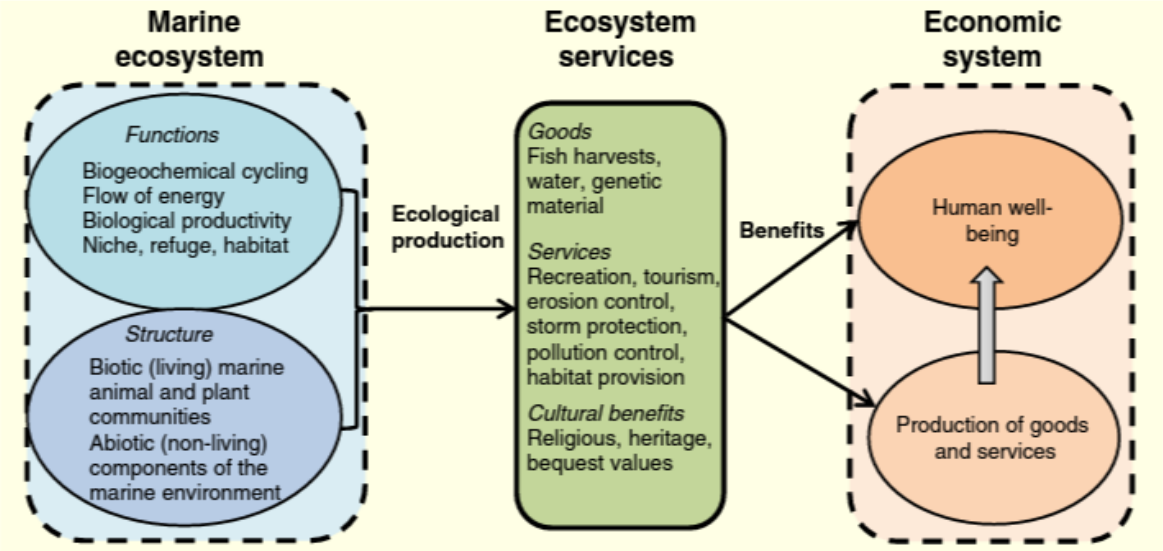
According to the CICES paradigms (Haines-Young & Potschin, 2018), a pathway on the provision of ecosystem services from ecological structures and processes to people's well-being which links ecosystems and socio-economic systems can be identified. The pathways consist of five key components, as follows:

- Biophysical structure or process, which, together with the characteristic functions, are the basis for providing the final ecosystem service;
- Ecosystem services of goods, services, and/or cultural benefits;
- Benefits derived from the service, which can be of a material or immaterial nature;
- Value that the service has or generates, which can be valued in different ways, moral, spiritual, aesthetic, monetary, and that ultimately contributes to human being.

A simplified exemplification of this pathway in the marine environment is shown in Figure 6.70.

When the benefits are over exploited, they act as pressures in the ecosystems that are providing the services. Marine ecosystems represent some of the most heavily exploited ecosystems throughout the world, and human activities are threatening many of the world's remaining marine ecosystems and their respective benefits.

Ecosystems in the coastal marine environments, estuaries, marshes, mangroves, sand beaches, dunes, seagrass beds, coral reefs, and of the open sea are found within the AII. The provision of ecosystem services for each ecosystem is presented in Table 6.27 (Bordt & Saner, 2019).



Source: Barbier (2017).

Figure 6.70: Marine ecosystem services flow

The supply of either wild or aquaculture produced seafood for human consumption is the most common provisioning service from marine environments. Other provisioning services include the supply of wild and cultivated plants and genetic material often used by the pharmaceutical industry, water supply and groundwater recharge. According to Bordt & Saner (2019), all marine habitats are important as a source of wild seafood biomass, with the provision of wild and cultivated plants and animals important from mangroves and other coastal ecosystems versus the open ocean ecosystems. The provision of genetic material, surface or groundwater is more common for coastal specific ecosystems such as mangroves and coral reefs.

The provision of wild seafood is the most relevant provisioning service in the AII. Coastal habitats are utilised by artisanal fisheries while open sea fisheries are mostly carried out by licensed foreign fleets that includes vessels from the EU, Japan, Taiwan, and Korea.

The provision of regulating services is concentrated in a smaller set of ecosystems. While seagrass beds, coral reefs, and mangroves serve as a nursery and breeding habitats for many fish species, supporting the production of biomass, these ecosystems also provide control of erosion and coastal buffers from severe weather events, thus protecting coastal human populations, property, and economic activities. Mangroves and estuaries are also relevant in regulating of biochemical cycles, acting as sinks for pollutants, sediment and other organic materials contributing to the dilution and filtration of waste and pollutants from anthropogenic or natural sources. This pollution and sediment control service benefits coastal communities and their production services and other ecosystems, thus enhancing their goods and services as well.

Table 6.27: Important ecosystem services provided by the ecosystems in the project area, according to Bordt & Saner (2019). Important services in each ecosystem are highlighted in light grey

		Provisioning			Regulation & Maintenance		Cultural	
Ecosystems		Biomass	Genetic material from all biota (including seed, spore, or gamete production)	Water	Regulation of physical, chemical, biological conditions	Transformation of biochemical or physical inputs to ecosystems	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting
Mangroves								
Coastal water bodies	Pelagic							
	Benthic							
Inter-tidal areas	Lagoons							
	Rocky shores							
	Beaches							
	Coral reefs							
	Seagrass beds							
	Estuaries							
	Coastal dunes							
Open ocean	Pelagic							

All marine ecosystems have the potential in providing cultural services. Coastal water bodies may have the potential to provide services of heritage and cultural significance and are often associated with historical or cultural origins of communities. Marine ecosystems also provide aesthetic experiences, opportunities for sport and recreation, and the interaction with local flora and fauna.

These ecosystems also provide indirect services such as entertainment, inspiration for cultural activities such as the making of films or books, among other cultural expressions. Species or biophysical characteristics from these ecosystems are often recognized by people for their cultural, historical, or iconic character and can be used as emblems or signifiers of some type.

In the Project AoI the most relevant cultural services are related with the touristic activities, according to the socioeconomic data. Although tourism has slowed given the past and current conflicts, it is considered a relevant sector for the future in the Cabo Delgado Province. Still in its infancy, Cabo Delgado has made tourism one of its priority sectors in the Cabo Delgado 2014 Economic and Social Plan 2014. The District of Palma encompasses a number of islands within the Quirimbas Archipelago, deemed the 'Blue' product line by the Ministry of Economy, by providing diving, deep sea fishing, eco-tourism, adventure tourism, high yield 'island' tourism, and cultural tourism. The

archipelago is rapidly becoming a sought-after international luxury tourism destination with some of the resorts being rated as within the top 100 hotels in the world, and among the top 20 international destinations.

6.9.4 Critical Habitat Assessment

6.9.4.1 Critical Habitat Assessment Methodology

This section presents a Critical Habitat Screening and Assessment (CHSA) in compliance with the requirements of IFC's PS6 criteria. The CHSA is based on the analysis of the available primary environmental baseline and secondary data available. In addition to mapping and verification of data within the ADI, the CHSA provides a quantification of the area and quality of habitats and priority biodiversity features that may be impacted; determining restoration and offset requirements in the immediate and broader seascape area.

Critical habitat (CH) is a description of the areas with the highest biodiversity conservation value. It considers both global and national priorities and builds on the conservation principles of 'vulnerability' (threat) and 'irreplaceability' (rarity and/or restricted distribution). The IFC distinguish two main levels of CH: Tier 1 Critical Habitat is of highest importance in which development is very difficult to implement and offsets are generally not possible except in exceptional circumstances. Tier 2 Critical Habitat is of high importance in which development may be possible and offsets may be possible under some circumstances. Identification of Critical Habitat is fundamentally based on five criteria, as shown in Table 6.28.

Table 6.28: IFC PS 6 criteria for determination of CH and thresholds for each criterium

Criteria	Thresholds
1. Critically Endangered or Endangered Species	- Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species). - Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR; - As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.
2. Endemic / Restricted Range Species	- Areas that regularly hold ≥10% of the global population size.
3. Globally significant concentration of Migratory / Congregatory Species	- Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle; - Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.;
4. Highly threatened or Unique ecosystems	- Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN; - Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning;
5. Key Evolutionary Processes	- Areas associated with key evolutionary processes.

Source: IFC (2019).

While numerical thresholds have been defined for the first three criteria (IFC, 2012b), numerical (population dimension) thresholds for Criteria 4 and 5 have not been developed. Criterion 4 does however use similar factors as the IUCN Red List of Threatened Species.

The geographic scale of a CHSA depends on the underlying ecological processes of the habitats and species and is not limited to the footprint of the Project. IFC PS6 Guidance Note 65 states that for Criteria 1 to 3, the determination of critical habitat should be based on a Discrete Management Unit (DMU), an area with a definable boundary within which the biological communities have more in common with each other than they do with those outside that boundary. A DMU may overlay an actual management boundary (e.g., legally protected areas, World Heritage sites, KBAs, IBAs, community reserves) and/or could also be defined by another sensitive ecologically definable boundary (e.g., seagrass habitat, coral reef, concentrated upwelling area, etc.).

The methodology used for the CHSA is based on the IFC standards, guidelines, and updates (IFC, 2012a, 2012b, 2019). In addition to the principal criteria highlighted in Table 6.28, IFC PS6 recognizes other high biodiversity values that may support a critical habitat designation. Secondary criteria must be evaluated on a case-by-case basis and include the following examples (IFC, 2012b):

A. Areas required for the reintroduction of CR and EN species and refuge sites for these species, and habitat used during periods of stress (i.e., flood, drought, or fire);
B. Ecosystems of known special significance to EN or CR species for climate adaptation purposes;
C. Concentrations of VU species in cases where there is uncertainty regarding the listing, and the actual status of the species may be EN or CR;
D. Areas of primary / old growth / pristine forests or other areas with especially high levels of species diversity;
E. Landscape and ecological processes (i.e., water catchments, areas critical to erosion control, and disturbance regimes such as fire or flooding) required for maintaining critical habitat;
F. Habitat necessary for the survival of keystone species; and
G. Areas of high scientific value, such as those containing concentrations of species new or little known to science.

Criteria A and B are not applicable in the Project's DMU analysis because there are currently no known areas for reintroduction and no known ecosystems especially significant for climate adaptation in the study area. Criteria C through G were considered within the critical assessment process.

Generally, the following internationally and/or nationally recognized areas of high biodiversity value are likely to qualify as critical habitat:

1) Areas that meet the criteria of the IUCN Protected Area Management Categories Ia, Ib, and II. Areas that meet criteria for Management Categories III-VI may also qualify depending on the biodiversity values inherent to those sites;
2) United Nations Educational, Scientific and Cultural Organization (UNESCO) Natural World Heritage Sites that are recognized for their Global Outstanding Value;

3) KBAs, which encompass inter alia Ramsar Sites, IBA, Important Plant Area (IPA), and Alliance for Zero Extinction (AZE);
4) Areas determined to be irreplaceable or of high priority and/or significance based on systematic conservation planning techniques carried out at the landscape and/or regional scale by governmental bodies, recognized academic institutions, and/or other relevant qualified organizations (including internationally recognized non-governmental organizations; and
5) Areas identified as High Conservation Value (HCV) using internationally recognized standards, where criteria used to designate such areas are consistent with the high biodiversity values listed by IFC PS6 (IFC, 2012b).

Points 1) and 2) are not present in the DMU and are therefore not considered in this assessment, and the areas defined in 4) and 5) are not known for the DMU.

Following the standard methodology, species classified as CR or EN according to IUCN designations, as well as species described as endemic or range restricted were screened to identify those likely to be present within the offshore DMU habitat.

Definition of Units of Analysis

Habitat classification was performed for the ADI with both pelagic and benthic habitats assessed in this CHA. Coastal and nearshore habitats were also assessed in the ADI subset area bordering Vamizi Island.

The Critical Habitat Assessment Area (CHAA) is the area considered ecologically relevant, surrounding, and including the anticipated extent of future projects' influence on biodiversity.

The CHAA was defined as the extent of the surface affected by potential impacts of underwater noise, spillages, and artificial lighting, deemed to have the greatest potential geographical influence.

The Project site lies within the Mozambique Channel at water depths of 2,000 m thus the focus of this critical habitat assessment is on the deepwater environment with the following considerations:

a. Definition of a sensible marine DMU to conduct the analysis is difficult and maybe subject to a certain extent of variables, such as bathymetry; and
b. Great number of identified and endangered species that occur within the Project ADI have large distribution areas.

Consequently, the unit of analysis and/or discrete management unit for this CHSA is based on a minimum area of influence along the deepwater environments (e.g., from the 1,000 m to 3,000 m depth contour) found adjacent to the Cabo Delgado province coastline. This minimum area of analysis is deemed adequate as both the pelagic and benthic environments, the defined habitats, in the area are highly homogeneous. Habitat and/or biodiversity features within the DMU will also be present beyond its borders due to many species having a wider geographic distribution, and thus providing an adequate picture of the wider deep offshore features that may potentially trigger critical habitat designation.

In addition, the area assessed for Critical Habitat included both the direct and potential secondary and/or indirect impacts. This approach is precautionary, to acknowledge the inherent connectivity of ecological systems. Furthermore, this approach also considered areas in the vicinity of the eastern coastal area of Vamizi Island, where depths of less than 400m are found.

6.9.4.2 Natural and Modified Habitat Assessment

Habitats can be classified as modified or natural based on following criteria within the IFC PS6:

- Modified Habitat: Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture, forest plantations, reclaimed coastal zones, and reclaimed wetlands. The developer is required to mitigate impacts to biodiversity within modified habitats as appropriate; and
- Natural Habitat: Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. Based on IFC PS6 mitigation for any impacts is required to show No Net Loss of Biodiversity. Biodiversity Offsets may be required on a basis of like-for-like or better.

Both the defined pelagic and benthic habitats are considered to be "natural", with no modification. To simplify, this assessment considers the pelagic zone as a single habitat, considering it hosts the majority of the sensitive species that have been identified in this baseline assessment (e.g., fish, turtles, cetaceans, and birds). The benthic environment is also considered as a single habitat unit.

6.9.4.3 Critical Habitat Screening and Assessment

For a description of the species considered and analysed, as well as the habitats present and ecologically sensitive, the subject of this screening, please see sections 6.9.1 and 6.9.2.

The definition and criteria for screening and assessment of habitats and species to trigger critical habitat status is given in Section 6.9.4.1 and Table 6.30.

A number of globally threatened species have the potential or are known to occur in the DMU, as the Mozambique channel is considered an important migratory route for a number of species, such as marine turtles, sharks, and marine mammals However, little to no data is available on populations sizes and hence it is only possible to perform a qualitative spatial assessment for determination of critical habitat status.

Assessment of Criteria 1 to 3

The CHA used the extent of occurrence (EOO) which is commonly used for population size and trend assessments (IUCN, 2012). EOO is the area contained within the shortest continuous imaginary boundary and drawn to encompass all the known, inferred, or projected sites of present occurrence of a taxon. EOO and distribution data for the potential and known occurrence of marine species within the DMU were obtained through IUCN data (IUCN, 2022). Screening for species that could trigger

Criterion 1, 2, or 3 was conducted by comparing the global EOO, or global area of occupancy (AOO) if available, of each species to the total area of the DMU.

Overall, potentially a total of 290 IFC PS6 criteria 1-3 species (21 mammals, 106 birds, 19 reptiles, 215 fish, IUCN 2022) have EOO which overlap with the ADI (see Annex VIII; Volume IV). The percentage for the thresholds was calculated by dividing the DMU area (considering the area of one or more DMUs depending on the habitat requirements of the species) by the global value.

Table 6.29: Summary of species candidate to meet IFC PS6 Criteria 1-3

Biological Group	Criterion		
	1	2	3
Mammals	2	0	20
Birds	1	0	106
Reptiles	5	0	7
Fish	20	1	41

Table 6.30 shows all the species with probability of occurrence within the DMU, and likely to meet the criteria 1 through 3 for CHSA.

Table 6.30: Marine fauna assessed for the Coral North CHSA and likely to meet criteria 1 to 3 of IFC PS6

Class / Species	Common name	IUCN Red List status 2022	Criteria of Critical Habitat Screening
Mammalia			
Balaenoptera borealis [b]	Sei whale	Endangered	1
Balaenoptera musculus brevicauda [a,b]	Pygmy Blue whale	Endangered (species) / subspecies status not assessed	1, 2
Balaenoptera physalus [b]	Fin whale	Vulnerable	1, 2, 3
Reptilia			
Chelonia mydas [a,b]	Green turtle	Endangered	1
Dermochelys coriacea [a,b]	Leatherback turtle	Vulnerable / Critically Endangered*	1
Eretmochelys imbricata [a,b]	Hawksbill turtle	Critically Endangered	1
Aves			
Morus capensis [a,b]	Cape gannet	Endangered	1, 2
Chondrichthyes			
Carcharhinus longimanus [a]	Oceanic white tipped shark	Critically Endangered	**1
Rhincodon typus [a,b]	Whale shark	Endangered	1
Sphyrna lewini [a,b]	Scalloped hammerhead	Critically Endangered	1
Sphyrna mokarran [b]	Squat-headed Hammerhead Shark	Critically Endangered	1

Sources: [a] – Consultec (2018); [b] – ERM (2016).

The CHSA found that only one species, the Cape gannet, nearly triggered Criterion 1, as being an Endangered species. However, it was not observed or known to inhabit the DMU in globally important

number, as the AII would host only 0.4 per cent of the global area of occurrence of this species using the EOO as the basis.

Cape gannet breeds on six islands in South Africa and Namibia, with a restricted nesting range. Historically it bred on four more islands (Kemper *et al.* 2007), also in Namibia and South Africa. Outside the breeding season, adults are generally sedentary; however, some birds together with young and immature individuals range east to KwaZulu-Natal, Angola, Mozambique, and Tanzania, and regularly as far north as Nigeria. The birds utilise areas usually not far from the shoreline. In Mozambique, the Cape gannet occurs along the coastal and adjacent offshore waters, extending its range to north up to the Cabo Delgado coastline. While its presence has been confirmed in the ADI of this project, it appears to be irregular and scarce.

Assessment of Criterion 4

According to IFC PS6 definitions, the following ecosystems are qualified as highly threatened or unique:

- Ecosystems that are at risk of significantly decreasing in area or quality;
- Ecosystems with a small spatial extent;
- Ecosystems containing unique assemblages of species including assemblages or concentrations of biome-restricted species; and
- Areas determined to be irreplaceable or of high priority / significance based on systematic conservation planning techniques carried out at the landscape or regional scale by governmental bodies, recognized academic institutions or other relevant qualified organizations (including internationally recognized NGOs) or that are recognized as such in existing regional or national plans (IFC, 2012b).

Nearshore and coastal habitats within the proximity of the FLNG location and DMU were also assessed against Criterion 4 by evaluating their global and local distribution and the biological values identified within the habitat. The habitats assessed included mangroves, coral, and seagrass beds. The aim was to assess the extent of an eventual overlap with the ADI, and the potential risk to the conservation of these ecosystems from the implementation of the Coral North project. The ecosystems were assessed according to IUCN Red List of Ecosystems guidelines when the appropriate data were available (CEM-IUCN & Provita, 2012; Keith *et al*., 2013; Rodriguez *et al*., 2011).

Mangroves, coral reefs, and seagrass beds are classified under IFC PS6 Criteria 4 as Critical Habitat and supported by the national level of habitat mapping (CEAGRE, 2015), and designation of these habitats (World Bank Group and Profor, 2016).

The designation of mangroves, coral reefs and seagrasses as critical habitat in Mozambique is based on the following attributes (World Bank Group and Profor, 2016):

- Mangroves: '*due to their role in coastal protection and their importance in the reproduction of many marine species, mangroves should always be categorized at least as critical habitat*';

- Coral reefs: '*although corals can recover strongly when stressors are removed, due to their very high productivity and the dramatic worldwide decline in coral coverage, corals in any state of conservation should always be categorized at least as critical habitat, with corals in a good state of conservation being categorized as "no-go"*';
- Seagrasses: '*due to their limited range, their importance for reproduction of marine species, the fact that they are one of the most productive habitats on earth, and the fact that they are notoriously hard to restore, seagrass beds in any state of conservation should always be categorized at least as critical habitat, with well conserved beds being "no-go" areas*'.

In Mozambique the extent of mangroves and coral reefs is decreasing.

The closest coral areas are more than 1.100 metres distant from the designated DMU boundary (see section 6.9.1.2 for coral areas mapping), and the nearest mangrove areas is at a minimum distance of 10.8km (for mangrove mapping, see section 6.9.1.3). Similarly, seagrass areas are not found within the DMU as seagrass beds tend to grow in the sheltered coastal areas versus the exposed eastern coast of Vamizi Island. However, while, the modelling results indicated that the worst-case oil spill scenario may reach the shoreline (AII), the probability, potential risk and area that may be impacted was deemed very low. Spills that may potentially reach the coastal area would have a very low thickness (~0.1µm), below the threshold considered to be harmful for marine biodiversity (i.e., 1µm). No measurable adverse impacts on critical habitat values, supporting processes or no net reduction in CR or EN species population are predicted for these habitats. Nevertheless, it is important to recognise these critical habitats found within the Cabo Delgado province.

The ADI is located in close proximity to Vamizi Island and the associated offshore KBA (at 4.5 km east). No project activities will occur in this area and the potential impacts of artificial lighting on birds, the basis for defining the extent of the ADI, will have no influence on this habitat. A 20 km distance threshold has been established by UNEP *et al*. (2020) for potential negative impacts on marine turtles, seabirds, and migratory shorebirds. Hence, while being important as a nesting ground of the green turtle, Vamizi Island is located outside the ADI for the impact of artificial lighting on biodiversity. Consequently, Vamizi Island falls outside the scope of the Criteria 4 assessment.

The offshore Vamizi KBA hosts one of the ten largest known aggregations of giant trevally (*Caranx ignobilis*), the trigger the KBA designation for an important fish species. Since the Project activities will not occur in this area, with no impacts identified on the giant trevally, as well as no other measurable adverse impacts on CH values, supporting processes, reduction in CR or EN species population, the Vamizi KBA will not be influenced by the Coral North FLNG Project and is not considered for critical habitat.

Assessment of Criterion 5

Criterion 5 covers habitats that are relevant to key evolutionary processes, which are defined as follows:

- Physical features of landscape that might be associated with particular evolutionary processes; and

- Sub-populations of species that are phylogenetically or morphogenetically distinct and may be of special conservation concern given their distinct evolutionary history, including evolutionarily significant units and Evolutionarily Distinct and Globally Endangered species (IFC, 2012b).

No areas within the ADI fulfil these criteria.

6.9.4.4 Conclusions of CHSA

The CHSA identified that the habitats and/or species assessed for the offshore DMU qualified as Natural Habitat; however, did not trigger the Critical Habitat criteria.

Nonetheless, a number of biodiversity features found within the wider northern Mozambique Channel are considered as potential triggers of future Critical Habitat designation, specifically:

- Migrating whale, turtle, and/or fish species corridor;
- Presence of an endangered species (Cape Gannet) encompassing an area close to the 1% threshold (using EOO as a comparison basis);
- Vamizi KBA adjacent to the DMU.

Due to the potential triggers and proximity of ecologically important nearshore area such as coral reefs and coastal islands, the CHSA recommends that biodiversity monitoring actions are implemented, as proposed in the EMP (see Volume III).

6.10 Socioeconomics

6.10.1 Methodology

The methodological procedure to describe the socioeconomic environment included the collection and interpretation of both secondary and primary data. Available secondary information for the Province of Cabo Delgado and District of Palma was collected and assessed through a desktop review. This review was complemented with primary information collected during field work conducted in August 2023. Using qualitative participative methodological processes, the study conducted semi-structured interviews with key informants such as traditional authorities, traditional leaders, and government authorities, representing all communities located within the AII.

The collection and interpretation of secondary and primary data formed the basis for the socioeconomic and human rights situational analysis within the AII and enabled the identification and assessment of potential project impacts. The following provides further details on the data collection and analysis processes utilised in order to elaborate the social and human rights baseline conditions.

6.10.1.1 Secondary Data Collection

Available secondary information on the Province of Cabo Delgado, District of Palma and the City of Pemba was collected and analysed. Particular attention was given to the EIA conducted for the Coral South project between 2014 and 2015, given that the AII is the same for both projects. Additional resources included the National Institute of Statistics (INE) 2017 census and 2023 INE district

statistics for Palma and Pemba, Pemba District Socio-Economic Plans (PES) and Activity Reports for years 2023 and 2024, and additional studies and publications for the area (see the references section, in Volume II, for a complete list).

6.10.1.2 Primary Data Collection

The review of secondary data informed the identification of important information gaps and the most suitable method for the collection of primary data including through a qualitative methodological approach, to collect in depth information on local communities and populations within the AII.

Data was collected using a single qualitative method, namely targeted semi-structured interviews were conducted with key community stakeholders, focusing on areas identified from the gap analysis.

The site selection for the qualitative data gathering processes was concentrated mainly on Palma Village due to security reasons and site visits were conducted in July and August 2023 in Palma Village.

6.10.1.3 Data Analysis

Socioeconomic profile and human rights

The socioeconomic profile of the province, the district of Palma and the Quirimbas Archipelago was prepared based on the analysis of the acquired data and has been structured in accordance with the requirements of the socioeconomic profile as detailed in the Mozambican EIA legislation and the IFC PS1. The socioeconomic profile has also been prepared taking into consideration the International Petroleum Industry Environmental Conservation Association (IPIECA), Danish Institute for Human Rights and IFC Performance Standards on Environmental and Social Sustainability guidelines on project related human rights impacts. The approach encompasses the integration and focus of accountability, participation, non-discrimination, and transparency principles throughout all processes and steps in the assessment of human rights risks and impacts from operations, value chains, and business relationships. This approach establishes a solid foundation for conducting the assessments in a manner that upholds human rights standards, safeguards the rights and well-being of individuals, workers, and communities potentially affected by the project. The approach ensures the meaningful inclusion, involvement, and consideration of all relevant stakeholders. Accordingly, this report focuses on the integration of the following four pillars;

- Human rights in the workplace – equal treatment, safe and healthy working conditions, freedom of association and collective bargaining;
- Human rights in relation with suppliers and business partners – including modern slavery, migrant workers, and working conditions;
- Human rights in community relations – land rights, environmental impact that effect livelihoods, health, educational outcomes, and availability of water; and
- Human rights and security – vulnerability, including gender, excessive use of force and employee safety.

Data Limitations and Assumptions

The secondary research identified the following main gaps:

1. Very little information and disaggregated data are available on the coastal islands of the Quirimbas Archipelago specifically and due to security concerns, primary research in the AII coastal islands was not possible.
2. Most available statistics and social information are from 2013-2018 or based on projections from 2017-2024. Therefore, the information preceded or did not account for extreme events, such as COVID-19, cyclone Kenneth in 2019 and the most recent insurgency attacks in 2021, which caused significant socio-economic and infrastructure shifts in the areas of direct and indirect influence, including
    - In Palma, the destruction of infrastructure (health units, schools, business establishments), the fleeing of personnel (medical, teachers, businesses and oil and gas workers, etc.) and the general population, the decrease in agricultural and fishing production and interruption of schools, commercial circuits, and mobility;
    - In Pemba, the significant influx of internally displaced persons (IDPs), humanitarian aid and workers, and defence forces, and an increased pressure on all resources, services, and infrastructure.

To address gaps in the changing environment, the most effective approach was to conduct general primary qualitative data collection, mainly through semi-structured interviews with key stakeholders, to enable an updated understanding of the current dynamics as well as acknowledging, confirming and/or explaining the limitations of the quantitative data.

Although the primary data collection did enable and support a more comprehensive and up-to-date socioeconomic baseline, the precarious conditions in some of these regions suggests data will be changing very rapidly in the coming years, in Pemba and Palma specifically.

6.10.2 Geographic Location

Palma is the north-eastern district of Cabo Delgado Province in Mozambique. It has an area of approximately 3,561 km^2 and is bordered to the south by the Mocímboa da Praia District, to the north by the Rovuma River that establishes the border with Tanzania, to the west by the Nangade District, and to the east by the Indian Ocean.

Palma district is divided into four administrative posts (Olumbe, Pundanhar, Palma, and Quionga), which in turn are sub-divided into eight localities (Palma-sede, Mute, Olumbe, Quissengue, Pundanhar, Nhica do Rovuma, Quionga-sede, and Quirinde). Palma District also includes the islands of Tecomaji, Comeji, Rongui, Vamizi, Metundo, Quifuqui, Vumba, Queramimbi, and Suavo, which are part of the Quirimbas Archipelago.

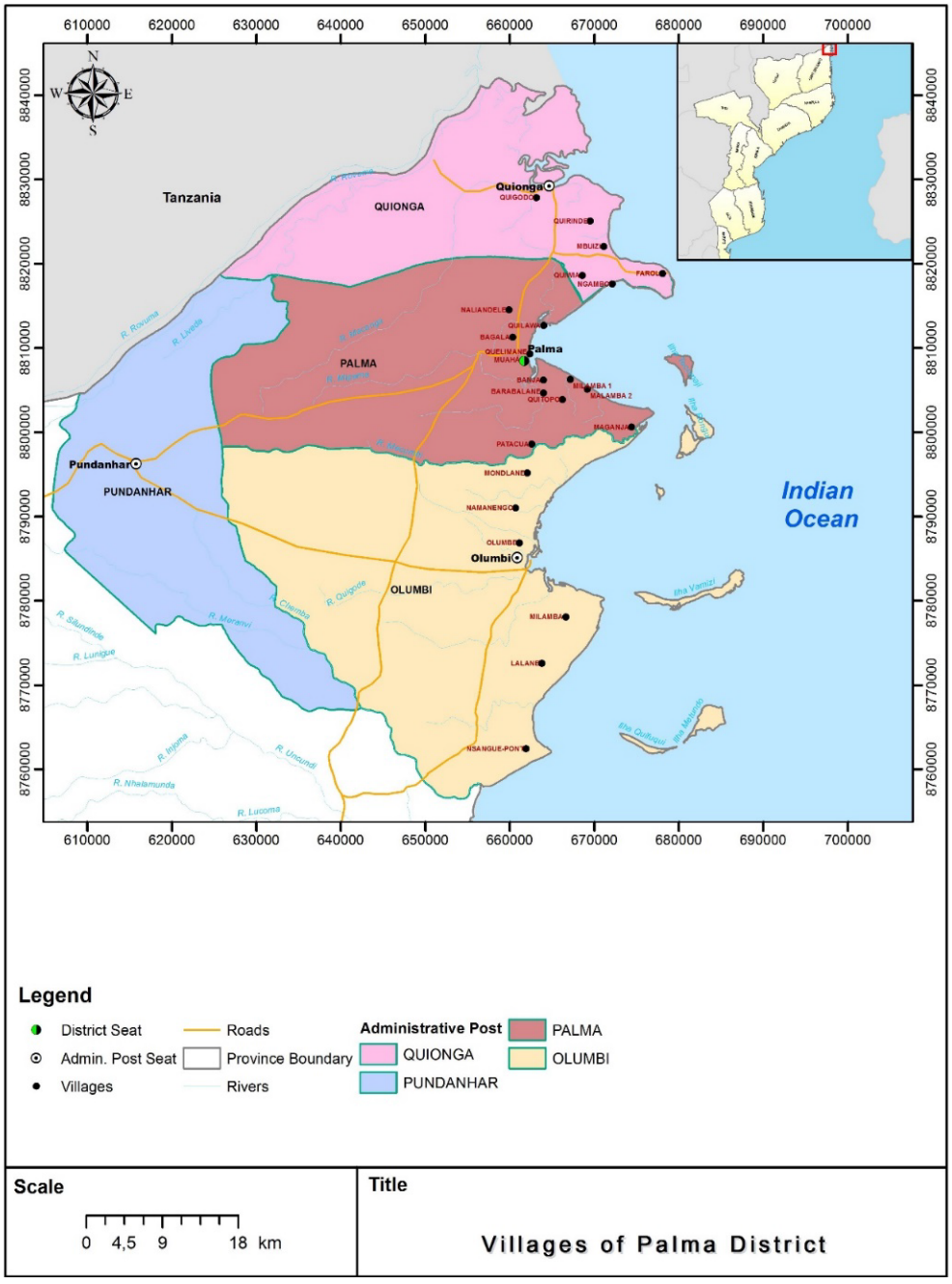
The district is essentially rural, except for Palma Town which shows some urban characteristics (i.e., geometrical arrangement of internal roads, distribution grid of piped water and electricity,

conventional housing construction, etc.). The district capital coincides with Palma Town, and this is where most social and economic infrastructure, as well as state institutions, are concentrated.

Table 6.31 and Figure 6.71 illustrate the villages located in the AII within their geographical context.

Table 6.31: Villages in the AII

Administrative Post	Villages in the ADI (5km from the coast)
Palma	Muaha
	Senga/Banja
	Quelimane
	Bangala
	Patacua
	Naliandele
	Barabalene
	Quilawa
	Quitupo
	Maganja
	Milamba 1 and 2
Quionga	Quigodo
	Mbuize
	Quiwia
	Ngambo
	Quirinde
	Farol
Olumbe	Milamba
	Lalane
	Nsangue-Ponta A
	Mondlane
	Namanengo
	Olumbe-Sede



Source: Consultec (2014).

Figure 6.71: Villages and localities within the AII

As discussed in Section 5, the AII also includes the city of Pemba, the capital of Cabo Delgado province, located in the north of Mozambique, along the south-central axis of the province. The city of Pemba confines to the north and west with the district of Metuge, through the Pemba Basin, to the south with the districts of Mecufi and Metuge and to the east is bounded by the Indian Ocean.

The City of Pemba is divided into 13 neighbourhoods and according to the National Census 2017 the population in the city was of 201 846 Inhabitants. The figure below illustrates the administrative division of Pemba City.

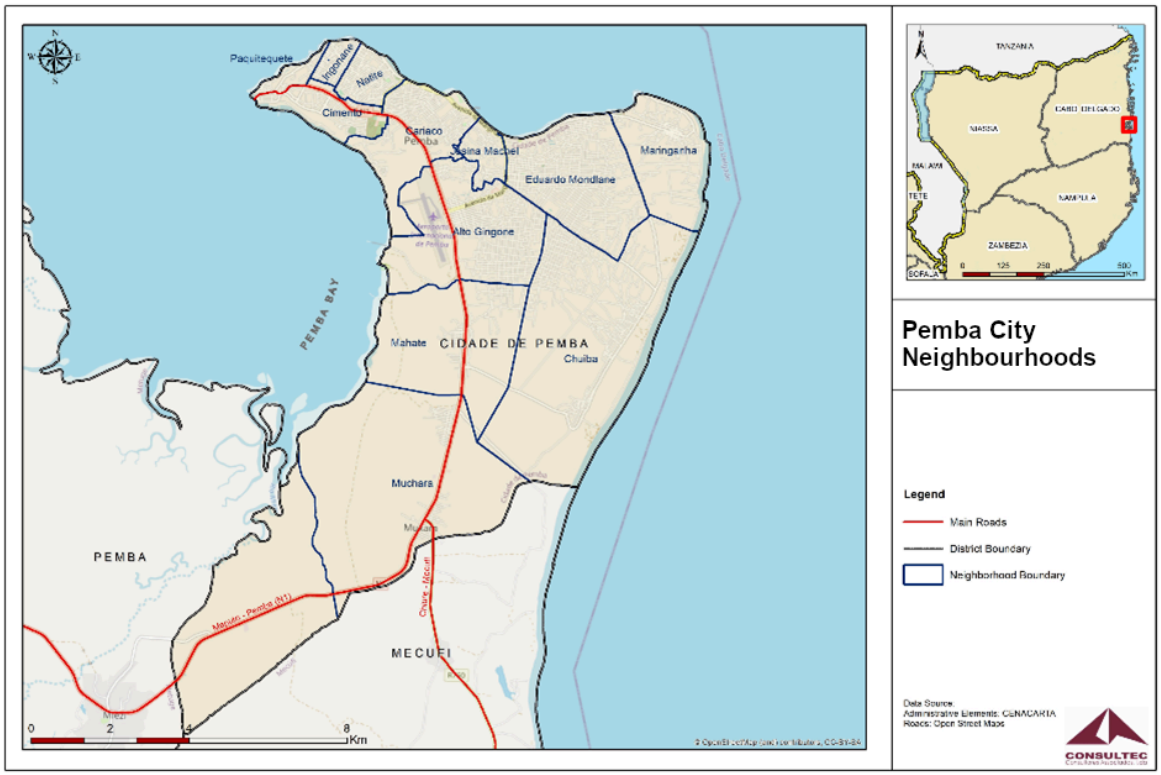


Figure 6.72: Administrative division of Pemba City

6.10.3 Overview of Current Conditions

Cabo Delgado has been the site of an ongoing non-state armed group (NSAG) attacks since 2017, carried out by the Islamic extremist group *Ahlu Sunna Wal-Jama*, locally known as *Al-Shabaab*, with suspected links to the Islamic State (ISIS). The attacks have been primarily focused along the coastal districts of Palma, Mocímboa da Praia, and Macomia and have resulted in significant human suffering and societal disruptions in the area, including the destruction of infrastructure, loss of lives (estimated at over 4,000), loss of livelihoods and over 1,000,000 people having fled their homes as a result of the violence (ISS, 2022; IOM, 2023b). The United Nations (UN) have defined the situation as one of the worst humanitarian crisis in Africa since the Rwandan genocide (IOM, 2023a)

The humanitarian crisis has been exacerbated by cyclone Kenneth in April 2019 and the COVID-19 pandemic in 2020-2022. Cyclone Kenneth caused further loss of lives, the destruction of homes, social infrastructure (health, education, electricity, access roads, among others) and the loss of agricultural land as well as forcing populations to seek shelter in the already overburdened IDP housing centers.

The combined effect of the violence and natural disasters led to, at its peak, an estimated total of over 1,000,000 IDPs in the northern provinces, living in either displacement sites or host communities, in extremely precarious conditions, subject to high levels of vulnerability, including food insecurity, disease (ongoing cholera outbreak in Nampula and Cabo Delgado), exploitation, abuse, other forms of violence and overburdened infrastructure and services (IOM, 2023b).

Whist the security situation in Cabo Delgado has stabilized over the last year and people are beginning to return to their homes, as of April 2023, over 834,000 individuals and 208,000 households remain displaced in the northern provinces, the bulk of whom are in Cabo Delgado (781,679 individuals and 197,602 households)[10]. Pemba City, Metuge and Mueda are the top three districts hosting IDP, as per the table below.

Table 6.32: Estimated number of IDPs

	Pemba City	Metuge	Mueda
Individuals	166,966	139,373	89,821
Households	41,743	32,566	21,034

Source: IOM (2023b).

The majority (543,903 or 65%) of the IDPs are currently living in host communities, with approximately 290,401 or 35% living in displacement sites. Fifty-six percent (56%) of the IDPs are female, over 50% of the total are children and 7% are elderly. Furthermore, it is estimated that 16%, or 134,000 IDPs suffer from diverse disabilities, ranging from physical, cognitive, sensory and/or psychological impairments (IOM, 2023b).

As a result, there have been significant socio-economic and infrastructure shifts in the Project's AII as follows:

- Palma and Quirimbas islands, the destruction of infrastructure (health units, schools, business establishments), the fleeing of personnel (medical, teachers, oil and gas workers) and the general population, the decrease in agricultural and fishing production and interruption of schools, commercial circuits, and mobility;
- Pemba, the significant influx of IDPs, humanitarian aid and workers, and defence forces, and an increased pressure on all resources, services, and infrastructure.

According to a 2021 study (OMR, 2021), based on questionnaires and field observation, housing conditions, access to natural resources and conditions of production were all worsening, making the population largely dependent on humanitarian aid. The high concentration of displaced populations along the Pemba-Montepuez axis has resulted in increasing demand and pressures on already overburden public infrastructure and services. The displacement of populations exacerbated many of the existing social inequalities in a province which has the lowest human development indices in the country.

In displacement sites, competition for access to land and tensions with the local populations have increased, and the difficulty of access to agricultural production and uncertainty of food assistance have precipitated return movements to yet unsecured locations, subjecting the population to violence and making them easy targets for attacks, robberies, and kidnappings, further intensifying the conflict.

[10] United Nations International Organization for Migration (April 2023) Emergency Tracking Tool Report by the United Nations International Organization for Migration.

Containing the insurgency and providing security has been a challenge, even with Southern African Development Community (SADC) and Rwandan forces providing military assistance and donors providing financial assistance and humanitarian aid. The war, displacement, environmental disasters, and COVID-19 have all negatively impacted on health, education, stability, livelihoods, and prospects of the population, hindering socio-professional and social-cultural integration of young people in particular, generating alienation, marginalisation, cognitive dissonance and increasing the risk of them joining violent groups (OMR, 2021).

6.10.4 Governance and Social Organization

6.10.4.1 Provincial Administration

The province of Cabo Delgado, as with all other provinces in the country, has a provincial government divided into two bodies: (1) the Provincial Council of State Representation led by the Provincial Secretary of State, the representative of the Central Government at the Province Level, and appointed by the President of the Republic; and (2) the Provincial Executive Council, which is led by a governor, who acts as a political figurehead elected by popular vote. The governor and the governor's office are supported and aided by a Director of the Governor's Cabinet, and Provincial Directors of Agriculture and Fisheries, Transportation and Communication, Industry and Trade, Health, Education, Work, Culture and Tourism, Territorial and Environment Development, and Infrastructures. In turn, the Secretary of State's office is assisted by the Office Director of the Provincial Secretary of State, and the Provincial Services Directors. The Secretary of State oversees areas such as economy and finance, economic activities, social affairs, infrastructure, justice, and environment, all of which represent national line ministries.

The province is administratively sub-divided into districts and municipalities. The municipal councils are managed by the municipal president and the municipal assembly, which is an elected body. For their part, the districts, falling directly under the province are governed by district administrators, supported by chiefs of the various administrative posts and localities and their respective district directorates, as per Figure 6.73.

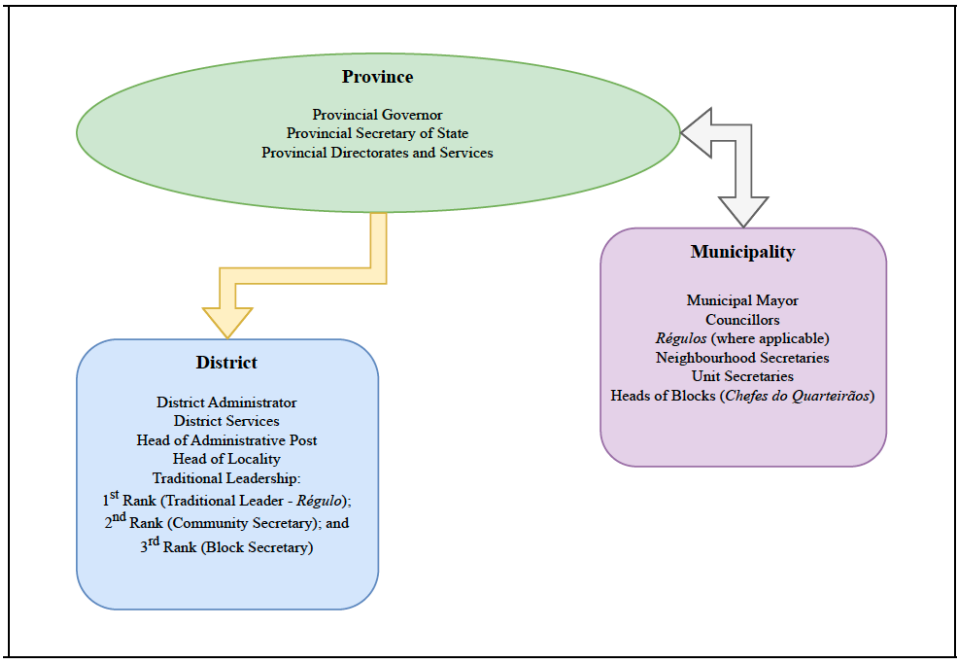


Figure 6.73: Basic administrative structure: province, district, and municipality

6.10.5 District Administration

Districts are managed by a District Administrator who is appointed by the Ministry of State Administration and Public Service. These administrators are supported by his and/or her secretariat and several district services including economic activities, planning and infrastructure, education, youth and technology, health, district services of the ministry of labour, gender and social action, as well as other services, such as the civil registry and notary services and a district division of the National Police Service (PRM). Figure 6.74 below outlines the basic structure of the district administration.

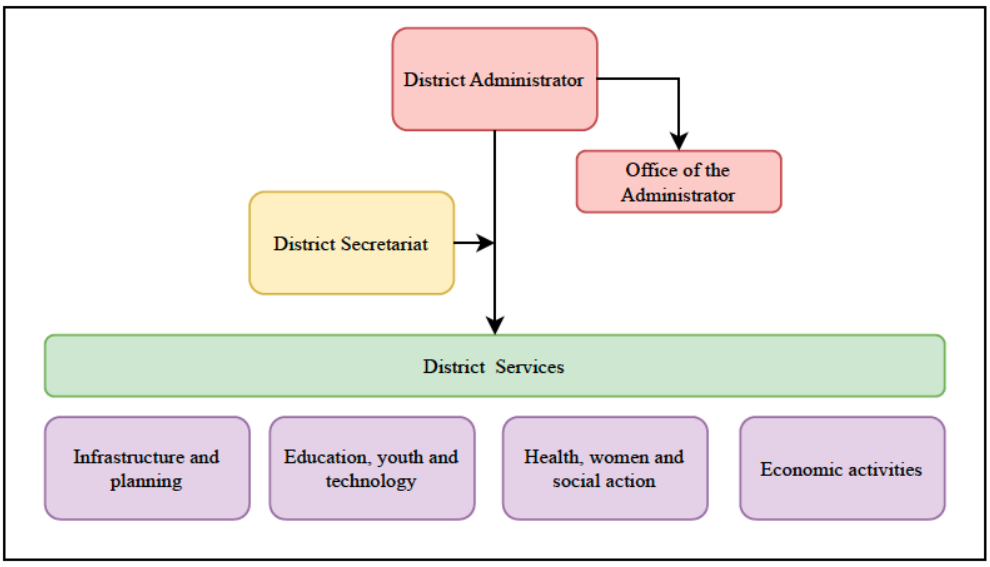


Figure 6.74: Basic structure of district administration

This seemingly simple governance structure is much more complex due to several different foundations of power that intersect and often overlap with each other. In the first place, the district directorates (health, education, youth, and technology, etc.) are formally linked to and responsible to the various line ministries at provincial and central levels of government, while at the same time being administratively accountable to the district administrator. There is an on-going public sector reform process of decentralization, but the dependence between the central, provincial, and district tiers of government vary considerably between the different directorates and their departments. Figure 6.75 below shows the basic district administrative subdivision.

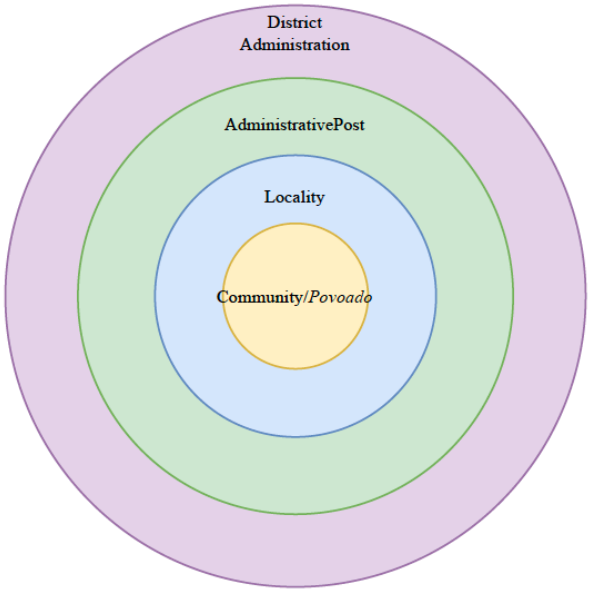


Figure 6.75: Simplified district administrative divisions

At district and local levels there is a further line of governance which plays an important role with respect to community participation. In most districts, there is a parallel line which consists of local leaders and/or community leaders and traditional authorities, which slots into the administration of the districts at local level. These entities are recognized based on Decree No. 15/2000, of June 20th, and No. 11/2005, of June 10th. These decrees recognize the role of local leadership and traditional leaders within communities as a form of legitimate authority. In terms of legitimacy, these parallel systems are based on the principle that traditional leaders are an intrinsic component at local level, with authority and hence enable greater and improved participation and communication between citizens and governments administrative divisions.

District planning follows a hierarchical process where economic and social development plans and activities are developed based on the policies and guidelines provided from the central (PES) and provincial (Provincial PES) economic and social plans. Emanating from these policies, districts produce their own economic and social plan (District PES), which are then fed back into the provincial PES and further up into the annual national plan. This process and community participation within it, is facilitated by the current governance structure which includes community and traditional leadership. In addition to this, consultative councils (*conselhos consultivos*) have been created at the

level of the administrative posts and localities to enhance and strengthen participation within these planning processes.

Localities (the lowest rung of the state administrative system) are generally comprised of a number of communities and/or villages or *povoados*. These terms are ambiguous, with different meanings in different contexts and settings, however, they are most often used to signify a grouping of households, a village, or a group of villages (herein these terms are used interchangeably). At this level – community – authority is generally exercised by community leaders, who can be secretaries of neighbourhoods or secretaries of a constellation of blocks (*quarteirão*), depending on whether the administrative section is urban, peri-urban, or rural. In peri-urban and rural areas, these authorities are often supported by community leaders and possibly traditional leaders whilst traditional leadership often plays a more important role in more rural areas.

Whilst the local authorities play an important role in mobilizing people in relation to district planning sessions and communication with the state, etc., their primary role is to maintain a form of social order and resolve individual or social conflicts at community level prior to any potential escalation to the formal judicial system. Community leaders play an additional and extremely important role in the attribution and management of land used by community members and new individuals and households who seek land for subsistence. This particular role, in relation to land, is based on the national land policy (Resolution No. 10/95, of 17 October), guaranteeing access to land to all communities, households and individuals. In conjunction with this, the land law (Law No 19/1997) recognizes customary rights to land without a formal land title (DUAT).

6.10.5.1 Municipal Administration

Municipalities, unlike districts, are elected administrative bodies within provinces and as noted above are managed by an elected municipal president, who is accountable to the municipal assembly, which is likewise comprised of elected municipal councillors. Municipal assemblies are by and large responsible for services in a similar manner to the districts and as such are responsible for the following:

- Housing and urban planning;
- Urban roads and transport;
- Education and culture;
- Economic activities and services;
- Youth and sports;
- Social action and civil society;
- Markets and fairs;
- Public works
- Municipal administration and receipts;
- Waste management, the environment, parks, and municipal gardens.

As with the districts, the municipal governance structure is complex and the management and provision of services such as health, education, criminal justice, social welfare, etc., remain formally the responsibility of the various line ministries at provincial and central levels of government.

Municipalities currently have limited direct revenue and are primarily responsible for waste management, water and sanitation, municipal roads, housing, and urban planning. In addition, in several cases, as with that of Pemba City and/or District, there are currently two overlapping administrative divisions, and as such, Pemba is presently both a district and a municipality.

6.10.6 Demographics

The Province of Cabo Delgado covers an area of 78,778 km^2 and, according to the INE statistics the population in 2021 was of 2 597 016 people (7.9% of the total population in Mozambique), with a density of 31,4 habitants per km^2 of which 48% were men and 52% women. According to the same source, the average household is composed of 4.1 members.

With regards to the population in the District of Palma and Pemba City, presenting an up-to-date figure of the population is challenging, due to the 2021 insurgent attacks. As stated above, these attacks caused significant internal displacement. Table 6.33 below provides the population figure for Palma district and Pemba City, according to the 2017 National Census, prior to the attacks.

Table 6.33: Population in the AoI divided by gender in 2017

Province/Districts	Total	% Men	% Women	% of Province
Cabo Delgado Province*	**2 597 016**	**48%**	**52%**	**100%**
Palma District**	67 025	49%	51%	2.9%
Pemba City**	200 529	49%	51	8.8%

*Source: INE (2021). **Source INE (2017).

Table 6.34 below shows the same demographic figures for the administrative posts in the AII.

Table 6.34: Population divided by gender in the administrative posts in the AII

Administrative Post	Population (2017)	Men	Women	% Men	% Women
Palma	40 229	19 712	20 517	49%	51%
Quionga	8 185	4 089	4 096	50%	50%
Olumbi	14 436	7 269	7 167	52%	48%

Source: INE (2017).

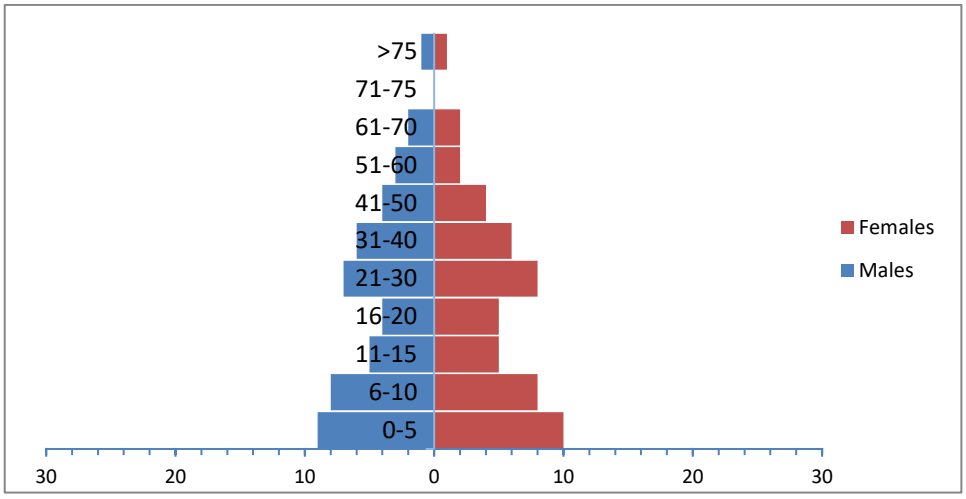
According to the 2017 national census, Cabo Delgado province had experienced a significant population increase between 2007-2017 (38%). Similarly, the District of Palma had also seen a demographic increase of 38%, and Pemba City an increase of 47%, in the same period. These figures have likely significantly changed in recent years, due to the insurgent attacks and COVID pandemic.

The 2017 national census showed that most of the districts in Cabo Delgado Province experienced an influx of people. According to the International Organisation for Migration (2014), one of the main reasons for people to migrate is poverty, as they tend to move to more developed areas seeking better opportunities.

Further to an increase in influx of people to the district, it is also expected that this influx will be less gender balanced, with more men coming to the area than women. As such, whilst the 2017 demographic showed a balanced gender division (see Table 6.34 above), this scenario is expected to be significantly different in the coming years for Palma District and even in Pemba City.

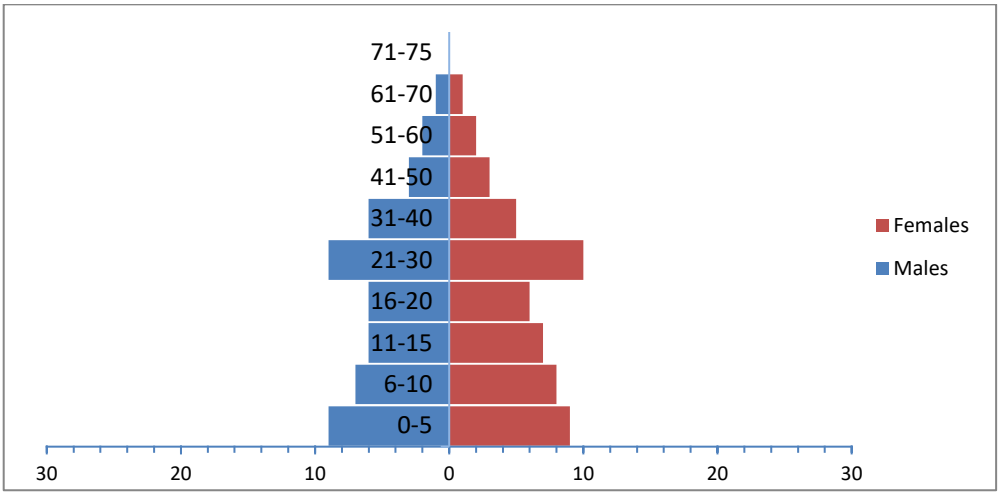
In Mozambique, the family is considered the most important social unit, and even society is viewed as one large family. A typical family is composed of a husband, a wife, and children. They usually have an elderly parent or other relatives living with them and perhaps some other family members. In 2005, family law changed to no longer acknowledge new cases of polygamy. Although no new polygamous marriages can be contracted, many still exist and are socially accepted.

Similarly, the estimated 2017 age distribution in the province and in the District of Palma and Pemba City (Figure 6.76 and Figure 6.77) show a very typical scenario of developing communities with a low life expectancy where there is a large number of young people and a small number of elderly.



Source: District of Palma, INE (2017).

Figure 6.76: Age distribution for Palma District (2017)



Source: INE (2017).

Figure 6.77: Age distribution for Pemba City

There is no official data published by INE regarding the population in the villages located within the AII, the INE publishes data down to the locality and/or neighbourhood level. The table below presents the population by locality and/or neighbourhood according to the 2017 National Census.

Table 6.35: Number of people residing in the localities in the AII

Administrative Post	Locality/Bairro	Population	Men	Women
Palma - Sede	Palma-Sede	25 586	13 494-	14 092
	Mute	12 643	6 218	6 425
Quionga	Qirinde	8 185	4 089	4 096
Olumbi	Olumbi Sede	9 222	4 597	4 625
	Quissengue	5 214	2 672	2 452
Pemba City	Alto Gingone	29 544	14 657	14 887
	Cariaco	51 359	25 585	25 774
	Chuiba	9 776	4 652	5 124
	Cimento	3 544	1 759	1 785
	Ingonane	11 588	5 705	5 883
	Muchara	10 105	4 979	5 126
	Mahate	10 263	5 024	5 239
	Natite	19 707	9 740	9 967
	Paquitequete	16 069	7 731	8 338
	Eduardo Mondlane	17 069	8 621	8 448
	Josina Machel	18 426	9 109	9 317
	Birro Maringanha	3 079	1 541	1 538

Source: INE (2017)

6.10.7 Heritage, Language and Religion

Cabo Delgado is home to several ethnic groups, including the Makonde, Makua, Mwani, and Yao, with main spoken languages including Emakhuwa (66.8%), followed by Shimakonde (spoken mainly on the plateau, 21.8%), and Kinwani (spoken mainly along the coast, 6.1%). Other languages include Portuguese (around 22.2%), Swahili (mainly spoken along the border with Tanzania) and Ajaua (spoken mainly near Niassa Province). It is common for one village to contain speakers of three, sometimes four, different ethno-linguistic groups.

Although the official language of Mozambique, the 2017 INE census shows that only 20% of the population of Cabo Delgado, with five years of age or more, speak Portuguese. In the District of Palma, the percentage is considerably lower, only 16.6%. INE did not present the statistics for Pemba City; however, given its urban nature, it is likely above the province average. Mostly men and community chiefs have a better understanding of Portuguese compared to women, who often have to drop out of school early to conduct house chores.[11] Conversely, men's typical role is to have formal

[11] House chores such as looking after children, fetching water, collecting wood, and working in the *machamba* (subsistence farms).

employment or to practice an activity which tends to generate some form of income to the family such as selling traditional drinks, fishing or hunting, or selling the produce from the *machamba*. Their role therefore requires them to speak and understand Portuguese and they often have greater opportunity to attend school for longer periods of time.

Nonetheless, the predominant spoken language among the population in the district is Maconde, followed by Macua and Mwani, although specifically along the coast is Macua and Swahili (Consultec, 2014). Table 6.36 below shows the language spoken in each affected village according to Consultec (2014).

Table 6.36: Languages spoken in the coastal villages in the AII

Administrative Post	Villages in the AII	Languages Spoken
Palma	Muahá	Emakhuwa
	Senga	Emakhuwa
	Quelimane	Emakhuwa
	Bangala	Emakhuwa
	Patacua	Emakhuwa
	Naliandele	Emakhuwa
	Barabalene	Emakhuwa
	Quilawa	Emakhuwa
	Quitupo	Emakhuwa
	Maganja	Not available
	Milamba 1 and 2	Not available
Quionga	Quigodo, Quirinde & Farol	Emakhuwa, Kinwani & Swahili
	Mbuize	Emakhuwa
	Quiwia & Ngambo	Emakhuwa & Swahili
Olumbe	Milamba	Kinwani
	Lalane	Emakhuwa, Kinwani & Swahili
	Olumbe-Sede	Emakhuwa, Kinwani & Swahili
	Nsangue-Ponta A	Emakhuwa, Kinwani & Swahili
	Namanengo	Shimakonde, Swahili & Kinwani
	Mondlane	Shimakonde, Swahili & Kinwani

Source: Consultec (2014)

While INE does not present data regarding the languages spoken in Pemba it is likely that the information listed for urban areas applies to Pemba as well. According to INE, 67% of the population in urban area of Cabo Delgado spoke Emakhuwa, followed by Portuguese (6%), Kinwani (5%), and Shimakonde (3%).

People in the project area follow a matrilineal organization, which refers to a social structure or system in which descent, inheritance, and kinship are primarily traced through the female line. It means that family lineage, property, and other important aspects are passed down in the mother's family, although the authority and decision-making power may still lie with the male members of the

maternal family. This is often seen in matters such as land tenure and inheritance, where the maternal uncles or other male relatives may play significant roles in the allocation and management of property. It is important to note that the precise details of matrilineal organization in Cabo Delgado may vary depending on the ethnic group or community being considered.

The religious landscape of the region is diverse and influenced by a wide range of historical, cultural, and social factors. Islam is the predominant religion in Cabo Delgado, with Muslims making up 53% of the population, followed by Catholics at 36% and evangelicals at 7% (INE, 2017). INE does not provide data on religion delineated at District or City level. Mosques are common, and Islamic religious practices and traditions are an integral part of the local culture. Communities also continue to practice traditional local rites and customs that do not originate in Islam.

Some of these traditional rites and customs are shown in Table 6.37 and further described below.

Table 6.37: Traditional rites and customs practiced in the AII

Admin. Post	Villages in the AII	Maulide	Initiation rites	Aruce (Virgin ceremony)	Madjine	Zihara
Palma	Muahá & Quelimane	X	X	X	X	
	Bangala	X	X	X	X	
	Quilawa		X			
	Naliandele	X	X	X	X	
	Quitupo	X	X	X	X	
	Patacua	X	X	X	X	
	Barabalene	X	X	X	X	
	Banja	X	X	X	X	
	Maganja	X	X	X		X
	Milamba 1 & 2		X			
Quionga	Quigodo, Quirinde & Mbuize	X	X			X
	Quiwia, Farol & Ngambo		X			
Olumbe	Milamba	X	X			
	Lalane	X	X			
	Mondlane, Olumbe-Sede, Nsangue-Ponta A & Namanengo	X	X			

Source: Consultec (2014).

Traditional rituals practiced in the AII include:

- *Maulide* is described as a ceremony where a number of people get together in one place, and a “chê” from the mosque is summed to read the Koran and to light the *ruban* and *ude* (incenses). After the prayer, people dance and eat until dawn. This ceremony is to celebrate the birth of the Prophet Mohamed and is practiced in the month of July;
- *Aruce* is described as a ceremony to celebrate the virginity of a bride. It is practiced anytime of the year before a virgin bride is about to get married;

- *Matxonda, Unhango, Rigo* and/or *Ncomango* is described as male and female initiation rites. These have been learnt from their ancestors and are practiced in the month of December to January, when the children are off from school and mark the entry of children into adulthood. The time of the ritual has decreased from six to 12 months to one month, due to schooling and food insecurity being felt more now than in the past. Male children are taken to specific locations where they are taught about the activities that await them in their adult lives and are circumcised. Girls are initiated at home and then taken to the woods for further training (note that female genital mutilation is not practiced in Mozambique);
- *Madjine* is described as a ceremony designed to expel bad spirits from sick people. During the ceremony people play drums and dance in the presence of the sick person;
- *Zihara* is described as a ceremony undertaken in February with the objective of remembering the Islamic traditions where the community dances and the specially made liquor, *Ziquire*, is drunk.

6.10.8 Education and Skills

In Mozambique, the education system is divided according to the following categories:

- Level 1 Primary Education (EP1) – grade 1 to 5;
- Level 2 Primary Education (EP2) – grade 6 to 7;
- Secondary Education Level 1 (ESG1) – grade 8 to 10;
- Secondary Education Level 2 (ESG2) – grade 11 to 12;
- Professional and Technical Education – Technical and Vocational Training Institutes; and
- Higher Education – Universities.

Primary education in Mozambique is free and compulsory for children between the ages of six (6) and 12. Despite this, most people in the country do not complete primary education. Even before the armed conflict, the province of Cabo Delgado had the highest rates of illiteracy in the country (52%) (OMR, 2021). This was due to a myriad of factors, from poor infrastructure to unmotivated or unprepared teachers, and preference of families for children to engage in income-generating activities leading to high drop-out rates.

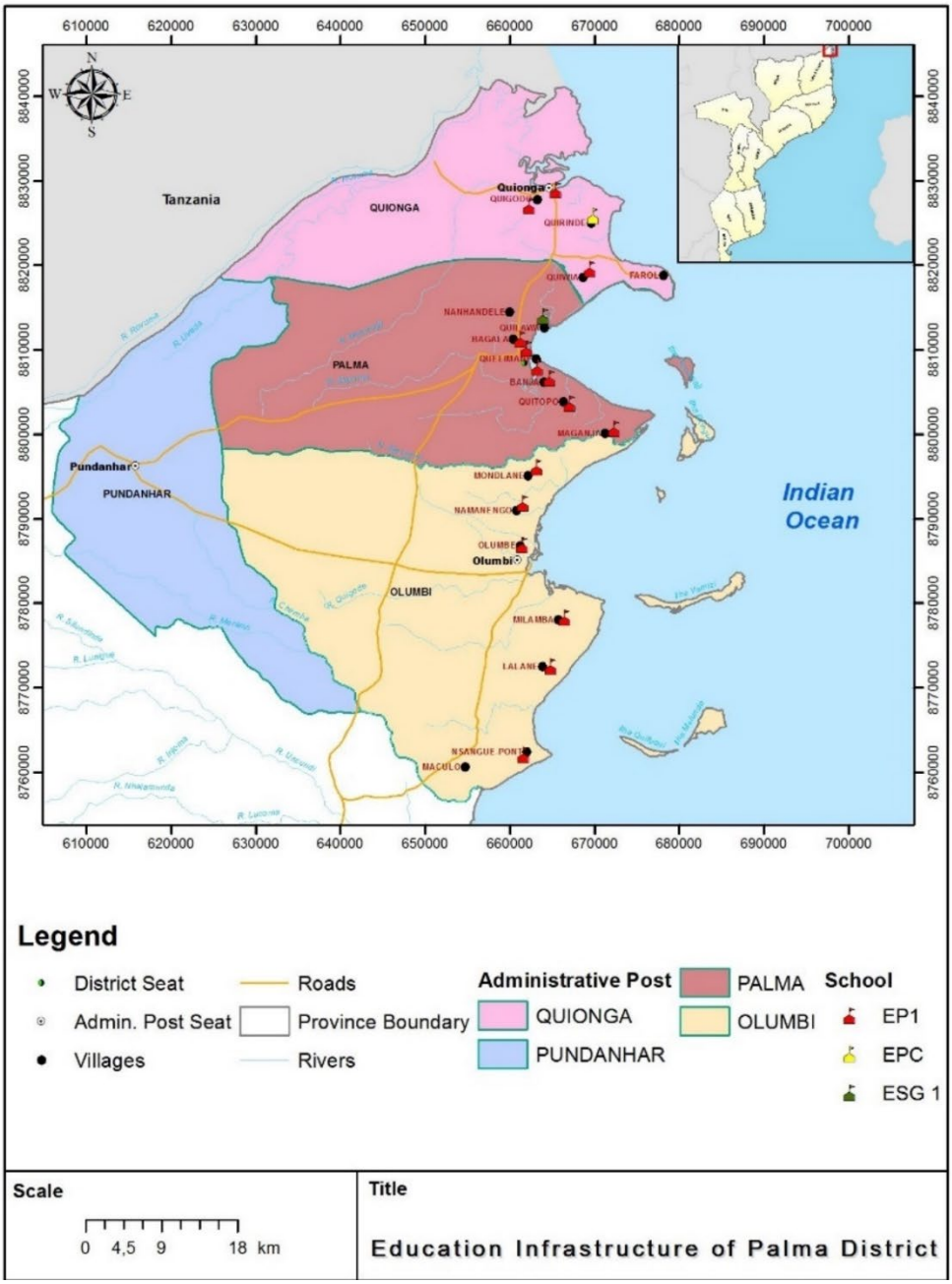
According to INE (2021), Cabo Delgado had in total 1 204 primary schools, 47 secondary schools, eight Professional and Technical Schools (PTS) and two Universities. Table 6.38 below shows the number of educational institutions in Cabo Delgado Province, District of Palma, and Pemba City.

Table 6.38: Number of educational institutions in Cabo-Delgado Province, District of Palma, and City of Pemba (2017)

District/City	EP1	EPC	ESG1	ESG2	PTS	Universities
Cabo Delgado	721	493	25	22	8	2
Palma District	24	17	0	0	0	0
Pemba City	34	32	14	12	ND	ND

Source; INE (2021); ND= No data.

Figure 6.78 below maps the education infrastructure located within the AII.



Source: Consultec (2014).

Figure 6.78: Education Infrastructures in District of Palma

However, these numbers likely do not reflect the reality since schools were one of the main targets of the recent insurgent attacks: destruction or closure of 354 primary schools and seven secondary schools, affecting 86,835 students in primary education and 13,661 students in secondary education in Cabo Delgado Province (OMR, 2021). According to the 2023 Palma District PES, there are 26 schools in operation with 17 requiring restoration.

Due to insecurity, Palma was one of the districts that experienced a total interruption of school activities throughout 2021. Some of the schools not affected by the conflict were turned into accommodation centers, disturbing school activities.

Insecurity led to the displacement of more than 2000 teachers and tens of thousands of students to several districts in the south of the province, concentrated in Pemba, Montepuez, and Chiúre, resulting in a slow enrolment process and 154% over subscribed. The preventative measures of COVID-19 also added to these constraints.

One of the Government priorities is to improve school facilities. According to the Government Budget, 2023 (*Orçamento do Estado 2023)*, the government allocated 83 billion meticais for the education sector for 2023. In terms of government expenses, the education department is allocated the biggest portion of the government budget.

Even with government efforts to improve the education sector, illiteracy rates are still very high among the population. According to INE, in 2017 the illiteracy rate in the Province of Cabo Delgado was 60%. This number increases substantially when looking at gender. The same source showed that 68% of the female population cannot read nor write.

Education levels in Palma District are similar. According to INE (2021), 60% of the population are illiterate. Pemba City presents a better education level, where 20% are illiterate.

The high illiteracy rate in Palma District is also compounded that the district only has 41 education facilities (EP1 and EP2) that encompass 17 778 students which is equivalent to 23% of the total district population (INE, 2021).

During the field survey it was not possible to verify the school conditions due to security concerns. According to Consultec (2014), the condition of school facilities, varied from poor to good, with “poor” being under a tree or precariously constructed classrooms, and “good” being inside a zinc roof covered classroom. Figure 6.79 and Figure 6.80 below illustrate schools in the project’s AII.

Figure 6.79: “Good” school in Senga

Figure 6.80: “Poor” school in Quiwia

Figure 6.81: New school in Quitunda resettlement village

6.10.9 Health

This section provides an assessment of the study area's health including the health profile for the Province of Cabo Delgado, the Districts of Palma and Pemba. The health baseline is based on secondary data and structured in the following sections:

- Provincial Health Profile – providing a summary on the provincial healthcare system, including infrastructure, coverage, and the province's epidemiologic profile;
- District Health Profile – providing relevant although brief information on the healthcare system at the district level, namely existing infra-structure, and health coverage indicators.

In addition, an overview of the national health system is also provided.

6.10.9.1 Overview of Health Care System

The Mozambican National Health Service has a four-tiered system (Law No. 25/91, of 31 December) which is comprised of:

- Primary level – Health Posts and Health Centers, each serving a specific geographic area;
- Secondary level – Rural, District or General Hospitals; and
- Tertiary / Quaternary level – Provincial, Central and Specialized Hospital.

A referral system forwards the patients to the next level if they cannot be adequately attended to at the receiving level. This system works in an integrated way, both in medical and administrative terms, ensuring the patient is followed through the levels. This system also allows for the recording and exchanging of information between the hierarchical levels.

The main provider of health care services throughout Mozambique is the public National Health Service. In 2022, there were 1,819 health units in Mozambique (excluding those that were privately funded); this equates to one health facility per 17,778 inhabitants, based on the 2022 population (*MISAU - Direcção de Planificação e Cooperação*, 2023). This falls short of the WHO's goal of one per 10,000 inhabitants.

Table 6.39 contains a description of the various types of health units in Mozambique. Some of the facilities are better equipped than others, depending on their location and the number of users.

Table 6.39: Description of the health units

Type of Health Package	Type of Health Facility	Type of Services Offered
Community Package	Community	Traditional Midwife Basic Multi-task Healthcare Helper (APE – Agente Polivalente Elementar): member of the community, trained by a Non-Governmental Organization (NGO) or by the National Health Service (SNS – *Serviço Nacional de Saude*) to provide basic and preventive and promotional care to same community
	Health Posts (provide primary health care)	APE Basic Midwife Basic Nurse
Minimum Health Package	Type II Rural Health Centre Type II Health Centre is the most modest in its infrastructure and staff. It is led by a medical technician instead of a doctor. Nevertheless, it provides consultations and midwifery. They provide primary health care	Basic Midwife Basic Nurse Nutrition Agent
Inclusive Health Package	Type II Rural Health Centre	Medical Technician or Assistant Doctor Basic Midwife Basic Nurse Nurse or Basic Healthcare Helper
	Type I Rural Health Centre In a rural environment the Type I units are the best equipped. They usually have a qualified doctor, trained medical staff and all the infrastructure for providing basic care as well as surgery.	Doctor, Technician or Medical Assistant Basic Midwife Preventive Medicine Agent Basic Nurse
	Type C Urban Health Centre	Basic Midwife Preventive Medicine Agent Basic Nurse
	Type II Urban Health Centre	Doctor, Technician or Medical Assistant Basic Midwife Preventive Medicine Agent Basic Nurse
	Type A Urban Health Centre	Doctor, Technician or Medical Assistant Basic Midwife Preventive Medicine Agent Basic Nurse
	District Hospital	Doctor, Technician or Medical Assistant Basic Midwife Preventive Medicine Agent

Type of Health Package	Type of Health Facility	Type of Services Offered
		Basic Nurse
Specialised	District Hospital	Doctor Medical Technician Obstetric Surgery Technician Obstetric Nurse Laboratory Technician or Assistant Basic or Intermediate SMI (Maternal-Infant Health) Nurse Basic or Intermediate Nurse
	Rural Hospital	Doctor Medical Technician Obstetric Surgery Technician Obstetric Nurse Laboratory Technician or Assistant Basic or Intermediate SMI (Maternal-Infant Health) Nurse Basic or Intermediate Nurse
	General Hospital	Doctor Medical Technician Obstetric Surgery Technician Obstetric Nurse Laboratory Technician or Assistant Basic or Intermediate SMI (Maternal-Infant Health) Nurse Basic or Intermediate Nurse
	Provincial Hospital	All
	Central Hospital	All

Primary Care

The Health Centre or Health Post is the basic level of health care and is equipped to solve up to 80% of the population's health needs. The Health Centre provides healthcare services to a specific geographic area, and the communities within its health area; it is fully responsible for all healthcare issues inside its area. Since health areas can be vast, and the population dispersed, a Health Centre can establish a number of Health Posts to ensure a more local presence. Health Posts are therefore satellite structures of a Health Centre, and for that reason are more modestly equipped and manned. The Health Posts can treat minor health issues, but their main objective is to provide a point of contact and referential for the population, where the size of that Health Centre's health area so demands it.

Secondary Care

The secondary level of healthcare is represented by the Rural, District or General Hospital (these are structurally and functionally the same and the different designations refer only to their geographic location). These hospitals provide curative healthcare, using technological equipment (such as x-ray, echocardiograph, and endoscopic equipment), and are manned by medical doctors of several specialties, such as general practice, general surgery, gynaecology and obstetrics, paediatrics, optometry, and psychiatry.

Tertiary and Quaternary Care

Provincial, central, and specialized hospitals constitute the tertiary and quaternary levels. These provide a broader range of specialized, curative, surgical and rehabilitative services.

Traditional Medicine and/or Healers (Curandeiros)

The continuing importance of traditional medicine is recognized in Resolution No. 4/95 of the Council of Ministers. National policy on traditional medicine is further described in Resolution No. 11/2004, of 14 April, which sets out a framework for integrating practitioners of traditional medicine into the National Health Service. The Ministerial Diploma No. 52/2010, of 23 March, established the Institute of Traditional Medicine.

Despite official support for it, health professionals within the study area consider the use of traditional medicine as detrimental to health as it allows diseases to progress.

Traditional medicines are generally made from herbs. Traditional doctors collect these herbs from areas surrounding the villages and use them to make tea and to bathe the patient. Such herbs include *uquidibe* and *mutu* which are used to cure insanity, *unpuesarua* which is used for fever and pain, and *nhocola* which is used for toothache.

6.10.9.2 Health Infrastructure, Services, and Resources

Health facilities

Cabo Delgado province has a total of 134 health facilities, including five hospitals. The City of Pemba has the highest number of health facilities, including the provincial hospital and 13 health centers. The health facilities in the Province of Cabo Delgado and in the District of Palma are presented in Table 6.40 below. Among the health units in the district of Palma, only one, in the village of Palma, is type I and the remaining six are type II - one of which, the Pundanhar Health Centre, has been inoperative due to security reasons. There are also nine private clinics in the province. These are all located in the City of Pemba, which also has 11 private pharmacies.

Table 6.40: Health care facilities at province and district level (2022)

Health Unit	Cabo Delgado	Palma
Provincial Hospital	1	-
Rural Hospital	3	-
District Hospital	1	-
Rural Health Centers (I and II)	112	7
Urban Health Centers	17	-
Total	134	7

Source: Director of Cabo Delgado's Provincial Health Services.

The Palma Health Centre is the main health facility in the district, and it used to provide satisfactory levels of care, depending on the availability of material and human resources before the attack on the village in March 2021. It was not possible to accurately determine the current operational status of the center, nor to take any photographs, due to security reasons.

However, the seven health facilities in Palma District have been closed due to the terrorist attacks, albeit at different times (MISAU, 2022). Furthermore, according to HeRAMS (2022), in Palma district, the health facilities were partially (29%) or totally (57%) damaged as a result of the attacks and/or pillaging. As for the damage to equipment, 86% were partially damaged due to the same cause. Only the Quitunda Health Centre (14%) did not suffer any material damage from the armed attacks.

Figure 6.82 illustrates the newly built Quitunda Health Centre, which is part of the Mozambique LNG Project Resettlement Plan's implementation process, as required though the resettlement process.

Figure 6.82: Quitunda health centre in Palma

The main constraints of the health sector, as identified by the Provincial Directorate of Health (DPS) of Cabo Delgado, the District Service for Health, Women and Social Action (SDSMAS) of Palma, and by technicians of the health centers in Palma, are summarized as follows:

- Insufficiency of health units, medical-surgical equipment, and hospitality supplies for the reopened health units;
- Insufficiency of health facilities with inpatient services in the city of Pemba, needed to relieve congestion at the Provincial Hospital; and
- At the Quitunda Health Centre, lack of material resources for the stomatology and laboratory services, as well as a lack of power supply in two blocks.

Services

According to Consultec (2015), and recent field work, the geographic location of the health infrastructure in Pemba City provides the best health coverage in the province, although the number of facilities and resources in relation to the population density is still low.

The low availability of healthcare facilities per inhabitants creates significant pressure on the limited healthcare network in the provincial capital. This situation has been further exacerbated by the outbreak of armed conflict in the northern part of the province, leading to the displacement of a large portion of the population from the north to districts considered relatively accessible, including the city of Pemba.

The Pemba Provincial Hospital is the best-equipped unit in the province, providing the services of Paediatrics and/or Neonatology, Medicine, Surgery, Orthopaedics and Traumatology, Gynaecology, Obstetrics and Stomatology.

In general, at the beginning of the period under review, the distribution of the health network in most districts of Cabo Delgado was uneven, thus greatly limiting its access by the population (Consultec, 2015).

Since the attacks in the north of the province began in 2017, the situation has worsened, leading to the closure of 39 health facilities in the districts of Macomia (7), Meluco (1), Mocímboa da Praia (8), Muidumbe (7), Nangade (2), Palma (7) and Quissanga (7), which in turn caused the displacement of the populations, essentially, to the districts of Ancuabe, Balama, Chiúre, Mecufi, Metuge, Montepuez, Namuno and Pemba, which are considered to be the most accessible (MISAU, 2022).

The closure of these health facilities, albeit temporary in some cases, has led to disruption in the provision of primary health care services in the affected districts.

Table 6.41 below summarizes the extent of damage to buildings and equipment in some health facilities in northern Cabo Delgado. In all districts, damage was caused by conflict, attacks and/or looting, with the exception of Nangade district, where damage was caused by natural disasters.

Table 6.41: Damages to buildings and equipment in selected districts of northern Cabo Delgado

District	Closed Units	Assessed Units	Damages to buildings			Damages to equipment		
			Undamaged	Partially damaged	Completely damaged	Undamaged	Partially damaged	Completely damaged
Macomia	7	7	14%	14%	71%	14%	14%	71%
Meluco	1	5	0%	60%	40%	20%	40%	40%
Mocímboa da Praia	8	7	0%	14%	86%	0%	14%	86%
Muidumbe	7	7	0%	14%	86%	0%	0%	100%
Nangade	2	5	40%	60%		40%	60%	0%
Palma	7	7	14%	29%	57%	14%	86%	0%
Quissanga	7	7	0%	0%	100%	0%	0%	100%
Total	39	45						

Source: HeRAMS (2022).

Overall, across the entire Cabo Delgado province, the levels of damages to buildings can be summarized as: completely damaged (22%), partially damaged (26%), undamaged (41%) and not relevant (11%). Equipment damages consist of completely damaged (19%), partially damaged (16%), and undamaged (65%).

However, by the end of 2022, some of the previously closed health facilities were back in operation, although limited, either by the total or partial destruction of infrastructure and/or equipment, or by staff shortages.

In the district of Palma, the Health Center of Pundanhar is still closed due to staff shortages and security reasons.

With the limitations described above, at the provincial level, the average number of inhabitants per health unit has increased from 16.339 in 2012 to 19.926 in 2022, with the main cause being the growth in population, based on the 2017 general census.

As highlighted in Table 6.42 below, the ratio of inhabitants to health facilities in the District of Palma is 11,463, greater than the levels recommended by WHO.

Table 6.42: Access and equity of the primary health network in the District of Palma

Province / District	Population Density (inhab./km²) (2022)	Inhabitants / health facility		% change in the number of inhabitants / health unit (2012 / 2022)
		2012	2022	
Cabo Delgado	32.3	16,339	19,926	+0.2
Palma	17.4	8,573	11,463	+0.3

Sources: Consultec (2015) & DPS Cabo Delgado.

Resources

Mozambique has a low ratio of health professionals to inhabitants (Table 6.43 below) with only 0.8 physicians and 0.1 pharmaceutical personnel per 10,000 people.

Table 6.43: National overview: health professional provision

Health Professional	Number per 10,000 population
Physicians	0.8
Nurses and midwives	5.7
Pharmaceutical personnel	0.1

Source: WHO (2023).

In Cabo Delgado, while the number of health personnel remains low, there have been improvements between 2012 and 2022 as shown in Table 6.44 below.

Table 6.44: Health personnel evolution and dynamics in Cabo Delgado Province (2022)

Level	Existing	
	2012	2022
Medical Doctors (MD)	57	148
Technician (high level)	56	354
Technician (medium level)	754	2,293
Technician (basic level)	896	313
Technician (elementary level)	167	15
General support	1,193	N/A
Total	3,123	3,123
Evolution (%)		0%

Source: DPS Cabo Delgado & Consultec (2015).

As shown in Table 6.44, above, the medium level is the most representative in 2022. During the 2012-2022 decade, the province followed the national pattern of human resources management, which involved retraining elementary and basic level staff, with mostly support staff (Service Agents) remaining at the elementary level. Data reported for the year 2021 showed this structure at the national level, with a prevalence of the medium level 52.3%, followed by elementary (19.3%), higher (19.1%) and basic (9.2%) (MISAU, 2022).

In 2022, the number of inhabitants per medical doctor (MD) showed some improvement, from 30,407 inhabitants/MD in 2012 to 18,041 per MD in 2022. The inhabitant/MD indicator is still very high in the Province, and far above the recommended threshold (1,000 inhabitants/MD) for all districts.

The Palma District has an inhabitant/MD figure of 40,120, much higher than the province and significantly higher than the WHO recommended 1,000 inhabitant/MD.

In 2022, the Palma District had the following health resources: doctors (4), senior health technicians (9), health technicians (89) and technical health assistants (16), totalling 118 professionals (Cabo Delgado DPS).

6.10.9.3 Health Profile

The main diseases registered in the health facilities of Pemba and Palma in 2022 were malaria, followed by diarrhoea and HIV/AIDS (Cabo Delgado DPS), as illustrated in Table 6.45, below.

Table 6.45: Main diseases affecting populations (# cases) in 2022

Diagnostic	Palma	Pemba
Malaria	234 745	95 476
Dysentery	318	2 886
Diarrhoea	1 184	10 923
Tuberculosis	0	1 231
HIV/AIDS	640	5 593

Notwithstanding the prevalence of malaria, in both Pemba and Palma, the leading cause of inpatient mortality is HIV/AIDS, followed by tuberculosis in Pemba, and other causes in Palma. Table 6.46 below shows the mortality rates in both project-affected areas.

Table 6.46: In-hospital mortality rates in 2022

District of Palma				City of Pemba			
Paediatrics		Medicine		Paediatrics		Medicine	
Causes	Rate	Causes	Rate	Causes	Rate	Causes	Rate
Diarrhoea	0%	Malaria	2%	Diarrhoea	0%	Malaria	0%
Measles	0%	Diarrhoea	0%	Measles	0%	Diarrhoea	2%
Malaria	0%	TB	0%	Malaria	1%	TB	18%
Pneumonia	0%	Pneumonia	0%	Pneumonia	2%	Pneumonia	8%
Anaemia	0%	Anaemia	2%	Anaemia	4%	Anaemia	4%
Malnutrition	0%	HIV/AIDS	25%	Malnutrition	1%	HIV/AIDS	27%

District of Palma				City of Pemba			
Paediatrics		Medicine		Paediatrics		Medicine	
HIV/AIDS	50%	Other causes	8%	HIV/AIDS	7%	Other causes	10%
TB	0%			TB	0%		
Other causes	11%			Other causes	8%		
Total	2%	Total	2%	Total	4%	Total	2%

Source: Cabo Delgado DPS (2023).

Overall, according to the Cabo Delgado DPS, the mortality rate is 9% in Pemba, and 4% in Palma.

When asked about the levels of awareness among the population regarding HIV/AIDS, its modes of transmission and treatment, district and provincial authorities stated that all communities are informed through the dissemination of information about the disease. This information is shared through lectures, community dialogues, the use of Information, Education, and Communication (IEC) materials (posters, leaflets, banners, roll-ups, etc.), radio and television spots, social media, and the Alo Vida platform. They also stated that the main sources for obtaining health services are health facilities, with recourse to traditional medicine being the second option for communities.

6.10.10 Infrastructure and Services

6.10.10.1 Access Routes and Transportation

The city of Pemba is equipped with an international airport, which links the province with the rest of the country, as well as with South Africa, Kenya, and Tanzania.

Palma District is equipped with an aerodrome in Afungi receives charted flights from Maputo and Pemba City.

The transport of people by sea is usually from the mainland to the islands which are located close to the coast of Cabo Delgado. In addition, the province has two marine ports, one in Pemba City and the other in the village of Mocímboa da Praia. In Afungi Peninsula, in Palma District, the Mozambique LNG project was building a marine offloading facility, which was going to be used to receive the cargo for the construction of the LNG project, this project was put on standby, due to the terrorist attacks.

Ports are mainly used to transport cargo to and from Mozambique and between south, central, and northern Mozambique. Some cargo is transported by vessels between the Port of Pemba and Mocímboa da Praia and Afungi.

According to the National Roads Administration (ANE) the province has in total 3,609 km of road. ANE does not provide data regarding the status of the roads, however it can be assumed that the majority is in bad condition due to the Cyclone Kenneth that hit Cabo Delgado in 2019. Due to the security concerns some roads are only passable with military escort. Figure 6.72 shows the road network in Cabo Delgado Province.

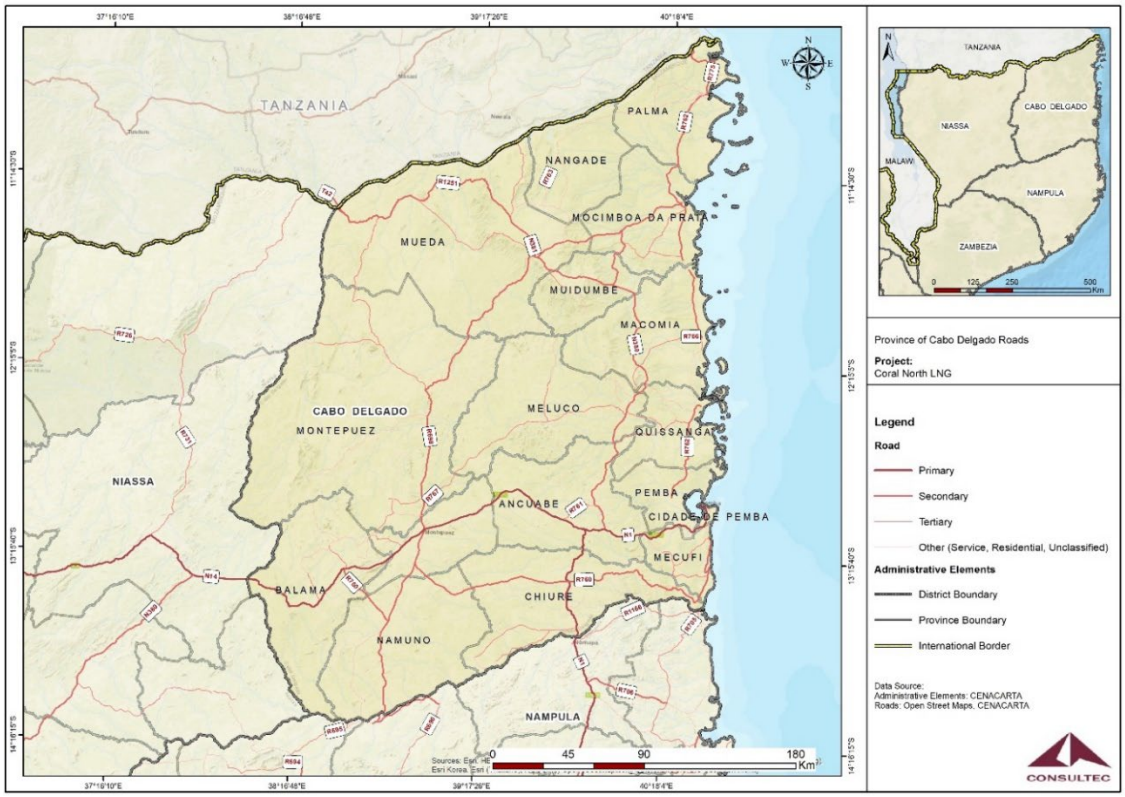


Figure 6.83: Road network in Cabo Delgado Province

In Palma District, the most frequently used roads are Palma to Mocímboa da Praia (ER762), Palma to Quionga (ER775), Palma to Olumbe (ER247), and Palma to Pundanhar (ER763). In general, road conditions in the district are poor, with only one road classified as a secondary road (Palma to Mocímboa da Praia - ER762). Similarly, some of these roads may require military escort. Table 6.47 shows the road conditions in Palma District.

Table 6.47: Road conditions in Palma District

Road Reference	Road length	Route	Type and condition
ER762	81	Palma – Mocímboa da Praia	Paved and recently rehabilitated
ER775	28	Palma – Quionga	No information
R1260	28	Quionga – Namoto	Dirt road and bad condition
ER762	25	Palma – Mute	Compacted dirt road and good condition
ER763	60	Palma – Pundanhar	Dirt road and bad condition
N/A	30	Palma – Nhica do Rovuma	Dirt road and bad condition
N/A	30	Pundanhar – Nhica do Rovuma	Dirt road and bad condition
ER247	58	Palma – Olumbe	Dirt road and bad condition
N/A	58	Palma – Mangaja	Dirt road and bad condition
N/A	115	Palma – Nangade	Dirt road and bad condition

Source: Consultec (2014).

There is no data regarding the road network of Pemba City. However, the Activity Report of the 2022 Annual Balance Sheet of the District Planning and Infrastructure Service of Pemba District reported

that there are 165 taxi services, 345 public semi-collective passenger services, and 25 urban public transport licensed in the city.

6.10.10.2 Water

The displacement of hundreds of thousands of individuals has placed great pressure on water access in general, in a context where access to this vital asset was already limited (OMR, 2021).

Data from INE (2023) on water supply in Pemba City points to 146 water sources in 2021. Data on the number of boreholes, wells, and operational water indicate 140 boreholes and 40 operational water wells.

According to a Consultec study (2021), only 40% of households within the neighbourhoods of Pemba City have access to piped water into their homes or back yard, meaning that the remaining need to find water from other sources such as borehole, public taps, or water bodies among others, having to leave their dwelling to fetch water. In relation to households who claimed to use other water sources, most within the neighbourhoods of Pemba claim to use their neighbours' house to access water.

The photos of Figure 6.84 below illustrates examples of water sources utilized by the population.

Protected Borehole

Protected Borehole

Yard pipped water

Public Tap

Figure 6.84: Water sources used by the population

Although households use various water sources, not all of them are reliable, and sometimes the water supply is compromised due to lack of conditions and consistency of these sources. Consultec (2021) showed that only 16% of the households claim that the water supply services are always working, which means that they have to find another water source in order to collect water. The field data also showed that 39% of the population in Pemba is not satisfied with the quantity, which may not be enough for their daily needs. The data showed that the majority (91.5%) are happy with the water quality.

For the district of Palma, INE data (2023) on water supply indicates 42 water sources in 2021, which serve a population of 30,111. In 2021 there were 32 operational boreholes (15 in Palma-Sede Administrative Post [PA], eight in Olumbe PA, seven in Quionga PA and two in Pundanhar PA). There is no data for the number of operational water wells. In 2021 the PA of Palma-Sede a population of 30,111 were served by water sources.

According to the report on the Balance of the Economic and Social Plan and State Budget 2023 of the District of Palma, water supply coverage increased from 54% to 58% in 2023.

The process of fetching water plays an important role in the lives of people in Pemba City and Palma District and is usually part of a women's role. Sometimes young girls have to drop out of school in order to fulfil this chore in the household. Fetching water is part of the day-to-day activity of community members, as the women claimed they fetch water every day.

6.10.10.3 Electricity

Electricity in the Province of Cabo Delgado comes from the Cahora Bassa dam located in the Province of Tete. According to the Provincial government, all District capitals have access to electricity. In the past few years there has been an expansion in the delivery of electricity in the Province of Cabo Delgado, however this service is limited to the households living in urban areas.

According to the Household Budget Survey (2022), the main source of energy used for lighting in the province of Cabo Delgado is batteries and/or solar (54.9%) followed by public network (21.8%). Regarding the type of energy and/or fuel for cooking, most households use firewood (73.1%) followed by charcoal (24.3%).

The Activity Report of the 2022 Annual Balance Sheet of the District Planning and Infrastructure Service of Pemba City states that 6,645 new electricity connections and 307 public connections were made by the company Electricidade de Moçambique in the Pemba distribution area, a process aimed at ensuring lighting in the neighbourhoods.

Eighty-seven percent (87%) of the households residing in Pemba City are connected to the Electricidade de Moçambique electricity grid (Consultec, 2021). There is no similar data for Palma District.

6.10.10.4 Housing, Sanitation and Waste Disposal

According to the 2007 national census, most of the houses in the province are built with natural materials such as wood, palm leaves, sticks, clay, and sand. Houses built with more conventional

building material such as cement are mostly found in urban areas such as Pemba City, Mocímboa da Praia Villa, Montepuez, and Mueda.

In Palma District during the field visit it was observed that most of the houses are built with natural materials. However, with the oil and gas projects and the increase in formal employment, the number of houses built with conventional building material is increasing. In Afungi peninsula a resettlement village is being built, with around 600 houses made of manmade material. Figure 6.85 shows the resettlement houses.

Figure 6.85: Resettlement house in Quitunda Village

The data from the 2017 Census show basic sanitation conditions in Cabo Delgado's Northeast, with the predominance of open defecation situations. Only 21.6% of the population in Mocímboa da Praia district, 18.7% in Macomia, 10.9% in Quissanga, 15.2% in Palma, and 24.7% in Nangade had access to more hygienic sanitation (improved toilet or latrine). Population densification in high water table areas and the lack (and pressure on) of sanitation conditions increases the risk of cholera and diarrhoea (OMR, 2021).

Data from the Household Budget Survey (2022) shows that 71.9% of households in Cabo Delgado province use unimproved latrines, 11.3% use improved traditional latrine and only 0.3% use toilets with indoor flushing.

According to the Cabo Delgado delegation of the National Water and Sanitation Information System (SINAS) 2022/2023, the city of Pemba has 13 communities Free of Open Defecation (LIFECA), and the district of Palma has 18 communities. The proposed Economic and Social Plan and State Budget of the District Planning and Infrastructure Service of the Pemba City for 2024, in 2022 listed 4,576 improved latrines, 7,373 improved traditional latrines, 8,856 unimproved traditional latrines, and 39 septic tanks.

In Pemba city, a low number of households do not have latrines (7.3%) and most of the households have an improved latrine in their dwelling (50.7%) (Consultec, 2021).

6.10.10.5 Telecommunications

There is no current telecommunication data available. Furthermore, due to the ongoing conflict, several infrastructures of mobile carrier services were destroyed and have not been restored. Around 99 mobile towers in Mocímboa da Praia, Palma, Quissanga, Muidumbe, Nangade, Meluco, Ibo, and Macomia districts were vandalized. Around 941 km of Vodacom aerial fibre optics in the sections between Mueda-Awasse and Mocímboa da Praia; Palma-Mocímboa da Praia-Macomia-Metoro and Palma-Pundanhar-Nangade-Mueda and about 500km of Movitel aerial fibre optics including poles were damaged. TMcel's optical fibre, being underground, was only partially affected (PRCD, 2021). However, in Palma Sede and in the communities in Afungi Peninsula the telecommunication has been restored with all mobile companies that operate in Mozambique.

Table 6.48 shows the communication services in the area of AII prior to the insurgency attacks.

Table 6.48: Access to mobile networks, radio, and TV in the villages within the AII

Name of Village / PA	Mobile networks	Radio	TV
Olumbe Sede (PA)	Movitel, Mcel e Vodacom	Radio de Moçambique (RM)	Closed Caption
Nsangue-Ponta A	Movitel e Vodacom	RM	Closed Caption
Milamba	Movitel	RM	Closed Caption
Lalane	Movitel	RM	Closed Caption
Namanengo	Movitel	RM	Closed Caption
Mondlane	Movitel e Vodacom	RM	Closed Caption
Quigodo	Movitel	RM	Closed Caption
Quirinde	Movitel, Vodacom e Mcel	RM	Closed Caption
Quiwia	Movitel e Vodacom	RM	Closed Caption
Mbuize	Movitel	RM	Closed Caption
Farol	Movitel e Vodacom	RM	Closed Caption
Patacua	Movitel e Vodacom	RM	Closed Caption
Naliandele	Movitel	RM	Closed Caption
Quilawa	Movitel, Vodacom e Mcel	RM	Closed Caption
Muahá	Movitel, Vodacom e Mcel	RM	Closed Caption
Quelimane	Movitel, Vodacom e Mcel	RM	Closed Caption
Bagala	Movitel, Vodacom e Mcel	RM	Closed Caption
Quitupo	Movitel	RM	Closed Caption
Barbaralane	Movitel	RM	Closed Caption
Milamba 2	Movitel	RM	Closed Caption
Maganja	Movitel e Vodacom	RM	Closed Caption
Malamba 1	Movitel	RM	Closed Caption
Banja/Senga	Movitel e Vodacom	RM	Closed Caption

Source: Consultec (2014).

Pemba City is covered by the mobile network of the three operating carriers in Mozambique. Also, the city is covered by the Radio de Moçambique signal and by the STV and TVM tv signals.

6.10.11 Livelihood Strategies: Economic and Income Activities

The Province of Cabo Delgado has prepared a five-year programme, "*Programa Quinquenal do Governo para 2020-2024"*, which establishes strategies to create a favourable environment for the economic and social development of the province, aiming to reduce poverty and increase local people's well-being.

In Palma district, the main economic activities are agriculture, artisanal mining, livestock, and fishing. The main products produced are corn, cassava, peanuts, and fish (INE, 2023a). According to the report on the Balance of the Economic and Social Plan and State Budget 2023 of the District of Palma, the main products of the district are gas, fish, and cashew, with production including agricultural, fish, livestock (meat), industrial (flour) and tourism. In 2021 there were 39 hotels in the district of Palma (38 in Palma Sede and one in Olumbe). In the first semester of 2023, there were 5650 overnight stays.

The ongoing conflict and displacement of population has had a significant impact on these economic and income activities. According to OMR (2021), one of the main difficulties faced by the IDPs is the access to land, firewood, charcoal, water, and other natural resources, as they compete with the host population. Moreover, there was a significant decrease of assets ownership due to destruction, theft, and widespread abandonment of property (e.g., mobile phones, motorbikes, solar panels, boats and fishing nets, work tools, etc.).

The OMR (2021) report also showed that the abandonment of the places of origin resulted in a clear decrease in agricultural and fishing production, interrupting commercial circuits, and increasing the dependence of the populations in terms of food aid. For example, the Mwani population, strongly dependent on fishing, faced greater integration problems in their places of destination, where most of the support was in agricultural activities., to the detriment of fishing which has now become secondary.

The main economic activities in Pemba City are agriculture, livestock, industry, commerce, and tourism. The main products produced in the district are various vegetables, broilers (chickens), cattle and goats and fish. Regarding tourism, in 2021 there were 34 hotels in Pemba City (INE, 2023b; INE, 2022).

In the city of Pemba, the absence of agricultural production and security constraints on access to the sea led to severe food shortages. The situation improved with the relocation of numerous IDPs from Pemba city to the districts of Montepuez, Ancuabe, and Chiúre, as well as to the coast of Quissanga, especially from the second half of 2021 onwards (OMR, 2021).

Because of lack of land for cultivation, dependency and irregularity of food donations, many displaced families have to carefully manage their food or sell part of it to buy other basic necessities not provided by humanitarian organizations, as well as to finance unexpected expenses, including travel (OMR, 2021).

6.10.11.1 Forestry Resources

Local communities in Palma District harvest a large selection of wild plants from their surrounding environment. Some of these, along with their uses, include:

- Wood: firewood, construction, carpentry, tool making;
- Coconut palm leaves: thatching of roofs;
- Bark (especially *Brachystegia* and *Julbernardia spp*): string, rope, and beehives;
- Medicinal plants;
- Gum from *Hymenaea verrucosa*: incense;
- Roots of *Olax dissitiflora*: pounded and used as a white cosmetic face mask;
- Sap of *Hyphaene* palms: palm wine;
- Wild fruits, e.g., *Sclerocarya caffra, Parinari curatellifolia*, and *Vangueria infausta.*

When asked if their livelihoods were threatened by lack of the above resources, the consulted stakeholders expressed they did not feel threatened as there was an abundance of forest resources for everyone.

6.10.11.2 Tourism

Tourism in Cabo Delgado Province is still in its infancy, however, given its potential particularly for the islands and the coastal area, the province of Cabo Delgado has designated tourism as one of its priority sectors (Cabo Delgado PES 2014).

The District of Palma encompasses a number of islands that belong to the Quirimbas Archipelago. This Archipelago is under what the Ministry of Economy calls, the 'Blue' product line, and addresses a strategic niche by providing diving, recreational deep-sea fishing, eco-tourism, adventure tourism, high yield 'island' tourism, and cultural tourism.

Despite being in its 'tourism infancy', the Quirimbas Archipelago is rapidly becoming a sought-after international luxury tourism destination. Over the last decade, publications such as the UK London Sunday Times, Condé Nast Traveller, Times (UK), Dive Global, Harpers & Queen (UK), Volta ao Mundo, Paris Match, Observer (UK), and Der Speigel (Germany) have published rave reviews about the archipelago and specific resorts. Some of the resorts have been rated as within the top 100 hotels in the world, and among the top 20 international destinations.

The tourism operators in the area can be divided into two main categories:

- Operators with only accommodation (OA operators) – these operators only provide accommodation and are mainly based on the mainland;
- Operators with accommodation and leisure activities (OAL) – these operators provide accommodation as well as leisure and recreational activities such as diving, sports fishing, among others. The OAL are mainly based on the islands.

Prior to the insurgency attacks, OAL on some coastal islands, from north to south, included the following:

- Tecomaji – Potential development of the Palma Bay Lodge;

- Rongui – Rongui Island Lodge with six luxury villas planned to be built by the Maluane Group;
- Queramimbi –Beach resort is planned to be developed;
- Vamizi- Vamizi lodge is a five-star luxury lodge run by the Maluane Group. The high season for Vamizi is April, August, October, and December. The low season is February, June, and November. The rest is medium season;
- Metundo - Metundo Island Lodge providing ecotourism. This lodge has been opened although now closed (no reasons for closure were found during the study);
- Quifuqui – Potential development of tourism facilities;
- Tambuzi – Potential development of tourism facilities.

Most resorts and/or lodges in the Quirimbas target high end tourism with Vamizi lodge charging up to 1,000 USD per night per person.

However, all these tourism developments and potential developments have been suspended, due to the security conditions in the district. According to the website of the Vamizi hotel, it has been closed since 2019 due to security concerns in the area. There is no information regarding if and when these tourism operators plan to return to the area.

The closest island to the proposed Coral North Project is Vamizi, followed by Metundo, Table 6.49 shows the distances from the islands to the proposed FLNG site.

Table 6.49: Distance from the islands to the proposed project area

Islands	Distance (km) to Coral North site
Metundo	42.7
Vamizi	38.9
Rongui	47.7
Tecomaji	52.9

6.10.11.3 Commerce and Industry

According to the Social and Economic Plan for 2017, the province had a total of 700 industries in the province. The same source also showed that province has 11 079 commercial establishments. The data is not segregated by district or city, however as Pemba city is the main economic hub of Cabo Delgado Province, it can be assumed that the majority of the industry and commercial activities are set in the city.

In Palma District, due to the insurgency attacks many businesses closed. According with information provided by the District Government, during a visit by the President of Mozambique in 2023, there are 85 industries in the district, which represents an increase of 107% compared 2022. Also, the source stated that there are 119 commercial establishments in the district, representing an increase of 16% compared to 2022. With the reestablishment of security in the region and the restart of LNG activities it is expected that commercial and industry sector in Palma district will substantially increase in the next few years.

6.10.11.4 Formal Employment

In the AII, formal wage labour-based employment is almost non-existent. Specifically in Palma village, it is likely there will be two main formal employment providers, Total and MRV, once the security situation has stabilized and *force majeure* has been lifted. Employment in and around the village may expand to service providers based on the Total and MRV's requirements. As such, coastal villages such as Muaha, Milamba and Maganja that are closer to Palma village will have more opportunities for employment than villages that are further away such as Mbuize or Lalane. Overall, in comparison to other activities, formal employment is still of very low significance to the AII mix of livelihood strategies.

Whilst employment in the city of Pemba is limited, there are more formal employment providers than in the rural areas, including government institutions, hotels, factories, non-governmental organizations and also services linked to the oil and gas industry.

6.10.12 Fisheries

6.10.12.1 Overview

Mozambique has a vast territory, with coasts and continental waters of great fishing potential and resource diversity. The coastal zone consists of three sections, each with some differences in fishing activity: Zone A) the northern coast has a coastline of coral and rocky bottoms and a narrow continental shelf, with some sheltered bays and inland waters, and coastal islands, mainly in Cabo Delgado and some areas of the northern and central districts of Nampula; Zone B) the central coast, from the southernmost districts of Nampula to the north of Govuro, constitutes the Sofala Bank and is intersected by numerous rivers and channels lined by mangroves, providing sheltered estuarine areas and coastal beaches, sometimes protected by some coastal islands; and, Zone C) the southern coast, in its central part with deep waters, extends from Govuro to the south of Maputo province, has extensive areas, features a seabed with corals and rocky banks, has some sheltered bays and is exposed to strong winds, especially from Inhambane to the southernmost point (Capaina, 2021). Figure 6.86: below illustrates the geographical location of the three fishing zones along the coast of Mozambique.

Marine fishing in Mozambique is of great importance to food security, employment, and foreign exchange revenue. The contribution of the fisheries sector to the Gross Domestic Product (GDP) is about 2%. Coastal populations rely heavily on fishing for part of their income and much more for their subsistence, with a per capita fish consumption at 14.0kg per person (MIMAIP, 2020).

Fishing activities are divided into 1) extractive - those related to the catching, with or without on-board processing, or harvesting of fishery resources in marine and inland waters; and 2) aquaculture - those related to the rearing and/or maintenance of aquatic species in captivity with human intervention. There are complementary activities, which are subdivided into: (a) processing - those related to the canning, drying, smoking, brining, chilling, freezing and any other processing of fishery products; (b) marketing - those related to the first sale of fishery products and their transport; (c) port

services - which include docking of vessels, unloading and loading of fishery products or goods and inputs intended for fishing and aquaculture; and (d) construction and manufacturing - those related to the building and repair of vessels, and the manufacture of fishing nets, equipment, gear and other accessories.

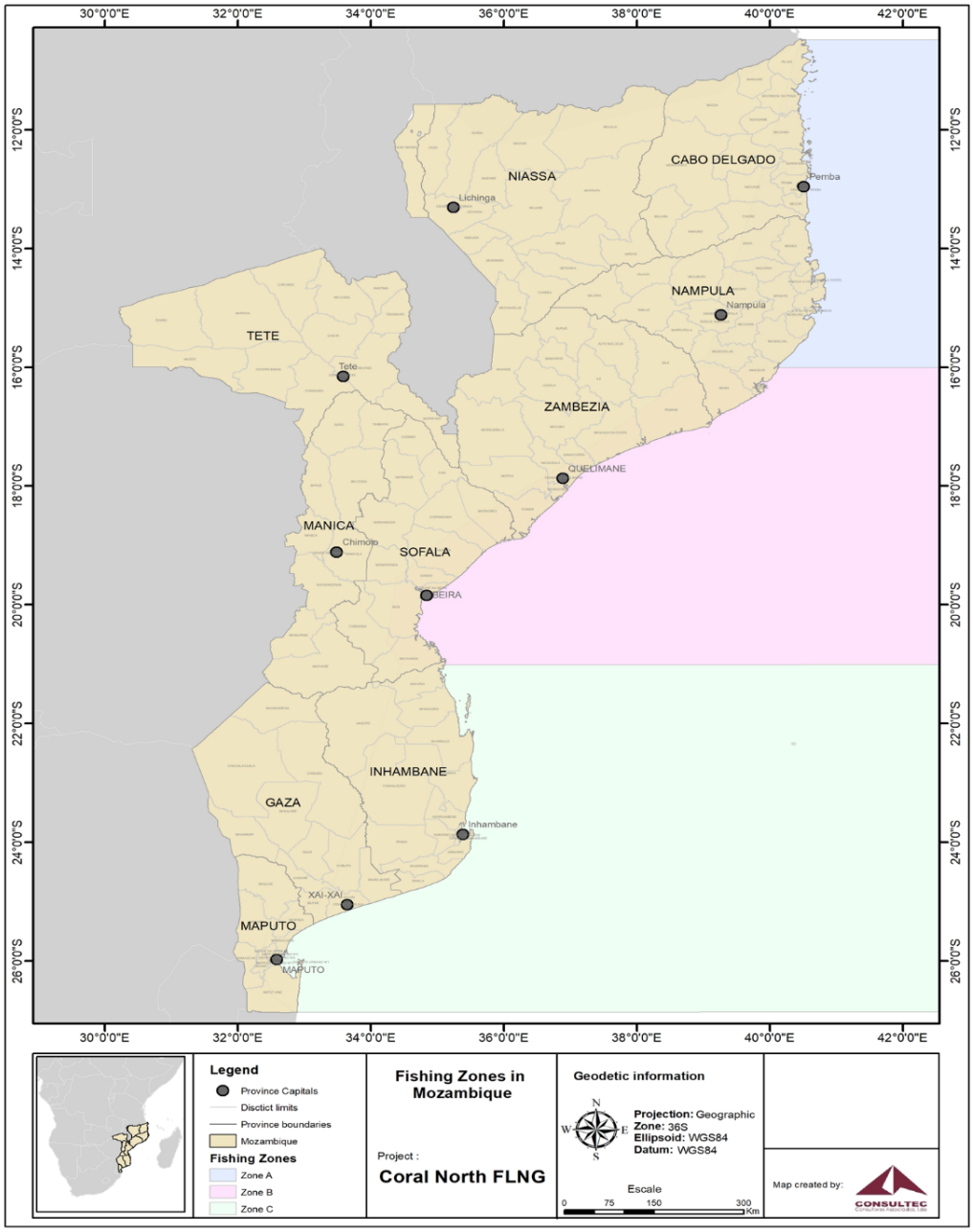


Figure 6.86: Fishing zones off the coast of Mozambique

With respect to planning and management, fisheries are classified as (a) marine or continental, depending on whether it takes place in the sea or in continental or inland waters; (b) commercial or non-commercial, depending on whether it is carried out for profit or not; (c) local, coastal, offshore or high seas, depending on the fishing area in which it takes place; and (d) artisanal, semi-industrial and industrial, depending on the complexity of the methods used to catch and preserve fish on board.

The complexity of the methods of catching and preserving fish is described below:

- Artisanal fishing: This category includes boats with a maximum length of 10 m and if motorized, the propulsion power must not exceed 100 hp or 74 kW; if motorized, the autonomy in the sea should not be lower than 24 hours. These vessels operate up to three nautical miles from the coast (in Palma case, from the oceanic coastline of the coastal islands) or the homeport if open-deck and without mechanical propulsion;
- Semi-industrial fishing: This category includes vessels with a length exceeding 10 meters and less than 20 meters, with autonomy not less than 48 hours. They can operate along the coast in national maritime waters up to a distance of 30 nm from the coast. The vessels must have propulsive power that enables the towing of loaded fishing gear, with a maximum of 350 hp or 259 kW of propulsive power in the case of trawlers. They may have refrigeration facilities for preserving ice and fish on board, as well as fish freezing systems, provided they are separated from refrigeration;
- Industrial fishing: This category includes vessels with a length equal to or greater than 20 meters and autonomy exceeding 15 days. They can operate without any distance limitation from the coastline, except for the restriction of fishing within three nm, unless expressly stated for certain fishing gear and fisheries. The vessels must have propulsive power that enables the towing of loaded fishing gear, with a maximum of 1500 hp or 1110 kW of propulsive power in the case of a trawler fishing vessel. They must have processing facilities and adequate means for fish preservation, including separate freezing chambers for fish freezing and storage or refrigeration, as well as facilities for preserving food for the crew (Capaina, 2021).

Fishing activity is carried out along the entire Mozambican coast, with different levels of technology and resource exploitation. The most important marine resources include crustaceans (shallow and deep-water shrimp, deep-water lobsters, crayfish, and crabs), demersal and pelagic fish, and molluscs.

Deep-sea fishing activities along the coast of Mozambique are primarily focused on crustaceans, and also include pelagic and demersal fish. Deep-water shrimp trawlers operate at depths of between 200 and 800 meters. Shrimp are distributed along the continental slope from about 17ºS to the southern border of the country at depths ranging between 300 and 800 meters (MICOA, 1998).

In Mozambique, fishing activities are subject to prior licensing, in accordance with the regulations in force. The legal framework for the exercise of the activity is summarized in Table 6.50 below.

Table 6.50: Legal framework for fishing activities

Acronym	Designation	Objective
	Fisheries Law	Its purpose is to establish the legal regime for fishing activities and complementary fishing activities, with the aim of protecting, conserving and sustainably utilising national aquatic biological resources.
	Law of the Sea	It aims to establish the legal framework for the exercise of sovereignty and jurisdiction over the national maritime space, the exploitation of living and non-living marine resources and the use of the maritime public domain.

Acronym	Designation	Objective
REPMAR	General Regulation on Marine Fisheries	Its purpose is to regulate the provisions of the Fisheries Law relating to marine fishing activity.
REPAI	General Regulation on Inland Fisheries	Its purpose is to regulate the provisions of the Fisheries Law relating to river and lake fishing.
RGA	General Aquaculture Regulation	Aims to regulate the provisions of the Fisheries Law relating to the exercise of aquaculture activities.

In addition to the laws and regulations described above, several plans and policies are relevant to the exercise of fishing activity, of which the following can be highlighted:

- Fisheries Master Plan (2010-2019);
- Policy and Strategy for Fisheries Administration and Inspection;
- Deep-Sea Crustacean Fishing Management Plan – 2021-2025; and
- Rocky Bottom Demersal Fisheries Management Plan – 2021-2025.

In Cabo Delgado, the fishing activities that are relevant to this study are 1) sea fishing, carried out on the coast of Palma by artisanal fishermen, generally for profit, and 2) commercial fishing, carried out on the high seas by industrial ship owners, for economic gain.

6.10.12.2 Coastal and Local Fishing in Palma District

As part of the implementation of the Artisanal Fisheries Promotion Project (ProPesca) by the now defunct National Institute for the Development of Small-Scale Fisheries (IDPPE), whose main objective was to improve the income and living conditions of families dependent on fishing for their livelihood, 30 growth areas were identified throughout the country, one of which was Palma (IDPPE, 2012).

Also, according to IDPPE, the town of Palma, the district headquarters, is the center of the growth area, which included four zones, 17 Fishing Centers (CP) and 18 associated villages. Data collected at the District Services of Economic Activities (SDAE) of Palma, indicate that the number of CP and associations increased to 21 (+23.5%) and 35 (+94.4%) in 2022, as shown in Table 6.51.

Table 6.51: Fishing centres and villages in the Palma district

Zones	Fishing centers		Associated Villages	
	2012	2022	2012	2022
Quirinde	4	7	4	12
Quiwia	3		3	
Palma-Sede	3	6	7	14
Olumbe	7	8	4	9
Total	17	21	18	35

Currently, two CP (Lalane and Sangue-Ponta) located in the Olumbe area, within the administrative post of the same name, are not operational due to the security situation, according to sources from the District Services for Economic Activities of Palma.

A number of community-based organizations (CBOs) are involved in fisheries, namely Community Fishing Councils (CCPs), Associations, Market Management Committees and Rotating Savings and Credit Groups (PCR). Table 6.52 below presents the CBOs in the fishing areas of Palma at the time of the artisanal fisheries census in 2012.

Table 6.52: Community-based organizations in the Palma fishing centers (2012)

Zones	CCPs	Associations	Market Management Committees	PCR Groups	Total
Quirinde	1	0	0	1	2
Quiwia	0	0	0	0	0
Palma-Sede	1	2	1	1	5
Olumbe	2	2	0	6	10
Total	4	4	1	8	17

The Institute for the Development of Fisheries and Aquaculture (IDEPA), successor of the defunct IDPPE, conducted a new national census of artisanal fisheries in 2022. Due to security reasons, field visits to fishing centers were not conducted. The results have not been released to date.

One of the two CCPs in Olumbe is the Vamizi CCP, located on the Vamizi island, approximately 38.9 km from the project area.) This CCP operates in Vamizi-Rance CP, which, according to the artisanal fishing census 2012 data hosted 67 boats and 75 fishing gear. The Vamizi-Quivune CP holds 16 boats and 56 fishing gear (IDPPE, 2013).

Vamizi Island has an area of 48 km^2 and has a permanent population of about 1500 people, which doubles during the dry season due to the annual migration of fishermen from Nacala, located in Nampula Province (Silva, 2019). Figure 6.87 illustrates the lodge and villages in Vamizi Island.

In Palma District's CP, the main types of boat used in the fishing centers of the Palma pole are the canoe, *Machua* and Dhow. None of these boats have onboard ice facilities. In Palma, there is a strong tradition of artisanal shipbuilding, although there are no marine engine mechanics.

The most commonly used fishing gear is hand lines and gillnets, followed by beach seines and purse seines. However, there are slight differences between the areas: in Olumbe, Quiwia, and Quirinde, the use of handlines predominates, followed by gillnets; in Palma, the most used gear is the handline, followed by beach seines, purse seines and gillnets.

The main resources caught by artisanal fisheries include a variety of shrimp species, pelagic and demersal fish, crabs and, to a lesser extent, cephalopods.

In 2012, and according to the available data from the sampling system of the main landings of artisanal fisheries, collected by sampling technicians under the guidance of the Fisheries Research Institute (IIP), the average annual production of the district of Palma is 1,217.6 tonnes. Beach seining contributed the most to the total production with 54 per cent, followed by line fishing (18 per cent) and bottom-set gillnetting (17 per cent).

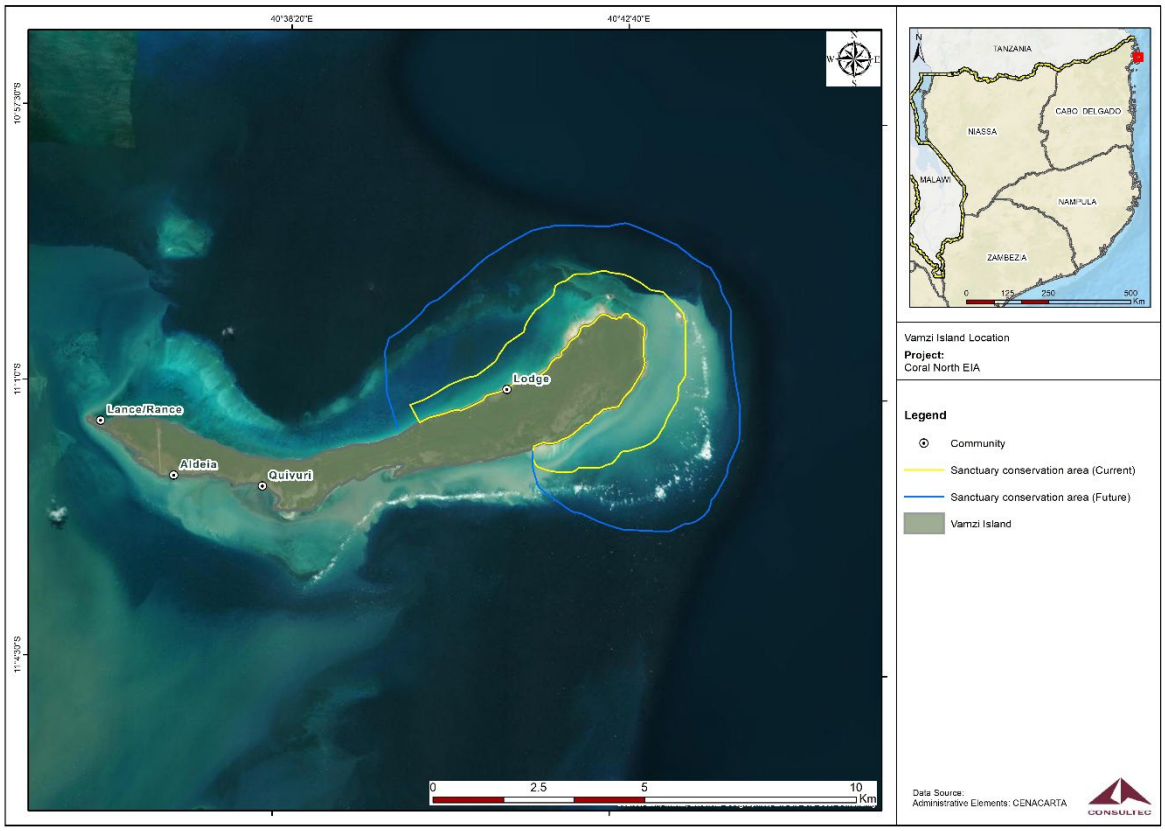


Figure 6.87: Satellite image of Vamizi Island

This data will likely be updated pending the release of the 2022 census results including the current state of artisanal fishing.

The fish caught in the Palma growth area is distributed by various parties to supply the districts of Mocímboa da Praia, Mueda, Nangade, Pemba, Montepuez and some districts of the province of Nampula (Namapa and Nampula city). Some of the fish is also exported across the border, mainly to Tanzania (Ntuara), with the main commercialized resources being oysters, octopus, lobster, mangrove crab, high-value fish, and sea cucumbers. The fish trade involves various types of parties along the supply chain, including fishermen, traders, transporters, and fish consumers.

Throughout the supply chain, fish pass through the following locations with different functions: fishing centers, concentration points and consumer markets. Fishing centers or landing points are where the first sale from fishermen to traders takes place, while concentration points are where products from different origins are brought together for transport and wholesale to different consumer markets. Most of the production first converges in the Mocímboa da Praia District, from where the product is redistributed to various points within the province or to the neighbouring Nampula Province, depending on the type of product. Octopus, oysters, and sea cucumbers are primarily sold to Tanzanian traders.

The movement of fish is currently very limited, due to the armed attacks in northern Cabo Delgado that have occurred since the end of 2017.

In the fishing center of the village of Palma, there is a first-sale fishing market that is currently not operational. It was built by the now-defunct IDPPE, under the ProPesca project, co-financed by the International Fund for Agricultural Development (IFAD) and the EU. Other institutions that have funded the artisanal fisheries sector in Palma in the past are:

- Food and Agriculture Organization (FAO), which donated fishing gear and/or materials (fishing nets, lines, hooks, and cooler boxes);
- The Civil Society Support Mechanism Foundation (MASC Foundation), which provided fishing materials, on credit; and
- The National Institute of Social Security (INSS), which supported fish traders with freezers and fishing supplies.

At the provincial level, in Cabo Delgado, the institution that currently provides funding to the sector is Pro-Azul.

6.10.12.3 Commercial Deepsea Fishing

Target Resources and Production

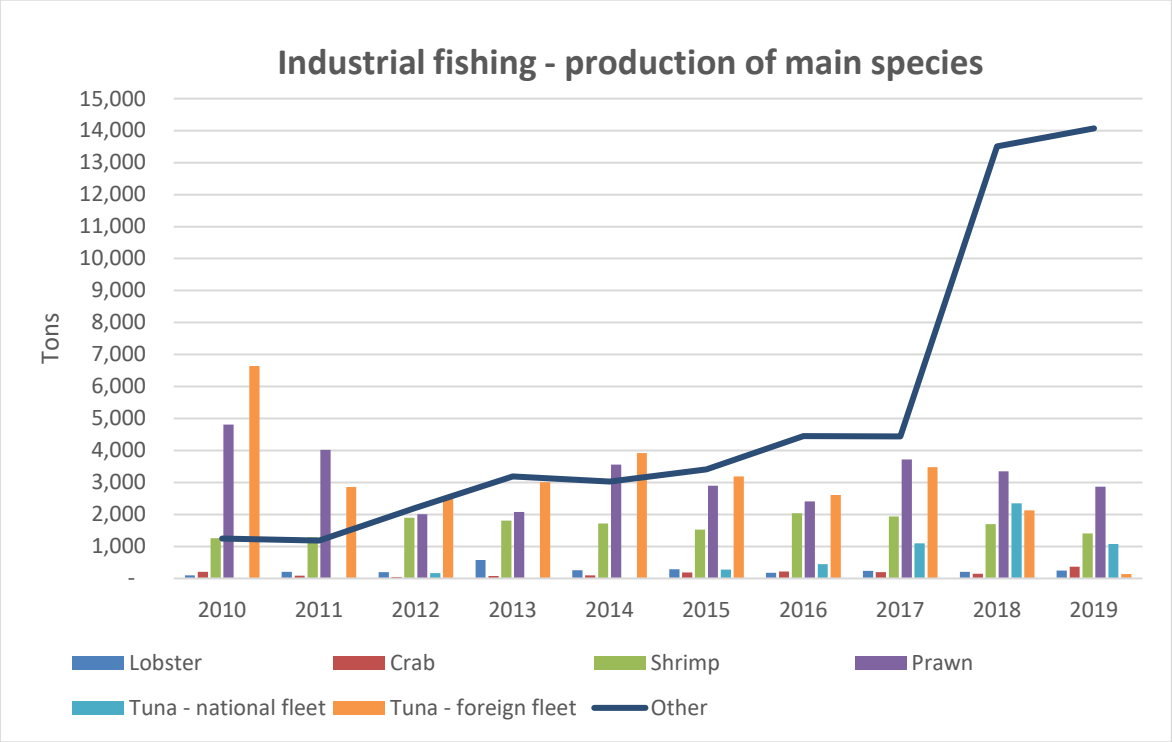
Industrial fishing in the country has been dominated by the demand for marine species with high commercial value at the regional and international levels. Species such as tiger prawn, shrimp and lobster have been prominent in this demand. Other species, such as tuna and crab, have also been of interest to industrial ship-owners.

Statistics in the country indicate a decrease in catches between 2010 and 2012, after which an increase began in the following year, reaching the peak in 2018 with 23 423 tonnes, more than 64.3% of the 2010 production. Average annual production was 13 910.6 tonnes; 3 170.7 tonnes of prawns, shrimp 1 658.3 and lobster 401.9. Another group of species, including tuna, shark, crab, grouper, and some cephalopods and other fishes, constitute the other part of the production, totalling an average of 8,679.7 tons annually.

Lobster catches peaked in 2013 at 574 tons, after which there was a successive decline. Prawn and tuna (foreign fleet) catches have been declining, despite the growth trend observed in 2014, when they reached 3 556 and 3,916 tons respectively. Shrimp catches showed a moderate behaviour: between 2010 and 2012 they had a continuous growth, then slowed down from 2013 to 2015, peaking in 2016 with 2 043 tons. The reason for these declines is unknown.

Figure 6.88 illustrates the industrial fishing production, based fisheries statistics, according to MIMAIP (2020).

The data analysed shows an average annual contribution of tuna (25.8%) to the total catch, with prawn (22.8%), shrimp (11.9%), lobster (1.8%), and all other species (37.7%). In the last two years, the contribution of these four species to the total production decreased significantly; tuna (19.1% and 6.0%), prawn (14.3% and 14.2%), shrimp (7.3% and 7.0%) and lobster (0.9% and 1.2%), respectively. In addition to the decrease in the stated species, a sudden increase in unspecified fish in the catches was recorded.



Source: MIMAIP (2020).

Figure 6.88: Industrial fishing - production of main species

With the decline in prawn catches in the 2000-2010 decade, many companies in the industrial sector have diversified their production. The current product range includes prawn, lobster, crab, grouper, shark, tuna, and other species with commercial value.

Fishing Areas in Cabo Delgado Province

According to Consultec (2015) there is a significant fishing activity for large pelagic species (tunas, swordfish, and sharks) that is particularly active in the northern part of Mozambique's EEZ. While fishing for large pelagic fish in the western Indian Ocean, vessels will pursue target fish species along annual migratory routes, travelling through several EEZs including Mozambique, Tanzania, French Overseas Territories (Reunion Island and Mayotte), Comoros, Madagascar, Mauritius, Seychelles, and South Africa. Therefore, vessels from this fishery will not be present in the same EEZ all year round and will follow the main concentrations of the target species, influenced, primarily, by the location and abundance of food resources (small pelagic fish, cephalopods, and pelagic crustaceans). For Mozambique, evidence suggests that the location and abundance of target food resources can change dramatically from year to year (Impacto, 2008a).

Purse seine fishing occurs between parallels 10º32' and 20ºS[12]. Longline fishing occurs between the parallels 20º and 26º 52'[13], with particular intensity below parallel 25º south[14] (Palha de Sousa, 2011). Some limited effort is found around the Saint Lazarus Bank (Impacto, 2008a) in Cabo Delgado.

[12] Almost 66.30 km north and 980 km south of the Coral North FLNG site.

[13] Almost 980 km and 1744 km south of the Coral North FLNG site.

[14] Almost 1530 km south of the Coral North FLNG site.

Fleet Characteristics

Industrial fishing units use fishing methods with improved technologies, utilizing trawling (both bottom and pelagic) and purse seine techniques. Equipped with refrigeration systems for freezing fish, some units conduct fish processing onboard, while others are associated with transport vessels where they carry out related operations such as transshipment or transfer of the caught fish.

Fishing Zones and Patterns of Operation

The fishing zones and operating patterns of the industrial fleet depend on the complexity of the methods used to catch and preserve fish and the type of catch desired. While the focus is on the Sofala Bank[15], industrial fishing also takes place along the coast between the provinces of Gaza and Inhambane. As most vessels are equipped with refrigeration systems for freezing fish, they are able to fish for more than two weeks without having to dock at a port.

The availability of ports and support structures for fish landing and docking of industrial fishing vessels is limited to the ports of Quelimane, Beira, and Maputo. Approximately 70% of industrial vessels use the Beira fishing port as their primary offloading point, while the remaining 30% offload at the Maputo fishing port.

Evolution of the Total and Licensed Fleet

Fisheries legislation limits the number of industrial and semi-industrial fishing vessels that can be licensed each year, and the quota of licenses is set annually as part of the management measures.

Overall, the licensed industrial fishing fleet increased by 85.7% in 2015 and peaked at over 100% in 2018 compared to the base year (2010). The data shows that the prawn trawler fleet has been prominent during this period, despite its reduction in 2019 to 72.2% of vessels when compared to the base year (Table 6.53). Another fleet that stands out is the shrimp trawler fleet.

Table 6.53: Industrial fishing units[16], according to target resources (2010-2019)

Fishing gear	Resources	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Seine	Pelagic	n.d.	n.d.	n.d.	n.d.	n.d.	8	7	4	n.d.	n.d.
Longline		0	0	1	1	2	34	40	32	34	18
Prawn trawling	Demersals	54	51	57	44	40	48	50	49	42	39
Fish trawling		0	0	0	0	0	0	0	0	41	50
Shrimp trawling		15	16	16	19	21	25	25	28	26	27
Gillnet		0	0	0	2	3	2	2	2	4	4
Cages/traps		0	1	1	1	0	0	1	1	1	3
Handline		2	2	3	3	3	2	2	2	2	1
Longline		n.d	0	0	0	1	1	1	2	n.d.	n.d.
Total		71	70	78	70	70	120	128	120	150	142

[15] Fishing Area B located almost 540 km south of the project.

[16] Defined as a vessel with its crew and fishing gear, or, in the absence of a vessel, a fisherman or a group of fishermen sharing one or more fishing gears. This definition is intended to cover fishermen without a boat, which is observed in artisanal fisheries.

The regional distribution of the fleet reflects the socioeconomic importance of the activity as well as the target species pursued for each fishing segment. For demersal and pelagic resources, 53.4% of the industrial fishing fleet is concentrated in the central zone, followed by the southern zone with 34.3%, while the northern zone presents only 12.2% of the industrial fleet registered in the country (Capaina, 2021).

For the 2022 fishing season, 36 fishing units were registered, which are distributed as follows (ADNAP, 2022):

- Surface prawn trawling – nine;
- Deep-sea crustacean trawling – 11;
- Bottom-set gillnet, demersal fish – eight;
- Traps, deep-sea lobster – two;
- Handline – one;
- Pelagic trawling, small pelagic – five.

Of the 36 registered fishing units, only eight operate north of the Sofala Bank (Fishing Zone A), targeting demersal fish (5), catfish (2), and small pelagic fish (1), using bottom gillnets (7) and pelagic trawling (1).

6.10.13 Human Rights

In accordance with the most recent Universal Peer Review of 2021 (UPR), the human rights situation in Mozambique has shown substantial improvements over the period 2016-2021, despite significant challenges, including the violence in the north, natural disasters, gender violence, limitation to freedom expression, information and budgetary limitations, and the Covid-19 pandemic.

6.10.13.1 Legislative and Policy Framework

Mozambique is a member of the United Nations (UN), the African Union (AU) and the SADC. The country is a signatory to and has ratified most Human Rights Conventions and international instruments, as per Table 6.54 below, thereby making binding international commitments to adhere to the standards set out in the universal human rights documents.

Table 6.54: Country ratification of international human rights instruments

UN Dedicated Instrument	Yes	No
UN Declaration on Rights of Peasants (UNDROP)		√
Declaration on Human Rights Defenders (UNDHRD)		√
United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)	√	
United Nations Guiding Principles on Business and Human Rights (UNGPs)	√	
Declaration on the Elimination of Violence against Women (DEVAW)	√	
United Nations Convention against Corruption (UNCAC)	√	
United Nations Convention against Transnational Organized Crime (CTOC)	√	
Convention on the Prevention and Punishment of the Crime of Genocide (CPPCG)	√	
WHO Framework Convention on Tobacco Control (FCTC)	√	

Core UN human rights conventions	Yes	No
Universal Declaration of Human Rights (UDHR)	√	
International Covenant on Civil and Political Rights (ICCPR)		√
International Covenant on Economic, Social and Cultural Rights (ICESCR)	√	
International Convention on the Elimination of All Forms of Racial Discrimination (ICERD)	√	
Convention on the Rights of the Child (CRC)	√	
Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW)	√	
Convention on the Rights of Persons with Disabilities (CRPD)	√	
Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT)	√	
International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families (ICRMW)	√	
International Convention for the Protection of All Persons from Enforced Disappearance (ICPPED)	√	
Main Environmental Instruments	**Yes**	**No**
Nagoya Protocol	√	
Aarhus Convention		√
Kiev Protocol		√
Escazú Agreement		√
United Nations Framework Convention on Climate Change (UNFCCC)	√	
Paris Agreement	√	
Convention on Biological Diversity (CBD)	√	
UN Convention to Combat Desertification (UNCCD)	√	
Ramsar convention	√	
Basel Convention	√	
UN Convention on the Law of the Sea (CLS)	√	
Main International Labour Standards	**Yes**	**No**
Forced Labour Convention, 1930 (No. 29)	√	
Protocol of 2014 to the ILO Convention 29	√	
Labour Inspection Convention, 1947 (No. 81)	√	
Migration for Employment Recommendation (revised), 1949 (No. 86)		√
Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)	√	
Labour Clauses (Public Contracts) Convention, 1949 (No. 94)		√
Protection of Wages Convention, 1949 (No. 95)		√
Migration for Employment Convention (revised), 1949 (No. 97)		√
Right to Organise and Collective Bargaining Convention, 1949 (No. 98)	√	
Equal Remuneration Convention, 1951 (No. 100)	√	
Social Security (Minimum Standards) Convention, 1952 (No. 102)		√
Abolition of Forced Labour Convention, 1957 (No. 105)	√	
Discrimination (Employment and Occupation) Convention, 1958 (No. 111)	√	
Equality of Treatment (Social Security) Convention, 1962 (No. 118)		√
Employment Policy Convention, 1964 (No. 122)	√	
Labour Inspection (Agriculture) Convention, 1969 (No. 129)		√
Minimum Wage Fixing Convention, 1970 (No. 131)		√
Minimum Age Convention, 1973 (No. 138)	√	

Human Resources Development Convention, 1975 (No. 142)		√
Migrant Workers (Supplementary Provisions) Convention, 1975 (No. 143)		√
Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144)	√	
Migrant Workers Recommendation, 1975 (No. 151)		√
Occupational Safety and Health Convention, 1981 (No. 155)		√
Workers with Family Responsibilities Convention, 1981 (No 156)		√
Maintenance of Social Security Rights Convention, 1982 (No. 157)		√
Vocational Rehabilitation and Employment (Disabled Persons) Convention, 1983 (No. 159)		√
Occupational Health Services Convention, 1985 (No. 161)		√
The Indigenous and Tribal Peoples Convention, 1989 (No. 169)		√
Working Conditions (Hotels and Restaurants) Convention, 1991 (No. 172)		√
Private Employment Agencies Convention, 1997 (No. 181)		√
Worst Forms of Child Labour Convention, 1999 (No. 182)	√	
The Maritime Labour Convention (2006)		√
Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187)		√
The Work in Fishing Convention, 2007 (No. 188)		√
Job Creation in Small and Medium-Sized Enterprises Recommendation, 1998 (No. 189)		√
Social Protection Floors Recommendation, 2012 (No. 202)		√
Forced Labour (Supplementary Measures) Recommendation, 2014 (No. 203)		√
Regional Instruments	**Yes**	**No**
African Charter on Human and Peoples' Rights (ACHPR)	√	
African Charter on the Rights and Welfare of the Child (ACRWC)	√	
Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (Maputo Protocol)	√	

6.10.13.2 Legal System and Judiciary

Mozambique is a constitution republic, with the new constitution adopted in 2004, and which serves as the supreme law of the country. It establishes the principles and structure of the government, including the judiciary. The judicial system in Mozambique is designed to be independent and operates separately from the executive and legislative branches to ensure impartiality and fairness.

The reform of the Justice Administration System has enhanced the efficacy and legitimacy of the judiciary over the past decade through the approval of several legislative packages, including the following:

- Criminal Procedure Code;
- Penal Code;
- Code on the Execution of Penalties and Alternative Measures to Prison;
- Other legislation strengthening of the power of the courts;
- Public Prosecutor's Office;
- Ministry of Justice, Constitutional and Religious Affairs prioritisation of engagement and dialogue with civil society to strengthen human rights and the increasing institutional and response capacity of national human rights institutions, especially the Ombudsman and the National Human Rights Commission.

Despite this, a recent United Nations University World Institute for Development Economics Research (UNU Wider) report notes that on the rule of law and judiciary independence, the level of independence and the rule of law in Mozambique remains very low when compared to its peers and neighbouring countries (UNU-Wider, 2020).

In as far as Mozambique has ratified the Optional Protocols for UN Human Rights Conventions or has accepted the competence of the corresponding UN Treaty Bodies, the inhabitants of Mozambique and their representatives are able to invoke their human rights through these bodies.

All inhabitants of Mozambique may turn to the UN Human Rights Committee through procedure 1503, to the Special Rapporteurs for violations of specific human rights or to the United Nations Economic and Social Council (ECOSOC) for women's rights violations.

Since Mozambique is a member state of the United Nations Educational, Scientific and Cultural Organization (UNESCO), its citizens may use the UNESCO procedure for human rights violations in UNESCO's fields of mandate.

Employers' or workers' and certain other organisations (not individuals) of Mozambique may file complaints through the ILO procedure in the cases of those conventions which Mozambique has ratified.

Since Mozambique is an AU member, its citizens and Non-Governmental Organisations (NGOs) may file complaints to the African Commission on Human and Peoples' Rights.

They may also file complaints according to the EU guidelines (on Human Rights Defenders, Death Penalty and Torture) to embassies of EU Member States and the delegations of the European Commission.

In cases of human rights violations by multinational enterprises, they may also invoke the National Contact Point in an Organisation for Economic Co-operation and Development (OECD) member state.

Mozambique has, however, not yet joined the International Criminal Court (ICC).

6.10.13.3 Civil and Political Rights

Freedom of expression is enshrined in the Mozambican constitution, protecting the freedom of expression, allowing individuals to express their opinions and ideas without censorship. While State-run outlets dominate the Mozambican media sector, several smaller independent outlets provide important coverage.

Citizens in Mozambique have the right to peacefully assemble and associate with others. Political parties, civil society organisations, and other groups all play a role in the democratic process, contributing to the country's political landscape, which is considered fairly open.

Whilst Mozambique is a multiparty democracy, and citizens have the right to participate in political activities, including the right to vote in elections, the country has been dominated by FRELIMO since independence in 1975.

6.10.13.4 Corruption and Transparency

As part of its commitment to fight corruption, Mozambique has ratified a number of regional and international instruments, notably the African Union Convention on Preventing and Combating Corruption and the United Nations Convention against Corruption. Furthermore, the Government has been adopting various legislative and administrative measures aimed at combating impunity, including:

- Implementation of the Global Strategy for Public Sector Reform;
- Capacity building of Development Observatories and District Consultative Councils;
- Second survey on governance and corruption;
- Creation of the Administrative Inspection career;
- Regular monitoring by the Inspectorate General of Finance;
- Implementation of the State Assets Module (UPR, 2021).

The Public Probity Law was approved in 2012, outlining the priority of public interests over private interests. It defines conflict of interest and prohibits holders of public office from accepting gifts, facilities, etc., that may jeopardize the independent execution of their duties. It also establishes the duty of holders of public office to declare their assets and defines sanctions for violators of the law. In light of this law, the Central Commission for Public Sector Ethics was created. Under the provisions of article 178, paragraph 1, of the Constitution of the Republic, Mozambique approved the Law 13/2020 of 23 December establishing the Special Regime for Extended Asset Forfeiture and Asset Recovery, a special legal regime for extended confiscation of assets, asset recovery and asset management, in favour of the State, resulting from illicit or criminal activity.

Despite such progress, Mozambique continues to experience significant challenges related to corruption, including both petty corruption and more systemic issues. Mozambique is currently ranked 142st (out of 180) on the Corruption Perception Index (CPI), with a lowly score of 26/100 (TI, 2023). Corruption has been identified in various sectors, including public administration, law enforcement, and natural resource management. There have been a number of high-profile corruption cases in Mozambique involving government officials, business figures, and public institutions. Mozambique has and is collaborating with international organisations and donor countries to address corruption. This includes efforts to improve governance, enhance transparency, and strengthen accountability mechanisms.

6.10.13.5 Gender Equality, Non-Discrimination, and Gender-Based Violence

National Level

The 2017 census shows that the current Mozambican population consists of 28,861,863, of which 52.2% are female and 47.8% are male. Article 36 of the Constitution of the Republic of Mozambique enshrines the principle of gender equality, and states that *"men and women are equal before the law in all spheres of political, economic, social and cultural life"*. The legislation encourages the adoption of quotas favourable to women as a mechanism to ensure their representation in politics and in decision-making positions. Given the subordinate role that women have historically occupied, the Government has actively strived to ensure women's representation in society (UPR, 2021). In 2005,

Mozambique signed and ratified the SADC Protocol on Gender and Development, with the intention of reaching a 50/50 parity of women in decision making bodies in both the public and private sphere.

The government approved the National Plan to Prevent and Combat Gender-Based Violence (2018-2021), which falls under the Government's Five-Year Program (2015-2019) and is also in line with the Beijing Declaration and Platform for Action (1995), as well as being aligned with the Sustainable Development Goals (SDG-2015), especially Goal n°5 "Achieve gender equality and empower all women and girls".

Mozambique has and continues to fair very well when compared to the region, the continent, and the world, particularly with regard to the presence of women in the national assembly. In the first multi-party elections of 1994, female representation in the national assembly reached 25.20%. This figure rose to 29.20% in 1999; 35.60% in 2004; 39.20% in 2009, 39.60% in 2014 and 42.4% in the 2019 elections (Statista, 2023). Despite this, however, Mozambique has only three women in the electoral management body (EMB) out of 17 members, representing one of the lowest levels of women representation in EMBs in Southern Africa. In municipal governance, in the 2018 elections, only six women were elected as Mayors and eight as Presidents of the Municipal Assemblies, among the 53 municipalities.

Despite progress, gender-based violence (GBV) is widespread in Mozambique, affecting women and girls across various age groups and socioeconomic backgrounds. Common forms of GBV include domestic violence, sexual violence, harassment, and abuse (UNICEF 2022). Domestic violence is a pervasive issue, with incidents occurring within households. Prevalent societal norms and gender roles can contribute to the perpetuation of violence against women within intimate relationships. Sexual violence, including rape and sexual assault, is also a significant concern. Conflict-related sexual violence has been reported in certain regions, particularly in the context of the armed conflict in Cabo Delgado. Mozambique also has one of the highest rates of child marriage in the world at 53% (GNB, 2023). Early and forced marriage exposes girls to various forms of violence, including physical and sexual abuse.

Gender Dynamics at Local Level

Gender norms constitute an important dimension of household economic and income activities, as well as intra-household agency or decision-making. In the project area and at a national level, women and girls generally lack equal access to (i) time, (ii) education and health opportunities, (iii) employment, (iv) use of direct productive assets, and (v) decision making (Consultec, 2014b).

An example of this inequality is that a female can generally only be considered a household head if she is an unmarried woman, single, separated, divorced, or widowed. A married woman has little chance of being considered a household head being responsible for managing household finances and/or extra-household activities, particularly if the husband is present, even in a matrilineal society as is the case in Cabo Delgado (Consultec, 2014b).

Women and girls tend to spend considerably more time during the year on agricultural production and household chores (including cleaning, foraging, collecting wood and water). Nevertheless, women do not have exclusive control over what is produced or the utilisation of agricultural products;

these are generally family joint decisions. The only products that women control are low value products such as clay water pots and thatch grass (Consultec, 2014b). Women and girls are also those who generally care for the young. There is a tendency for elderly women to care for the young, with the assistance of young and adolescent girls whilst older women work the agricultural plots or are out foraging. Girls are more likely to not attend school, drop out or be drawn upon when household needs arise. Fishing is generally a male domain and gainful employment, when available, is primarily accessible to males.

Larger decisions on income expenditure are taken by the head of household, irrespective of their sex, whilst decisions with implication for the household's welfare seem to be taken both by men and women (e.g., health, education, and household medical care) (Consultec, 2014b).

Women often find it more difficult to actively engage in extra-household decision making and community dialogue and decisions, partly as a result of unequal levels of education and partly given the prevalent sociocultural norms of male dominance.

The only valuable resource over which women and men have equal access and equal control is cultivated land. Women's control of land tends to be strong because land inheritance lines are matrilineal. This gives women a certain amount of power in knowing that they can often count on the support of their communities and community leaders in land related disputes and usage terms (Consultec, 2014b).

GBV and particularly intimate male partner violence (IPV) was fairly common in Cabo Delgado prior to the conflict, as was early marriages (UNHCR/LSHTM, 2021). According to the United Nations Refugee Agency (UNHCR), the conflict has aggravated GBV in the province, with increased incidences of IPV, compounded with other forms of physical and sexual violence, abduction, sexual trafficking, sexual exploitation, abuse, and harassment (SEAH), early and forced marriages (UNHCR/LSHTM, 2021). The conflict and displacement have decimated the support structures and prevention measures and exacerbated vulnerability to GBV/SEAH. Displaced populations face heightened GBV and/or SEAH risks in IDP sites and host communities, particularly from armed forces. According to the UNHCR, IPV and early or forced marriages have been reported by households who have lost their livelihoods, and experienced acute or severe food insecurity and housing instability, as a result of the crisis (UNHCR/LSHTM, 2021). Other forms of GBV are directly linked to the socioeconomic vulnerability of already at-risk groups. This includes the sexual and economic exploitation and abuse of women and girls within a wider context of transactional sex and unequal gender norms within household, community leadership and humanitarian assistance distribution structures (UNHCR/LSHTM, 2021).

6.10.13.6 Labour Framework

The Constitution of the Republic of Mozambique provides the foundation for labour rights and protections. It outlines fundamental principles related to labour, including the right to work, the right to just and favourable conditions of work, and the right to strike.

Mozambique has specific labour laws that regulate employment relationships, working conditions, and other related matters and are in line with the ILO instruments. The Labour Law (2007), governs

various aspects of employment, including contracts, working hours, wages, and termination procedures. It establishes the framework for employment contracts, outlining the rights and obligations of both employers and employees. It covers issues such as probationary periods, working hours, annual leave, safety requirements and termination conditions. Mozambique has provisions for the determination of minimum wages, and these may vary based on the sector and type of work. The government periodically reviews and adjusts minimum wage levels. The law stipulates standard working hours, overtime regulations, and provisions for annual leave. It also addresses issues related to maternity leave, sick leave, and other types of leave. The legal framework includes provisions for occupational health and safety, emphasising the employer's responsibility to provide a safe working environment. The law specifies requirements for workplace safety measures, equipment, and training.

The right to form and join trade unions is recognised in Mozambique. Workers have the right to engage in collective bargaining to negotiate employment conditions and terms.

The law also outlines the procedures and grounds for terminating employment contracts, including both employer-initiated and employee-initiated terminations. It includes provisions related to notice periods and severance pay.

Mozambique has social security laws that provide for benefits such as pensions, and limited disability coverage for workers. Employers and employees contribute to social security funds.

The legal framework also includes provisions prohibiting discrimination in employment based on factors such as gender, race, religion, and disability.

6.10.14 Security in All

6.10.14.1 Population

The overall security context in the province has on the whole stabilized or improved since the peak of the attacks in 2020 and 2021, as a result of the deployment of Rwandan and SADC Mission in Mozambique (SAMIM) troops, along with the ongoing support to the Mozambican defence force provided by the EU. This improvement in security is however limited to the districts of Palma, Ancuabe, and Mocímboa da Praia, and particularly around the Afungi Peninsula and the main towns in the districts of Macomia, Nangade, Muidumbe, and Mueda. The security situation in the more rural areas and the ‘bush’ remains uncertain, with people, both residents and IDP’s, reluctant to venture to, resulting in increasing pressure on arable land within more secure areas and high levels of food insecurity.

The high levels of despair amongst the local population both in IDP sites and in host communities, have led to people resorting to extreme measures to retrieve their livelihoods, such as fishers in IDPs around Macomia trying to access and fish their old areas in Quissanga, Mucojo, or Quiterajo, or even the Quirimbas archipelago. They are often caught in the crossfire between insurgents and military forces, or those resorting to sex work along the main patrolled road routes (ISS, 2022). Such measures have exacerbated the risks of violence and abuse of an extremely vulnerable population

and there have been both confirmed and unconfirmed reports of human rights abuses carried out by security forces and/or services as well as by insurgents (ACLED, 2022).

Further to this, it has been reported that IDPs, who are mainly women and children, fleeing their villages and homes are often considered as suspects and possible infiltrators by security services when they arrive in host communities and IDP sites, and their treatment often violates their human rights (ISS, 2022).

6.10.14.2 Private Companies

The ongoing instability in the province has created significant challenges for companies operating out of Cabo Delgado and the national government, with security providers being required to protect citizen and towns and infrastructure, assets, workers, contractors, and service providers.

6.10.14.3 Foreign Militaries

In general, and with the exception of the approximately 2 800 Rwandan Soldiers and the 1 900 SADC forces (SAMIM), Mozambique has limited foreign military assistance to logistical support and training.

According to the local media the United States is engaged in patrolling areas within Cabo Delgado, through the Bureau of International Narcotics and Law Enforcement (INL) and the Drug Enforcement Administration (DEA). It is also working through the UN Office on Drugs and Crime (UNODC), to strengthen the capacity of Mozambican maritime law enforcement agencies to assist with the fight against transnational organised crime at sea (CoM 2021). US Special Operations Forces have also trained Mozambican soldiers.

The Joint Combined Exchange Training (JCET) programme launched on 15 March 2021 has the objective of Mozambican marines benefiting from the experience and knowledge of US Special Forces to improve their skill levels. France is considering a cooperation agreement with Mozambique, and the French Armed Forces in the Indian Ocean (FAZSOI) have conducted training with the Mozambique services. The EU is supporting Mozambique to re-establish security in Cabo Delgado, through providing training, logistics and medical services to support the Mozambique military and Portugal has strengthened ongoing military cooperation with Mozambique.

6.10.14.4 Private Military / Security Companies

Several private military and security firms have been and are also involved with the government of Mozambique in combating the insurgency in Cabo Delgado. The Russian based Wagner group was assisting the Mozambican Armed Forces (FADM) and operated in Cabo Delgado until 2019 being replaced by the Dyck Advisory Group (DAG) and later the Paramount Group (ISS, 2023).

A number of private security companies are also engaged in providing security to private companies in the province, with the largest being the international companies of Arkhe, G4S, Gardaworld and the Blue Mountain Group (CoM 2021). Such security contracts are considered extremely lucrative and particularly those involving the protection and provision of security to the Total Energies staff and infrastructure (CoM 2021).

6.10.15 Community Perceptions

This section presents the community perceptions regarding the oil and gas industry and Eni operations, as well as the expectation to the Coral North Project.

6.10.15.1 Oil and Gas Industry

The main explanation for the ongoing violence by non-state armed groups (NSAGs) and rise in terrorism in the region have focused primarily on historic disenfranchisement, poverty, marginalization, endemic corruption, and political exclusion, resulting in growing inequality and what has been termed the 'natural resource curse' (ISS, 2022). Given the focus on inequality and the 'natural resource curse' more attention (bilateral donors, multilateral agencies, academics, and civil society) is being placed on the prospects of improving the management of natural resources through the inclusion of local and regional interests as well as improving local and regional benefits from the exploitation of natural resources (Chatham House, 2021).

A recent study conducted in conjunction with the Ministry of Justice, covering 309 respondents and three focal group meetings in Cabo Delgado, found that over 50% of respondents stated that the main cause of the violent insurgency was the discovery of natural resources. Almost 24% stated that terrorism is the main challenge facing Cabo Delgado, followed by employment (17%), health (15%), and poverty (14%) (ISS, 2022). As the local perception is that the extractive industries may have been a major contributor to the crisis, the oil and gas industry likely has an important role to play in the security, prosperity, and development of the region.

6.10.15.2 Coral North Development

Interviews carried out with community leaders in Palma revealed that the currently operating Coral Sul FLNG does not have any impact on communities, as its actions are imperceptible in Palma. Similarly, they believe that as the project will have the same characteristics, Coral North will also not cause impacts in Palma.

The interviewed stakeholders did communicate concerns regarding oil and gas projects, although focused on the onshore projects in Afungi (Palma District). Apart from the issues dealt with in the resettlement processes, the concerns of the communities mainly arise from the noise caused by Total's generators and partners (particularly the CCSJV, in the community of Maganja, which is outside the company's DUAT and not subject to physical resettlement). Another community concern is associated with terrorist attacks, first in Mocímboa da Praia and other places far from Palma and, later, in the village of Palma. These attacks provoked a massive arrival of displaced people in Afungi, with no means of subsistence and requiring help, which did not arrive. This situation in which the displaced people would go for more than three days without anything to eat provoked clashes with the local communities, as thefts began to occur in the fields of the local communities. On the other hand, many of the displaced people arrived by boat from Mocímboa da Praia and invaded the local community fishing areas, increasing competition in catches and in the markets for selling fish.

Today, the situations have improved due to the intervention of the mosques to sensitize the parties, the arrival of humanitarian support, particularly from World Food Programme (WFP) and Total, the

handing over of farmland areas to the displaced people and even with the return of most of the displaced people to their origins.

Total has supported fishermen in Mocímboa da Praia and, in Maganja, WFP supports around 150 semi-industrial fishermen. The leaders interviewed consider that life on the islands is normal now, and that it served as a refuge during the attacks on Palma. However, they highlighted that with the introduction of security forces the risk of rape on women travelling to and from the fields increased, violence which the interviewed stakeholders attributed to the Defence and Security Forces (FDS).

The interview with the MASC Foundation representative indicated that he does not see any impact from the Coral South FLNG on the communities of Palma and that he believes that it will be the same with the Coral North project.

The MASC representative also said that there were several violations, including sexual ones, perpetrated by the FDS. After the attack on the village of Palma, Quitunda was home to around 30,000 people, devoid of livelihoods, subject to increased hunger and theft for survival, with support only arriving in June 2021.

In August 2023, with the support of MASC, commercial activity resumed in Palma and life began to return to normal. With the arrival of the Rwandan forces, the abuses by the FDS military have reduced.

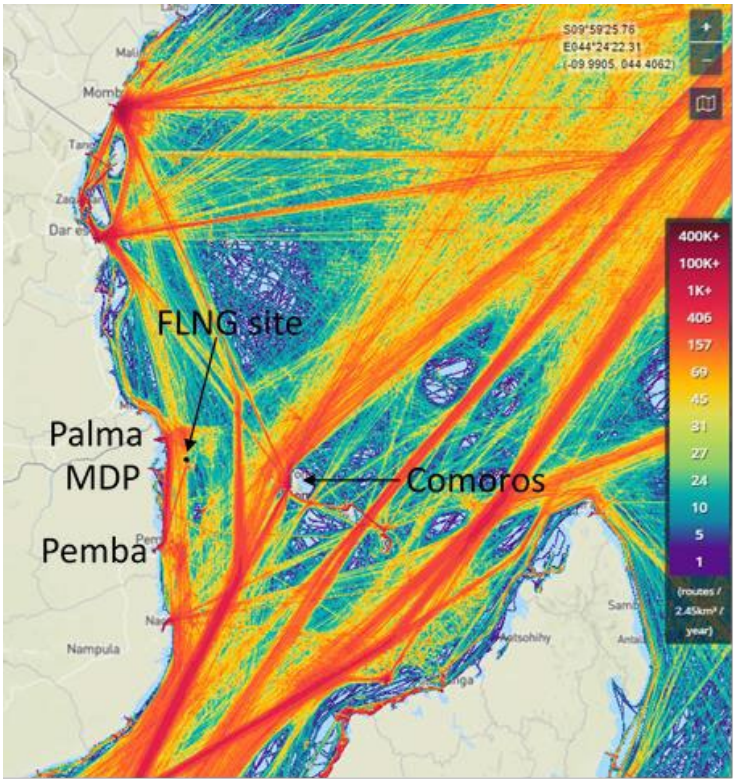
6.11 Marine Traffic

This section provides baseline data on marine traffic in the Project area of influence. The FLNG facility will be located at a depth of 2000 m, more than 50 km east off the coast of Palma District. Relevant baseline marine traffic for the project includes:

- Marine traffic in the Mozambique Channel between Pemba (the main port servicing the Project) and the FLNG site;
- Nearshore marine traffic at Pemba port.

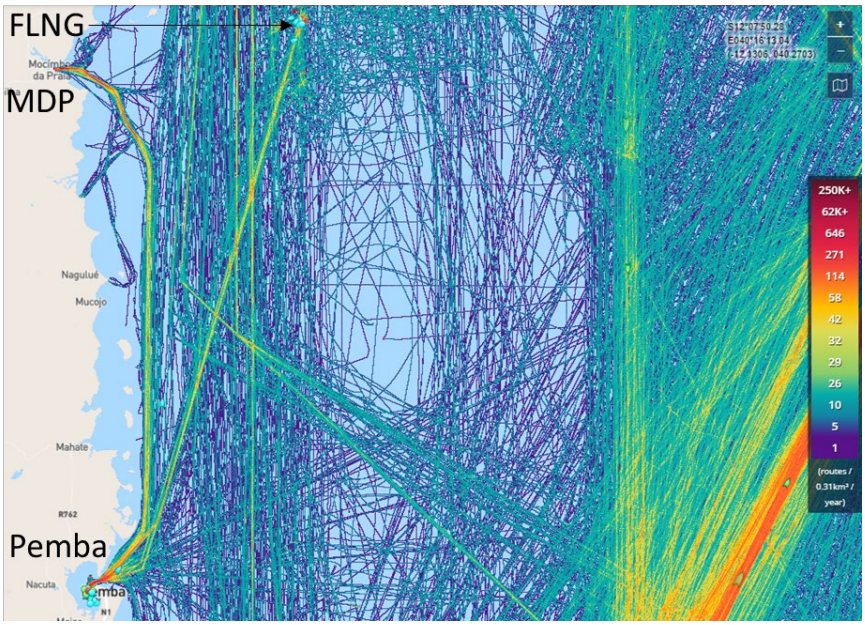
6.11.1 Inshore Traffic in the Mozambique Channel

The traffic density map in Figure 6.89 shows vessel movements in the greater region surrounding the area of operations in 2020. Most of the traffic in the Mozambique channel will not be affected by the project operations as it passes between Comoros and Madagascar en route to and from the Far East, or just west of the Comoros en route to and from the Middle East and Suez Canal. The inshore traffic (or cabotage routes) following the northern Mozambican coastline will, however, be affected by project operations as the FLNG is situated on the eastern edge of this coastal traffic zone, as shown in the more detailed traffic density map in Figure 6.90.



Source: MarineTraffic (2021).

Figure 6.89: Traffic density map for the northern Mozambique channel



Source: MarineTraffic (2021).

Figure 6.90: Traffic density map at the area of operations

A clearer illustration of the traffic trends surrounding the area of operations is shown in Figure 6.91, together with the expected project vessel traffic routes.

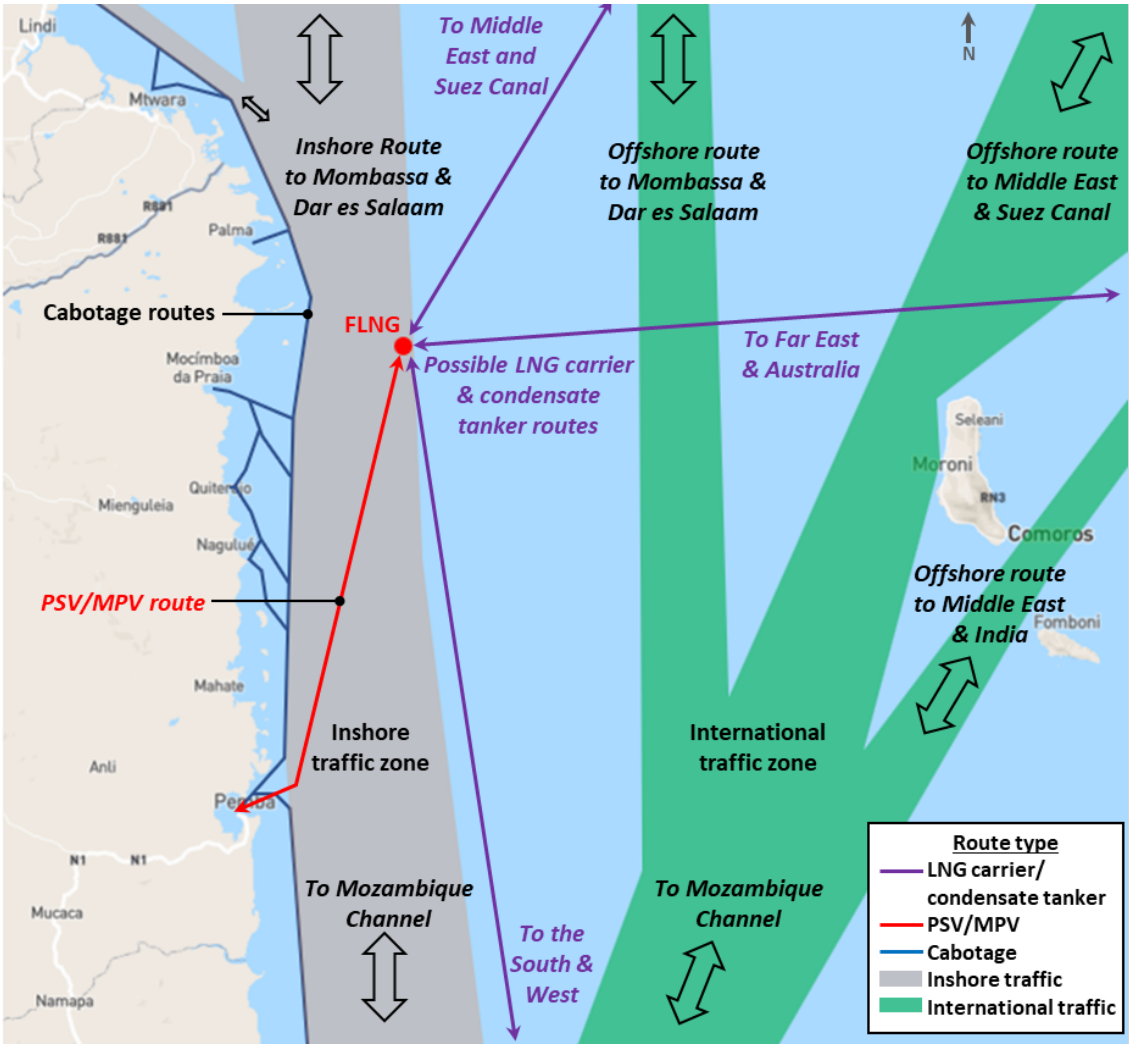


Figure 6.91: Map of current traffic trends and project vessel routes

The vessels comprising the inshore traffic, passing through the 25 nm wide zone between the area of operations and the coast in the years of 2018, 2019, and 2020[17], including the route followed by each vessel type, are presented in Table 6.55. As shown in the table, most vessels using the coastal route are either involved in domestic cabotage or are using the shortest international route between Dar es Salaam or Mombasa, and Southern Africa.

A significant portion of the tugs and special craft counted during 2019 and 2020 passed between Pemba and Area 4 (MarineTraffic, 2021) and are therefore contributable to the Coral South Project (2019 – 40, 2020 – 60). In total, the baseline traffic for 2020 totalled 460 vessel transits. Traffic through the coastal navigation zone is likely to increase during the project lifetime; however, estimating this traffic increase is not an accurate exercise as shipping trends can change suddenly and rely on several different factors. Local and global economies, markets and commodities have an effect, as well as infrastructural developments in the surrounding countries and in shipping channels, such as the Suez Canal.

[17] These years are more representative of the regional traffic baseline than the more recent years of 2021 and 2022, which were heavily impacted by the COVID-19 pandemic.

Table 6.55: Observed inshore traffic

Vessel Type	Inshore traffic (vessels/year)			Route
	2018	2019	2020	
Passenger vessels	23	1	102	Between Nacala, Pemba, MDP and Palma
Cargo vessels	110	108	134	Between Dar es Salaam, Mombassa and South
Tankers	7	11	40	Between Dar es Salaam, Mombassa, Palma and South
Tugs and Special Craft	25	47	60	Between Pemba & FLNG site, and between all local ports
Pleasure vessels	5	5	6	Between Dar es Salaam, Mtwara and Pemba
Fishing vessels	15	18	19	Deep sea fishing north of FLNG site
Container ships	55	51	59	Between Dar es Salaam, Mombassa and South
Liquefied Petroleum Gas (LPG) carriers	21	43	40	Between Dar es Salaam, Mombassa and Madagascar
Total	**261**	**284**	**460**	

Source: MarineTraffic (2021).

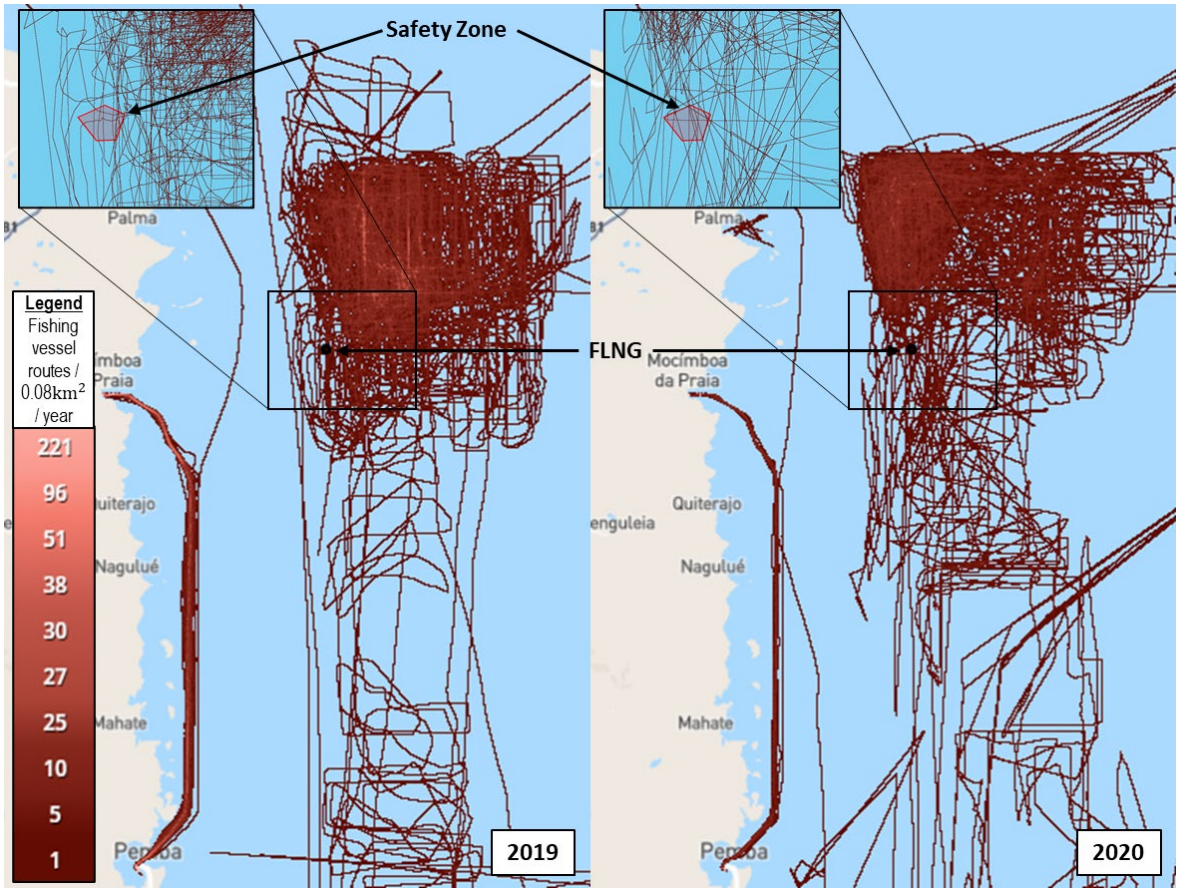
In order to establish a baseline during the project lifetime , the traffic growth rate was assumed to be aligned with the average annual economic growth rate from the countries directly influencing this traffic. The 5-year average GDP growth rate of South Africa, Mozambique, Tanzania, and Kenya between 2015 and 2019 was calculated to be 4% per annum (The World Bank, 2021). This was used to calculate the baseline traffic at the proposed start and end of the FLNG project, as shown in Table 6.56, where the inshore traffic projected for 2052 will be approximately 1600 vessel transits per annum.

Table 6.56: Baseline inshore traffic

Description	Year	Marine traffic in coastal navigation zone			Source / Assumption
		Per annum	Per week	Per day	
Data source	2020	460	9	1.3	MarineTraffic (2021)
Start of FLNG operations	2027	605	12	1.7	4% per year growth rate
End of FLNG operations	2052	1614	31	4.4	4% per year growth rate

Traffic heatmaps indicate that the FLNG is positioned on the eastern edge of the observed inshore traffic area, with the most congested traffic corridor approximately 10 nm west of the FLNG (refer to Figure 6.89). The number of vessels passing through the area designated as an exclusion zone around the area of operations (a 500 m buffer around the subsea infrastructure) was counted as 25 in 2019 and 54 in 2020 MarineTraffic (2021). All this traffic is expected to divert east or west of the exclusion zone. Of these vessels, 30% were contributed to commercial fishing vessels.

As presented in Table 6.57, the area to the north and east of the area of operations is relatively densely populated with pelagic and long-line fishing vessels. Although the fishing vessels show unpredictable patterns and vary from year to year, all fishing activity as well as transit traffic is expected to cease within the exclusion zone once established.



Source: MarineTraffic (2021).

Figure 6.92: Fishing vessel density maps from 2019 and 2020

6.11.2 Baseline Traffic at Nearshore Pemba

The number of vessel transits through the Pemba approach channel for years 2018, 2019, and 2020 are presented in Table 6.57 (MarineTraffic, 2021). From 2019 onwards there was a significant increase in tugs and special craft with these vessels attributed to the Coral South Project. Similarly, passenger vessel traffic increased by 91 vessel transits from 2019 to 2020, potentially as a result of civil unrest in the northern parts of the Cabo Delgado province and is not considered representative of normal traffic distribution. Therefore, the 2019 traffic count of 18 vessels per year was used for the 2020 baseline calculation. In the absence of a port master plan, the 2020 baseline of 196 vessels per year will be used as the basis for the Pemba channel.

Table 6.57: Traffic at Port of Pemba

Vessel Type	Pemba Port traffic (vessels/year)		
	2018	2019	2020
Passenger vessels	8	18	18
Cargo vessels	33	5	6
Tankers	0	23	40
Tugs and Special Craft	13	87	109
Pleasure vessels	0	6	3
Fishing vessels	2	34	11
Container ships	34	17	9
LPG carriers	0	0	0
Total	**90**	**190**	**196**
Baseline vessels /week	**1.7**	**3.7**	**3.8**
Baseline vessels /day	**0.2**	**0.5**	**0.5**

Source: MarineTraffic (2021).

All the marine traffic data above only includes vessels that have Automatic Identification System (AIS) and consequently informal vessels have not been accounted for in this data set. Pemba has a large fishing community; most would use informal vessels including dugout canoes made from large tree trunks, fibreglass, and wood boats. A total of 462 vessels are registered across Pemba's fishing centres. These vessels are assumed to 'give-way' to larger vessels (under pilotage) within port limits. Conventional marine traffic is obliged to 'give-way' to fishing vessels when the latter are engaged in fishing operations in open water. In general, informal fishing vessels will follow diurnal patterns, either leaving early in the morning and returning in the evening or leaving in the evening and returning in the morning. Project vessels are aware of these peak arrival and departure times and maintain a robust and effective lookout as often small vessels may be difficult to pick up visually or by vessel radar.