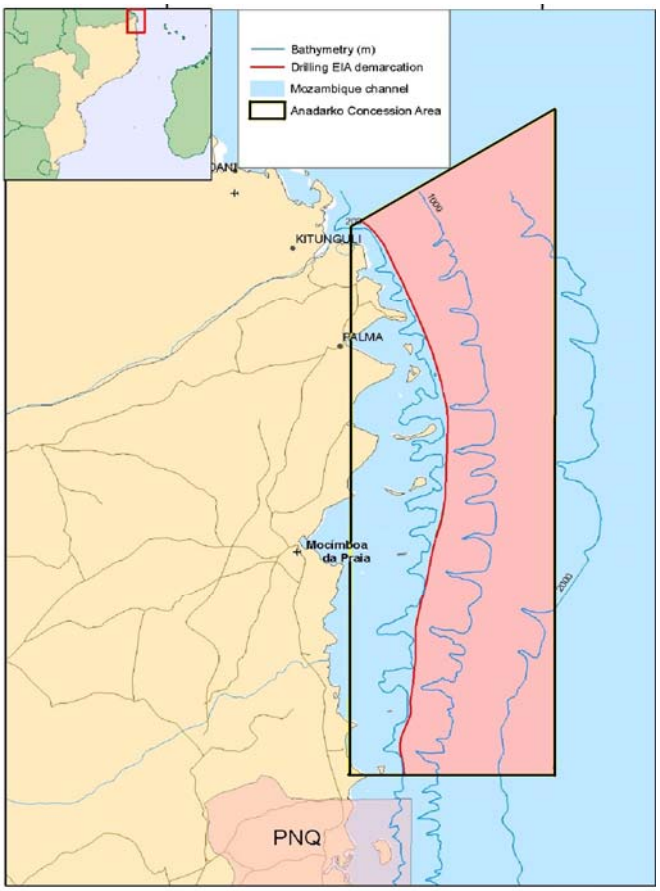
Anadarko

Moçambique Área 1, Lda

DEEPWATER EXPLORATION

DRILLING OPERATIONS IN ROVUMA OFFSHORE AREA 1



VOLUME I

NON-TECHNICAL SUMMARY

October, 2008

Impacto

Projectos e Estudos Ambientais

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Anadarko Moçambique Área 1, Lda (AMA1) signed an Exploration and Production Concession (EPC) contract with the Government of the Republic of Mozambique for Offshore Area 1 (Area 1) in the Rovuma Basin. The EPC contract gives AMA1 exclusive rights to explore for and produce commercial quantities of hydrocarbons in the block. As part of the agreement AMA1 has committed to undertake 2D and 3D seismic surveys and to drill a minimum of seven wells, with a minimum of four in water depths greater than 200m.

The main objective of the drilling phase is to determine if the identified prospects (arising from the seismic survey[1] initiated in January 2008) have hydrocarbons in commercial quantities. The exploratory drilling is a temporary activity.

This project refers only to the drilling of a minimum of 4 exploratory wells in water depths greater than 200m in Area 1 in the Rovuma Basin. According to the Environmental Impact Assessment Decree (Decree 45/2004) and the EPC, an Environmental Impact Study (EIS) must be prepared for the project.

This Non-technical Summary is part of the Environmental Impact Assessment Report (EIAR) for the deepwater drilling (DWD) operations proposed by AMA1 in the Rovuma Offshore Area 1, which consists of three volumes:

- Volume I – Non - technical Summary (this document);
- Volume II – Part A: EIS and Part B: Environmental Management Plan (EMP);
- Volume III – Public Participation Report.

AMA1 has selected Projectos e Estudos de Impacto Ambiental Limitada (IMPACTO) to conduct this EIA. IMPACTO has extensive experience in conducting impact assessment studies for oil and gas exploration and development in Mozambique.

The EIA was prepared by a multidisciplinary team which comprised the following specialists:

Lead Consultants

- Mr. António Emílio Leite Couto – Project Manager/Public Consultation and Institutional Specialist
- Ms. Uke Overvest – Team Leader/EIA Specialist

Project Scientists

• Emídio André	Fisheries Biologist
• Almeida Guissamulo	Coordinator for Biophysical Studies
• Horácio Francisco Gervásio	Artisanal Fisheries Specialist
• James Wilson	Commercial Fisheries Specialist
• Johan Van der Walt	Tourism
• António Mubango Hoguane	Oceanographer
• Rune Woie	Drilling Operations Specialist
• Mike Oberholzer	Oil Spill Specialist

[1] The seismic survey allows for the identification of the most suitable locations for the drilling wells.

• Lucinda Cruz	Legal expert
• Carlota Quilambo	Public Consultation Assistant
• Naíca Costa	GIS Specialist
• Juan Ramon Miguelez	Quality Assurance and Control

All the documents produced throughout the EIA process are available in English and Portuguese. Electronic copies can be downloaded from the AMA1 website (http://www.anadarko.com/mozambique).

For more information about the project, please contact the Public Participation Office as follows:

Impacto Lda - Public Participation Office
Av. Mártires da Machava, 968
Maputo, Mozambique
Tel: +258 21 499 636
Cell (Impacto): +258 82 304 6650
Fax: +258 21 493019
E-mail: impacto@impacto.co.mz

Contact person: Carlota Quilambo
E-mail: cquilambo@impacto.co.mz

2.0 PURPOSE

The purpose of the EIA is to evaluate potential impacts to the physical, biological and social environments of northern Cabo Delgado Province in Mozambique, resulting from the proposed deepwater drilling operations.

In Mozambique, the EIA process is a legal requirement under the Environmental Law 20/97 and it is defined and governed by the Regulation on the Environmental Impact Assessment Process (Decree No. 45/2004) and the General Directive for Environmental Impact Studies (Ministerial Diploma nº 129/2006). Under these regulations, MICOA has classified the proposed drilling operations as a Category A activity, which is subject to the EIA process.

3.0 PROPOSED PROJECT

AMA1 proposes to conduct drilling operations within the limits of Area 1 offshore in water depths greater than 200m, once the results from the seismic activities are available. AMA1 is required to drill a minimum of seven wells, with a minimum of four in water depths greater than 200m, as part of the work commitment of the EPC contract granted by the Republic of Mozambique.

The drilling operation is a short-term activity. A drilling rig will be brought from international waters to Area 1 and will be responsible for the well drilling. Each well will take up to 2 months to drill.

The proposed activities will be conducted in the area delimited by the northern, eastern and southern borders of the Area 1 concession. The western border will be defined by a vertical projection of a line that joins the most eastern points of the 200m bathymetry line (Figure 1). However, the exact location of the wells will only be determined after the results of the seismic activity are available. The seismic survey was completed in May 2008 and the results are expected by the 4Q of 2008.

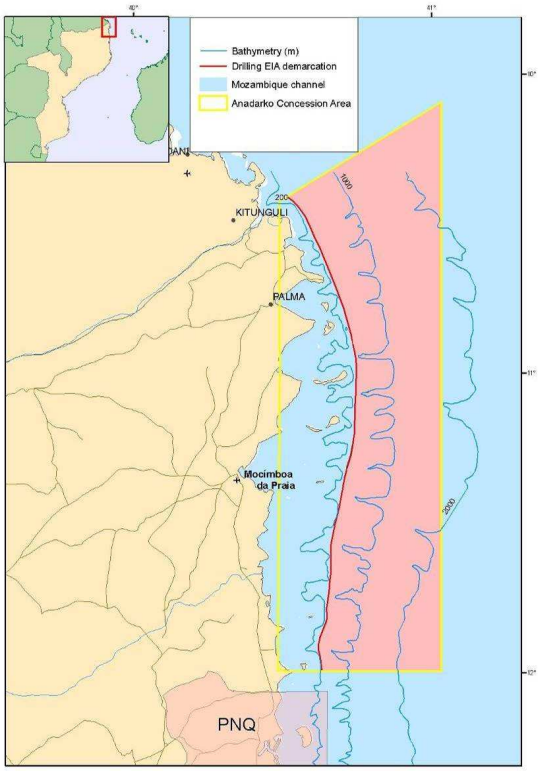


Figure 1 Offshore Drilling Area in the AMA1 Concession Area in the Rovuma Basin

The operations will be coordinated from the AMA1 office in Pemba and most vessel supplies/support services will commence from and terminate at Pemba Port. Wastes from the drilling rig shall also be transferred (where necessary) to shore via Pemba Port for appropriate disposal.

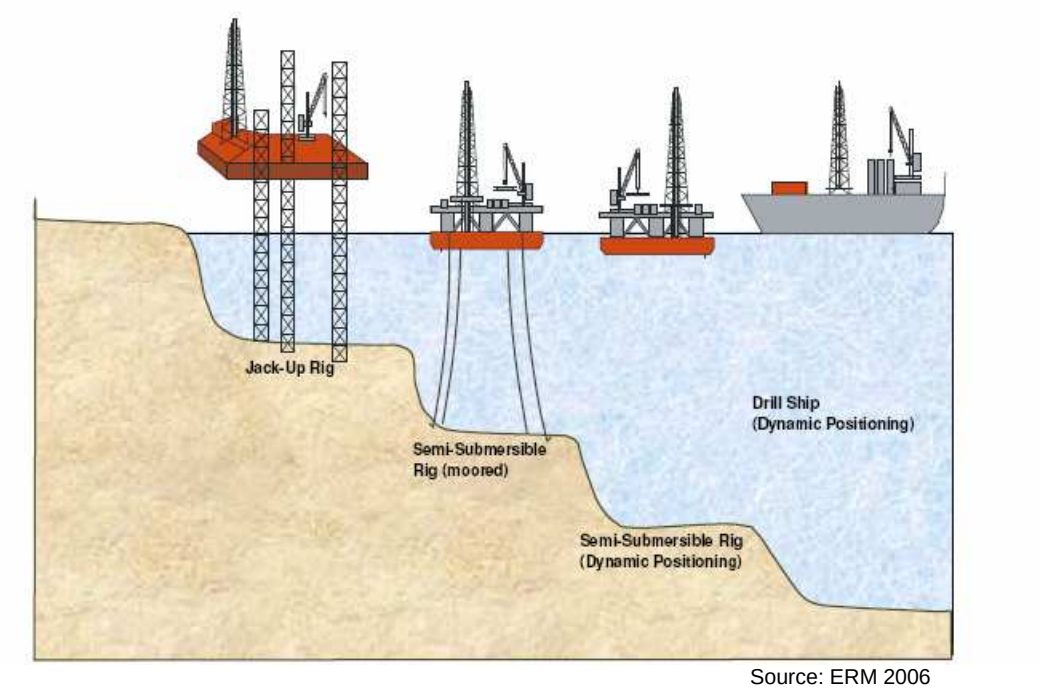
Supplies to the rig will be primarily routed through the AMA1 supply base at Pemba. Typical supplies include fuel, water, food, drilling fluid chemicals, oil well cement and chemicals, well tangibles (piping, wellheads), equipment, tools and other items. Some supplies may be delivered directly to the rig.

Type of Rig

Two types of rigs are capable of operating in the deep water environment: Dynamically positioned rigs and moored rigs. However, rig availability will ultimately dictate what rig will be utilized. The selected rig will be equipped for operations in up to 2,200m of water; it will possess a very high variable load capacity, it will carry up to a 15,000 psi blowout preventer (BOP) system, and will be equipped with a remotely operated vehicle (ROV).

The dynamically positioned drilling rig will be the operator's first choice of rig type. This rig could either be ship-shaped or a column-shaped semi-submersible rig capable of drilling in water depths of up to 3,000m. Vessels are usually self-propelled and well-site positioning is maintained dynamically using GPS satellites. This allows operations at sea where mooring or anchoring is not feasible due to deep water, congestion on the sea bottom (pipelines, templates), or other problems. Additionally, since no anchoring is taking place with a dynamically positioned drilling rig, there will be no direct impact to the seafloor from positioning the rig.

The moored drilling rig could either be ship-shaped or a column-shaped semi-submersible rig capable of drilling in water depths of up to 2,200m. Vessels are usually towed to location. The rig is maintained on location through a system of moored lines anchored to the sea floor. The surface area directly impacted by the positioning of the vessel is limited to the area where the anchor lines make contact with the seafloor.



Source: ERM 2006

Figure 2 Examples of drilling rigs (moored and dynamically positioning)

Preliminary activities

The rigs will be mobilized to site either under tow by a vessel or under own propulsion in open navigable seaways. At this time, it is not anticipated that the

vessel will come in to any of the ports in Mozambique except if needed to clear customs.

Before the drilling operations, a shallow hazard study will be carried out for each possible well location, with the purpose to provide a pre-drilling assessment of shallow geohazards at the proposed well location. This will be limited to the seafloor and shallow geologic section. Depth of investigation would apply to only the top hole section (extend to 1.5 seconds TWT below the seafloor).

Before drilling commences, a remotely operated vehicle (ROV) will be launched from the drilling vessel to scan +/- 500m area around the location at the seabed. The main objective is to scan for the presence of chemosynthetic life and potential obstructions. This will ensure minimal impact to the environment and drilling operations.

Drilling operations

The proposed exploration wells will be drilled to a total depth (TD) of +/- 5500m including water and drilled depth.

The drilling process is characterized by the application of weight to and rotation of the drill bit, and by the circulation of fluid around the drill bit. Figure 3 illustrates the main features of a drilling rig.

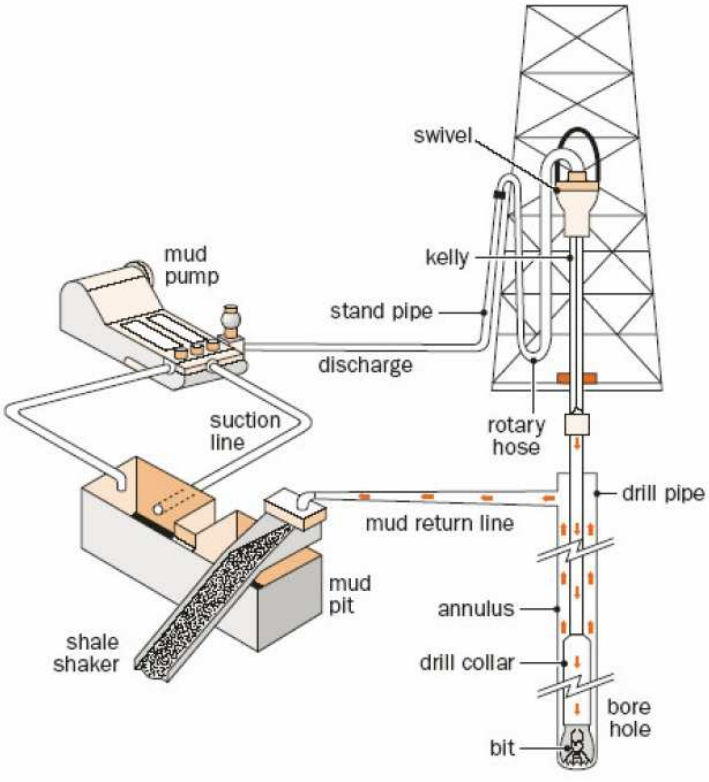
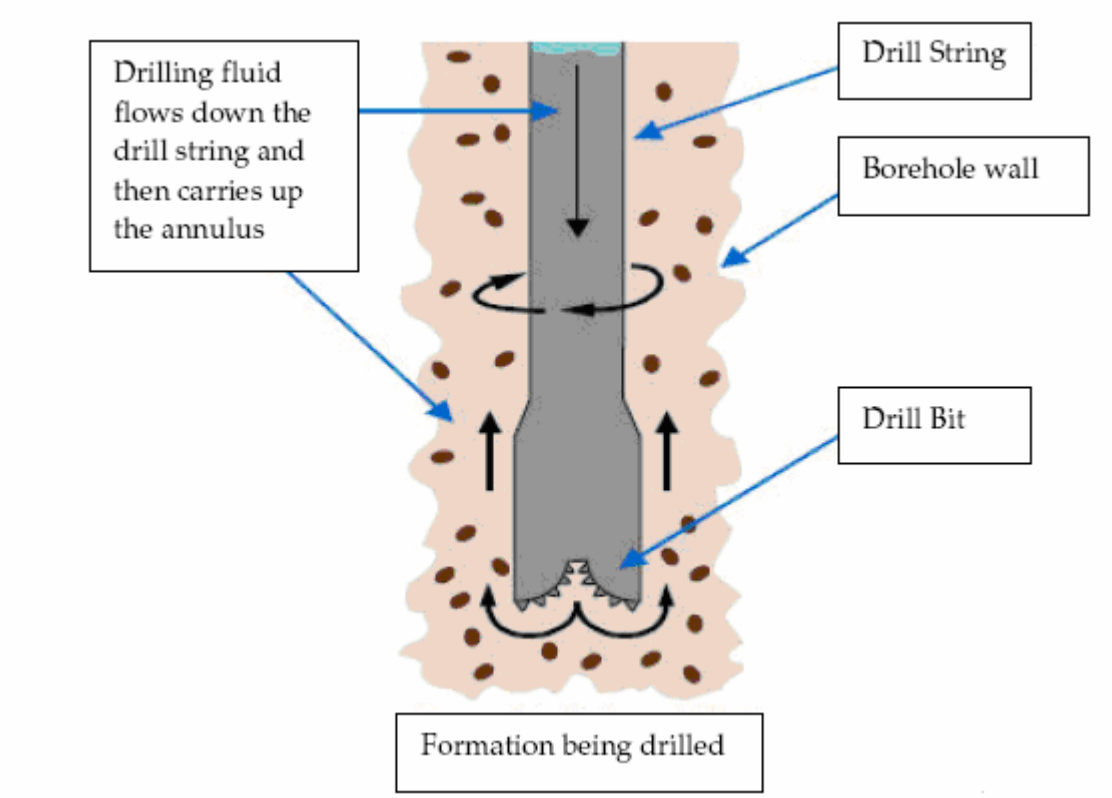


Figure 3 Main features of a drilling rig

The drilling process consists of the following steps:

Drill pipes are fitted together with a drill bit at the bottom end. This is known as the drill string. The drill string is lowered from the derrick into the bore hole. Once the bit reaches the bottom of the borehole, weight and rotation are applied. Once drilling commences, drilling fluid or mud continuously circulates down the drill pipe and back to the surface equipment. Drilling mud is used for maintaining the hydrostatic pressure on the fluid column, removing the cuttings from the bottom of the well, lubricating the drilling bit and piping, and stabilizing the wellbore.

The following shows the fluid circulation system around the drill bit.



Source: OGP 2003

Figure 4 Circulation of fluids in the drill bit

Once the cuttings and drilling mud reach the surface, they are separated in order to recirculate the drilling mud. Drill cuttings are 'cleaned' by passing them through a solids control device. The function of this device is to separate the cuttings from the drilling mud. At the end of the cleaning process the maximum amount of mud remaining on the drill cuttings is generally less than 6.9%.

There are several technologies used to remove the solids from the drilling mud. Typically, solid control devices consist of the following components:

- Shale Shakers (remove the larger fragments);
- Degasser (removes any gas);
- Desanders (removes sand particles);
- Desilters (removes silt particles);

The following additional equipment will be available if low toxicity synthetic/mineral oil based mud is used:

- Cuttings dryer (cleans cuttings of residual oil before discharging to the sea)
- Centrifuge (recovers fine, light solids and weighting materials such as barite)

So-called "casing" of the well is carried out to isolate portions of the well so as to protect the aquifers of groundwater, as well as to provide a support structure to the well itself. In addition, "casing" also serves to guarantee safety and efficiency during drilling operations. It is accomplished by placing a string of casing pipe in the well and then setting it in place by pumping specially designed cement between the outside of the casing pipe and the well bore wall. After a string of casing is in place, a smaller drill bit is then used to drill a narrower well section. The process of drilling then continues until the desired depth is reached.

It is recommended that while the drilling vessel is operational, an area of 500m of safety radius be maintained around the drilling site, regardless of the type of rig.

After drilling operations are complete, a ROV will be used to see whether the site is left in a safe and environmentally sound manner during decommissioning, i.e. guarantee that no unnecessary infrastructure or debris from the activity is left on site.

Drilling fluid system

The use of specifically designed drilling fluid (or drilling mud) has crucial functions in the drilling process: suspension of drilling cuttings, pressure control, stabilization of the borehole walls, lubrication and cooling of the drill bit, among others.

There are two types of drilling mud: Water Based Mud (WBM) and Non Aqueous Drilling Fluids (NADF), which can be oil-based (OBM) or synthetic-based (SBM).

The use of water-based mud (WBM) and/or synthetic-based mud (SBM) as non-aqueous drilling fluid is expected for this program. In most applications, water-Based-Muds are the most environmentally friendly fluids and can be discharged to the sea under deep water circumstances. However at greater wellbore depths they lose efficiency and the best option is to use Synthetic-Based-Muds. SBM systems are not discharged to sea and are retained aboard the drilling vessel.

Required personnel

All rigs are self-contained with a highly trained and specialized crew. The rigs used for drilling the wells will be sourced from the global international market. This may limit opportunities for local participation to on-shore support services such as supply base services, catering, and other basic provisions.

Accommodation is supplied on the drill vessel which will cater for 2 drilling shifts working on a 12 hour basis, as well as for daily operational and maintenance staff requirements. All other supporting drilling technical services will also be accommodated on board. The total work force on the drilling vessel will depend on the specific vessel's accommodation capacity but it likely to range between 100 to 130 people.

Wastes generated during the drilling programme

The waste items that could be generated during the proposed project include solid wastes (drilling cuttings, used drums, filters, used batteries, lumber and packing materials, waste rags, rubbish/garbage, etc) and liquid wastes (drilling muds/fluids, cooking oils, deck drainage, gray water, chemicals, used solvents, used oil, sanitary waste water, etc).

A Waste Management Plan has been included in this EIA (Part B of Volume II). The drilling vessel should comply with regulations detailed in the Annex V of MARPOL 73/78, which clearly defines the procedures to be applied for each category of domestic waste.

Abandonment Procedures

After the drilling activities have ended, the well will be properly sealed/plugged and abandoned. A detailed program of abandonment and decommissioning shall be developed in line with the applicable Mozambique Petroleum Regulations/Environmental Guidelines and issued based on results from drilling and evaluation.

4.0 TENTATIVE SCHEDULE OF THE MINIMUM 4 DEEPWATER WELLS

The tentative schedule of the minimum 4 deepwater wells is as follows:

- Move rig to deepwater location in Q1, 2009 for 1st campaign
- Spud 1st well, drill and evaluate well – 2 months
- Drill 2nd well immediately after the first well (depending on rig share arrangement)
- Evaluate results for up to 6 months (meanwhile prepare for 2nd deepwater drilling campaign)
- Move rig to deepwater location in from Q4, 2009 to early 2010 for 2nd campaign
- Spud 3rd well, drill and evaluate well – 2 months
- Drill 4th well immediately after the third well (depending on rig share arrangement)
- Evaluate results for up to 6 months

5.0 ALTERNATIVES CONSIDERED

According to the Mozambican EIA legislation, an analysis of alternatives is required. This report assesses two types of alternatives: a) No action and b) Project alternatives. The assessment of project alternatives included a) project location and b) project technologies, within which (i) rig type and (ii) drilling fluids were analyzed.

6.0 KEY ISSUES FOR INVESTIGATION

Critical factors in the Category A activity classification related to this project include the following:

- The activity will take place close to or possibly in a sensitive ecosystem (in this case, the Quirimbas Archipelago). The project area lies in the East African Marine Ecoregion, as defined by the World Wildlife Fund (WWF). The Quirimbas Archipelago stretches a distance of approximately 400 km from the Tanzanian border at the mouth of the Rovuma River southward to Pemba, the capital of Cabo Delgado Province. The Archipelago comprises 32 islands, banks, and reefs. Inshore of these islands is a rich complex of mangroves, patch reefs, seagrass, and sand/mud flat habitats.
- The activity may cause potential impacts to local communities (especially artisanal fisheries) and tourism; and
- The activity is related to petroleum exploration. Specific regulations in Decree No. 45/2004 for petroleum-related operations require the identification, assessment, and mitigation of potential environmental impacts from exploration activities associated with petroleum operations.

In accordance with Decree No. 45/2004, the project was approved by MICOA on 18 January 2008. Later, a Pre-Viability Report Scope Definition Study and Terms of Reference (EPDA and TOR) were submitted to MICOA on 6 May 2008 and approved on 2 July 2008. The EIA process considered the following potential impacts:

- Reduction in air quality due to project emissions and due to a hydrocarbon release or fire/explosion
- Impacts from the discharge of drilling muds and cuttings in the marine environment (including water turbidity, smothering effects, etc)
- Impacts from deck drainage, bilge water and sewage discharge in the the marine environment
- Impacts from solid waste discharge in the marine environment
- Reduction in water quality due to the disposal of produced water
- Effects of pre-drilling assessment on deepwater benthic macrofauna
- Effects of drilling on deepwater benthic macrofauna, including mooring anchors and chains (if applicable)
- Impacts due to the introduction of invasive species in ballast water
- Noise impacts
- Increased vulnerability of fauna attracted to the rig´s lighting/Flare
- Social conflicts due to the presence of foreign workers
- Increased revenue due to the presence of the crew in Pemba and possibly in the islands
- Loss of access to fishing grounds due to the exclusion zone (artisanal and commercial fisheries)
- Temporary catch decrease due to fish displacement (artisanal and commercial fisheries)
- Damage to trawl nets caused by surface structures remaining after well suspension/abandonment
- Reduction in revenue due to a perceived decline in tourist potential (includes discussion about visual impacts, increased air traffic and impacts on recreational offshore sport-fishing activities and whale watching)
- Interference with maritime traffic
- Impacts from hydrocarbon spills

These issues emerged from the stakeholder engagement and the EIA team's assessments.

The present EIS is based primarily upon an extensive review of published literature already available for Area 1. The main reports reviewed were the EIA Report prepared for AMA1 prior to the seismic survey, which was also prepared by Impacto Lda in a joint venture with CSA International, and the EIA Report for Area 4 prepared for Eni East Africa by Impacto. The relevant specialists studies prepared for each of the above have been updated.

The affected environment for this impact assessment encompasses the following three elements:

- Physical environment – meteorology/climate; air quality, oceanography (wind, currents, waves, and tides); geology, sediments, and water quality;
- Biological environment – macrobenthic communities, inshore habitats (coral reefs, mangroves and seagrass beds), fisheries, marine birds, marine turtles, marine mammals, migration pathways; and
- Socioeconomic environment – artisanal fisheries, commercial fisheries, shipping routes, coastal industries and tourism industry.

Based on the Consultant's knowledge of the area, additional fieldwork was not deemed necessary. However, short visits to the project area were carried out to update the information about the socio-economy, tourism industry and artisanal fisheries[2].

7.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

The impact assessment process started with a procedure to identify the activities from the project description that could interact with the environment. In parallel to that procedure, an identification focused on the key environmental and social features from the baseline information was undertaken, aimed at identifying the key biological, physical and human components of the project area.

The potential positive and negative changes resulting from the defined project activities were then predicted for the study area and for the entire project lifecycle. These predicted changes (impacts) were then evaluated using a significance ranking process.

An outline of the impact assessment procedure is as follows:

- Identification of the key project activities;
- Identification of the environmental components;
- Impact identification;
- Impact evaluation; and
- Significance ranking

[2] Because this EIA was prepared based on previous EIAs, which included the Specialist Studies, the present EIA will not include this studies. Additionally, the information from the specialist studies has been totally included in the EIA.

Identification of key project activities/components:

An environmental aspect is an element of an organisation's activities, products or services that can interact with the environment in a manner that is positive or negative. The environmental aspects may affect the physical or socio-economic environment in adverse or beneficial ways. Some impacts are experienced within the program area, and others can result in changes beyond the program area. As described in this EIA, the environmental aspects of the proposed drilling program, listed in Table 1 below, have been used to identify and evaluate the significance of potential impacts and to develop appropriate mitigation recommendations.

Table 1 Project components and Environmental Aspects

Project Component	**Environmental Aspect**
Equipment Mobilization	Vessel movements along the access route
Site Preparation	Pre-drilling assessment of shallow geohazards
Drilling Program	Personnel accommodation and management
	Drilling
	Well evaluation
	Waste (solid, liquid, gaseous) Management
Decommissioning	Well abandonment
	Demobilization (move rig off location)
Non-routine Events	Leaks and spills
	Blowout
	Fire and explosions
	Collision with other vessels

Identification of environmental components:

For the purpose of evaluating environmental impacts, the receiving environment is divided into Environmental Components (EC). An EC can be defined as any part of the environment or society that is considered important by the developer, operator, general public, or any non-governmental or governmental organisation involved in the assessment process.

Inherent to the identification of a particular environmental component is the understanding that preservation of the component is desirable; in other words, any diminishment in its value is undesirable. However, it is recognised that some ECs may be considered to have greater importance than others, and therefore a simple evaluation of each EC is made to determine its relative importance. The EC characterisation value is obtained by taking into consideration the fragility, quality and social values of each component. It also represents the sensitivity of the receptor to potential impacts together with any local, national or international designations, where appropriate. This importance rating is classified as Very Low, Low, Medium, High or Very High (Table 2), and ensures that the more important ECs are afforded a greater weighting in the impact evaluation process. The same aspect can generate a higher impact on an EC categorised as High than on an EC categorised as Low.

Table 2 Environmental Component Categorisation

EC CATEGORISATION	VL	L	M	H	VH
Increasing environmental and social value and/or fragility	→				

The environmental components for the proposed project are listed by category in Table 3, together with the assigned EC value and a description of why the EC is important.

Table 3 Environmental Component (EC) Categorization

Category	**EC**	**EC Categorisation**	**Why is it Important?**
Air	Air quality	Medium	Health implications on neighbouring communities. Ecological implications for neighbouring areas. Cumulative impacts in combination with other industries in the region.
Water	Marine water quality	Very High	Indirect impacts to marine wildlife and human users of the sea including use by desalination plants from lodges). Cumulative impacts in combination with other industries in the region.
Ecology and Biodiversity	Flora (mangrove forest)	High	Impacts on an important breeding/ nursery area and habitat for a variety of bird species, crustaceans, fish, and molluscs.

Category	EC	EC Categorisation	Why is it Important?
	Shallow Water Macrobenthic Communities (Coral reefs and seagrass)	Very High	Impacts on these will affect breeding and feeding grounds of a vast array of animal species. Indirect impacts on the livelihoods of the local populations as coral reefs are important in terms of nursery areas for the juvenile life stages of reef fishes and invertebrates harvested by artisanal fishers along the reef line. Indirect impacts on the local tourism industries through impacts on the recreational activities such as scuba diving and snorkelling. Impacts on the conservation value.
	Deep Water Macrobenthic Communities (echinoderms, molluscs, arthropods, etc)	Low	Deep water macrobenthic communities are important in the biological processes of the sea floor, food chain and biodiversity.
	Fauna (marine mammals, turtles, fish)	High	Fauna species are important for their biodiversity value and conservation status in the project area.
	Protected Areas	Very High	Very important due to their intrinsic conservation value.
Human Environment and Economic Activities	Population and local economy	Medium	There are no inhabited islands in the study area. However the population living in the coastline/islands use depend upon the coastal/marine resources for living.

Category	EC	EC Categorisation	Why is it Important?
	Artisanal Fisheries	High	Impact on an important source of protein and income generation in the study area for the poor people living in Macomia, Mocímboa da Praia and Palma coastal areas (it is the main source of income).
	Commercial Fisheries	Medium	Impact on Mozambique's economy as purse seine fishery for large pelagic species (tunas, swordfish and sharks) is periodically focussed on fishing grounds within Area 1.
	Tourism	High	Impact on Mozambique's economy as the northern region is considered to be one of the most important due to its historical past, rich marine life and unique biodiversity.
	Navigation	Very Low	Impact on national and regional cabotage shipping, with traffic to and from Madagascar, Comoros, Tanzania and Kenya, linking up with the Ports of Pemba and Mocímboa da Praia.
	Coastal industries	Very Low	Impact on local and country's economy, especially if the industries located on the shoreline such as salt pans and aquaculture projects are affected.

Impact Identification:

For the impact identification of this project, professional judgement and the use of a matrix were the techniques used.

A matrix is a grid-like table that is used to identify the interaction between project activities (Environmental Aspects), which are displayed along one axis, and environmental characteristics (Environmental Components), which are displayed along the other axis. Using the table, environment-activity interactions can be noted in the appropriate cells or intersecting points in the grid.

Table 4 presents the results of that identification process in the form of a matrix where Environmental Aspects and Environmental Components are shown in rows and columns respectively and the impacts are shown as a highlight where a certain Environmental Aspect potentially affects an Environmental Component (adverse and beneficial aspects are not distinguished).

Table 4 Impact Identification Matrix

Environmental Aspects		Air	Ecology and Biodiversity						Human Environment and Economic Activities					
		Air Quality	Water Quality	Flora	Deep Water Macrobenthos	Shallow Water Macrobenthos	Fauna	Protected Areas	Population	Artisanal fisheries	Commercial fisheries	Tourism	Navigation	Coastal industries
Equipment mobilization	Vessel movements along the access route													
Site preparation	Pre-drilling assessment of shallow geohazards													
Drilling program	Personnel accommodation and management													
	Drilling													
	Well evaluation													
	Waste management													
Decommissioning	Well abandonment													
	Demobilization													
Non- routine events	Leaks & Spills													
	Blowout													
	Fire and explosion													
	Collision with other vessels													

Impact evaluation:

The significance of each potential impact will depend on the EC category and the project activities. The impact evaluation was conducted using the following criteria based on internationally accepted criteria and compliant with Decree 45/2004:

- **Nature of impact**: negative or positive (beneficial);
- **Magnitude (Intensity) of impact** : Describes the quantity of the resource potentially affected by the project activity (i.e., very small, small, moderate, large and very large)
- **Extent of impact:** an assessment of the geographic extent of an impact (i.e., site specific, local, regional, national, or trans-boundary);
- **Duration of impact**: how long the impact would last (i.e., will effects be short term, medium term, long term, or permanent);
- **Type of Impact**: Direct or Indirect. When the resource is affected directly by the activity, it is considered to be a direct impact. When the resource is affected through another resource that has been previously affected by the activity, it is considered to be an indirect impact.
- **Cumulative**: Cumulative effects may be considered significant if an impact is added to existing or future similar impacts.
- **Reversibility**: An impact is considered reversible when the affected resource can revert to its previous state. An impact is considered irreversible when the affected resource can not return to its previous state.
- **Probability of occurrence**: very unlikely, unlikely, probable, or highly likely/certain.

The impact evaluation is conducted using two sets of criteria described as basic and supplementary (Bojórquez – Tapia, *et al*., 1998).

Basic Criteria:

- Magnitude;
- Spatial extent; and
- Duration.

The impact **Magnitude** is measured on an ordinal scale corresponding to the proportion of the EC affected by each project activity. This evaluation may require the participation of environmental experts in each area, as the magnitude of a given impact will vary as a function of various factors (e.g., fragility, scarcity, location) of an Environmental Component. A blanket or generalised estimation of the magnitude on an impacted resource will not always apply. Depending on the activity and the impacted resource,

the magnitude will be assigned to a scale from one to five corresponding to the following descriptions: very small (1), small (2), moderate (3), large (4), and very large (5).

The **Spatial Extent** of an impact is allocated one of the following categories:
Very Small (1) – local scale impact in the immediate area of the activity
Small (2) – local impact in the study area
Moderate (3) – regional scale impact
Large (4) – national scale impact
Very Large (5) – trans-boundary impact

The **Duration** of an impact is described by one of the following categories:
Very Short (1) – less than one year
Short (2) – one to five years
Moderate (3) – six to ten years
Long (4) – greater than ten years / duration of the project's lifetime
Very Long (5) – permanent

Where there is uncertainty between two values during evaluation, the higher figure is assigned in order to reduce the chance of underestimating an impact (i.e., the precautionary principle is applied), thereby minimising risk (Crowfoot, *et al.* 1990).

The Basic Impact Index is obtained by averaging the three values assigned to Magnitude, Spatial Extent and Duration (rounded up), to obtain a whole number between 1 and 5 (Table 5).

Tabela 1 Basic Impact Index

BASIC IMPACT INDEX	VL	L	M	H	VH
Average of Magnitude, Spatial Extent and Duration	1	2	3	4	5

Supplemental Criteria:

- Type of Impact
- Cumulative
- Reversibility

Type of Impact. Direct or Indirect. When the resource is affected directly by the activity, it is considered to be a direct impact. When the resource is affected through another resource that has been previously affected by the activity, it is considered to be an indirect impact. No additional value is assigned, as the type of impact has no bearing on significance.

Cumulative Effects Cumulative impacts result from a combination of a proposed project's impacts and those from other existing, or realistic future, developments. Cumulative impacts can also include situations where two or more potential impacts from a single project, while individually insignificant, could produce more severe impacts when considered together. Cumulative effects are evaluated using the following parameters:

Nil – No effect
Low – unlikely to contribute to a cumulative effect
Medium – likely to contribute to a cumulative effect
High – highly likely/certain to contribute to a cumulative effect

Reversibility. An impact is considered reversible when the affected resource can revert to its previous state. An impact is considered irreversible when the affected resource can not return to its previous state. Reversibility is assessed as follows:
Reversible – likely to be reversible in the medium term. Reversible impacts are assigned a value of Low or Medium.
Irreversible – likely to be irreversible. Irreversible impacts are assigned a value of High.

The Total Impact Index is a combination of the basic and supplementary criteria. The Total Impact Index will be equal to the Basic Impact Index, except where one or more of the supplementary criteria are High or both are Medium. In this case the Total Impact Index will be increased to the next category.

Significance ranking:
The final impact significance (adverse or beneficial) is the result of the combination of the Total Impact Index and the Environmental Component categorisation, as shown in Table 6. This results in one of the following impact significance classifications: Insignificant (IN), Minor (MI), Moderate (MO) or Major (MA).

Table 5 Impact Significance

	Total Impact Index				
EC Categorisation	VL	L	M	H	VH
VL	IN	IN	MI	MI	MO
L	IN	MI	MI	MO	MO
M	MI	MI	MO	MO	MA
H	MI	MO	MO	MA	MA
VH	MO	MO	MA	MA	MA

Table 7 defines the impact significance as assessed above.

Table 6 Definition of the Impact Significance

Impact Significance	Description
Beneficial	Likely to cause some enhancement to the environment or socio-economic benefits.
Insignificant	No changes, or changes that are unlikely to be noticed or measurable against background activities.
Minor	Minimal adverse effects on environmental resources, which will not require any modification in project plans or specific mitigation measures.
Moderate	Significant. Project activity will have measurable effects on environmental resources. These impacts may require modifications to the project design and/or implementation of effective mitigation measures.
Major	Severe. Will have a major effect on environmental resources. Such potential impacts may represent fatal flaws in the project and will require modifications to the project design and implementation of mitigation measures.

The immediate aim of an EIA is to inform the process of decision-making by identifying the potentially significant environmental effects and the risks of development proposals (UNEP 2002). Discussed up to this point in this section has been the assessment of the effects of project activities assuming they definitely occur. This approach allows for the preparation of preventive measures that otherwise could be deemed unnecessary. Nevertheless, some events, while severe if they occur, are highly unlikely to take place. This is especially true for non-routine events. Each impact is therefore evaluated in terms of its probability of occurrence to complement the impact significance assessment.

The **probability** of occurrence for a particular event can be categorised as follows:

Very unlikely – remote chance of occurrence within the lifetime of the project
Unlikely – Unlikely to occur during the lifetime of the project
Probable – likely to occur at least once during the lifetime of the project
Highly likely/certain – will occur one or more times during the lifetime of the project

8.0 SUMMARY OF THE POTENTIAL IMPACTS AND MITIGATION MEASURES

Table 7 Impacts from Routine Events

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
BIOPHYSICAL ENVIRONMENT							
1	AIR	MEDIUM	Mobilization/ demobilization and drilling operations	Reduction in air quality due to project emissions	**MINOR**	Regularly maintain drilling rig motors and engines. Operate and maintain exhaust systems and engines in accordance with the manufacturer's specifications. Use preventative maintenance, leak detection and repair programs. Maintain and effectively control well test burners for high efficiency. Consider the use of an alternative "green burner" test flare to improve the quality of flare emissions and to minimize incomplete combustion and black smoke and to prevent hydrocarbon fallout to the sea. Limit periods of hydrocarbon burning to the operationally required minimum. Compliance to Annex VI MARPOL emission standards: • Diesel engine NO_x emissions should be limited to between 9.8 and 17 g/kWh, depending on maximum operating speed. • Substances harmful to the ozone layer (including halon and CFCs), cannot be deliberately released. New facilities can contain HCFCs until 1Jan 2020, but cannot contain other substances that harm the ozone layer.	**INSIGNIFICANT**
2	WATER	VERY HIGH	Drilling operations (waste management)	Reduction in water quality due to the discharge of drilling muds and cuttings	**MODERATE**	Mud recovery systems must be used, whenever possible, and the rig should have an efficient solid control and mud recirculation system with the following main components: • Shale shakers to remove large-sized cuttings • De-gasser to remove entrained gas • De-sanders to remove sand-sized cuttings; • De-silters to remove silt-sized cuttings	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
						• Centrifuge to recover fine solids and weighting materials such as barite. WBM and low toxicity additives should be used whenever possible. For SBM, use the Group III NADFs – Non Aqueous Drilling Fluids (most environmentally acceptable with low to negligible aromatic content). Synthetic fluids that are low in toxicity, biodegradable and non-accumulative should be used. All chemicals used should conform to internationally accepted standards and submitted to MICOA and INP for approval when necessary before the drilling activities begin. The use of all drilling fluid components and other chemicals should be monitored and recorded. WBM mud and cuttings and SBM cuttings will be discharged to sea in compliance with international practices as described below. However a final decision will be made based on the results of the site-specific drilling and mud cuttings dispersion modeling so as to ensure that the environmental components described in the EIA are not affected. This is especially important if the well sites that might be located close to the western limit. As with most oil and gas companies in their worldwide offshore operations, AMA1 will comply with the following requirements for discharge of drilling cuttings and muds (EPA, 2007): • Metal concentrations in the barite added to mud must not exceed: 1mg/kg for mercury and 3mg/kg for cadmium. • No discharge of drilling wastes allowed within 3 miles of shore. • Discharge rate not to exceed 1,000 bbls/hour. • Cuttings coated up with 6.9%SBMs may be discharged • Ester SBMs can have up to 9.4% SBM on cuttings.	
3			Mobilization/ demobilization and drilling operations	Reduction in water quality due to deck drainage, bilge water and sewage discharge	**MINOR TO INSIGNIFICANT**	All vessels must be certified for seaworthiness through an appropriate internationally recognized marine certification body. The rig must have adequate safety systems (alarms and automated shut-down devices), that meet regulatory and industry standards. Adequate maintenance and testing programs must be in place.	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION

						Establish separate drainage systems for hydrocarbon-contaminated water (closed drains) and water from non-process areas (open drains). Bund all process areas to prevent contamination by storm waters, contain spills and leaks, and channel drainage water into the closed drains.
						Ensure that oil separators are in place and that spills are cleaned up immediately. Equip oil and water separators with sensors and an alarm to avoid exceeding the discharge limit.
						Use drip trays to collect run-off and spills from equipment not contained within a bunded area and channel runoff to the closed drainage system.
						Train crew members regarding the risks of contamination from deck water discharge and the importance of cleaning up spills as soon as they occur.
						
						Disposal of liquid waste in accordance with MARPOL 73/78 (Annexes 1-4):
						• Liquid effluents must be treated before discharged to the sea (Refer to Section 2.3.2).
						• Sewage must be treated and disinfected (on-board treatment plant) prior to discharge.
						  • Collect and adequately treat grey and black waters with a small on-board sewage treatment station before release into the sea.
						  • Treated effluents shall achieve a BOD < 40 ppm, suspended solids < 50 ppm and a coliform count < 200 cells per 100 ml of effluent.
						  • The discharge depth is variable, depending on the draught of the rig at the time, but it should not be less than 5m below the surface.
						
						• Discharge of ballast water and bilge water (water coming from machinery spaces) according to established international maritime guidance and legal requirements.	

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
						• The discharge of residues into the ocean is forbidden, except when the ship has an operation approved device for treatment of residue or when it is discharging disinfected residues and in small amounts, using an approved system at more than 3 nautical miles from the nearest coast; or discharging non-disinfected and un-fragmented residues, at more than 12 nautical miles from the nearest coast. • The concentration of oil in the water after treatment in an IMO approved oil/water separator shall not exceed 15 ppm. • Do not discharge deck water near sensitive habitats, such as seagrass beds and coral reefs. • Route water from machinery spaces to the closed drainage system, or contain and treat the bilge water before discharge. • Untreatable waters should be contained and shipped to shore for disposal. • Contain oil and chemical use areas and equipment (deck, mud tanks and pumps) • Use efficient oil and water separators in bilges.	
4			Drilling operations (waste management)	Reduction in water quality due to solid waste discharge	**INSIGNIFICANT**	Disposal of solid waste in accordance with MARPOL 73/78: • Domestic waste must be disposed in compliance with Annex V. • Solid waste (kitchen waste) can be macerated to 25mm and then discharged to the sea. • All other solid waste must be segregated and contained for appropriate treatment and disposal according to the Waste Management Plan. • Hazardous wastes will not, under any circumstances, be discharged to the sea. No garbage[3] can be discharged closer than 12 nautical miles (21,6km) from the nearest land.	**INSIGNIFICANT**

[3] Under Annex V of the Convention, garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically.

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
5			Drilling operations (waste management)	Reduction in water quality due to the disposal of produced water	**MINOR**	Comply with the MARPOL 73/78 requirements. Ensure that oil separators are in place and establish separate drainage system for hydrocarbon-contaminated water (closed drain). The concentration of oil in the water after treatment in an IMO approved oil/water separator shall not exceed 15 ppm.	**INSIGNIFICANT**
6	FLORA	HIGH	Drilling operations (waste management)	Impacts of waste disposal (including muds and cuttings) on the coastal mangroves	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to the discharge of drilling muds and cuttings (Action # 2) and waste (Action # 4) ensures the mitigation of the impact on coastal mangroves.	**INSIGNIFICANT**
7	SHALLOW WATER MACROBENTHOS	VERY HIGH	Drilling operations (waste management)	Effects of waste disposal (including drilling muds and cuttings) on coral reefs and seagrass beds	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to the discharge of drilling muds and cuttings (Action # 2) and waste (Action # 4) ensures the mitigation of the impact on shallow water macrobenthos.	**INSIGNIFICANT**
8	DEEP WATER MACROBENTHOS	LOW	Drilling operations (pre-drilling assessment of shallow hazards)	Effects of pre-drilling assessment on deep water benthic macrofauna	**INSIGNIFICANT**	Ensure that the drilling vessel is certified for seaworthiness through an appropriate internationally recognised marine certification body. Adhere to specific safety precautions and procedures to minimise the risk of offshore accidents and/or incidents. In case a moored rig is used, the integrity of its mooring system must be ensured. The drilling contractor must be registered with the International Association for Drilling Contractors (IADC), and all responsible personnel must be qualified. Use the ROV to assist the positioning of the rig and ensure that anchoring avoids significant seafloor features.	**INSIGNIFICANT**
9			Drilling operations	Effects of drilling on deep water benthic macrofauna including mooring anchors and chains (if applicable)	**INSIGNIFICANT**		**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
10			Drilling operations (waste management)	Effects on deep water benthic macrofauna due to the discharge of drilling muds and cuttings	**MODERATE**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to the discharge of drilling muds and cuttings (Action # 2) ensures the mitigation of the impact on deep water macrobenthos.	**MINOR**
11	FAUNA	HIGH	Drilling operations (waste management)	Impacts due to the disposal of muds and cuttings on fauna through increased turbidity and contaminant load	**MINOR**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to the discharge of drilling muds and cuttings (Action # 2) ensures the mitigation of the impact on marine fauna.	**INSIGNIFICANT**
12			Mobilization/ demobilization and drilling operations	Impacts due to deck drainage, bilge water and sewage discharge	**MINOR**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to deck drainage, bilge water and sewage discharge (Action # 3) ensures the mitigation of the impact on marine fauna.	**INSIGNIFICANT**
13			Drilling operations (waste management)	Impacts due to solid food waste discharge	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction and impacts on coastal mangroves,due to the discharge of waste (Action # 4) ensures the mitigation of the impact on marine fauna.	**INSIGNIFICANT**
14			Mobilization/ demobilization and drilling operations	Impacts due to the introduction of invasive species in ballast water	**INSIGNIFICANT TO MAJOR**	• Discharge of ballast water according to established international maritime guidance and legal requirements. • Discharged no closer than 12 nautical miles (21,6km) from the nearest land.	**MINOR**
15			Drilling operations	Impacts of noise on marine mammals, turtles and fish	**MINOR**	Periodically maintain equipment to minimize noise. Use a top drive motor on the drill string to limit drill noise.	**INSIGNIFICANT**
16			Drilling operations	Increased vulnerability of fauna attracted to the rig's lighting/flare	**INSIGNIFICANT**	Not applicable	**INSIGNIFICANT**
17	PROTECTED AREAS		Drilling operations (waste management)	Impact of waste management (discharges) on protected areas	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction and impacts on coastal mangroves due to the discharge of waste (Action # 4) ensures the mitigation of the impact on protected areas.	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
SOCIO-ECONOMIC ENVIRONMENT							
18	POPULATION AND LOCAL ECONOMY	MEDIUM	Drilling operations and support operations	Social conflicts due to the presence of foreign workers	**MODERATE**	Personnel should be informed of social conduct codes based on cultural characteristics of the resident population, of local culture and costumes and of the importance of respectful social relationships with the local community. Personnel should be provided with information about avoidance of sexually transmitted diseases through hygienic practices and low risk behaviour.	**INSIGNIFICANT**
19			Drilling operations and support operations	Increased revenue due to the presence of the crew in Pemba and possibly in the islands	**POSITIVE**	Local goods and service providers in Pemba should be used whenever possible.	**POSITIVE**
20	ARTISANAL FISHERIES	HIGH	Drilling operations	Loss of access to fishing grounds due to exclusion zones	**MINOR**	Inform artisanal fishers, at least two months prior to the start of the drilling, of well locations, safety exclusion zones, and vessel locations, and of planned events through established means of communication. • Political forums, such as the *Foruns de Localidade* (Localidade Forums), *Conselhos Consultivos Distritais* (District Consultative Councils), and *Conselhos Comunitários de Pesca* (Community Fisheries Councils) • Traditional and other local leaders • Radio stations Provide a grievance procedure regarding the project. Consider a Compensation Plan that outlines strategies for, and means of, compensation in the event of loss of catch by artisanal fishers based on annual catches declared during previous years (a Compensation Plan will be submitted to MICOA together with Grievance Procedures).	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
21			Drilling operations	Temporary catch decrease due to fish displacement	**MINOR**	Implementation of mitigation measures to minimize the impact on marine mammals, turtles and fish (Action # 17), will reduce the impact on catches. Coordination and communication with fishers, the establishment of a grievance procedure and the consideration of a compensation plan are also recommended (a Compensation Plan will be submitted to MICOA together with Grievance Procedures).	**INSIGNIFICANT**
22			Drilling operations	Effects of noise on artisanal fishery divers	**INSIGNIFICANT**	Implementation of mitigation measures to reduce impacts on artisanal fisheries will reduce the impact on divers (Actions # 23 & 24).	**INSIGNIFICANT**
23	COMMERCIAL FISHERIES	MEDIUM	Drilling operations	Loss of access to fishing grounds due to exclusion zones	**MINOR**	Inform maritime authorities prior to rig mobilization regarding detailed routes, rig locations, exclusion zones and scheduling plans through established means of communication. • National Maritime Authority (INAMAR), with details about vessel entry, duration of stay and exact area(s) and duration of exclusion. INAMAR should make a formal Notice to Mariners for international dissemination • Notice to Mariners through maritime communications networks and GMDSS / Inmarsat Provide advance notice writing to the Delegation of the European Commission, Maputo, and the Ministry of Fisheries, Mozambique	**INSIGNIFICANT**
24			Drilling operations	Temporary catch decrease due to fish displacement	**INSIGNIFICANT**	Not Applicable	**INSIGNIFICANT**
25			Drilling operations (abandonment)	Damage to trawl nets caused by surface structures remaining after well suspension/ abandonment	**MINOR**	Implement a detailed program of abandonment and decommissioning adhering to applicable Mozambique Petroleum Regulations and Environmental Guidelines. Submit the abandonment and decommissioning plan to MICOA and INP. Inform trawling vessels operating in the area with the geographical locations of any obstructions left on the seabed. Publish a notice to mariners via INAMAR and the Ministry of Fisheries with a clear definition of the area where bottom gears (bottom trawl, bottom set gill nets) are prohibited.	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
26	TOURISM	HIGH	Drilling operations	Reduction in revenue due to a perceived decline in tourist potential	**MINOR**	Provide a media fact sheet for use by L&A Operators to brief staff and inform clients regarding the temporary nature of the drilling program and the measures taken to mitigate environmental impacts. Helicopter flight paths should avoid tourist areas, when possible, or fly at sufficient altitude to minimize noise disturbances when rerouting is not possible. The EIS should be appended with the exact drill sites for later identification of site-specific effects to be addressed. Consider a Compensation Plan that outlines strategies for, and means of, compensation (a Compensation Plan will be submitted to MICOA together with Grievance Procedures).	**MINOR**
27			Drilling operations	Effects of noise on recreational divers	**INSIGNIFICANT**	Compile a Communications Plan to inform tourism interests of the drilling locations and scheduling. AMA1 could coordinate with dive operators. Provide a grievance procedure regarding the project. Refer to the Communication Plan included as part of the EMP. A Compensation Plan will be submitted to MICOA together with Grievance Procedures.	**INSIGNIFICANT**
28			Drilling operations (waste management)	Impacts of waste disposal	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for the avoidance of water quality reduction due to the discharge of waste ensures the mitigation of the impact on tourism (Actions # 4 & 5).	**INSIGNIFICANT**

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
29	NAVIGATION	VERY LOW	Mobilization/ demobilization and drilling operations	Interference with maritime traffic	**INSIGNIFICANT**	Apply for authorization to conduct oil exploration drilling activities at sea from the Maritime Authority (INAMAR). Inform maritime authorities prior to rig mobilization regarding detailed routes, rig locations, exclusion zones and scheduling plans through established means of communication: • National Maritime Authority (INAMAR), with details about vessel entry, duration of stay and exact area(s) and duration of exclusion. INAMAR should make a formal Notice to Mariners for international dissemination • Notice to Mariners through maritime communications networks and GMDSS / Inmarsat • Provide advance notice writing to the Delegation of the European Commission, Maputo, and the Ministry of Fisheries, Mozambique Whenever necessary, maintain the exclusion zone using the rig and support vessel resources. Prohibit purse seine fishing in the area at least 10km up current of the drilling vessel to avoid drift into the exclusion zone. Provide a grievance procedure regarding the project (a Compensation Plan will be submitted to MICOA together with Grievance Procedures).	**INSIGNIFICANT**

Table 8 Residual Impacts from non-routine events after Mitigation

No.	EC	EC Sensitivity	Environmental Aspect	Impact	SIGNIFICANCE	MITIGATION MEASURES	SIGNIFICANCE AFTER MITIGATION
BIOPHYSICAL ENVIRONMENT							
1	AIR	MEDIUM	Mobilization/ demobilization and drilling operations	Reduced air quality due to hydrocarbon release or fire/explosion	**MINOR**	The aim should be in preventing the occurrence of hydrocarbon release and of fires and explosions. Compliance to the Emergency Response Plan and Oil Spill Contingency Plan is mandatory.	**INSIGNIFICANT**
2	WATER	VERY HIGH	Drilling operations and support operations	Reduced water quality due to a hydrocarbon release	**MAJOR**	Planning • General Oil trajectories and an Oil Spill Contingency Plan (OSCP)/Emergency Response Plan (ERP) prepared for this project are presented in Part B of Volume II. • Prepare & submit site-specific Oil Trajectory Models and OSCP/ERP to the MICOA & the INP before drilling activities o Incorporate results of the site-specific Oil Trajectory Models in the OSCP/ERP o The Mozambique draft National Oil Spill Contingency Plan (NOSCP) should be considered • Drilling operations will not commence until the OSCP/ERP has been updated and addresses local environments. • Compliance to the OSCP/ERP is mandatory • Consider acquiring or contracting services (Southern Africa region) for rapid response to accidental oil spills as local resources are limited. Prevention Ensure that the rig and the supply vessel comply with the following: • International certification and approval by the Mozambican Authorities • Good operational conditions and serviced according to a service maintenance plan • Have OSCP/ERPs for (i) oil and chemical spills; (ii) fire and explosions, (iii) diesel or bunker fuel spills • Crews trained for emergency response relative to the cargo they transport and operations they perform • Maintain contact with the Port Authorities • Have updated information regarding the weather conditions in the area	**MINOR**

						• Safety measures such as BOPs are in place • Fuel tanks or drums capped, not overfilled, marked with contents, and valves closed between connected fuel tanks • Store petroleum products & hazardous substances in adequately labeled approved containers • Store petroleum products & hazardous substances in bunded areas where spills can be contained & collected • Use oil collector trays or drip pans under equipment • Ensure that pipes and hoses are properly connected, closed and in good condition • Monitor tank levels throughout the program • Make available absorbent pads near the area where spills may occur • Conduct transfer operations during calm weather conditions • Ensure that transfer hoses are of sufficient length and strength to maneuver vessels as sea conditions require • Only conduct transfer operations during the day, if possible, and hoist the “bravo” flag. • Transfer under reduced visibility conditions (night or overcast), hoist a red light flag • Conduct transfer under favorable wind and tide conditions that would carry any spill away from sensitive habitats • Post warning signals before transfer operations begin • During transfers, maintain effective communication between the supply vessel and the drilling rig and monitor the transfer • Implement drilling rig fuel transfer procedure <u>Response</u> • Response procedures shall be outlined in the site-specific OSCP/ERP. • Limit the spill at the source to the extent possible and contain or recover the material before it reaches the coastal or marine resources. • Clean-up actions are required if hydrocarbons reach shore. • Inform the port authorities immediately in the event of any spill or accident that could result in a spill. • Report all leaks and spills in accordance with the OSCP/ERP. Refer to the Communication Plan included as part of the EMP.	

3	FLORA	HIGH	Drilling operations and support operations	Effects on coastal mangroves due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on the mangroves (Action # 2).	**INSIGNIFICANT**
4	SHALLOW WATER MACROBENTHOS	VERY HIGH	Drilling operations and support operations	Effects on coral reefs and seagrass beds due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on the shallow water macrobenthic communities (Action # 2).	**INSIGNIFICANT**
5	DEEP WATER MACROBENTHOS	LOW	Drilling operations and support operations	Effects on deep water macrobenthic communities due to a hydrocarbon release	**MINOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on the deep water macrobenthic communities (Action # 2).	**INSIGNIFICANT**
6	FAUNA	HIGH	Drilling operations and support operations	Effects on marine mammals, turtles, fish and seabirds due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on marine fauna (Action # 2). <u>Response measures include:</u> • Use marine mammal deterrents with the buoys signaling the spill to prevent the animals from entering affected areas. • Do not apply hydrocarbon dispersion agents directly onto the affected animals (cetaceans & sea turtles).	**MINOR**
7	PROTECTED AREAS		Drilling operations and support operations	Effects on protected areas due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on the protected areas (Action # 2).	**MINOR**

SOCIO-ECONOMIC ENVIRONMENT							
8	POPULATION AND LOCAL ECONOMY	MEDIUM	Drilling operations and support operations	Effects on population due to a hydrocarbon spills or fire/explosion	**MODERATE**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on population (Action # 2).	**MINOR**
9	ARTISANAL FISHERIES	HIGH	Drilling operations and support operations	Effects on artisanal fisheries due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on artisanal fisheries (Action # 2). Whenever necessary, maintain the exclusion zone using the rig and support vessel resources.	**MINOR**
10	COMMERCIAL FISHERIES	MEDIUM	Drilling operations and support operations	Effects on commercial fisheries due to a hydrocarbon release	**MODERATE**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on commercial fisheries (Action # 2). Additional measures include: <u>Prevention</u> • Whenever necessary, maintain the exclusion zone using the rig and support vessel resources. • Establish and maintain radio communications with vessels fishing within 15km of drilling rig • Prohibit purse seine fishing to 10km up current from the drilling vessel to avoid drift into the exclusion zone <u>Response</u> • Radio is the first means of communication, and vessels within 15km should be advised to leave the area immediately. • Prohibit fishing in the area immediately down current or downwind of the drilling rig (temporary high risk.	**INSIGNIFICANT**

11	TOURISM	HIGH	Drilling operations and support operations	Effects on tourism due to a hydrocarbon release	**MAJOR**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on tourism (Action # 2).	**MINOR**
12	NAVIGATION	VERY LOW	Mobilization/ demobilization and drilling operations	Effects on navigation due to hydrocarbon release	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on navigation (Action # 2).	**INSIGNIFICANT**
13	COASTAL INDUSTRIES	VERY LOW	Drilling operations and support operations	Effects on coastal industries due to a hydrocarbon release	**INSIGNIFICANT**	The implementation of the proposed mitigation measures for reduced water quality due to hydrocarbon release will ensure the minimization of such impacts on coastal industries (Action # 2).	**INSIGNIFICANT**

9.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed deepwater exploration drilling operations will take place within the AMA1 Concession area, in water depths greater than 200m. Therefore, no sensitive habitats, such as coral reefs, mangroves and seagrass beds, will be encountered. Additionally, inhabited islands are not located in the project area.

In the specific case of this project the following factors should be taken into consideration:

- The project is an exploratory and not a production activity
- Well locations are still not known;
- The period of time is limited: up to 2 months per well;
- It is located beyond the 200m bathymetric line, where there are no mangroves, seagrass beds, coral reefs or population.

For the purpose of evaluation of environmental impacts, the receiving environment was divided into several important Environmental Components (EC): air, water, flora, shallow water and deep water macrobenthic communities, fauna, protected areas, population and local economy, artisanal fisheries, commercial fisheries, tourism, navigation and coastal industries. Each of these ECs are considered important on the basis of cultural values and/or scientific and public concern, and have been used to support the impact assessment.

A number of potential environmental and socio-economic impacts associated with the drilling activities have been identified, and the value of each EC value (most of them had a medium-high value) was considered. Most of the impacts from routine events were determined to be insignificant or of only minor significance, while most of the impacts from non-routine events were determined to be of major significance, but these are very unlikely to occur. Furthermore, the majority of impacts associated with the drilling programme can be reduced to insignificant if mitigation measures are implemented. No moderate or major impacts would remain if mitigation measures are adequately implemented.

Of major importance is that protected areas are not impacted by the AMA 1 drilling activities. The Quirimbas National Park (QNP) is located directly to the south (7.8km) of the study area, and the Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP) in Tanzania is located 3km to the north of the concession area.

Marine mammals, turtles and fish are abundant in the project area. At least three species of whales (pilot, sperm and humpback) and several species of dolphins have been observed in the project area. Humpback and sperm whales are listed as Vulnerable species on the Red List of Threatened Species (The World Conservation Union (IUCN, 2007).

The turtles nesting beaches are located on the Vamizi (3.8km from the western boundary of the AMA1 deepwater area), on Rongui and on Macaloe (5km and 5.6km,

respectively, from the western boundary of the AMA1 deepwater area). The islands are protected by the Cabo Delgado Biodiversity and Tourism Project (CDBTP) and by the Forestry and Wildlife Regulation (Decree No. 12/2002). In 2004, 250 nest sites belonging to the green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) species were identified and protected within the CDBTP study area. Both turtle species are listed as endangered or critically endangered on the Red List of Threatened Species (IUCN, 2006). Although within the AMA1 concession, these islands are located outside the AMA1 deepwater drilling project area and should not be affected by routine events.

The scoping phase (EPDA) report indicates that the precise locations of the drilling sites can only be determined after processing and interpretation of the seismic survey data. The EPDA also refers to the fact that the project area would be divided into two distinct impact zones (Sensitivity Zone 1 and Sensitivity Zone 2) to better identify the potential impacts with the help of specialist studies. However, during the course of the EIA it was decided not to differentiate between the two zones and only one study area was considered as drilling will take place where the water depths are greater than 200m and at these depths the biophysical variations are minimal. Only some socio-economic impacts, such as the visual impacts on tourism are of the highest sensitivity. The EPDA also stated that additional specialist studies may be required once the drilling sites were known. During the EIA it was concluded that the only additional specialist studies that should be carried out are (i) drilling and mud cuttings dispersion modelling and (ii) oil spill modelling. Other biophysical and socio-economic studies may be required and the types and quantities of these will be determined on a case-by-case basis.

Artisanal fisheries are an important source of protein and income generation in the study area for the coastal communities living in Macomia, Mocímboa da Praia and Palma coastal areas, and fishing is the main source of income.

The majority of artisanal fishing activities take place close to the islands or between the islands and the mainland. Most of the fishermen do not go as far as the 200 bathymetric line, but hand liners may go as far as 13km east of the islands and fish in depths of up to 400m.

There are no national commercial fisheries activities in the Area 1 concession. There may be some sporadic international fishing effort north of 16˚S, but this will normally be limited to water depths of 25m-200m (Almeida 2005) and not within the potential drilling area. The impacts of exploratory drilling on commercial fisheries in Area 1 will be confined to the purse seine fishery. Fishing for large pelagic species (tunas, swordfish and sharks) is only periodically focussed on fishing grounds within the entire Area 1. The vessels are not present in any one area all year round. Their location depends on the position of the principle concentrations of target species, which changes throughout the year. Otherwise, they will only cross through AMA1 area.

Although the tourism industry in the Quirimbas Archipelago is in its infancy, it is growing rapidly, and is already a sought-after international destination in the high-end tourism market. Tourists visiting the resorts in the study area are predominantly from the UK and Europe. Lodges in the Quirimbas capitalise on the theme of unspoilt wilderness, and luxury holidays in a tropical island paradise. Diving, recreational fishing, and whale watching are integral parts of their marketing, important factors when targeting high-end consumers who want a unique experience. If the perception of a “unique experience” is

not sustained, there could be a decline in tourism. The potential effect of the proposed drilling operation on the image of the Quirimbas is strongly dependant on how activities associated with the drilling are managed. The magnitude of the impact is likely to be low, if the following is assumed:

- There will be no significant effect on recreational fishing, diving, or Cetacean sightseeing excursions
- The visibility of the drilling rig and associated activities would be limited (it should be taken into account that a drilling rig can be seen within 10 km).

The Mozambique Channel is a preferential international navigation route, but there are no formally established routes and the international traffic passes outside the project area. Area 1 in the Rovuma Basin is mainly used by national and regional cabotage shipping, with traffic (low intensity) to and from Madagascar, Comoros, Tanzania and Kenya, connecting the Ports of Pemba and Mocímboa da Praia.

Early consultation with all relevant authorities, prior to rig mobilization, must be established to avoid interference with maritime traffic and other activities by providing detailed drilling locations, transportation routing and scheduling information.

Key to these measures is the establishment and maintenance of proper, transparent lines of communication between the proponent and the tourism industry, the artisanal fishing representative, the commercial shipping stakeholders and the other relevant stakeholders (a Communication Plan has been included as part of the Environmental Management Plan). Through proper liaison, due notification of activities and careful monitoring of grievances, many of the potential impacts can be either avoided or minimized. Where impacts cannot be avoided, the affected parties should be compensated (a Compensation Plan will be submitted to MICOA together with a Grievance Procedure at a later stage, following agreements with the relevant Government Authorities (INP, MICOA; Fisheries and Tourism sectors).

It is recommended that while the drilling vessel is operational, a 500m radius safety zone be maintained around the drilling site, regardless of the type of rig. In this regard, a communication strategy must be developed to inform the key stakeholders of the location and timing of the drilling operations and the exclusion zone, ensuring that they are well covered by the *"Navigation Warnings"* dissemination systems.

Management of these impacts will require special attention prior to and during the exploration period. Therefore, mitigation measures have been designed to minimise or eliminate the negative impacts. This EIA includes an Environmental Management Plan (EMP), Part B of Volume II of this EIA, that clearly defines responsibilities and obligations when implementing the mitigation measures and when monitoring their implementation.

Adherence to environmental operating procedures described in this report, in conjunction with adherence to the EMP will reduce adverse environmental impacts to a minimum. In addition, close attention should be paid to the prevention of non-routine events and impacts on water quality. The prevention of both is inherent to preventing impacts to other Environmental Components.

The drilling rigs must have adequate safety devices and procedures, such as BOPs, adequate lighting and signally (for day and night); visual radar and support vessels to prevent collisions.

The crew must be adequately trained in safety, waste management and environmental protection prior to the beginning of operations. The topics should include:

- Regulatory requirements for drilling operations
- Environmental considerations and special procedures to be used for environmental protection
- Safety procedures with particular regard for appropriate conduct on vessels and safe use of equipment
- Emergency preparedness and response procedures

At the end of drilling operations, no equipment is to be left in the area, except for the wellhead, and the Remotely Operated Vehicle (ROV) should be used to make a final assessment. The location of any equipment that may be hazardous to future marine operations should be reported to relevant authorities for inclusion in the appropriate hydrographic charts.

AMA1 will permanently abandon the well if commercial volumes of hydrocarbons are not found. The well will be temporarily abandoned if the potential of commercially viable hydrocarbons exists. This means the well can be re-entered and used during future production operations. In either case, the well head and casing will be left on the seafloor, rising no more than 4 meters above the mud line.

All stakeholders must be informed of the completion of the operation through the same means of communication used before and during operations.

Although a low-probability non-routine event, an oil spill could reach shore, island or mainland, between six hours and one and a half days based on hypothetical oil trajectory modelling. The required oil spill response time would be very short. Training is crucial in such an event, but more effective is training to prevent situations that could result in an oil spill (e.g. spills during transferring or refuelling, blowouts, explosions and collisions).

The Framework Emergency Response Plan and Oil Spill Contingency Plan (OSCP/ERP) contained in this EIA (Part B of Volume II) should be updated when well locations are defined, and should be submitted to MICOA and INP. The OSCP/ERP should follow the Mozambican National Oil Spill Contingency Plan (2006), and it should consider local resources and the need to acquire or contract services within the Southern Africa region for a rapid response to reduce the impacts from an accidental oil spill.

A Waste Management Plan has been included in this EIA (Part B of Volume II). The drilling vessel should comply with regulations detailed in the Annex V of MARPOL 73/78, which clearly defines the procedures to be applied for each category of domestic waste.

All activities conducted during the scope of the project should comply with the legislation in force (Section 2 of Volume II of this EIA).

With proper implementation of the mitigation measures outlined in this EIA, the project is feasible from environmental and socio-economic viewpoints. If hydrocarbons are discovered in the offshore Rovuma Basin, revenues will add to the Gross National Product and generate foreign exchange and job opportunities.

At this point, the well locations have not been defined. Once established, this report and the EMP may require adjustments