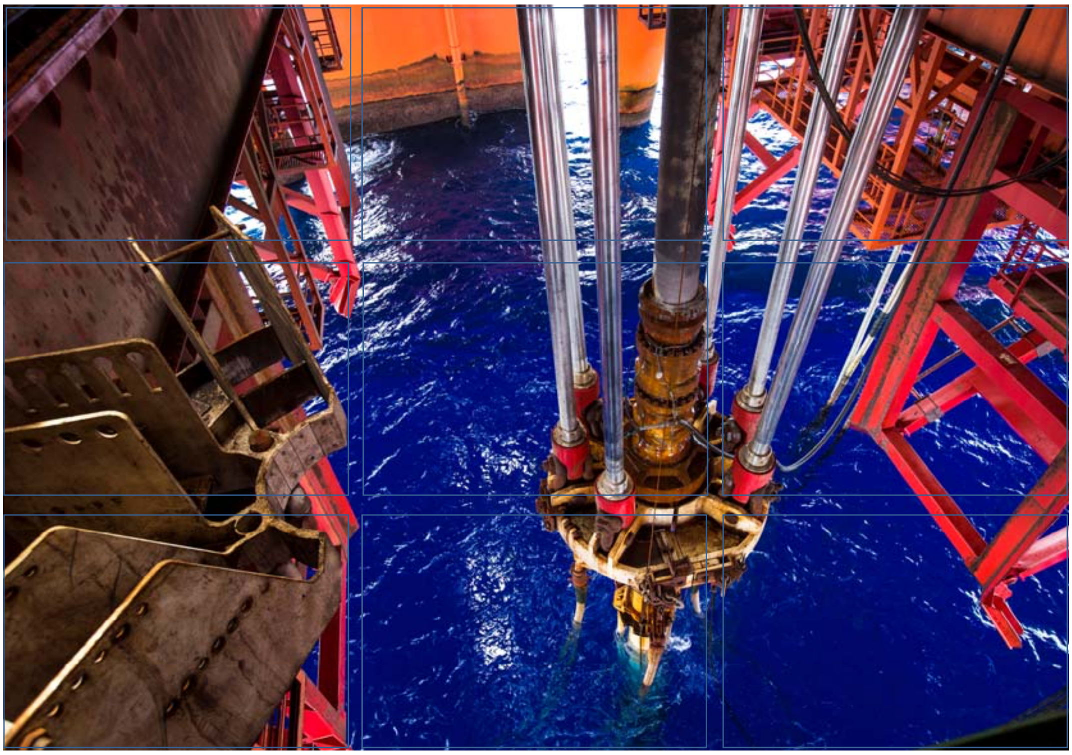

Environmental, Social and Health Impact Assessment (ESHIA) for an exploratory and appraisal drilling programme in Block 6, São Tomé e Príncipe

Prepared for:

GALP Energia São Tomé e Príncipe Unipessoal, Limitada

January 2019

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Environmental Resources Management Iberia S.A; in collaboration with Grupo L & R Nazare

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ACRONYMS

3D	3-dimensional
ACE	Africa Coast to Europe submarine communications cable
ALARP	As Low As Reasonably Practicable
ANP	National Agency of Petroleum (in Portuguese, *Agência Nacional do Petróleo*)
API	American Petroleum Institute
BAOAC	Bonn Agreement Oil Appearance Code
BAST	Best Available and Safest Technology
BO	Blowout scenario
BOD	Biochemical Oxygen Demand
BOP	Blow-out Preventer
BOPD	Barrels Of Oil Per Day
BWM	Ballast Water Management Convention
BWMP	Ballast Water Management Plan
CBD	United Nations Convention on Biological Diversity
CCAMN	STP Advisory Council (in Portuguese, *Conselho Consultivo da Autoridade Marítima Nacional*)
CHEC	China Harbor Engineering Company
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLC	Convention on Civil Liability for Oil Pollution Damage
CMS	Convention on Migratory Species
CNMC	National Committee on Climate Change (in Portuguese, *Comité Nacional para as Mudanças Climáticas*)
COD	Chemical Oxygen Demand
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
CONPRE	National Council for Prevention and Disasters (in Portuguese, *Conselho Nacional de Prevenção e Catástrofes*)
COSIM	Chemical/Oil Spill Impact Module
CR	Critically Endangered (IUCN designation)
DAH	Dissolved-phase Aromatic Hydrocarbon
DP	Directorate of fisheries (in Portuguese, *Direcção das Pescas*)
DPS	Dynamic Positioning System
DSV	Drilling Supervisor
DWT	Deadweight Tonnage
E&P	Exploration & Production
EEZ	Economic Exclusive Zone
EIA	Environmental Impact Assessment
EN	Endangered (IUCN designation)
ENAPORT	National Port Administration Company (in Portuguese, *Empresa Nacional de Admnistração dos Portos*)
ERM	Environmental Resources Management Iberia
ERP	Emergency Response Plans
ERT	Emergency Response Team

ESHIA	Environmental, Social and Health Impact Assessment
ESIA	Environment and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
FAD	Fish Aggregating Device
FAO	Food And Agriculture Organization
FLO	Fisheries Liaison Officers
FSV	Fast Support Vessel
GCLME	Guinea Current Large Marine Ecosystem
GDP	Gross Domestic Product
GEMSS	Generalized Environmental Modelling System for Surface waters
GHG	Greenhouse Gases Emissions
GIFT	Generalized Impact Fate and Transport
GNI	Gross National Income
GOM	Gulf of Mexico
GWP	Global Warming Potential
HOCNF	Harmonised Offshore Chemical Notification Format
HOCNS	Harmonised Offshore Chemical Notification Scheme
HPWHH	High Pressure Wellhead Housing
HSE	Health Safety and Environment
HSSE	Health, Safety, Security and Environment
HYCOM	HYbrid Coordinate Ocean Model
IADC	International Association Of Drilling Contractors
IAEA	International Atomic Energy Agency
IBA	Important Bird Area
ICCAT	International Convention for the Conservation of Atlantic Tunas
IFC	International Finance Corporation
IMAP	Maritime and Ports Administration (in Portuguese, *Instituto Marítimo e Portuário*)
IMO	International Maritime Organization
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
IPIECA	Oil and Gas industry association for environmental and social issues
ISPPC	International Sewage Pollution Prevention Certificate
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
LC	Least Concern (IUCN designation)
LD	Large Diesel spill scenario
LLI	Long Lead Items
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MINRE	Ministry of Infrastructure, Natural Resources and Environment (in Portuguese, *Ministério das Infraestruturas, Recursos Naturais e Ambiente*)

MMO	Marine Mammal Observer
MMSCF, MMscf	Million Standard Cubic Feet
MSDS	Material Safety Data Sheets
MSL	Mean Sea Level
NADF	Non-Aqueous Drilling Fluid
NAPA	National Adaptation Program of Actions
NBSAP	National Biodiversity Strategy Action Plan
NCEP	National Centers for Environmental Prediction
NCS	Norwegian Continental Shelf
NCDC	National Climatic Data Center
NDC	Nationally Determined Contributions
NMA	National Maritime Authority
NOAA	National Oceanographic and Atmospheric Administration
NOEC	No Observable Effects Concentration
NT	Near Threatened (IUCN designation)
NTM	Notice To Mariners
O&G	Oil & Gas
OCNS	Offshore Chemical Notification Scheme
OIM	Offshore Installation Manager
OOC	Oil On Cuttings
OSCP	Oil Spill Contingency Plan
OSPAR	Oslo-Paris Convention
OSRS	Oil Spill Response Strategy
PAD	Pump And Dump
PAHs	Polycyclic Aromatic Hydrocarbons
PLONOR	List of Substances Used and Discharged Offshore which Are Considered to Pose Little or No Risk to the Environment
PSV	Platform Support Vessels
PTS	Permanent Threshold Shift
RAMSAR	Convention on Wetlands of International Importance
ROC	Retained Oil on Cuttings
ROV	Remotely Operated Vehicle
SAR	International Convention on Maritime Search and Rescue
SCF, scf	Standard Cubic Feet
SIDS	Small Island Developing States
SMA	System of Maritime Authority
SMPEP	Shipboard Marine Pollution Emergency Plan
SOBM, SBM, SBF	Synthetic Based Muds/Fluids
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SS	Semi-submersible
SST	Sea surface temperatures
STCW	International Standards of Training, Certification and Watch keeping Convention
STI	Sexually Transmitted Infections
STP	São Tomé e Príncipe
TCP	Tubing Conveyed Perforation

TSS	Total Suspended Solids
TVDSS	Total Vertical Depth Sub-Sea
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USCS	United States Continental Shelf
VSP	Vertical Seismic Profiling
VU	Vulnerable (IUCN designation)
WBM	Water Based Mud
WHO	World Health Organization
WMP	Waste Management Plan

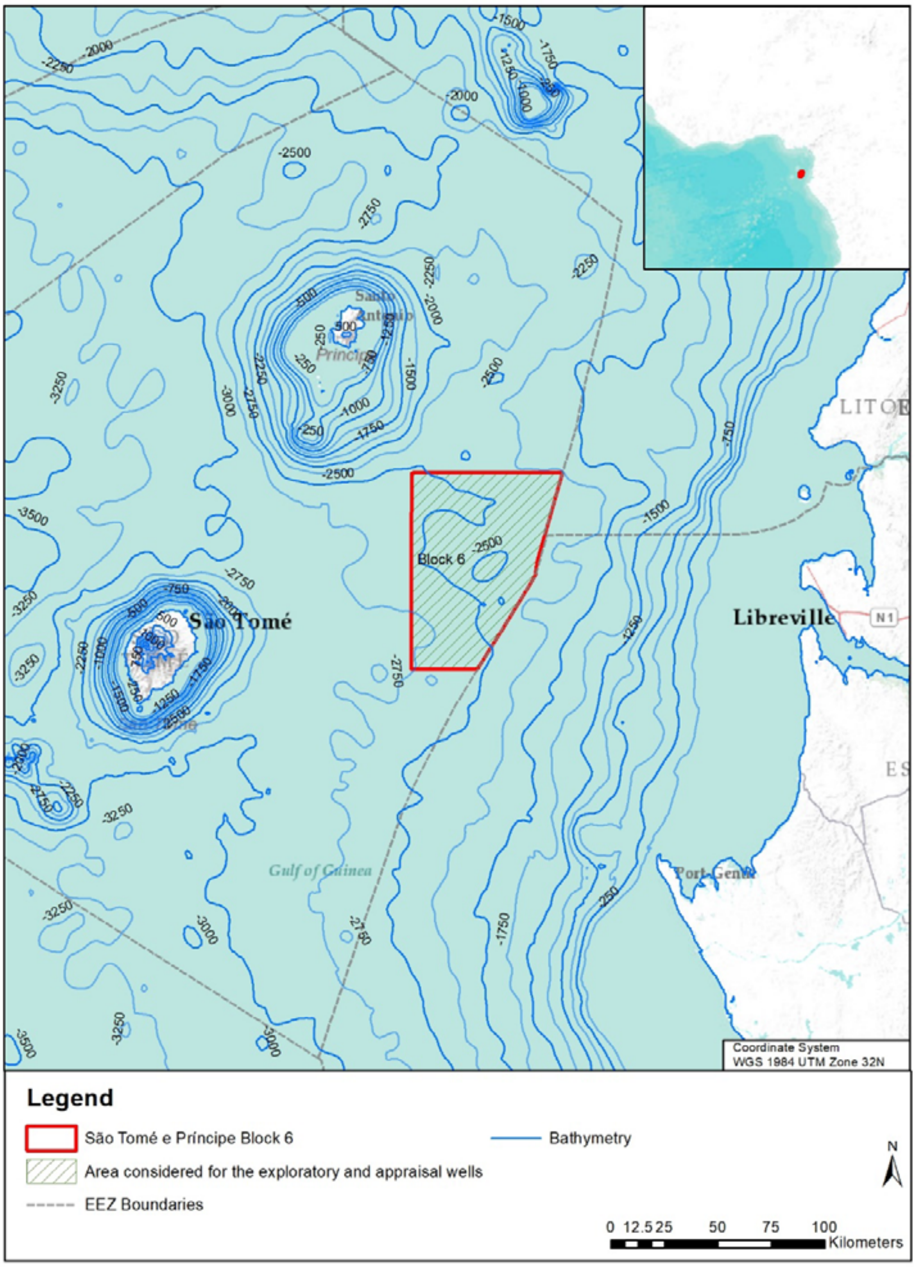
Non Technical Summary

This document presents the results of the Environmental, Social and Health Impact Assessment (ESHIA) for the exploratory and appraisal drilling programme proposed by GALP in Block 6, São Tomé e Príncipe. This document has been prepared by *Environmental Resources Management Iberia S.A* (ERM), in collaboration with local STP consultancy *Grupo L & R Nazare*.

The proposed project area lies at a minimum distance of 100 km to the north east of São Tomé Island and 65 km southeast of Príncipe Island, in water depths varying between 2,275 and 2,590 meters (see *Figure 0.1*).

Due to the proximity of Block 6 with Blocks 5, 11 and 12 in São Tomé and Príncipe, GALP has agreed with Block 5, Block 11 and Block 12 Operator (KOSMOS Energy) to develop a coordinated offshore drilling campaign along the four Blocks (5, 6, 11 and 12). As a result of this partnership the configuration of the Project has been designed covering the four Blocks. Nevertheless, according with São Tomé e Príncipe legislation and as required by the authorities, this document covers the potential impacts related only to Block 6.

Figure 0.1 *Location of São Tomé and Príncipe Block 6*



Source: ERM, 2018

Legislation, legal and institutional framework standards

In São Tomé and Príncipe, the main environmental institution is the Ministry of Infrastructure, Natural Resources and Environment (MINRE; *Ministerio das Infraestruturas, Recursos Naturais e Ambiente*). It is the competent body responsible for aspects related with natural resources management, conservation and environment, including environmental management of in-country resources and approval of all sector ESHIAs.

Key regulations, legislation, as well as international conventions and standards relevant to the Project, are summarized in *Table 0.1*.

Table 0.1 Key São Tomean regulations and international conventions relevant to the Project

	Thematic	Reference
National Framework	Environment	Law No. 10/1999 Environmental Law
		Decree No. 37/1999 relative to Environmental Impact Assessments.
		Law No. 11/1999 relative to the protection of flora and fauna and the creation of protected areas.
		Law No. 9/2001 on Fisheries.
		Health, Safety and Environment provisions in ANP-STP's Regulation of Petroleum activities of 2010 applicable within the Economic Exclusive Zone (EEZ).
	Hydrocarbons	Law No. 16/2009 Petroleum Operation Law.
		São Tomé and Príncipe Petroleum Operations Regulations (2010 - 28º Supl., DR n.º114).
		Decree-law No. 57/09. On the exploration zones and petroleum Blocks.
	Air, Effluents, Waste and protected areas	Law No. 13/2007 relative to the regulation of safe seas and preventing marine pollution.
		Law No. 4/2003 on the management of cultural and natural heritage and its registration.
		Decree No. 36/1999 relative to waste management and disposal within the country.
	Health and Safety	Law No. 14/2007 Safety, hygiene an health Law.
	Water and Maritime Protection	Law No. 7/2018 framework law for water resources management
		Decree-law 2/2018 framework for maritime security
		Decree-law no 03/2018 creates the System of Maritime Authority (SMA)
		Decree-law no 4/2018 creates the National Maritime Authority (NMA)
		Decree-law no 5/2018 establishes the legal framework for offenses in the areas under maritime jurisdiction
Key International Conventions	Marine Resources	Convention on Cooperation for the Protection, Management and Development of Marine and Coastal Environment (Abidjan Convention, 1984).
		United Nations Convention on the Law of the Sea (UNCLOS, 1982).
		Convention on the International Maritime Organization (IMO; 1948).
	Prevention of marine pollution	International Convention for the prevention of Pollution from Ships - MARPOL (1973/1978).
		International Convention on Civil Liability for Oil Pollution Damage (CLC, 1992).
	Flora, Fauna and Protected Areas	Convention on the Conservation of Migratory Species (Bonn Convention, 1979).
		Memorandum of Understanding concerning Conservation Measures of Marine Turtles of the Atlantic Coast of Africa (1999).
		International Convention for the Conservation of Atlantic Tunas (ICCAT, 1969).
		African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968).

	Thematic	Reference
		Convention on Wetlands of International Importance (Ramsar Convention, 1971).
	Chemicals and Waste	Bamako Convention on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1991).
		Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989).
International Standards	Environment, health and safety	IOGP n°254 (1997) - Environmental management in oil and gas exploration and production
		IOGP n°342 (2003) - Environmental aspects of the use and disposal of non aqueous drilling fluids associated with offshore oil & gas operations
		IOGP n°389 (2007) - Environmental/Social/Health risk impact management process.
		IOGP n°475 (2012) - Managing Oil and Gas activities in coastal areas
		IOGP n°543 (2016) - Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations
		IOGP n°557 (2016) – Drilling waste management technology review
		IPIECA (2003) - The Oil and Gas Industry: Operating In Sensitive Environments.
	Marine fauna	JNCC Guidelines for minimising the risk of injury to marine mammals from geophysical surveys (2017).
GALP's Standards and Policies	Environment, health and safety	GALP's HSE Management System (System G+) based on the HSE Internal Reference.

Source: ERM, 2018.

Project description

GALP proposes to undertake exploration and appraisal activities in STP's Block 6 to evaluate the viability of the Block resources. In particular, Block 6 STP has a surface of 5,023.82 km² and is located at a minimum distance of approximately 63 km off the Coast of Principe Island (and approximately 100 km from Sao Tome Island).

The Block 6 exploration and appraisal wells are expected to be drilled with either a drillship or a semi-submersible (SS) rig. Three Platform Support Vessels (PSVs) will transport supplies between the drillship/SS and the onshore supply base. Staff transfers between São Tomé and the drillship/SS will be via helicopter, from the STP airport. The GALP offices will be located at São Tomé, from where all operations will be organized and managed. However, due to the lack of current port facilities in STP, the onshore logistic support base for the Block 6 drilling activities will be located at in a neighbouring country.

Exploration drilling activities are expected to commence between mid Q3 2019 and Q1 2020. The expected total campaign duration for Block 6 is expected to last between 210 and 270 days for a 3 well campaign considering a well drilling duration ranging from 50 days up to 70 days approximately (with some additional days expected, considering mobilization to next well site); and appraisal activities in one or two of these wells of up to 30 days duration each. Depending on the equipment configuration and the weather conditions, the expected duration of the program planned for the 4 blocks can last up to 3 calendar years, although the effective days of work will be less.

The exploration and appraisal drilling campaign will comprise the following phases:

1. Drillship/SS rig Mobilisation;
2. Pre-drilling activities;
3. Drilling and well construction;
4. Complementary activities (well testing/flaring; geophysical surveys);
5. Plugging & Abandoning of the well (P&A);
6. Demobilisation; and
7. Onshore activities (concurrent with activities 1-6) including support activities and office activities (i.e. storage spaces, fuel supply, equipment services, etc.)

A drilling project can have the following types of impacts, which are assessed in the ESHIA:

- Impacts to sea water and seabed sediment as a result of the wastewater which will be released from the project vessels.
- Impacts to sea water and seabed sediment as a result of the disposal of certain types of drilling 'mud' (fluids used during the drilling process) and 'cuttings' (fragments of rock from the drilling process) into the sea.
- Effects on animals such as whales, turtles and fish, due to the drilling activities, in particular the presence of the project vessels and the noise that will be produced by drilling activities.
- Localized and short term pollution of the atmosphere and contribution to greenhouse gases around the drilling locations, as a result of emissions from the Project vessels and well testing activities.
- Disturbance to fishing activities, and other vessels such as commercial shipping using the Project Area.
- Positive (but limited) impacts such as employment opportunities through existing in-country suppliers and subcontractors.
- Unlikely effects from accidental events, such as hydrocarbon/ crude spills and diesel spills from vessels.

Description of the baseline environment and social

Climate
In the Gulf of Guinea, where São Tomé e Príncipe islands are located, the climate is typically equatorial and therefore sees little variation throughout the year with typically persistent high temperatures and frequent spells of high humidity.

The regional climate of São Tomé e Príncipe is driven by the northward and southward migrations of the Inter-Tropical Convergence Zone (ITCZ) associated with the south west monsoon and the Northeast Trade Winds, and leading to two main seasons, dry and wet.

The dry season in São Tomé and Príncipe islands occurs from December to February and from June to September, while the wet season takes place between March and May and from October to November.

Mean annual rainfall ranges from 1,000 mm in the northeast of São Tomé island to more than 4,000 mm in the southwest. Average annual temperatures range from a maximum of 30° to 33°C to a minimum of 18° to 21°C, with little seasonal variation and high humidity all year.

Oceanographic conditions
Water circulation in the Gulf of Guinea is dominated by the Guinea Current that runs parallel to the coast from Senegal to Nigeria and the South Equatorial or Benguela Current that flows northwards along the coasts of STP and then turns westward along the equator.

The predominant surface current in Block 6 is therefore the South Equatorial Current (Benguela Current) that flows westwards.

The continental shelf around São Tomé and Príncipe islands is characterized by being very narrow and limited to 5-10 km. The area where the proposed drilling activities are to be located lies in waters where depths vary between approximately 2,275 m in the northeast edge of Block 6 and 2,590 m in its extreme southwest.

Marine ecological sensitivity
Block 6 is located within the Guinea Current Large Marine Ecosystem (GCLME), characterized by a water column overlying the West African continental shelf which is fed by seasonal upwelling of nutrient rich water, particularly during the rainy seasons as a result of offshore winds. This phenomenon supports high phytoplankton productivity that in turn supports a diverse marine ecosystem and associated fisheries.

The main fish groups encountered in the waters of Sao Tomé and Príncipe are pelagic and demersal fishes, many of them of commercial interest, as well as 27 species considered to be threatened according to the IUCN red list.

The Project area is important for many migratory species, especially marine mammals, marine turtles and birds.

The Waters of São Tomé and Príncipe host up to 28 cetacean species. Three of them are assessed as endangered, the Blue whale (*Balaenoptera musculus*), the fin whale (*Balaenoptera physalus*) and Sei whale (*Balaenoptera borealis*), that could be present along the coasts of São Tomé and Príncipe during their annual migration, mainly in summer and early autumn. The sperm whale (*Physeter macrocephalus*), assessed as vulnerable by the IUCN, is also known to forage in the Gulf of Guinea.

The Gulf of Guinea serves also as an important migration route, feeding ground, and nesting site for sea turtles, where five species may be observed, all of them assessed as threatened on the IUCN Red list and protected by international agreements. Based on data from from STP and nearby Island of Bioko, olive ridley (*Lepidochelys olivacea*), hawksbill (*Eretmochelys imbricate*), green (*Chelonia mydas*) and leatherback (*Dermochelys coriacea*) turtles are considered to nest regularly in Saotomean beaches, mainly between October and February; with a fifth species the loggerhead turtle (Caretta caretta) present in the offshore but not known to nest in STP beaches.

Seabirds are abundant over the continental shelf but several species can also be present further offshore, along the project area in Block 6, where they can be observed feeding.

Fisheries in the Project area
Fisheries in São Tomé and Príncipe are exploited through artisanal, semi-industrial and industrial fleets. In the region, the fisheries sector provides a major source of employment and foreign currency, and represented 4.7% of national GDP in 2012.

The offshore waters, where the drilling activities are planned are mainly exploited by semi-industrial and industrial fleets, most of foreign origin. They target small pelagics such as the round sardine (*Sardinella aurita*), European anchovy (*Engraulis encrasicolus*) and jacks (*Caranx spp.)* as well as large migratory pelagic fishes such as tuna (*Katsuwonus pelamis, Thunnus albacores* and *T. obesus).*

Assessment of impacts

The present ESHIA document is focused on activities to be carried out in Block 6. However, provided that the exploratory and appraisal drilling programme will be developed jointly along Blocks 5, 11 and 12, certain impacts have been assessed for the whole project along the four Blocks (i.e. atmospheric emissions) as the potential effects of these cannot be considered independently.

The ESHIA refers to the resulting impacts to the environment or people in terms of their 'significance.' As so, the purpose of the impact assessment is:

- To identify and evaluate the significance of potential impacts on identified physical, biological and social receptors and resources;
- To develop and describe mitigation measures that will be taken to minimise any potential adverse effects and enhance potential benefits; and
- To report the significance of the residual impacts that remain following mitigation.

Impact significance categories for potential environmental and social impacts are illustrated in *Table 0.2*. Significance is assessed as the combination of magnitude and receptor quality/importance/sensitivity to evaluate whether an impact is, or is not, significant and if so its degree of significance.

Table 0.2 ***Overall Significance Criteria for Impacts in the ESHIA***

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

Source: ERM, 2018

Significance of potential impacts is devised from a combination of the predicted magnitude of an impact, taking into consideration all the mitigation measures; and the sensitivity of the receptor. As so, impacts are ranked as being negligible, or of minor, moderate or major significance.

The methodology adopted for the ESHIA is consistent with the methodology being used by GALP and ERM in the environmental and social assessment of potential effects of offshore activities in STP and in other areas around the world.

The definitions for the four categories of impact significances are the following:

- Negligible impact is where a resource or receptor will not be affected in any way by a particular activity or the predicted effect is deemed to be "imperceptible".
- Minor impact is where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity.
- Moderate impact is an impact within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below

- which the impact is minor up to a level that might be just short of breaching the legal limit.
- Major impact is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors.

The main sources of impacts and receptors are summarized in *Table 0.3.*

Table 0.3 Block 6 Exploratory and Appraisal Drilling Campaign Impacts Matrix

				Physical Environment			*Biological Environment*							*Social Environment*				
				Air Quality and Climate Change	*Sea water Quality*	*Seabed and sediments*	*Plankton*	*Benthic communities*	*Fishes*	*Sea turtles*	*Marine Mammals*	*Seabirds*	*Sensitive coastal areas*	*Navigation, traffic and sea users*	*Fisheries*	*Local economy, employment and livelihoods*	*Local Infrastructures and Services*	*Community and Workers Health and Safety*
#Sources of Potential impact	***Exploratory and Appraisal drilling Campaign***	***Routine Events***	1 *Mobilization and demobilization of the drillship/SS*	***A1***						***T1***	***M1***			***NT1***	***FS1***			
			2 *Physical presence of the drillship/SS and support vessels*							***T1***	***M1***	***SB1***		***NT1***	***FS1***			
			3 *Operation of the support vessels and helicopters*	***A1***								***SB1***		***NT1***		***E1***		
			4 *Operation of the drilling unit*	***A1***					***F1***	***T2***	***M2***			***NT1***	***FS1***	***E1***		
			5 *Operation of the onshore facilities (supply base and helibase)*										***SA1***			***E1***	***I1***	***C1***
			6 *Vertical seismic profiling (VSP) operations*					***B2***	***F1***	***T2***	***M2***			***NT1***	***FS2***			
			7 *Well testing (flaring)*	***A1***														
			8 *Use of local goods and services*													***E1***		
			9 *Waste generation and management including the production of wastewater discharges*		***W1***		***P1***		***F2***	***T3***	***M3***	***SB2***			***FS3***	***E1***	***I1***	***C1***
			10 *Drill cuttings and muds discharges*		***W2***	***B1***	***P1***	***B1***	***F2***	***T3***	***M3***							
			11 *Freshwater treatment, storage and consumption*													***E1***	***I1***	
		Accidental Events	12 *Spills of mud, hydrocarbons from the well bore (e.g. blow-out) or fuel (diesel) spills from vessels or drillship/SS*	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***	***AE1***

Source: ERM, 2018

A1	*Impacts on air quality and climate change due to the release of air pollutants*	*M3*	*Impacts on marine mammals due to the change of seawater quality due to effluents and waste to the sea*
W1	*Impacts on seawater quality due to the discharge of effluents and waste to the sea*	*SB1*	*Impacts on seabirds due to the physical presence of the drillship/SS and to the operation of the support vessels*
W2	*Impacts on seawater quality due to the discharge of drill cuttings and muds*	*SB2*	*Impacts on seabirds due to the waste generation and management*
B1	*Impacts on seabed and benthic communities due to the discharge of drill cuttings and muds*	*SA1*	*Impacts on sensitive coastal areas due to the operation of the onshore facilities*
B2	*Impacts on benthic communities derived from the generation of noise emissions during VSP activities*	*NT1*	*Impacts on Navigation and Traffic / Sea users*
P1	*Impacts on plankton due to the change of seawater quality due to effluents and waste to the sea*	*FS1*	*Impacts on Fisheries due to the presence and operation of the drillship/SS and support vessels*
F1	*Impacts on fishes due to the generation of noise emissions during VSP activities*	*FS2*	*Impacts on Fisheries due to the generation of noise emissions during VSP activities*
F2	*Impacts on fishes due to the change of seawater quality due to effluents and waste to the sea*	*FS3*	*Impacts on Fisheries due to the change of seawater quality as a result of effluents discharge to the sea*
T1	*Impacts on sea turtles due to the mobilization, demobilization and presence of the drillship/SS*	*E1*	*Impacts on Local economy, employment and livelihoods*
T2	*Impacts on sea turtles due to the generation of noise emissions during VSP activities*	*I1*	*Impacts on Local Infrastructures and Services*
T3	*Impacts on sea turtles due to the change of seawater quality due to effluents and waste to the sea*	*C1*	*Impacts on Community Health and Safety*
M1	*Impacts on marine mammals due to the mobilization, demobilization and presence of the drillship/SS*	*AE*	*Impacts due to potential accidental events (hydrocarbon spills)*
M2	*Impacts on marine mammals due to the generation of noise emissions during seismic (VSP) activities*		

Table 0.4 presents a summary of the significance of residual impacts (after implementation of mitigation measures) resulting from the exploratory and appraisal drilling programme planned by GALP in the São Tomé and Príncipe Block 6.

Table 0.4 Summary of Potential Impacts

Receptor	Potential Impact	Impact Significance
Air Quality and Climate Change	• Potential reduction in localized air quality and contribution to greenhouse gases.	**Negligible**
Seawater Quality	• Potential localized reduction in water quality, including increased turbidity and BOD. • Potential introduction of alien invasive species from ballast water discharges.	**Negligible** (routine effluents and ballast waters) **Negligible** (discharge of cuttings and muds)
Seabed and Benthic communities	• Generation of noise emissions. • Loss of seabed, habitats and benthic fauna in the direct footprint of the well and where cuttings and cement are deposited. • Potential localized and short term increase in total suspended solids (TSS) in the water column and near the seabed. • Impacts on sediment quality and benthic organisms from contaminants contained in WBM directly discharged to seabed and NADF coated in cuttings discharged from the drillship/SS.	**Negligible** (noise) **Negligible** (change in water quality)
Plankton	• Potential localized increase in organic matter and reduction in water quality.	**Negligible**
Fish	• Impacts due to the generation of noise emissions. • Secondary impacts due to changes in water quality.	**Negligible**
Sea Turtles	• Disturbance from the presence of Project vessels. • Potential collision risk with Project vessels. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Minor** (physical presence and risk of collision) **Negligible** (noise and secondary impacts due to changes in seawater quality)
Marine Mammals	• Disturbance from the presence of Project vessels. • Potential collision risk with Project vessels. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Minor** (physical presence, risk of collision and noise generated by VSP) **Negligible** (secondary impacts due to changes in seawater quality)
Seabirds	• Disturbance from the presence and movements of Project vessels and helicopter flights. • Secondary impacts due to changes in water	**Minor** (physical presence and helicopter flights)

Receptor	Potential Impact	Impact Significance
	quality.	**Negligible** (secondary impacts due to changes in seawater quality)
Sensitive coastal areas	• Disturbance to sensitive coastal areas from onshore activities.	**Negligible**
Oher Marine Users	• Impacts to maritime traffic. • Increase of collision risk.	**Negligible**
Fisheries	• Impacts due to the presence of drillship/SS and associated exclusion area for fisheries. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Negligible** (presence of Project vessels) **Negligible** (impacts from underwater noise and from water quality changes)
Local Economy	• Impacts on local economy, livelihood and employment.	**Minor (positive)**
Local Infrastructure and Services	• Impacts on submarine infrastructures (i.e. marine cables). • Impacts on local water network.	**Negligible**
Community and Workers Health & Safety	• Worker-community interactions resulting in lack of appreciation of local customs. • Use and handling of hazardous materials.	**Minor**

Source: ERM, 2018.

Project Impacts and Mitigation

The ESHIA process identified a number of mitigation measures that should be conducted to ensure that environmental and social impacts are reduced to a point where they have no adverse effects, and to create or enhance positive impacts such as environmental and social benefits.

Impacts to Air Quality and Climate Change

Air quality could be affected by the project due to the emissions from drillship and support vessel engines (including the drilling unit's dynamic positioning thrusters), power generation exhausts and helicopter operations.

Due to the distance from shore where most activity will occur, the majority of project related pollutants are expected to disperse quickly and to not reach the coast. There will be emissions near the coast as the platform supply vessels (PSV) move to and from the supply base. The dispersion rate of this type of emissions is expected to be high, due to the project's offshore location and the fact that many of the sources are mobile sources.

Effects on air quality will be localized and temporary at the vessels location. In addition, background levels of pollutant concentrations are expected to be reached within tens of meters from the sources, and in any case pollutants are not expected to reach onshore receptors.

All project vessels will comply with standard requirements such as the international 'MARPOL' standard which specifies limits relating to emissions to air. All propulsion systems, exhausts systems, and power generation equipment will also be well maintained for optimal efficiency and the fuel consumption of all vessels will be regularly monitored. Low-sulphur fuel used will be used where possible.

Based on these considerations, and the above measures that will reduce air quality impacts, the potential impact on air quality was assessed in the ESHIA as Negligible. The Project's greenhouse gas emissions were also assessed as Negligible.

Impacts to Seawater Quality

The project could affect water quality due to the fact that the project vessels will release wastewater discharges to the sea. The drilling process will also affect water quality by releasing some drilling 'mud' and 'cuttings' to the sea. Vessels will also be required to ballast/de-ballast which may also affect water quality. Finally, water quality could be affected if an accidental event such as an oil spill occurred.

Vessel discharges to sea are regulated under established legislation, for instance the internationally accepted International Convention for the Prevention of Pollution from Ships (the 'MARPOL' convention) specifies applicable standards for what may be discharged to the sea. These requirements will be complied with at all times.

In regard to wastes from the actual drilling process, before any cuttings and muds are disposed of to the sea, they will be treated on board to limit the amount of drilling fluid that will remain on them (Retention on Cuttings, ROC). Discharge limits for drill cuttings and drilling muds will be met in accordance with GALP's Standards and Policies and the volume discharged will be regularly monitored.

After consideration of all the standard management practices that will ensure liquid discharges, cuttings and drilling muds disposed to the sea are all within acceptable standards, the combined residual impact to water quality from the Project's activities has been assessed in the ESHIA as Negligible significance.

Impacts to Biodiversity

A number of protected species are known to be present in São Tomean waters at different times of year, including marine mammals, marine turtles and fish. Other animals present in the area include coastal and marine birds, and benthic fauna (animals that live on the seabed).

Impacts on biodiversity from the project could result from the physical presence of project vessels and helicopters (e.g. due to a vessel colliding with a whale or turtle, or disturbance to such species from vessel noise or Vertical Seismic Profiling (VSP) activities which are used in order to build a better understanding of the subsurface features). The drilling of the seabed and release of drill cuttings to the sea has also the potential to affect benthic fauna and fish as it could affect the quality of the water that they live in or will swim through. Unplanned events (e.g. oil spills offshore) could affect marine biodiversity if a spill were to occur. Finally, the ballasting / deballasting of vessels could also potentially introduce non-native species and pathogens to the water of the project area if this is not properly managed.

Various measures will be taken to ensure that the potential for these impacts is minimised. For example, a Marine Fauna Observer will be present onboard the drillship/SS during VSP activities and maintain watch for marine mammals and sea turtles and all project vessels operators will maintain a watch for marine mammals and turtles, and take avoidance action should a collision seem likely and when safe to do so. VSP activities will be started up and then increased slowly to give marine species the chance to move away, mitigating the impact of this activity. Helicopter flight paths and operations will also be designed to minimise impacts to environmentally sensitive species and areas. Project vessels will use designated and relevant speed restrictions where possible.

In relation to the disposal of drilling cuttings to sea, as mentioned in seawater quality impacts, before any cuttings are disposed of to the sea, they will be treated on board in accordance to GALP's Standards and Policies and regularly monitored.

A seabed inspection will be undertaken using a Remotely Operated Vehicle (ROV) around the drilling point before and after the drilling operations. This seabed imagery will be taken as part of GALP's monitoring system and thus the images will be taken in the near vicinity of the wells. The seabed imagery conducted will be documented and shared with relevant stakeholders.

The potential residual effects on marine fauna are assessed to be of Negligible significance and Minor significance for marine species (the ranking is different depending on the type of animal and the impact). This is because any impacts that will occur will only affect a very small area of the overall range for the species concerned, the effects will have a limited duration and because of the various mitigation measures that GALP will put into place. Marine environmental data such as opportunistic marine fauna sightings will be documented and shared with relevant stakeholders to deepen the knowledge of the São Toméan offshore environment.

Impacts on Other Marine users and fisheries

For safety reasons, there will be a 500 m exclusion zone around the drilling unit. This means that other vessels will not be allowed into this zone while each well is being drilled. The size of the area which the Project will restrict from industrial fishing is small relative to available fishing areas; and the duration of the project is limited to 270 days. The vessels which will be affected by this exclusion zone include commercial vessels, semi-industrial and industrial tuna fishing vessels. Artisanal fishing vessels will not be affected by the exclusion zone as fishermen do not fish in such deep water so far offshore.

The supply vessels for the project will travel between the drillship/SS offshore and the supply base. There is therefore the potential that they could affect fishermen if they collide with any rafts. Engagement with fishing associations and local fishery administration will be carried out to gain advance knowledge of where rafts are most likely to be encountered.

A number of measures will be taken to minimise these potential impacts. Communication will take place with other vessels moving through the area to advise other vessels of the drilling unit's presence. A Notice to Mariners will be issued by the São Tomean government to provide advanced notice of the drillship/SS presence in the area so that they can plan alternative vessel routes. A grievance mechanism will be in place so that people can complain if they feel that they have been negatively affected by the Project.

Taking these management measures into account, the impact on other sea users' is assessed to be of Negligible significance for other marine users and for fisheries. From a safety perspective, it should be noted that all vessels will use pre-planned vessel routes to consider traffic and obstacles and all vessels will be equipped with collision risk reducing devices. The project also has an Emergency Response Plan which will address the steps to be taken if any incident occurs. From a marine security perspective, a surveillance mechanism will be set, limited to the drillship and supply vessels, and any potential suspicious activities will be reported as part of engagement activities.

Impacts to Local Economy, and Local Infrastructure and Services

The project will result in direct and indirect employment opportunities in the areas where onshore base and helibase will be located. It is estimated that a limited amount of local people will be hired. With regards to indirect employment opportunities, these cannot be estimated but they are equally expected to be limited. Taxes and purchase of local goods and services may also impact positively the local economy. Therefore there will be a small positive impact due to some local employment, but this is not a large employment opportunity for local people. GALP will maximise local hiring wherever practicable and will provide where relevant and appropriate training to local staff. Therefore the socio-economic impact of the Project is considered to be of Positive and Minor significance.

It is expected that local health infrastructures will only be used in case of emergency as so the impact is very limited.

Impacts to Community and Workers Health and Safety

An additional issue requiring consideration is the potential for increased transmission of diseases between project workers and local communities; although they are expected to have a short stay at São Tomé, this might occur when offshore workers are transiting on/offshore.

Various measures will be implemented to reduce the potential for these health impacts including for example, through regular health screening for employees.

Other negative interactions could occur around general social contacts, differing customs or lack of appreciation of local customs on the part of non-São Tomean workers. To minimize this risk, the Project workforce will be briefed on appropriate local code of conduct matters and cultural awareness.

Overall the significance of these potential impacts on Community and Worker Health and Safety has been considered in the ESHIA to be of Minor significance. This is due to the overall small scale of any worker community interactions due to the relatively small workforce and short periods in São Tomé, and the measures that will be implemented as discussed above.

Impacts from Accidental Events

The ESHIA has also addressed the potential for accidental events. It is possible that accidental oil spills during the project could occur: major spills of crude as a result of a well blow-out event or diesel from a vessel collision are still possible but highly improbable.

Diesel spill volumes are typically small. The worst case spill that could occur would be a spill of diesel due to the total rupture of the vessel's fuel tanks in a collision, which is extremely rare due to the navigational systems and procedures in use on the vessels.

The primary mitigation measure for avoiding the impacts of an accidental spill is to prevent any such spill from taking place through standard controls and checks, good maintenance of equipment and training of competent staff.

The project will have an emergency response system for the event of a crude spill incident due to a blow-out event. GALP will develop a comprehensive Oil Spill Contingency Plan (OSCP) to respond to any significant spill.

Overall the impact of spills is considered to be tolerable if mitigation renders them as 'ALARP' (As Low As Reasonably Practicable) on the basis that the most likely spills would be small scale, that these likely spills can be mitigated via the project oil spill response measures and effective spill response devices, and that large oil spills are highly unlikely to occur.

Environmental and Social Management Plan

In this ESHIA, no impacts were identified that could not be minimised to acceptable levels through the application of the proposed mitigation measures detailed in the impact assessment chapter and further described in the project´s Environmental and Social Management Plan (ESMP). The ESMP will ensure that all the mitigation measures provided for in the ESHIA are implemented while the Project is carried out, in accordance with the commitments made by GALP. The ESMP is to be considered a dynamic document that may be continuously revised as part of an on-going environmental management and improvement process.

The objectives of the ESMP are:

- To provide the mechanism to ensure compliance with STP legislation, GALP HSE policies, management system and procedures, international law and standards, and Oil & Gas industry best practices;
- To ensure that all the mitigation measures and all the commitments made by GALP and identified in the ESHIA report are taken into account during the project planning and operation phases;
- To provide a framework for mitigating impacts that may be unforeseen or unidentified;
- To establish an environmental surveillance and monitoring programme so that the ESMP can be updated and improved as the project progresses.

Based on the key identified impacts, specific operational controls and mitigation procedures have been considered for the following environmental and social aspects:

- Sensitive marine fauna protection: the project will adopt the Joint Nature Conservation Committee (JNCC, 2017) guidelines for minimising the risk of disturbance and injury to marine mammals from geophysical surveys. These guidelines will further protect other marine fauna such as turtles through the use of: marine mammal observers (MMO), visual monitoring and VSP operation protocols (i.e. soft start, restart procedures).
- Oil pollution emergency procedures: in order to ensure effective management of refuel operations a Shipboard Oil Pollution Emergency Plan (SOPEP) will be in place before commencement of operations.
- Waste management procedures: the development of a Waste Management Plan (WMP) in accordance with MARPOL 73/78 (Annex V) and other relevant guidelines for the storage, collection and disposal of all identified waste streams, and especially with regards to hazardous substances.
- The ESMP further establishes the procedures set forth to effectively implement all proposed actions, relevant information to be communicated and change management procedures when modifications of the ESMP may be warranted.

ESHIA Report

1 INTRODUCTION

1.1 OBJECTIVE OF THIS REPORT

This document presents the results of the Environmental, Social and Health Impact Assessment ("ESHIA") undertaken for the exploratory and appraisal drilling programme proposed by GALP in the Block 6, in São Tomé e Príncipe. This document has been prepared by *Environmental Resources Management Iberia S.A* ("ERM").

1.2 PROJECT BACKGROUND

Following the acquisition and interpretation of 3-dimensional (3D) seismic data in 2017 in Block 6, GALP plans to drill up to three wells within Block 6 that depending from the results can be exploratory or appraisal wells. The exact proposed location for the prospective wells within the Block was still unknown at the time of writing of the ESHIA but it is expected that in most cases wells they will be located within the seismic survey area studied by GALP.

GALP will coordinate the drilling campaign that will be performed in Block 6 with the drilling campaign that is planned to be performed by the Company KOSMOS Energy in adjacent Blocks 5, 11 and 12 (subject to standalone ESHIAs each).

For projects of this type in São Tomé e Príncipe, there is a legislative requirement to undertake an Environmental, Social and Health Impact Assessment (ESHIA) and to report the findings to the Ministry of Infrastructure, Natural Resources and Environment (MINRE). An ESHIA is a systematic process that predicts and evaluates the potential impacts that a proposed project may have on aspects of the physical, biological, socio-economic and human environment. Mitigation measures are developed as part of the project plan to eliminate, minimise or reduce adverse impacts and, where practicable, to enhance benefits.

This introductory chapter presents the scope of this ESHIA, provides details of the Project sponsors and the ESHIA team, outlines the approach taken and presents the structure of the ESHIA.

1.3 PRESENTATION OF THE PROPONENT

The proponent of this project is GALP Energia São Tomé e Príncipe Unipessoal, Limitada, a company wholly owned by GALP. GALP is a global energy company engaged in all segments of the energy mix and with operations ranging from exploration to marketing of oil products and natural gas. GALP offers efficient and environmentally sustainable energy solutions to consumers looking for the most flexible solutions for their home and mobility needs, as well as for industries looking to increase their productivity. GALP's businesses are segmented in 3 categories: Exploration & Production, Refining & Marketing and Gas & Power.

Exploration & Production (E&P) portfolio includes over 50 projects across seven countries at various exploration, development and production stages. These projects span across three core areas: the Santos basin pre-salt, in Brazil; onshore Angola and Mozambique. In 2017, GALP reached the 100 thousand barrels per day production milestone. In 2017 GALP reported an average production of 93 kboepd and a portfolio of reserves accounting for 965 Mboe on a 3P basis.

In 2015 GALP started its exploration campaign in São Tomé e Príncipe where it is currently present in 4 blocks. GALP has operated other exploration projects in Brazil, Morocco and Namibia.

Refining & Marketing
GALP is a leading player in Iberia, operating across the refining and marketing of oil products activities. GALP holds an integrated refining system with a total processing capacity of 330 thousand barrels of oil per day and a wide distribution network for oil products in Iberia and in selected African countries.

Gas & Power
GALP is focused on the supply of natural gas in Iberia and has been consolidating its trading activity in the international markets. The Company holds a power generation portfolio and has been expanding its presence in the Iberian electricity market, positioning itself as an integrated energy supplier.

1.4 PRESENTATION OF THE CONSULTANCIES IN CHARGE OF THE ESHIA

This document has been developed by Environmental Resources Management Iberia S.A, which is part of the ERM Group in collaboration with Saotomean local consultancy, Grupo L & R Nazare.

ERM is an international sustainability consultancy company employing approximately 5,000 people in more than 160 offices across the world.

ERM operates exclusively in the sustainability, environmental, social and health, risks and safety fields and the vast majority of its clients are private industrial clients or public sector clients of an industrial nature. ERM has been operating on the African continent for several decades mostly from its African and European offices in South Africa, Kenya, Mozambique, Tanzania, Senegal, Spain, Italy, France, Belgium, Germany and the United Kingdom. ERM's experience covers numerous sectors, particularly oil and gas, mining and power.

ERM has extensive experience in Projects in offshore environments in several geographies around the world, including the Gulf of Guinea and specifically in the block of concern for in the present Project. ERM has developed Offshore Impact Assessment Studies for seismic, drilling or development of Oil & Gas in São Tomé e Príncipe, and in other countries in Africa such as Gabon, Ghana, Equatorial Guinea, Angola, Morocco, Mauritania, Algeria, Libya, Egypt and Republic of Congo.

The L & R Nazare Group is an environmental consulting firm based in STP, able to deal with the various aspects of legislation and environmental studies in STP, monitoring of environmental conditions and activities subject to licensing. Their action is geared towards reducing negative environmental impacts aligned with current regulations, as well as the application of the most current techniques of environmental studies and biodiversity.

1.5 *PURPOSE OF THIS ESHIA*

The purpose of the ESHIA is to provide information to regulators, the public and other stakeholders to aid the decision making process. The main objectives of the ESHIA are therefore:

- to define the scope of the Project and the potential interactions of Project activities with the natural and social (including socio-economics and health) environment that should be defined and assessed during the ESHIA;
- to assess applicable national and international legislation, standards and guidelines, so as to allow for the various stages of the proposed Project to take into consideration the requirement of São Tomé e Príncipe legislation, GALP's HSE policies and standards and internationally accepted environmental guidelines;
- to provide a description of the proposed Project activities and the existing physical, biological, socio-economic and human environment that these activities may interact with;
- to assess the potential environmental and social impacts resulting from the Project activities and identify viable and practical mitigation measures and management actions that are designed to avoid, reduce, remedy or compensate for any significant adverse environmental and social impacts and, where practicable, to maximise potential positive impacts and opportunities that may arise due to the Project; and
- to provide the means by which the mitigation measures will be implemented and residual impacts managed, through the provision of an Environmental and Social Management Plan (ESMP).

1.6 REPORT STRUCTURE

The structure of this ESHIA follows the requirements *of* São *Tomé e Príncipe Decree No. 10/1990 and Decree No. 37/1990-03 relative to Environmental Impact Assessments*, with impact assessment methodology being in accordance with internationally accepted assessment criteria. The contents are summarised in *Table 1.1*.

Table 1.1 ESHIA report structure

Section	Title	Content
	Executive summary	Executive summary of the ESHIA for the benefit of the decision-makers and the public.
	Acronyms	A list of acronyms used during the report.
1	Introduction	Provides general context and justification for the ESHIA.
2	Legislation, legal and institutional framework	This chapter describes the São Tomé e Príncipe environmental legislation applicable to the Project, as well as applicable national and international best practice standards of environmental management, and GALP's HSE corporate management standards.
3	Project description	Technical description of the Project.
4	Description of the baseline environment	Analysis of the baseline data regarding the existing natural and socio-economic environment. Review of environmental sensitivities identified as having the potential to be affected by the Project.
5	Impact Assessment	Provides a description of past and current activities within the area of influence of the proposed survey, with a focus on existing and potentially existing impacts. Presents a screening matrix of the main environmental and social aspects of the Project activities, and a subsequent assessment of the positive and negative impacts of the Project on the natural and socioeconomic environment, including cumulative impacts. Description of the Project's intrinsic mitigation measures ("base case" taken into account in the ESHIA) and of any additional mitigation or compensation measures recommended by the ESHIA. Assessment of the Project's residual impact.
6	Environmental and social management plan (ESMP)	Compilation of the Project's mitigation and compensation measures in the form of a detailed plan to ensure that they are implemented at each stage of the Project.
	References	A list of references and bibliographic sources used for this report.
ANNEXES		
A	Oil Spill and Drill Cuttings Deposition Modelling	An annex containing a summary of the Oil Spill and Drill Cuttings Deposition Modelling.

Source: ERM, 2018

2 *LEGISLATION, LEGAL AND INSTITUTIONAL FRAMEWORK, STANDARDS*

2.1 *INTRODUCTION*

This chapter provides details on São Tomé and Príncipe's institutional framework, relevant authorities and applicable regulatory framework. It also describes relevant international conventions and agreements ratified or signed by São Tomé and Príncipe, as well as GALP Corporate HSES policies and guidelines.

2.2 *INSTITUTIONAL FRAMEWORK*

The Constitution is the overarching legislation of São Tomé and Príncipe. Under the Constitution, the government defines and executes the general administrative policies of the country. Legislative branch is held by the National Assembly (unicameral parliament) and the Government. The President is the Head of State and the Prime Minister leads the Government and assumes the executive role regarding state tasks.

There are four organs of sovereignty: the President, the National Assembly, the Government and the Courts. The President is elected by direct universal suffrage for a term of five years. The National Assembly is unicameral, composed of 55 members elected by direct popular vote for a term of four years. The Prime Minister and Head of Government is appointed by the President depending on the election results and the remaining members of the Government are appointed by the President, upon proposal by the Head of Government. The courts are independent of political power.

Presently, the XIV Constitutional Government is composed of 11 Ministries, whose fundamental roles and tasks are defined in the Decrees-Law no. 1/2015 and no 4/2016.

The main environmental institution in São Tomé and Príncipe is the Ministry of Infrastructure, Natural Resources and Environment (MINRE; *Ministerio das Infraestruturas, Recursos Naturais e Ambiente*). It is the competent body responsible for aspects related with natural resources management, conservation and environment, including environmental management of in - country resources and approval of all sector EIAs. The mandates are shared by two different services:

- Directorate General of Natural Resources and Energy (*Direção Geral dos Recursos Naturais e Energia*): It is responsible for permits related with the use of resources, such minerals, sand and gravel, industrial licensing, and intellectual property.

- Directorate General of Environment (*Direção Geral do Ambiente*): It is responsible for the execution of the government policy for the environment.

In addition, the Environmental National Council, created by Law no. 10/99, is an advisory institution for environmental aspects, including legislation and national plans.

The main regulatory body for the petroleum industry is the National Agency of Petroleum of São Tomé and Príncipe (ANP-STP; *Agência Nacional do Petróleo de São Tomé e Príncipe*), an institution under MINRE´s control, created by Decree-Law no. 5/2004, altered by Decree- Law 07/2014 and with its internal rules of procedure established by the Ministerial Order published on the 04/03/2005. According to its regulations, in conjunction with Law 16/2009 (Petroleum operation law), it is responsible for licensing, monitoring and compliance of oil and gas operations and also negotiates petroleum contracts on behalf of the government. In addition, the National Petroleum Council, created by Decree-law no. 03/2004, sets the State's general policies of hydrocarbons.

Other institutional organisms of relevance for the project are:

- The Directorate of Forests and Biodiversity (*Direção das Florestas*), under the Ministry of Agriculture and Rural Development´s control is responsible for biodiversity issues.
- The Directorate of fisheries (DP- *Direção das Pescas*), under the Ministry of Economy Finance, Commerce and International Cooperation and Blue Economy´s control, deal with issues related with fisheries, management of artisanal fisheries projects, registration of artisanal or industrial fisherman, surveillance and statistic registration of industrial vessels.
- ENAPORT – *Empresa Nacional de Admnistração dos Portos*. This state owned Ports Administration Company is responsible for the management of both port facilities of Sao Tome and Principle islands. In the ports of Sao Tome ENAPORT is responsible for Port Security.
- Maritime and Ports Administration- *Instituto Marítimo e Portuário* - IMAP , created by Decree-Law no. 32/2007, under the guidance of MINRE was established under the Maritime Safety and Pollution Prevention Act. Its main responsibilities are registration and certification of vessels, regulation of shipping, seafarers certification, implementation of IMO conventions, and all other maritime issues defined by the Law.

2.3 *REGULATORY FRAMEWORK*

Table 2.1 below describes applicable laws and regulations related to the Project activities and the relevant environmental aspects under analysis, as well as the applicable permits.

Table 2.1 Relevant national regulatory framework

Title	Description
Petroleum	
Law No. 16/2009 Petroleum Operation Law	Regulates the access, exercise and conduct of petroleum operations. The law contains eighteen chapters and eighty- five articles, establishing the rules of access, exercise and conduct of Petroleum Operations in all of the Territory. Its first and second chapters are devoted to the definition of terms and expressions, setting its scope of application, declaring the State as the owner of the petroleum deposits and defining the National Petroleum Agency (ANP) as the institution to whom all oil related issues are to be presented. The third chapter specifies the different types of Authorizations as (a) Prospecting – consisting of granting the rights to perform geological, geophysical and geochemical surveys in the Authorized Area (b) Petroleum Contracts, concluded by the National Petroleum Agency after approval by the Government, based on the model of a "Production Sharing Contract" or in the form of a "Risk-Service Contract". The following two chapters (IV and V) define the procedure for invitation, bidding and State participation. Chapter VI defines basic rules, rights and obligations of all the parties related to the conduct of Petroleum Operations. Chapter VII (Petroleum Contracts) defines the terms, conditions, content and different forms of termination, based on the "production sharing contract", for all the petroleum contracts. As for chapter VIII (Development of Petroleum Operations), it imposes on the contractor some obligations while developing petroleum operations. Note that, under authorization, the contractor may carry out studies of the petroleum potential in the adjacent areas. The Law promotes national recruiting, the use of Saotomean products and services and Saotomean investors in Chapter X. In Chapter XI, the State, through ANP, is declared as the owner of all data and information, whether raw, derived, processed, interpreted or analyzed, obtained pursuant to any Authorization or acquired during the course of Petroleum Operations covered by an Authorization and, Chapter XII sets the ANP as responsible for monitoring, supervising and inspecting all activities of Authorized Persons and their Associates also, to: (a) order such Petroleum Operation to be suspended; (b) order the withdrawal of all persons from the locations deemed dangerous, in coordination with the relevant State authorities; and/or (c) order the suspension of the use of any machinery or equipment which may jeopardize the lives of persons or the preservation of the environment. Chapter XIII obliges the Authorized Persons and their Associates to ensure the fulfillment of standards of hygiene and security during Petroleum Operations. Also, they have to take all measures required for the prevention or elimination of any source of danger that Petroleum Operations in accordance with statutory prescription and applicable regulations and adhere to regulations governing the environment, health, safety, security and hygiene of

Title	Description
	personnel and installations related to Petroleum Operations implemented by the State administration. In the exercise of its activities, Authorized Persons and their Associates shall take all precautions necessary for the protection of the environment, in order to preserve the same, namely in respect of health, water, soil and subsoil, air, the preservation of biodiversity, flora and fauna, ecosystems, landscape, atmosphere and cultural values, archaeological and artistic heritage as per Chapter XIV and other regulations, including, within the legally required time frames, the presentation of the plans required by applicable law, specifying the practical measures which should be taken in order to prevent harm to the environment, including environmental impact studies and audits, plans for rehabilitation of the landscape and structures or contractual mechanisms and permanent management and environment auditing plans. The EIA shall include, among other things, evaluation of the direct and indirect effects of the proposed Petroleum Operations in the ecological equilibrium of the Authorized Area and of any neighboring areas, in the style and quality of the life of the populations and the environment in general. According to Chapter XV, all the contracts are subject to principles of transparency. As per Chapter XVI, the State has the power to request the Contractor to supply to an entity appointed by the National Petroleum Agency at the delivery point, from the Contractor's share in output, with a quantity of Petroleum aimed at satisfying the domestic consumption requirements of Sao Tome and Principe. Regulations and Directions made under this law by the ANP must be complied with by the Authorized Person and their Associates if relating to any matter set out in articles 78º and 79º (Chapter XVII) of this law. Chapter XVIII generically establishes regulations regarding Fiscal and Customs regimes and interpretation issues.
São Tomé and Príncipe Petroleum Operations Regulations (2010 - 28º Supl., DR n.º114)	Defines the types, terms and conditions of contracts, the Petroleum Operations and practices, including the management of resources, health, safety and environmental protection, as well as the submittal, by the holders of rights to conduct Petroleum Operations, of plans, reports, data, samples and other information, within the ambit of the terms of Article 3 of the Fundamental Law of Petroleum Operations, Law No.16/2009 which also sets forth the rules for the award of the right to conduct such activities in order to ensure that Petroleum Operations are performed in a systematic manner and on such terms that allow for its comprehensive and coordinated supervision. Approved by the Board of the National Petroleum Agency (ANP-STP) within the ambit of the terms of Article 78 of the Fundamental Law of Petroleum Operations, Law No.16/2009.
Law No. 8/2004 Oil Revenue Law	Regulates the mechanisms established for the effective management and investment of oil revenues.
Decree No. 11/2008 – Model of Production Sharing Contract	Creates the model production sharing contract as basis for negotiations with the Contractors.
Law No. 15/09 Petroleum Taxation Law	Creates specific tax regulations for petroleum operations.
Decree- law No. 57/09	Organizes the Exclusive Economic Zone into exploration zones and petroleum blocks.
General Environmental framework	

Title	Description
Law No. 10/1999 Environmental Law	This Law provides the basic legislation on environmental protection and sustainable development. The Law defines objectives and measures to be implemented in the national environmental policy, as well as competencies related to the environmental protection. Article 41 states that the generation, transportation and disposal of waste and effluents are subjected to prior authorization duly entitled by a waste consignment/transfer note which states its origin and destination. Waste effluents should be collected, stored, transported, disposed or reused in a way that does not cause immediate or potential danger to the health or the environment. In addition, waste and effluents can only be disposed in an authorised place determined for this purpose by the competent authority. Article 42 establishes the need to adopt noise level standards and permitting regimes for noise sources in order to maintain the health and well-being of the population[1]. Article 45 states that the plans, projects, activities and actions that may cause an impact on the environment, territory, or the quality of life of populations, should comply with environmental regulation and are subject to the development of an Environmental Impact Assessment (EIA). Article 45 further provides the minimum content of the EIA and specifies that environmental approval is provided by the Ministry in charge of Environment. As per article 46, before engaging in any activity susceptible to pollute or contaminate the environment it is mandatory to obtain an environmental licence. Articles 57 and 58 establish that the agent of environmental damage is under the obligation to compensate for the damage, even if the action abides by the regulations in force, and that those activities subject to a high risk to the environment require a civil liability insurance*. *: Insurance company shall be approved by the National Petroleum Agency, in the names of the Parties and with limit of liability no less than those required in accordance with good practice. The premium for such policies shall be included in Project Operating Costs. All policies shall name the National Petroleum Agency as a co-insured with a waiver of subrogation rights in favour of the Contractor. Such insurance shall cover (amongst other or more particular risks according to ANP) : Damage to the facilities; Damages caused by pollution; Third party liability; Removal of scrap and clean up after accidents; Labour insurance for all of the Operator's employees and persons engaged in the activities.
Environment Impact Assessment	
Decree No. 37/1999	Defines the rules and principles applicable to the Environmental Impact Assessment process, which applies to projects listed in its Annex I. This includes the extraction, storage, transportation and processing of fossil fuel and related products, as well as projects that may cause direct or indirect impact on sensitive areas. Article 4 determines that project proponents need to submit a brief description of project activities, a description of the whole project (containing the objectives, the intended work program, the intended area, technical and financial resources and the provisional budget, in addition to other information which the applicant deems relevant for the purpose), and a viability study.

[1] Noise standards and permitting regimes for noise sources have not been established yet by law.

Title	Description
	Article 5 provides the content of the pre-study, issued by the authorities, to determine the details and specific terms of reference to guide de proponent, and article 6 defines the minimum contents of the EIA, which are the location and description of the activities; the environmental diagnose of the area and the identification of all possible effects on the environment as a result of the activity, regarding: all natural resources; social an economic impact on humans; material assets and cultural heritage; waste and pollutant emission as well as the levels of odours and noise; major accident risk assessments, respective preventive measures and emergency plans; potential effects outside the sovereign territory and respective control and effect reduction measures; measures to reduce and eliminate negative effects, describing the control and impact monitoring systems within the national territory; brief description of the technical solutions or alternative methods, including the scenario of failure to proceed the activity and the grounds of the choice; summary of difficulties (technical deficiencies, information or knowledge) eventually found while compiling the required information; adopted methodology and sources used to compile the information; and proposed program and monitoring basis. Article 7 indicates that four copies of the non-technical summary of the environmental impact study are to be delivered to authorities for public consultation It is established in Article 7 that public consultation is to be held as part of the Environmental Impact Assessment process. The public consultation period shall last no less than 30 days. As established in Article 11, the Environmental Impact Assessment is reviewed within 60 days. Notifications of the need to update the EIA are submitted within 7 days. If no update is required, the approval is provided 7 days after the revision of the EIA. Article 14 establishes that the environmental license expires after 2 years if the activity has not been implemented.
Decree No. 51/04	Article 10 states that public consultation is limited to the disclosure of a nontechnical summary of the EIA highlighting the key impacts of the project and proposed mitigation measures.
Waste Management	
Law No. 14/2003	Defines principles and rules applicable to management of waste derived from packaging material with the view of waste prevention and recycling of waste.
Decree No. 36/1999	Regulates solid waste disposal requirements, including authorizations associated with the collection, transportation, storage, disposal or reuse of solid waste. Sets forth the foundations for the creation of a system of compulsory registration of waste (which has not been created yet) and sets out responsibilities for risk management. This regulation applies only to the wastes generated and managed within the country. For wastes generated offshore and managed in another country MARPOL and the regulations of the receiving country
Fisheries	
Law No. 9/2001 on Fisheries	Sets out basic legislation on fisheries, defining main principles related to the conservation, use and management of fisheries, with the aim of assuring biological diversity, protection of species and, at the same time, a sustainable development of the sector and establishes the legal regime for the protection, exploitation and management of marine resources. Despite being directed at fisheries, Chapter II regulates the "conservation, exploitation and

Title	Description
	management of other living aquatic resources". Its article nine states that "No human activity, whatever its nature, and even if developed under any legal authorization, may compromise, directly or indirectly, the equilibrium of ecosystems or cause the death of biological species, cause degradation or pollution of coastal areas, marine environment, rivers and lakes, or the immediate or progressive contamination of fish and human species. " and in article eleven are defined some of the activities likely to cause environmental damage. However, paragraph 3 of article nine also states that the exploitation of marine and coastal resources is subject to special legislation.
Decree No. 6/2002	It sets out the parameters related to fisheries which must be complied with by fishing activities.
Decree 28/2012 General Regulation on the exercise of Fisheries up to 12 miles from the coast	This Decree approves the General Regulation on Fisheries. This Regulation, consisting of 40 articles and 5 Annexes, establishes the requirements to be satisfied in order to perform fishing activity within the waters under Saotomean jurisdiction according to the Law on Fisheries No. 9/2001 of 31 December 2001. In particular it regulates the following sectors: subsistence fishing, commercial fishing, artisanal fishing, semi-industrial, industrial and sport fishing and also applies to research and scientific activities. It also provides for fishing taxes, administrative proceedings to obtain fishing licenses, specifies the type of license, the prohibition, the legal regime and sanctions for illegal fishing activities. It defines fishing gear and methods, competent authority to perform inspections and to issue fishing permits, local partners' committees, protective fishing measures to protect aquatic species, artisanal and industrial fishing vessels' requirements to obtain a fishing permit, registration and activities related to fisheries. Annexes list includes: forms for applying for a fishing license, vessels’ identification markings, authorized fish species, size and allowed quantity to be caught.
Protected Species and Protected Areas	
Order No.11/2012	Creates the National Committee for Monitoring Activities related to the National Strategy and Plan of Action for Biodiversity Protection. It defines composition, duties and responsibilities of the above mentioned Committee, entitled to: assess any activity to be implemented in order to update the National Strategy and Plan of Action related to Biodiversity; supervise the process of collection and treatment of data on biodiversity on the field as well as in different sectors of central and local administrations; organize workshops and define topics to be developed; organize sensitisation activities on the field and within the National communication entities; analyse and validate documents produced in the context of the above mentioned National Strategy and Plan of Action updating.
Law No. 11/1999	Provides the framework for the protection of flora and fauna and the creation of protected areas. It also provides a list of protected species. Marine protected areas are not considered in this law.
Law No. 4/2003	Regulates the protection and management of cultural and natural heritage and regulates its registration.
Law No. 6/2006 And 7/2006	Creates the “Obô” of São Tomé and of Príncipe Natural Parks; defines its geographical coordinates and rules on protection measures as well as zoning. The law provides sanctions and penalties.
Decree Law No. 6/2014	Established the legal regime on the capture and commercialization of sea turtles and their products.

Title	Description
Regional Legislative Decree No 3/ALRAP (2009)	This Decree provides norms related to the protection and conservation of marine turtles, in particular prohibiting their capture and exportation. Offences and penalties are appended to the text.
Cultural and Natural Heritage	
Presidential Decree No. 6/2005	This Decree ratifies the 1972 UNESCO Convention for the protection of Natural and Cultural Heritage.
Shipping and Pollution	
Law No. 13/2007	Basic legislation for regulating safe seas and preventing marine pollution. Creates and regulates the National System on Safe Seas, and sets out responsibilities and duties related to marine protection.
Decree- law No. 30/09 - General Regulation on Vessel Registration and Security	Regulates the registration and safety of vessels, and in Chapters XII and XIII, specifies the rules for "Certification under the International Convention for the Prevention of Pollution at Sea" (articles 154 et seq.) and for the "Convention on the International Regulations for Preventing Collisions at Sea" (articles 171 et seq.).
Land	
Law no. 3/91 Land Management Act	Defines the framework for government owned law ownership, identifying public and private property of the state. Maritime waters, riverbeds, coasts, harbours, airports and air space are considered as public (state) property.
Labour	
Law No. 14/2007 Safety, hygiene an health Law	The law establishes measures to ensure the safety, hygiene and health of workers in their workplace, defining the obligations of the employer and workers on these matters. It is applicable to all sectors - public, private, cooperative and social - with the exception of the military, police and civil protection services. The “General Labour Inspectorate” and the Health Authority are responsible for monitoring the compliance with the provisions of this law. Variable fines of between two (2) and 10 (ten) minimum monthly wages can be imposed on offenders.
Law No. 6/1992 Labour Law	Regulates the beginning, execution and termination of employment relations.
Water and Maritime Protection	
Law No. 7/2018	Establishes the Framework Law for water resources management. It aims at managing and protecting inland water resources of public domain, whether superficial, transitional, coastal, or groundwater waters in order to: a) prevent further degradation and protect and improve the status of aquatic, terrestrial ecosystems and wetlands that are directly dependent on aquatic ecosystems in relation to their water requirements; b) promote sustainable water use, based on long-term protection of available water resources; c) provide enhanced protection and improvement of the aquatic environment, in particular through specific measures for the gradual reduction and phasing out of waste, emissions and losses of priority substances; d) ensure the gradual reduction of pollution of groundwater and prevent its worsening; e) mitigate the effects of floods and droughts; f) ensure the supply of sufficient good quality superficial and groundwater as required for a sustainable, balanced and equitable use of water; g) protect marine waters, including territorial waters; h) ensure compliance with the objectives of relevant international agreements, including those aimed at preventing and eliminating pollution in the marine environment; i) ensure water is used by current and future generations in a rational manner and with satisfactory standards of quality and protection of biodiversity; j) harmonize the use of water with the strategic objectives of social

Title	Description
	promotion, regional development, district and environmental sustainability; k) implement and ensure prevention and defense measures against environmental damage, critical hydrological events of natural origin or arising from water use; l) ensure the equal and fair distribution of charges and benefits for the use of water; m) promote and strengthen principles of citizenship, self-determination of peoples and solidarity for the construction of a sustainable society. In addition, the Law establishes the National Policy on Water, whose objectives are: a) ensure the current and future generations the availability of water, in quality standards appropriate to their uses; b) promote the rational and integrated use of water resources, including waterborne transport, with a view to sustainable development; c) prevent and defense critical hydrological events of natural origin or due to inappropriate use of natural resources. The Law is divided as follows: General provisions (Chap. I); Institutional Framework and competencies (Chap. II); National Policy on Water (Chap. III); Policy Instruments (Chap. IV); Use of Water Resources (Chap. V); Programmes of measures of protection and valorization (Chap. VI); Water Monitoring, Surveillance and Inspection (Chap. VII); Economic and Financial Regime (Chap. VIII); Quantity and Quality of Water (Chap. IX); Administrative and Criminal Procedure (Chap. X); State of Emergency (Chap. XII); Final and Transitional Provisions (Chap. XIII).
Decree-law 2/2018	Establishes the framework for maritime security. Proclaims the strategic objectives for three main general purposes: A) Strengthen the maritime governance; B) Optimization of Blue Economy and C) Reinforce maritime safety and protection. Also, determines as goals for specific domains: a) Legal: Evaluate and disseminate all relevant legislation related to the sea and ensure the application of existing legislation; b) Economic: Attract national and international investments to the "Blue Economy" program; c) Environmental: Develop plans to control and combat maritime pollution; ensure that environmental impact studies are carried out in activities related to the development of infrastructures in the maritime space; d) Technic-scientific: Develop a program of inventory of the living and non-living resources of the Exclusive Economic Zone (EEZ) of the RDSTP; stimulate and strengthen international partnerships for training of public and private actors in marine affairs; establish mechanisms of standardization and articulation of interagency communication and create a training center focused on the affairs of the sea; e) Defense: encourage and strengthen international, regional and bilateral partnerships to ensure the continued presence of naval assets in the strategic space of national interest; establish fundraising programs with the international community for the acquisition of technical and naval resources; dissuading the concentration of hostile forces/offenders in Saotomean jurisdictional waters; ensure the monitoring and control of national and foreign vessels in Saotomean jurisdictional waters; ensure the mobility and effective presence of the Coast Guard's naval assets throughout Saotomean territorial waters; develop capabilities of human resources involved in marine affairs; ensure the interoperability of the Armed Forces, Security Institutions and the Public Prosecutors; ensure the interoperability of government bodies in connecting to the sea; prepare staff to combat environmental crimes and guarantee Law and Order; establish, maintain and expand continuously the capacity to meet international search and rescue (SAR) commitments; adjusting the Coast Guard to fulfil the State's

Title	Description
	responsibilities in matters related to the sea; transform the Coast Guard into an instrument of integration with international partners in marine affairs. Finally, establishes the lines of action to pursue these objectives and goals.
Decree-law no 03/2018	Creates the System of Maritime Authority (SMA), an institutional framework formed by public administration entities, bodies or services at central, regional or local level which, with coordinating, executive, advisory or police functions, exercise public authority in the maritime areas under national sovereignty or jurisdiction, translated into the execution of State acts, administrative procedures and maritime registry, exercise of inspection and police, compliance with applicable laws and regulations in maritime spaces under national jurisdiction.
Decree-law no 4/2018	Creates the National Maritime Authority (NMA). The NMA is the entity responsible for the coordination of national activities to be carried out by the Coast Guard and the Port Authority in the areas of jurisdiction and within the framework of tasks defined in the Maritime Authority System, in compliance with the guidelines defined by the Minister responsible for Defense. It is formed by an Advisory Council (CCAMN) and the Coast Guard.
Decree-law no 5/2018	Establishes the legal framework for offenses in the areas under maritime jurisdiction.

Source: ERM, 2018.

In addition to the above listed regulatory texts, São Tomé and Príncipe has developed a National Biodiversity Strategy Action Plan (NBSAP) 2015-2020, which considers major environmental issues including amongst others, capture of endangered species (e.g. turtles); marine pollution from ships and illegal dumping at sea. The NBSAP also includes an annex with flora/fauna species of local conservation concern, where some species of marine turtles and seabirds are included.

2.4 *INTERNATIONAL AGREEMENTS, AND CONVENTIONS*

São Tomé and Príncipe has signed and/or ratified a number of agreements and conventions, many of which relate to the protection of the environment. *Table 2.2* below gives an overview of those relevant to the project activities.

Table 2.2 International conventions and agreements, São Tomé and Príncipe

Name of the convention	Status in the country*
Air and atmosphere	
Kyoto Protocol to the United Nations Framework Convention on Climate Change (1997)	Accessed on 25th April 2008 and entered into force on 24th July 2008
Vienna Convention on the Protection of the Ozone Layer (1985) and the Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Accessed on 19th Nov 2001
Paris Agreement on climate change (2015).	Ratified 2nd November 2016 and entered into force on 2nd December 2016
Chemicals and waste	
Bamako Convention on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (1991)	Signed on 1st February 2010 (not ratified yet)
Stockholm Convention on Persistent Organic Pollutants (2001)	Signed on 3rd April 2002 and ratified on 12th April 2006
Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)	Accessed on 12th November 2013 and entered into force on 10th February 2014
Flora, fauna and protected areas	
Memorandum of Understanding concerning Conservation Measures of Marine Turtles of the Atlantic Coast of Africa (1999)	Signed on 9th May 2002
Convention on Wetlands of International Importance (Ramsar Convention, 1971)	Accessed on 21st August 2006
African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968)	Signed on 1st February 2010 (not ratified yet)
Convention on International Trade of Wild Fauna and Flora Endangered Species (1973)	Accessed on 9th August 2001 and entered into force on 7th November 2001
Convention on the Conservation of Migratory Species (Bonn Convention, 1979)	Entered into force on 1st December 2001
The Convention on Biological Diversity (Rio, 1992)	Signed on 12th June 1992 and ratified on 29th September 1999
United Nations Framework Convention on Climate Change – UNFCCC (1992)	Signed on 12th June 1992, ratified on 29th September 1999 and entered into force on 28th December 1999
International Convention for the Conservation of Atlantic Tunas	Contracting party since 15th September 1983

Name of the convention	Status in the country*
Marine Pollution	
MARPOL Convention for the Prevention of Pollution from Ships 1973 (as modified by the Protocol of 1978), except Annex VI. • *Annex I on the prevention of pollution by oil & oily water* • *Annex II on the control of pollution by noxious liquid substances in bulk* • *Annex III on the prevention of pollution by harmful substances carried by sea in packaged form* • *Annex IV on the pollution by sewage from ships* • *Annex V on the pollution by garbage from ships*	Accessed on 29th October 1998 Dates of entrance into force of the annexes are: *29th January 1999* *29th January 1999* *29th January 1999* *27th September 2003* *29th January 1999*
International Convention on Civil Liability for Oil Pollution Damage (CLC, 1992) and its protocol (Amends the 1969 Convention with regard to the method of calculation for the limitation of liability)	Accessed on 29th October 1998
Maritime safety	
International Convention for the Safety of Life at Sea (SOLAS, 1960)	Accessed on 29th October 1998
Convention on the International Regulations for Preventing Collisions at Sea (COLREGs, 1972)	Accessed on 29th October 1998
Marine Resources	
Treaty between the Federal Republic of Nigeria and The Democratic Republic of São Tomé e Príncipe on the joint development of petroleum and other resources, in respect of Areas of the Exclusive Economic Zone of the two states	Signed in February 2001
United Nations Convention on the Law of the Sea (UNCLOS; 1982)	Signed on 13th July 1983 and ratified on 3rd November 1987
Convention on the International Maritime Organization (IMO; 1948)	Accepted on 9th July 1990
Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central and Southern African Region (Abidjan Convention) (1984)	Member state of the convention but in process of ratification
Archaeology and Cultural Heritage	
Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	Ratified on 25th July 2006

** The dates refer to the moment Sao Tomé & Principe signed or ratified the respective convention.*

Source: ERM, 2018

2.5 RELEVANT NATIONAL GUIDELINES

2.5.1 *Health, Safety and Environment provisions in the Regulation of Petroleum activities of 2010 applicable within the Economic Exclusive Zone (EEZ)*

The National Petroleum Agency (ANP-STP) has established this regulation in order to define the types, terms and conditions of contracts, the Petroleum Operations and practices, as well as the submittal, by the holders of rights to conduct Petroleum Operations, of plans, reports, data, samples and other information. It also includes provisions on the management of resources, health, safety and environmental protection within the latter objective, it aims to:

- Ensure measures to fulfil the requirements and reach the objectives set out in the legislation relating to health, environment and safety;
- Enhance the observation and application of International Standards concerning health, environment and safety in petroleum activities;
- Further develop and improve the level as regards health, environment and safety.

The regulation includes general HS&E provisions such as:

Need of risk analysis, requirement for immediate notification of accidental situations to authorities, the establishment of measures for emergency preparedness, including the submission to the ANP-STP of a contingency plan in cases of a blow out of oil, gas or water, provisions for decommissioning activities and provisions for the promotion of local content.

Also provisions for the Operator to monitor and reduce the effect of all operational and accidental discharge, handling of waste and pollution emissions into the air, sea, to inform the ANP-STP of the amount of operational and accidental discharges, leakages and waste and for the information to be made public.

There are also specific details about the design of drilling wells in relation to risks to the environment and public health, which include but are not limited to the following:

- During drilling and well activities, at least two independent and sufficiently tested barriers shall be available in order to prevent an accidental flow from the well. If one barrier fails, well operations may not proceed before its restoration. A barrier plan shall be established for each projected operation to be carried out from a facility during the design phase. Operational requirements shall be defined with regard to the drilling capability of equipment and to its control, as well as to operative and mobilization capability so as to comply with the barrier plan. All systems and components shall meet these requirements.

- The facility shall be equipped with a tank with sufficient capacity to support the quantity of drilling fluid necessary to ensure full control of the well and to contain, at all times, sufficient quantities of drilling fluids and other substances. The drilling fluid system shall have adequate capacity to support a rapid increase of drilling fluid in an active system, as well as capacity for the increasing weight of the drilling fluid in the case of well instability. A reconditioning system with the necessary equipment for the separation of gas from drilling fluid shall be implemented in order to ensure the required quality of the drilling fluid. The composition of the drilling and completion fluids shall, at all times, be adjustable in order to ensure that the required properties of the fluid are preserved. It shall be possible to monitor, on a continuous basis, the fluids which comprise a barrier or that form part of the barrier's element.

- The Blowout Preventer ("BOP") shall be designed and installed in order to preserve its capability to function as a barrier and will be installed and start functioning during the initial phase of the operation.

- Valves and actuators of the "Christmas tree" type and safety valves shall be installed in a sufficient number and in such a manner as to preserve their barrier functions and shall be tested in accordance with established procedures, as well as with a test programme. These procedures apply to operability tests and those regarding leaks or spills.

- The drilling and well facilities shall be fitted with accessible equipment capable of ensuring control of the well, of allowing the work of personnel, and of shutting down the well in case of an uncontrollable influx into the well. In the event of equipment failure, mobile facilities shall be repositioned onto a safe area when the well is in an uncontrolled flow situation.

There are specifications related to Hazardous Materials, including:

- Preferential treatment shall be given to materials and chemicals least dangerous to health and of greater safety so as to minimise the risk to persons, to the environment and to the facilities. The recycling of materials and chemicals shall be duly taken into account.

- Transport storage and use of hazardous material shall take place in a controlled manner and in accordance with national legislation, as well as with internationally accepted rules and principles, for which purpose documented rules and procedures of their handling shall be made available.
- The danger of chemical exposure involving health hazards shall be minimised in the storage, use, handling, and disposal of chemicals, as well as in work operations or processes which produce chemical substances. Chemicals hazardous to health shall be classified, labelled and identified in accordance with internationally accepted standards.

- If chemicals are moved into other containers or appliances, it must be ensured that the contents are labelled and clearly identified so as to allow the identification of their contents by personnel, of which hazards are connected with the use of such chemicals, and of which safety precautions should be taken. Prior to the use of chemicals hazardous to health, a table of instructions, regarding the applicable safety rules of each of such substances, shall be available at the work site.

- Personnel shall wear individual protective equipment against risks which may not be otherwise avoided or limited to an acceptable extent.

- Use of radioactive and explosive substances shall be restricted on a need of use basis.

2.6 RELEVANT INTERNATIONAL GUIDELINES

2.6.1 IOGP and IPIECA Guidelines

The International Association of Oil and Gas Producers (IOGP) and the Global Oil and Gas Industry Association for Environmental and Social Issues (IPIECA) have developed guidelines of relevance to the Project:

- IPIECA (2003) - The Oil and Gas Industry: Operating In Sensitive Environments;
- IOGP n°254 (1997) - Environmental management in oil and gas exploration and production;
- IOGP n°342 (2003) - Environmental aspects of the use and disposal of non aqueous drilling fluids associated with offshore oil & gas operations;
- IOGP n°389 (2007) - Environmental/Social/Health risk impact management process;
- IOGP n°475 (2012) - Managing Oil and Gas activities in coastal areas;
- IOGP n°543 (2016)- Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations; and
- IOGP n°557 (2016) – Drilling waste management technology review.

2.6.2 IAEA Guidelines

The International Atomic Energy Agency (IAEA) establishes standards of safety for protection against ionizing radiation. Of relevance to the Project is their Safety report on “Radiation Protection and the Management of Radioactive Waste in the Oil and Gas Industry” (IAEA, 2003). Well logging activities include the use of tools and techniques that may include one or more radiation detectors and radioactive sources or a machine that generates ionizing radiation.

These tools are referred to as “sealed” radioactive sources and are routinely used in the O&G industry. The sources are lowered into the borehole as part of the well logging tools. They can be used to measure formation density and/or porosity. In a drilling context, these sources are used by trained personnel, and radiation exposure of those personnel is monitored. They are transported to a well site in shielded containers.

2.6.3 *JNCC Guidelines*

The Joint Nature Conservation Committee (JNCC) is a British regulatory body which has drawn up guidelines applicable to marine seismic surveys carried out relation to oil and gas exploration with a view to limiting the impacts of acoustic emissions from oil and gas exploration activities on marine mammals (*JNCC, August 2017*). The JNCC guidelines for minimising the risk of disturbance and injury to marine mammals from geophysical surveys were updated in August 2017 and include guidelines on soft-start procedures to be used during Vertical Seismic Profiling (VSP) operations. GALP will comply with these guidelines as a minimum, and may implement actions in line with internal standards.

2.7 *GALP'S INTERNAL POLICIES AND GUIDELINES*

2.7.1 *GALP's Health, Safety and the Environment policy*

GALP is fully committed to protect the Environment and to ensure the Health and Safety of its employees, customers and community in general, and has established a Health, Safety and Environment Policy, based on the following commitments:

- Establish Health, Safety and Environmental Protection as fundamental values of the Company;
- Acknowledge that managing Health, Safety and the Environment is a direct leadership responsibility and risk prevention is a shared responsibility within the Organization;
- Promote training for all employees in these subjects, involving partners and other interested parties, committing them to Health, Safety and the Environmental matters in order to act proactively both within and outside the working environment;
- Apply the best management practices and technical solutions available, over and above legal compliance, in continuous prevention strategies by identifying, controlling and monitoring risks to ensure Health, Safety and Environmental protection;
- Create conditions that allow the Organization as a whole to be permanently prepared to respond to emergencies;
- Ensure the sustainability of projects, ventures and products throughout their life cycle, through the use of technology, facilities, resources and best practices to prevent or minimize adverse consequences;

- Establish challenging targets and goals, measuring and evaluating the results obtained and taking the necessary action to pursue them;
- Ensure efficient use of energy and resources and the incorporation of safe and innovative technologies when managing its activities, minimizing the impact, so as to guarantee the Company's sustainability and Environmental protection;
- Make this Policy known and available, in a responsible and transparent way, to all interested parties, communicating regularly the Company's Health, Safety and Environmental performance.

2.7.2 GALP's HSE Management System / HSE Internal Reference

The management of GALP is committed to integrate HSE issues in the company´s strategy and operations and to engage its employees and contractors in a similar commitment.

In order to achieve this commitment, GALP decided to establish a HSE Management System (System G+) based on the HSE Internal Reference. The Internal HSE Reference consists of 22 management elements establishing minimum requirements for the different vectors that should be controlled to ensure a good HSE performance and to achieve sustainable development.

The mentioned elements are presented in ***Table 2.3***:

Table 2.3 GALP's HSE Management System elements

1-Management's Commitment	12-Incident Investigation
2-Health, Safety and Environment Policy	13-Management Of Change - Human Resources
3-Integrated Organization	14-Contractors
4-Line Management Responsibility	15-Facilities And Equipment Life Cycle Planning And Control
5-Goals, Targets and Plans	16-Pre-Start-Up Review
6-Hse Professionals	17-Mechanical Integrity
7-Procedures and Levels Of Operational Performance	18-Change Management - Facilities
8-Training and Development	19-Process Safety Information
9-Effective Communication	20-Change Management - Technology
10-Motivation and Awareness	21-Risk Analysis
11-Audits and Observations	22-Emergency Preparation And Response

Source: GALP, 2018

In addition to the above other GALP specific policies of relevance to this Project include the following:

- P-001 Quality Policy.
- P-002 Health, Safety and Environmental policy.
- P-003 Climate Change Policy.

- P-004 Security Policy.
- P-008 Risk Management Policy.
- P-011 Corruption Prevention Policy.
- G+ System – Gestão de Segurança, Saúde e Ambiente.

2.7.3 *Internal Guide of Integrating Biodiversity into Environmental and Social Impact Assessments Conducted in Connection with Upstream Projects*

The purpose of this Guide is to provide guidelines for integrating Biodiversity issues into Environment and Social Impact Assessments (ESIA) conducted in connection with Oil & Gas (O&G) projects. This Guide aims to promote a holistic approach to Impact Assessment, through increased focus on ecosystems, as recommended in the United Nations Convention on Biological Diversity (CBD). This guideline has been considered for the development of the present document.

3 PROJECT DESCRIPTION

3.1 INTRODUCTION

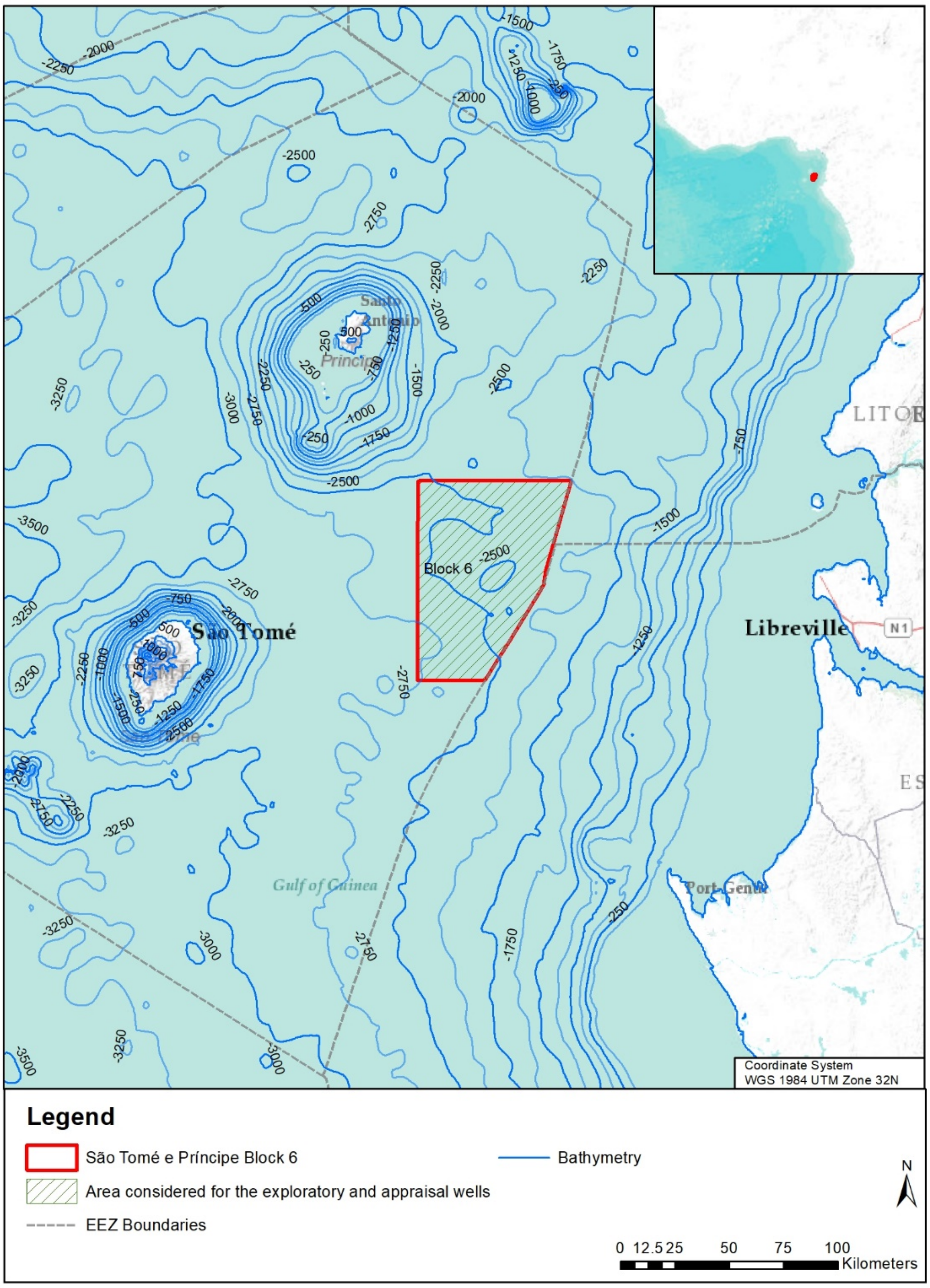
This chapter provides a technical description of the exploratory and appraisal drilling program proposed by GALP on Block 6 São Tomé e Príncipe (hereinafter STP) and presents the main characteristics of the Project at a level of sufficient detail to evaluate the potential environmental and social impacts resulting from Project activities. This chapter has been prepared based on information provided by GALP's technical team. At the time of writing the ESHIA some details of project design were still being defined, therefore for those aspects where specific data is not yet available, a conservative approach has been assumed and estimations have been provided on international standard practice and similar projects. This approach ensures the information provided in this chapter has a sufficient level of detail to properly describe the type and magnitude of operations and therefore a sound evaluation of potential environmental and social impacts analysis can be performed (i.e. the changes in the project description are expected to be minor and would not have implications on the final outcomes of the evaluations).

GALP has agreed with the Operator of the adjacent Blocks 5, 11 and 12 (KOSMOS Energy) to potentially develop a coordinated offshore drilling campaign along the four Blocks. Therefore, although this chapter focuses on the description of the operations planned in Block 6 the descriptions related to the calendar of activities provide the context of the operation at the 4 Blocks (e.g. timings planned for the overall campaign within the 4 Blocks).

3.1.1 *Overview of the Project*

Block 6 STP has a surface of 5023.82 km^2 and is located at a minimum distance of approximately 65 km off the Coast of Principe Island (and approximately 100 km from Sao Tome Island) in waters between 2275 m and 2590 m depth, its location is shown in *Figure 3.1*. In 2017, a combined 3-dimensional (3D) seismic acquisition program was acquired to investigate the potential of the four aforementioned Blocks and to define prospective drilling targets.

Figure 3.1 *Location of São Tomé Block 6*



Source: ERM, 2018

The objective of the drilling campaign in Block 6 is to drill at least one exploration well and two additional exploration or appraisal wells with the objective of assessing the presence of hydrocarbons-bearing formations, and the type and quantity of available hydrocarbons. The prospective well locations are being refined and thus have not been defined at the time of writing this ESHIA, nonetheless, they will be located within the Block 6 license area, as outlined in *Figure 3.1*. To date, no offshore wells have ever been drilled in the STP Economic Exclusive Zone (EEZ) (ANP-STP, 2017).

The first well of the overall drilling program (i.e. for all four Blocks) is planned to start no earlier than in the third or fourth quarter of 2019. It is estimated that one exploration well may be completed within 50-70 days (including non-productive time and demobilization). Where, whilst if appraisal activities are envisaged (i.e. well testing) it can take an additional 20-30 days.

The detailed plan, in terms of the specific number of wells in each block and the specific order of wells/sites, cannot be provided at this stage. The specific coordinates of the proposed wells are not known at the time of writing of the ESHIA, however because wells are planned to be drilled within the block boundaries, water depths at the prospective well locations are expected to range between 2,275 m and 2,590 m depth below mean sea level (MSL) and the planned Total Vertical Depth Sub-Sea (TVDSS) is up to around 6,775 m in a success case.

The number of wells drilled in each block will depend on the results as wells are being drilled (i.e. after the first well, more wells will only be drilled if data shows a good hydrocarbon potential). While the results of one well are being analysed, the drillship/semi-submersible (SS) rig is expected to move to a different block. Only one drillship/semi-submersible rig will be used for the whole campaign. Therefore the potential of either various wells in each block be drilled consecutively or two wells being drilled in parallel is not expected in this campaign.

In addition, it is likely that between each well there will be breaks in the drilling schedule to allow time to move and resupply the drillship/semi-submersible rig, assess the previous well results and adjust drilling plans to meet various contractual and license obligations.

3.1.2 Exploration versus appraisal wells

Exploration and appraisal activities focus on how to achieve petroleum reserve replacement by finding new reserves. In the first phase of exploration activities, geologists and geophysicists search out areas prone to hydrocarbon formation where the correct geological pre-conditions exist.

Exploration activities usually start with seismic surveys. These surveys allow mapping of the geological structures and help determine locations and relative sizes of oil and gas reserves beneath the surface in a specified area. Based on seismic surveys it can be decided whether it is worth to carry on with further seismic surveys or test drillings or to abandon the exploration at this point.

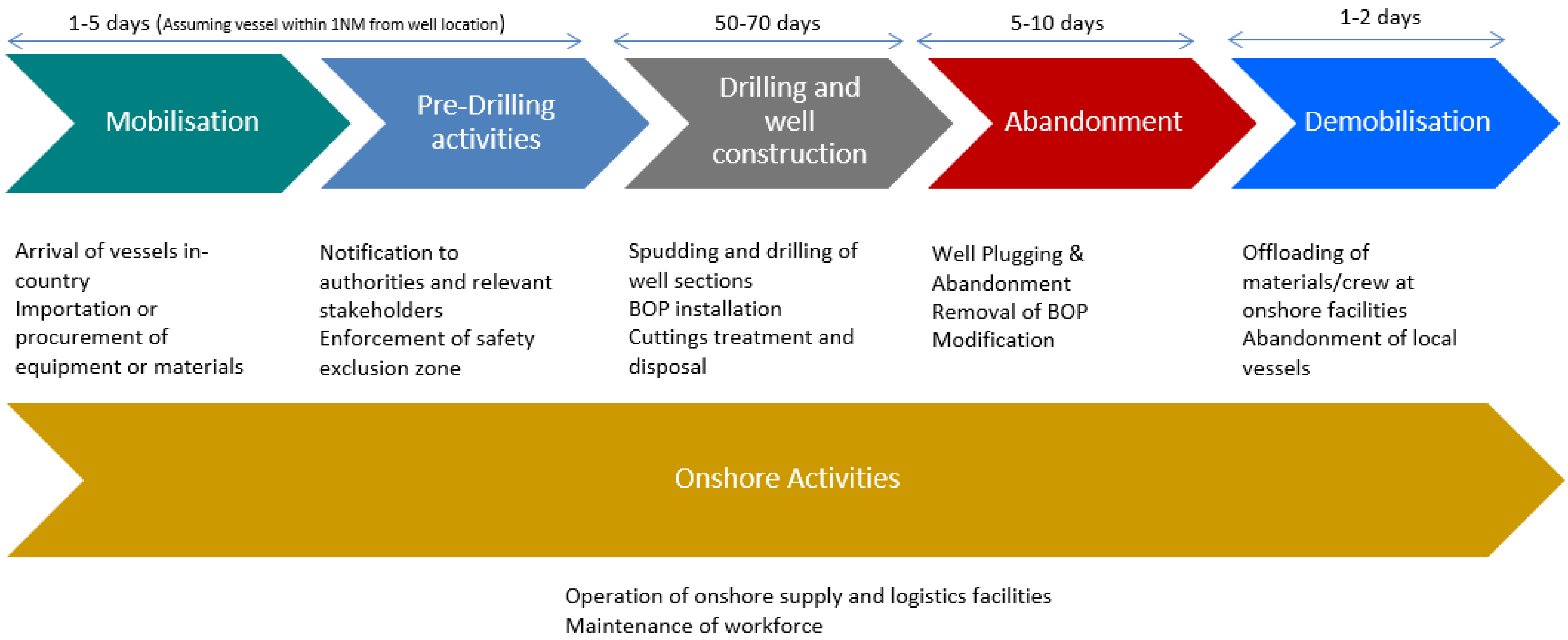
Continuing with exploration and appraisal drilling activities locations are determined, the main objective of exploration drilling is to gain vital information on the type of rock drilled and the fluids it contains. Once exploration drilling has encountered the presence of oil or gas, the appraisal phase of drilling starts.

During appraisal, delineation wells are drilled to define the extent of reserves. Once appraisal drilling is carried out, the data obtained is further analyzed to determine whether the reservoir is economically viable to produce, and if so, the geologists and reservoir engineers build models of the reservoir, to further determine reserve volumes which could be accessed at a later stage and subject to a different process through development drilling.

3.1.3 *Project Schedule*

The prospective schedule for the drilling of a single exploration/appraisal well envisaged by GALP is provided in *Figure 3.2* below. These activities are discussed in the following sections. The drilling program for the 4 blocks is planned to last up to 3 calendar years starting mid-late 2019, although as explained in previous sections, the effective days of work are less than this, due to non-productive time such as mobilization/demobilization and time required to analyze well results before defining how to progress on the program. Note that the overall drilling schedule may slightly change subject to the availability of the drillship/semi-submersible rig, as well as metocean conditions, previous well results and adjustment of drilling plans to meet various contractual and license obligations.

Figure 3.2 Approximate timing for each sub-activity required for the drilling of a single exploration well



Source: ERM, 2018

3.2 DESCRIPTION OF THE OFFSHORE DRILLING CAMPAIGN

This Section provides a detailed description of the main Project components.

3.2.1 *Drilling equipment*

The Block 6 exploration and appraisal wells will be drilled with either a drill ship or a semi-submersible (SS) rig, The drillship/SS will not be fixed or anchored to the seabed but will remain on station during drilling using a system of dynamic positioning (DPS). The thrusters and propellers located underneath drillship/SS hull will be controlled by a computer system linked to satellite positioning and work together to automatically maintain drilling unit position at all time.

At the time of writing this report, the drillship/SS has not been confirmed yet however a 5^{th} Generation Ultra-Deepwater Dynamic Positioning Drill Ship or a semi-submersible rig, capable of drilling in water depths up to 3,000 m is likely to be used (*Figure 3.3)*.

Figure 3.3 Example of a typical drillship (top) and semi-submersible rig (bottom)

Source: GALP, 2018

Drillship/SS will be equipped with a segregated waste storage and effluent treatment equipment, including slops oil-in-water separators compliant with the requirements of MARPOL 73/78 and other applicable international, regional and national maritime legislation, as well as a Blow-out Preventer (BOP) incorporating full redundancy control.

3.2.2 *Support Vessels and Air transport*

Three Platform Support Vessels (PSVs) Three will transport supplies (e.g. mud, casings, tools, food and water) between the drillship/SS and the onshore supply base. The onshore supply location is yet to be defined but considering local STP ports do not have the required facilities for this type of O&G activities it will be on the African mainland coast[1]. It is estimated that support vessels movement to/from the well location will be less than one per day in average. Potentially one additional fast support vessel (FSV) will also be employed. PSV's will also be equipped with a dynamic positioning system to enhance safety when along the drilling unit.

In addition, marine operations will comply with MARPOL and other applicable international, regional and national maritime legislation.

An example support vessel is shown in *Figure 3.4*.

Figure 3.4 Example of a Platform Support Vessel

Source: Shutterstock.com, N.A.

Helicopter operations for staff transfers between São Tomé and the drillship/SS will be via helicopter, from the STP airport. It is estimated that up to six helicopter return trips per week will be required during the drilling operations.

3.2.3 *Drilling process*

A drillship is a marine vessel that's been modified to drill oil and gas wells and is self propelled. A semi-submersible drilling rig is a drilling unit

[1] Note that although the onshore supply base will be located in a neighboring country, GALP offices will be partially installed in São Tomé prior and during operation for coordination and general management of the operations but also managed in a coordinated way from the headquarter in Lisbon.

supported by large pontoons submerged in the water and by at least a large buoyed column in each corner connected to the pontoons and is not self propelled and needs to be towed. However, a submersible drilling rig is self-propelled. Drillships/SS are equipped with a main drilling derrick and sometime with an auxiliary drilling derrick center to perform parallel operation to enhance efficiency. Drilling machinery within either type of vessels are powered by diesel engines with electric generators, giving power to a rotary system called "Top Drive", moving up and down with a drilling line cable hooked up to a drum. Drilling fluids are also passing through the top drive down to the drilling bit.

The drillship/SS is also equipped with a passive or active heave compensator allowing the drill string to remain on the bottom of the wellbore to crush the geological formation; compensating the wave and heave occurring at the sea (*Figure 3.5*).

Figure 3.5 ***Example Riser Tensioner (left) and Top drive (right).***

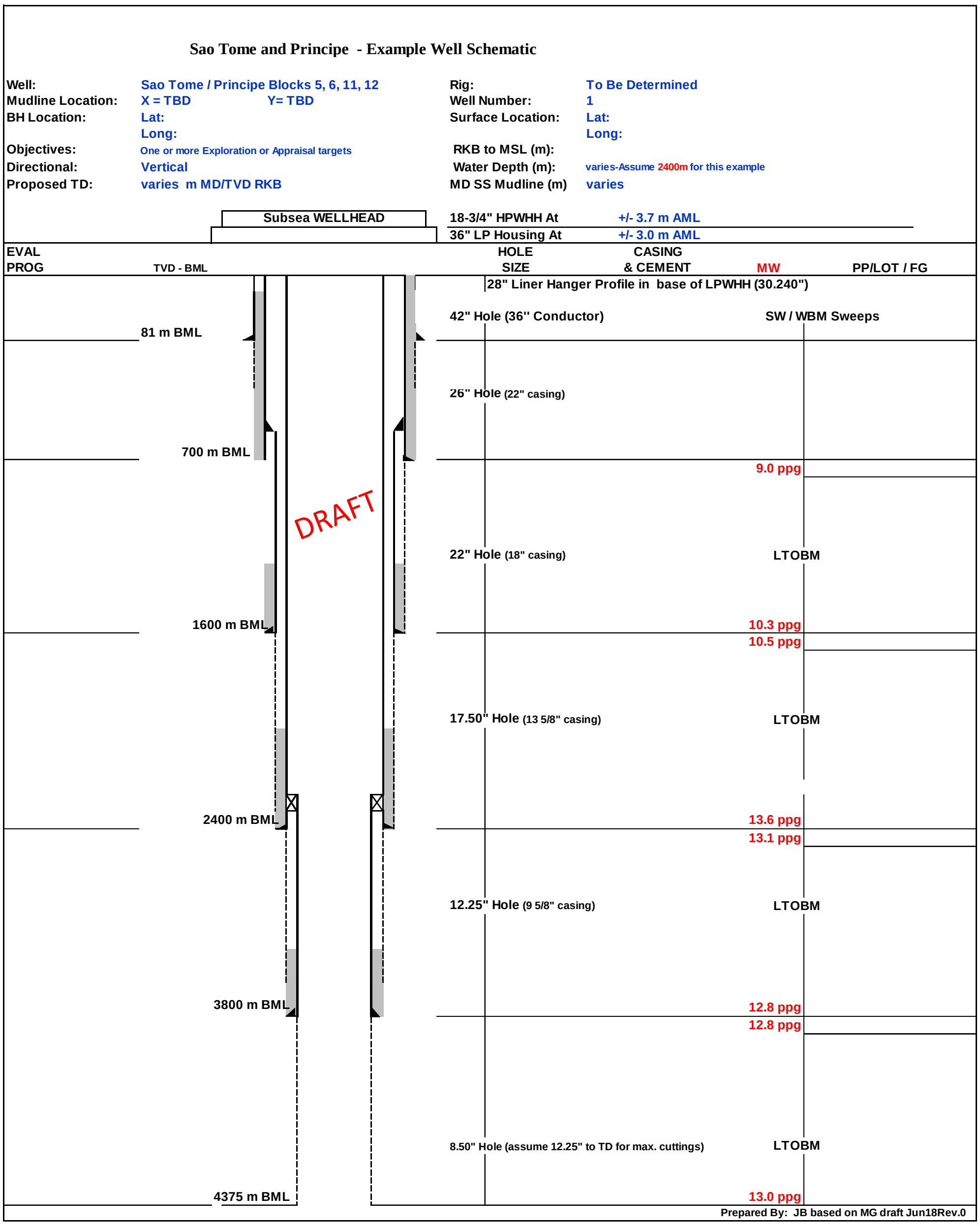
Source: GALP, 2018 *Source: IADC*

Drilling the hole will be done by applying rotation and weight on the bit. Heavy hollow drill collars are used to apply weight on bit. Drill collars are part of the drill string and are located just above the bit. Then the drilling string will get smaller and lighter in size and weight up to the drill pipe connected to Top Drive.

Wells are drilled using multiple casing sections, with the diameter of each casing section decreasing as depth increases. During the initial drilling operations, the top casing sections of the drill string (also known as conductor and or surface casing) are generally left open to seawater. However, before drilling lower casing sections, a hollow tube known as the 'marine riser' is run between the drillship/SS and the sea bed, with the drill string passing down the center of the riser. Once a marine riser has been run, the drilling mud can be returned to the drillship/SS, in the space between the drill string and the riser casing.

The lengths and diameters of each casing section of the well are established prior to drilling. The exact details are determined by the geological conditions through which the well is drilled and will be driven by the final desired hole diameter to drill the reservoir section as per *Figure 3.6*.

Figure 3.6 *Well Schematic Example.*



Source: GALP, 2018

3.2.4 *Drilling schedule and program*

The overall drilling program is expected to start between mid Q3 2019 and Q1 2020. The expected total campaign duration for Block 6 shall last between 210 and 270 days for a 3 wells campaign considering a well drilling duration ranging from 50 days up to 70 days approximately; and appraisal activities in one or two of these wells of up to 30 days duration each.

The first stage in drilling (known as 'spudding') is to place the conductor (typically 36 inch diameter casing) approximately 75 m below the seabed in the 42" bore section. Once this is in place, drilling will continue using a series of 3 or more progressively smaller diameter drill casings which will be cemented in place. *Table 3.1* summarizes the characteristics of a typical well.

Table 3.1 ***Proposed well design***

Hole Diameter	Casing Diameter	Indicative depth (m TVD)	Section length (m)	Mud Type
42"	36"	2481	81	WBM
26"	22"	3100	700	WBM
22"	18"	4000	900	NADF
17 ½ "	13 5/8"	4800	800	NADF
12 ¼"	9 5/8" "	6200	1400	NADF
8 1/2 "	Open Hole	6775	575	NADF

Source: GALP, 2018. Note that well design may be slightly modified to fit the exploratory and appraisal program objectives. WBM: Water Based Mud. NADF: Non-Aqueous Drilling Fluid (NADF).

A marine riser will be set in place after 22'' casing is positioned (26" bore section). At this stage a subsea Blow-Out Preventer (BOP) will also be installed at the sea floor. While the marine riser will connect the well to the drillship/SS forming a closed loop system, the BOP will seal this system in order to control and monitor the pressure and flow in the well.

This type of well control equipment is critical to the safety of well. For the Project, GALP will follow the API Standard RP 53 *Recommended Practice for Blowout Equipment (2012).*

During the drilling activities a Vertical Seismic Profiling (VSP) survey may be undertaken principally to calibrate the surface seismic data, giving an accurate depth measurement to geological features. This survey will provide an insight into the rock types in and around the wellbore as it travels through the earth and through interpretation of the rock velocities. For each of the wells, a VSP is planned to last 1 or 2 days of rig time (2,000 psi air guns, i.e. 138 bar).

3.2.5 Drilling Fluids

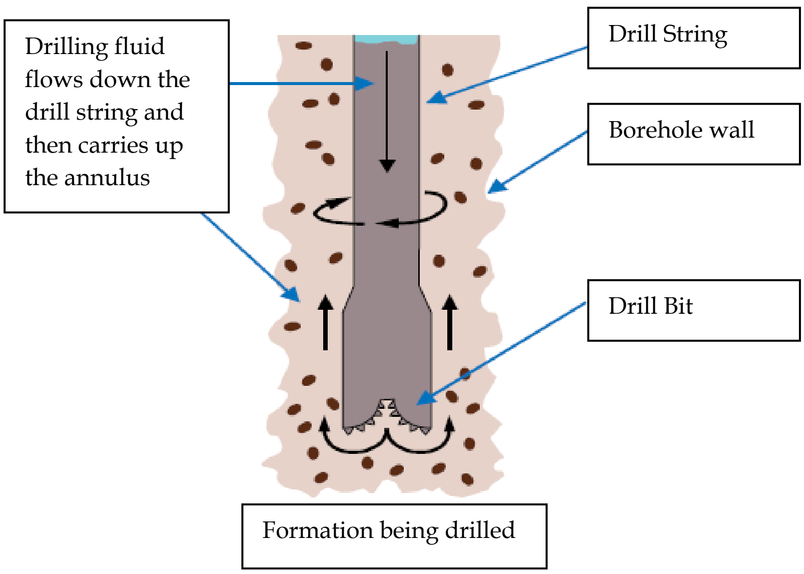
Drilling fluids (also called muds) are a fundamental part of the drilling process. The drilling muds are normally made up of a liquid set in a colloidal state and weighted down with specific products. Its purposes are:

- To remove debris (cuttings) from the bottom of the well and carry it up to the surface.

- To cool and lubricate the drilling bit and the bottom hole assembly.
- To contain the fluids present in the rock formations.
- To consolidate the walls of the borehole and reduce infiltration into the formation.
- To control well bore pressure.
- To reduce friction between the drill pipe and the hole.
- To inhibit reactive clays (prevent clay selling and hole degradation).
- To transport cuttings out of the wellbore.

Muds are pumped down the drill string to maintain a positive pressure in the well, cool and lubricate the drill bit, protect and support the exposed formations in the well and lift the cuttings from the bottom of the hole to the surface (*Figure 3.7*). Drilling fluids are slurries of various solids such as bentonite and other clays and/or polymers which are the basic constituents of the drill mud, along with additives used to control the fluids functional properties such as density/viscosity. All products will have Material Safety Data Sheets (MSDS) available to the employees.

Figure 3.7 ***Circulation of Drilling Fluid during Drilling***



Source: OGP, 2003

The well will be drilled using two types of fluid:

For the two primary sections shown in the well schematics in *Figure 3.6* and *Table 3.1*, the fluid will be majorly composed of water with a natural viscous agent. At the end of each section, a Pump And Dump (PAD) Mud will be pumped to keep the hole opened while running the 36” conductor and 22” Casing.

For the following deeper sections, a non-Aqueous Drilling Fluid (NADF) which could use mineral or synthetic base oil. Following IOGP terminology, “Non Aqueous Drilling Fluid (NADF)” refers to all non-water based mud systems used for the lower hole sections drilled with the riser in place. NADF is a more inclusive term rather than those used for "synthetic based muds/fluids" (e.g. SOBM, SBM or SBF).

IOGP (2016) defines NADF as: "A drilling fluid in with the continuous phase is a water-immiscible fluid such as an oleaginous material (e.g. mineral oil, enhanced mineral oil, paraffinic oil, or synthetic material such as olefins and vegetable esters." Thus, synthetic-based, enhanced mineral oil-based and oil-based drilling fluids are all subsets of NADFs.

The final list of constituents and additives of the WBM to be used in the Project are not available at the moment of writing this report. However, the additives most commonly used include Bentonite, Guar Gum and Barite. All of these are included in the OSPAR´s PLONOR list, which considers that products included in the list Pose Little or No Risk (PLONOR) to the environment (the OSPAR standards are among the most well known in the offshore industry and are very often used outside the North-East Atlantic by many operators[1]). Other commonly used components include Caustic Soda and Xantam Gums, which are categorized as the least hazardous components by the OSPAR HOCNS (Category E, which considers toxicity for the element at concentrations above 1,000 mg/l).

The constituents of the NADF are characterized by being non water-soluble organic compounds (i.e. esters) or highly refined low toxicity mineral oils. The precise composition of the NADF to be used is not known at the moment, but as the ones to be used are virtually free of Polycyclic Aromatic Hydrocarbons (PAHs) the toxicity is still considered relatively low (EPA, 1996). In any case the proposed NADF will always be at least Category III of OSPAR/OGP non aqueous fluids ((i.e. with less than 1/1000 of PAHs and less than 0.5 /100 of total aromatics). The Oil / Water ration will be generally between 70/30 and 80/20.

Prior to the drilling activity taking place, the drilling fluid service provider will have the obligation to provide the Material Safety Data Sheet (MSDS) for all additives which will be used for both drilling fluid system. These sheets will provide all information about the product in matter of chemicals, chemical compounds, toxicity, acidity and any other relevant information.

3.2.6 Solid Control Equipment

For the 42" inch section the drilling fluids and cuttings will be discharged onto the seabed, but once the riser is in place (after setting the 22'' casing, 26" bore section) the drilling fluids can be re-circulated between the drillship/SS and the well.

[1] *OSPAR Convention* or *Convention for the Protection of Marine Environment in the North-East Atlantic* is an international convention signed by all European Countries in the North-East Atlantic Sea which among others focuses and provides guidance on the management and evaluation of the offshore O&G industry.

Returned drill cuttings and drilling fluid will be separated on the drillship/SS using the shale shakers, centrifuge and a vertical cuttings dryer from the circulating system. All NADF fluids are passed through the solids control system; an integrated system of equipment that separates the cuttings from the drilling fluid to maintain the required viscosity and density of the drilling fluid. Separated drill cuttings will be processed in the solids control equipment before being discharged overboard while the cleaned muds will be recycled to re-enter the well. The drill cuttings treatment may include thermal treatment in order to destroy organic material and consequently to reduce the residual oil content to as low as possible.

At the end of the drilling campaign the NADF system will be returned to the supplier for reclamation and/or reuse.

The remaining oil on separated cuttings will be reduced to a target concentration below 6.9% in weight (Retained Oil on Cuttings (ROC), wet weight, total well average). GALP will provide to the appropriate authorities a daily report showing full compliance with the ROC maximum % allowed to overboard drilling cuttings.

3.2.7 Cement and Cement Chemicals

Well casings will be cemented into place to improve the safety and structural integrity of the well and also to aid the drilling process. Cement slurries will be used to fill a portion of the annulus between the outer face of the casing and the wall of the formation hole. This is achieved by pumping the slurry down through the drill pipe and casing and having it forced into the annulus and toward the surface from the base of the borehole filling the total or part of the annulus.

Though quantities are carefully calculated to ensure that all cement remains downhole, a small quantity of cement may be released to the seabed when casings are cemented back to the seafloor for the two primary strings, the 36” conductor and 22” surface casing. For the remaining casing string, no cement will be released to seabed.

In addition to basic cement, a number of additives are used to achieve the required performance. Cement properties and depths may be adjusted based on well conditions, pressure and temperature. The additives will depend on the bottom temperature and the volume of cement pumped will be accordingly to the real diameter. Those additives will be used to optimize the setting speed of the cement, to enhance its compressive strength, and to effectively isolate any reservoir that can be drilled. The cement planned for the current operations is Cement Grade G, which is part of the PLONOR list.

As per the drilling fluids additives MSDS sheets, MSDS sheets of cement additives will also be provided to the relevant authorities.

3.2.8 *Well Testing*

It is possible that a technical decision may be made to conduct well testing at one or more of the drilling locations, meaning at least one well test per appraisal well. A well test operation will require approximately 20-30 additional drillship/SS days on location to prepare for and conduct the testing; actual testing may take approximately 48 to 72 hours.

A well test would involve flowing formation fluids, including oil and/or natural gas, up to the drillship/SS where it will flow through special equipment to be separated, measured, and safely disposed of using modern hydrocarbon burners or flares.

In order to test the well effective flow communication between the wellbore and the reservoir. This is achieved through a perforating gun which creates a hole through the casing and cement. The hole is called a perforation tunnel and provides a pathway for fluid flow from the reservoir to the wellbore. A methodology called "Tubing Conveyed Perforation" (TCP) uses a tubing conveyed large diameter casing gun (3–1/8 to 5 in.) that is run on the end of tubing. This arrangement allows one to use a large diameter gun that fires a series of explosive charges and thus perforates the well with tubing in the hole. There are two techniques, "shoot and drop" or "shoot and pull" where the gun is either left at the bottom of the well or hauled back to the surface; for the latter, should there be a miss shoot, non-exploded gun charges would have to be disposed of. Explosives are always stored in a "bunker" on the drillship/SS rig site in a safe area.

The typical method of correlating a TCP gun string to the desired reservoir location is to use a radioactive marker, which can be used to make very accurate depth correlation of pipe conveyed gun systems. A small radioactive "pip tag" is secured inside a cavity on the side of the casing thread[1] a known distance above the firing head as part of the work string and run in hole to the proposed perforating depth. A wireline gamma ray logging tool is run through the tubing to perform the correlation log. The resulting log will show a large spike at the depth of the pip tag. When this log is compared to the open hole gamma ray log, adjustments can be made to the work string placing the guns on depth. All radiation emitting materials are stored in a contained radiation sealed area on the drillship/SS rig site.

The duration of the drill stem test is expected to last several days. Drill stem tests are multi rate tests designed to determine reservoir characteristics under a variety of flowing conditions. These test rate calculations reflect the maximum capabilities of typical well test equipment. For drill stem testing,

[1] The use of radioactive markers is an international standard for drilling projects and its use is required to verify well integrity and reservoir parameters. The marker is contained within the well casing, which facilitates its retrieval through standard industry procedures. Should, incidentally, the recovery of the marker be unsuccessful, the well abandonment procedures will take this into consideration. Considering best industry practice on well plugging and abandonment, the marker will be confined within the well, at its deepest position with multiple cement plugs isolating the well.

either gas flaring, oil flaring, or some combination of the two will occur, depending on the nature of the hydrocarbons encountered.

For emissions calculations, GALP assumes up to 20,000 BOPD for 72 hours (3 days) plus 4,000,000 scf/hr (96 MMSCF/D) methane gas for 72 hours (3 days). These rates are based on the maximum capacity for typical temporary flaring / well testing equipment.

At this stage of the study, it is difficult to predict which kind of fluid will be produced. As a standard well test procedure, a fluid separator will be used to separate all producing fluids from gas, oil to water. Each fluid will be treated at the appropriate level to be discharged or sent to shore for final treatment. No fluids will be discharged unless compliant with International Standard.

3.2.9 Well plug and abandonment

At the end of the program, each well will be plugged and permanently abandoned. This will be achieved by cement plugs across the well, according to good industry drilling practices. A dedicated pressure test procedure will be performed during this scope of work to verify that the well will be entirely safe with no possible flow from anywhere in the wellbore.

The High Pressure Wellhead Housing (HPWHH) will not be removed at the end of the well the elevation from the seabed being low with a maximum of 5 m stickup.

3.3 ONSHORE SUPPORT

The GALP offices will be located at São Tomé from where all operations will be organized and managed. However, due to the lack of current port facilities in STP, the onshore logistic support base for the Block 6 drilling activities will be located at in a neighbouring country. Most likely countries considered for the logistics are Equatorial Guinea and Ghana which seem to be the be most appropriate location considering practicality, safety, security and other relevant factors which will contribute to a safe, efficient and controlled operation.

The preferred location will be used to store all Long Lead Items (LLIs) which will be used for the drilling programme with a minimum of 1 well equipment backup and an additional set of equipment for a potential relief well.

Additionally, this location will also be used to pre-mix drilling fluids but GALP also reserves the right to mix drilling fluids at the drillship/SS site if judged more efficient from an operational point of view.

Helicopter support operations will be required to move personnel and equipment to and from the drillship/SS. This will be provided by an aviation contractor through an aviation facility in São Tomé.

3.4 PROJECT RESOURCES

3.4.1 Water consumption

Water will be required throughout the project's lifecycle; this includes the following activities: (1) producing drilling muds; (2) muds treatment; (3) drinking/potable water consumption, (4) sanitary purposes, (5) cleaning purposes and (6) firefighting (if needed). The water will likely be supplied from the local water network at the port of Neves in STP or from the logistic base location. Drinking water will be supplied in bottles. In total, it is estimated that approximately 4,000 m^3 of water will be pumped from the local water network per well drilled, excluding water for use in WBM.

3.4.2 Fuel consumption

Fuel consumption will be mainly associated to vessels engines (i.e. drillship/SS, supply vessels and to generators used for drilling activities. Fuel will be purchased locally if possible or from the logistic base and supplied to the drillship/SS by the supply vessels.

A summary for on-site fuel consumption is presented below (see *Table 3.1*). These calculations provide a good approach on the magnitude of the operations to be performed during the life-cycle.

Table 3.1 Estimated daily Fuel Consumption for one well

Drillship/SS mobilization/ demobilization (m^3)	Drillship/SS operations (m^3)	Supply Vessels mobilization/ demobilization (m^3 per vessel)	Supply Vessels operations (m^3 per vessel)	Helicopter operations (m^3)
40-50 m^3/day in transit	40-50 m^3/day, possibly more if strong currents	Avg 5 -15 m^3/day each boat; heavily dependent on run time / frequency /distance /spread	Avg 5 -15 m^3/day each boat; heavily dependent on run time / frequency /spread	Typical use would be about 50 m^3 for entire well

Source: GALP, 2018

3.5 EMISSIONS, DISCHARGE, WASTE AND HANDLING OF HAZARDOUS MATERIALS

This section presents components of the project that could potentially interact with the environmental and social receptors and resources of the project area. The main sources of emissions to air, discharges to water, and solid wastes that will result from the exploration drilling operations and the treatment and/or disposal procedures that will be followed in compliance with STP regulatory requirements.

3.5.1 *Atmospheric emissions*

The Block 6 exploration and appraisal program will generate a range of varying amounts of air pollutants and greenhouse gas emissions from combustion sources such as generators and thrusters on the drillship/SS, diesel engines of the support vessels, etc.

Fuel combustion will lead to the emission of sulphur dioxides (SO_x), nitrogen dioxides (NO_x), carbon dioxide (CO_2) and carbon monoxide (CO). Flaring will also lead to these types of emissions in addition to Methane gas (CH_4). As in any fossil fuel combustion engine, there will also be very limited emissions of unburnt hydrocarbons, volatile organic compounds and particles that may be generated by the vessels' turbines.

In addition to fuel consumption, air compressors of the energy sources will also generate occasional, limited emissions.

3.5.2 *Noise*

The main sources of underwater sound associated with the project can be categorized as follows.

- **Drilling noise.** Drilling noise can range between 145-190 re 1 µPa at 1 m (OSPAR, 2009). Blackwell *et al* (2004) found broadband (10 Hz – 10 kHz) levels reaching a maximum of 124 dB re 1 µPa at 1 km, mainly at 700 Hz – 1.4 kHz from well drilling operations, whilst noise from a caisson during drilling in the Beaufort Sea was approximately 150 dB re 1 µPa at 1 m at 30 - 40 Hz (Richardson *et al* 1995).

Box 3.1 ***Methods used to assess acoustic pressure***

Because submarine noise can be quantified in various ways, literature often refers to a variety of noise measurements. Submarine noise levels are usually expressed in decibels (dB). Decibels are based on the ratio of submarine sound pressure to a common reference of 1 micro pascal (dB / µPa).

The acoustic pressure referred to above can be expressed either in peak-to-peak (p-p) value, or in peak value (peak), or root mean square (rms). The type of pressure measurement used is an important consideration when comparing noise levels and criteria, and the type of pressure measurement must be indicated when noise levels are mentioned. The peak pressure is the maximum absolute pressure for an instantaneous signal. However, acoustic pressure varies from positive to negative to form the pressure fluctuations that are audible by animals. It is therefore also possible to express pressure in peak-to-peak (p-p), that is to say the difference between the highest point (positive) and the lowest point (negative) of an acoustic pressure signal. For a given signal, the peak-to-peak value is higher than the peak value.

- **Propeller and thrusters.** Noise from propellers and thrusters is predominantly caused by cavitation around the blades whilst transiting at speed or operating thrusters under load in order to maintain a vessel’s position. Noise produced is typically broadband noise, with some low tonal peaks.

- **Machinery noise.** Machinery noise is often of low frequency, and often becomes dominant for vessels when stationary or moving at low speeds. The source of this type of noise is from large machinery, such as large power generation units (diesel engines or gas turbines), compressors and fluid pumps. Sound is transmitted through different paths, *i.e.* structural (machine to hull to water) and airborne (machine to air to hull to water), or a mixture of both. The nature of sound is dependent on a number of variables, *e.g.* number and size of machinery operating, coupling between machinery and deck.

- **VSP noise.** Noise from the VSP is related to the compressed air used as a source of energy. The size of the source (volume) is approximately three to four times smaller than conventional vessel trailed seismic sources, thus the power and noise source level is smaller. The source intensity is approximately 185-195 dB re 1µPa-m and frequencies usually range from 0.005 kHz to 0.1 kHz.

3.5.3 Liquid discharge

All discharges to the sea will be in accordance with STP legislation, specifically the Petroleum operation regulations, and International Conventions such as MARPOL 73/78 Annex I Regulations for the Prevention of Pollution by Oil and Annex IV Prevention of pollution by sewage from ships and amendments, and other International Conventions of general application such as the Control and Management of Ships' Ballast Water and Sediments (standard of reference).

Discharges to water from the drilling activities are described in this section. The discharges and treatment systems are discussed below and summarized in *Table 3.3*. Discharges will result from the following activities:

- Drillship/SS and support vessel operations during well drilling will result in routine discharges to sea (*i.e.* sewage, grey water, and food waste, bilge water, and ballast water and deck drainage).

- Drill cuttings and fluids (WBM and potentially NADF) will be used, and cuttings will be discharged to the seabed up to the point where the 22” casing is positioned. The cuttings will then be recirculated to the rig via a riser and separated from the mud on the shale shakers. Separated cuttings will be discharged overboard.

The calculation provided below was based on a drillship/SS having a capacity of 200 people and overall 50 people on all support vessels. Further assumptions are: an estimated 100 liters/d/person of black water, 220 liters/d/person of grey water, and 1 kg/d/person of food waste.

Table 3.3 Summary of estimated discharges and proposed treatment - conservatory assumptions

Source	Treatment	Volume	Limit	Standard
Drilling and Installation: Routine Discharges				
Black water (sewage)	Treat with approved marine sanitation unit. Maceration and chlorination.	Variable depending on number of people on drillship/SS Estimated 100 l per person per day. Drillship/SS: 200 personnel, 20,000 l/d Support vessels: approx. 50 personnel, 5000 l/d	• Achieves no floating solids • No discoloration of surrounding water • < 1 mg/l chlorine concentration	MARPOL Annex IV
Grey water	Remove floating solids	Variable depending on number of personnel Estimated 220 l per person per day. Drillship/SS: 200 personnel, 44,000 l/d Support vessels: approx. 50 personnel, 11,000 l/d	• No visible floating solids or discoloration of surrounding water	MARPOL Annex IV
Bilge water	Oil-water separation	Bilge water generation variable, depending upon facility and vessel characteristics, discharge volume variable. Drillship/SS: up to about 32 m^3 per week (estimated) Support vessels: up to about 110 bbl/d (estimated)	• 15 mg/l of oil concentration	MARPOL 73/78 Annex I
Storage displacement water (ballast water)	Oil-water separation	Drillship/SS: up to about 620 bbl per day (estimated)	• 15 mg/l of oil concentration • Ballast exchange at least 200 nm from nearest land in > 200 m water.	MARPOL 73/78 Annex I BWM Convention
Deck drainage	Oil-water separation	Deck drainage water generation variable depending on facility and vessel characteristics and rainfall amounts; discharge volumes variable. Assuming monthly rainfall of about 170 mm: Drillship/SS : 17 x 10^{-5} l (estimated) Support vessels: 3 x 7.1 x 10^{-5} l (estimated)	• No free oil (Free oil is characterized by droplet sizes greater than 150 µm.) • 15 mg/l of oil concentration instantaneous reading oil water threshold •	MARPOL 73/78 Annex I

Source	Treatment	Volume	Limit	Standard
Drilling				
Drill cuttings and fluid	High performance WBM: No treatment – discharge to seafloor. Unused fluid will be returned to supplier Improved NADF: Recycle using solid control equipment. Unused returned to supplier	First estimation: see *Table 3.4* Below	• Use of high performance water based muds (WBM) • Contaminants as per IFC 2007 standards • Use of low toxicity improved NADF • Material on cuttings between 6.9% wt. • Discharge improved NADF cuttings below water surface via caisson. • Contaminants as per latest international standards	GALP

Note: The manning was chosen as 250 persons to maximize the outputs in order to obtain the worst case scenario.
MARPOL 1973/1978 = International Convention for the Prevention of Pollution from Ships.

Table 3.4 Preliminary estimates of drill cuttings volume for a single well

Drilling Operations				
Section and Bore Diameter	Section Casing	Well Interval between Sections	Discharge Depth from Surface (MSL)	Volume of Cuttings Discharged (m^3)
Section 1 - 42”	36”	81	Seabed	53
Section 2 - 26 “	22”	619	Seabed	318
Section 3 - 22”	18”	900	Drillship/SS	265
Section 4 - 17 ½ “	13 5/8”	800	Drillship/SS	132
Section 5 - 12 ¼”	9 5/8”	1400	Drillship/SS	128
Section 6 - 8 ½” “	Open Hole	575	Drillship/SS	52 (Assume 12 ¼”)
	Total discharged			948

Source: GALP, 2018

3.5.4 *Non-hazardous and hazardous solid waste*

Solid waste generated on board the drilling rig or support vessels during drilling operations will be shipped back to the marine operations base where it will be reused or recycled where possible, or disposed of in an environmentally acceptable manner and in compliance with applicable regulations and international conventions. Additional waste may be generated from onshore support activities at the onshore base at the port yet to be defined.

Non-hazardous solid waste expected to be generated by the Project include non-hazardous wastes, in particular:

- General domestic waste - from the galley and living quarters (Food wastes are generated from galley and food service operations. Food waste, a type of domestic waste (Estimated 1 kg per person per day), will be ground prior to discharge (i.e. comminuted), in accordance with MARPOL requirements (i.e., for vessels 400 gross tonnage and above). Food waste is typically ground to <25 mm diameter to meet discharge requirements. The discharge will be at a distance of more than 3 nautical miles from the (MARPOL 73/78 Annex V);
- Plastic - including drinks bottles;
- Paper and cardboard;
- Scrap metal - empty drums and cables; and
- Wood – pallets and crates.

Hazardous wastes anticipated from the Project include:

- Batteries - including large lead-acid type (small quantities, order of 1 m^3, at shore base);
- Empty chemical packaging (drilling mud additives);

- Clinical/medical wastes;
- Oil filters; oily rags and absorbents;
- Used oil –from engine maintenance; and
- Oily bilge water from drillship/SS deck drainage and engine rooms.

Wastes will be minimized, appropriately segregated and stored onboard prior to disposal at authorized and adequately equipped port reception facilities

The general estimated quantities of non-hazardous and hazardous waste that will be produced by the exploration and appraisal drilling are presented in *Table 3.5*.

Table 3.5 ***Estimated Waste Types and Estimated Generation Rates***

Category	Waste Type	Units	Estimated Quantity Range		
			Drillship / SS	Vessels (various)	Onshore Base
Non-hazardous	General domestic waste	m^3/month	400-600	–100-150	10 - 30
	Wood	m^3/month	10 – 45	0 - 5	0 - 2.5
	Plastic	m^3/month	0 – 2	0	0 - 0.25
	Scrap metal	m^3/month	5 – 19	0	0 - 0.5
Hazardous	Oily rags and oil filters	m^3/month	0.3 - 8	0.5 - 2.5	0 - 0.25
	Used oil	m^3/month	5 - 8	20 - 55	0 - 20
	Batteries	Tons/month	0 - 1.3	0 - 0.2	0 - 0.2
	Medical waste	kg/month	0 – 5	0 - 10	0 - 10
	Oily water (slops)	m^3/month	30 - 300	0 - 100	0
	Filter cartridges	No. units	0 – 10	0	0
	Drums (with residues)	No. drums	50 – 125	0 - 25	0 - 20
	Other various wastes	m^3/month	0 – 3	0 - 0.5	0

Source: GALP, 2018

All operational waste will be managed according to GALP's Waste Management Plan (WMP) under development, which will take into account available waste management facilities in the prospective port to be used and the wider region.

3.6 HSE PROCEDURES

In support of our commitment to health, safety and the environment, GALP has instituted a companywide Health, Safety and Environment Management System, which applies to all GALP personnel and contractors in our business. This Management System establishes and communicates expectations in broad management categories including safety and health, risk management, emergency preparedness, and environmental protection.

GALP's main policies of relevance to this Project are:

- P-001 Quality Policy.
- P-002 Health, Safety and Environmental policy.
- P-003 Climate Change Policy.
- P-004 Security Policy.

- P-008 Risk Management Policy.
- P-011 Corruption Prevention Policy.
- G+ System – Gestão de Segurança, Saúde e Ambiente.

All the activities will take into consideration that the basis of good maritime safety is compliance with all applicable conventions and codes that cover the type of operations being conducted. These cover all aspects of the project since design, to inspections and abandonment.

- International Convention for Safety of Life at Sea (SOLAS) 1974 and 1978
- Convention on the International Regulations for the Prevention of Collisions at Sea (COLREG) 1972.
- International Standards of Training, Certification and Watch keeping Convention (STCW) 1978 and 1995 Amendments.
- International Convention on Maritime Search and Rescue (SAR) 1979.
- These conventions are described in *Chapter 2*.

GALP is committed to maintaining high standards that protect our employees, contractors and the communities where we operate. These commitments are in addition to our basic obligation to comply with all health, safety, environmental and security laws and regulations.

3.6.1 Safety exclusion zone

Exclusion zones on the well sites are implemented for safety reasons and are intended to prevent interaction with other vessels in their travel path (e.g. cargo vessels in transit). The exclusion zone will be notified to the marine authorities/users prior to the initiation of project activities. A safety exclusion zone of 500 m from the drillship/SS is planned.

3.6.2 Emergency response

Prior to start project activities, a Risk Assessment will be undertaken by GALP in order to identify the relevant potential Emergency Scenarios that typically include Oil Spills, Severe Weather, Search and Rescue, Loss of Well Control, Operational Emergency, Vessel Emergency, Aviation Emergency, Refueling Spill, Medical Emergency and Fire. These scenarios will be dealt through specific Emergency Response Plans (ERP).

4 DESCRIPTION OF THE BASELINE ENVIRONMENT

4.1 INTRODUCTION

This chapter provides a description of the existing environmental and socio-economic conditions against which the potential impacts of the Project activities in Block 6 of the São Tomé e Príncipe are assessed.

The scope of the baseline study is directly influenced by the potential impacts of the project and the area of influence of the sensitive receptors. Drilling activities will be located within Block 6 (*Figure 4.1*) located 100 kilometres to the north east of the São Tomé Island; 63 km southeast of Príncipe Island and approximately 140 kilometres West of Libreville (Gabon), in water depths varying within the range of 2,000 and 3,000 meters.

At the moment of writing this report the precise well locations are still under definition and therefore the study area has been defined as the complete block perimeter. However, it is expected that in most cases well locations would be located within the area of the block where the 3D seismic survey was developed (*Figure 4.1*).

The baseline description draws on a number of primary and secondary sources, among others:

- Previous environmental studies performed by ERM, such as the 3D seismic survey ESHIA, and other Environmental firms in the area;
- Results of the Marine Mammal Observer (MMO) and Fisheries Liaison Officer (FLO) activities during the development of the 3D Seismic survey in the Block;
- National Reports on Biodiversity developed by institutions of São Tomé e Príncipe;
- Internationally recognized published sources and databases such as the Food And Agriculture Organization (FAO) and the International Union for Conservation of Nature (IUCN); and
- GALP ´s technical documentation.

A detailed list of references used in this report is provided in *Section 7 References.*

Figure 4.1 Location of São Tomé e Príncipe Block 6.

Source: *ERM, 2018*

4.2 PHYSICAL ENVIRONMENT

4.2.1 Climate

Temperature, rainfall and fog

In the Gulf of Guinea, where São Tomé e Príncipe islands are located, the climate is typically equatorial and therefore sees little variation throughout the year with typically persistent high temperatures and frequent spells of high humidity.

The dry season in São Tomé e Príncipe islands occurs from December to February and from June to September, while the wet season takes place between March and May and from October to November.

The islands lie within the wet tropical belt resulting in mean annual temperatures that range from a maximum of 30° to 33°C to a minimum of 18°C to 21°C, with little seasonal variation and high humidity all year (*WWF, 2012; McSweeney et al., 2012*). Annual rainfall ranges from 1,000 mm in the northeast of São Tomé island to more than 4,000 mm in the southwest. In Príncipe, the rainfall pattern is similar (*WWF, 2012).*

The regional climate of São Tomé e Príncipe is driven by the northward and southward migrations of the Inter-Tropical Convergence Zone (ITCZ) associated with the south west monsoon and the Northeast Trade Winds (Heileman, 2009).

In the STP area, the main wet season lasts from October to May, with recorded average rainfall of 200 millimeters per month (*McSweeney et al., 2012*). This wet season is punctuated by a brief and slightly drier spell between January and February, followed by a very dry season from June to September when rainfall is lowest (*McSweeney et al., 2012*).

The *Table 4.1* shows the most recent public available information to date from the São Tomé airport (information published in 2016). As shown in the table, monthly average precipitation for year 2015 registered in the São Tomé Airport Meteorological Station located at an approximate distance of 106 km west of Block 6.

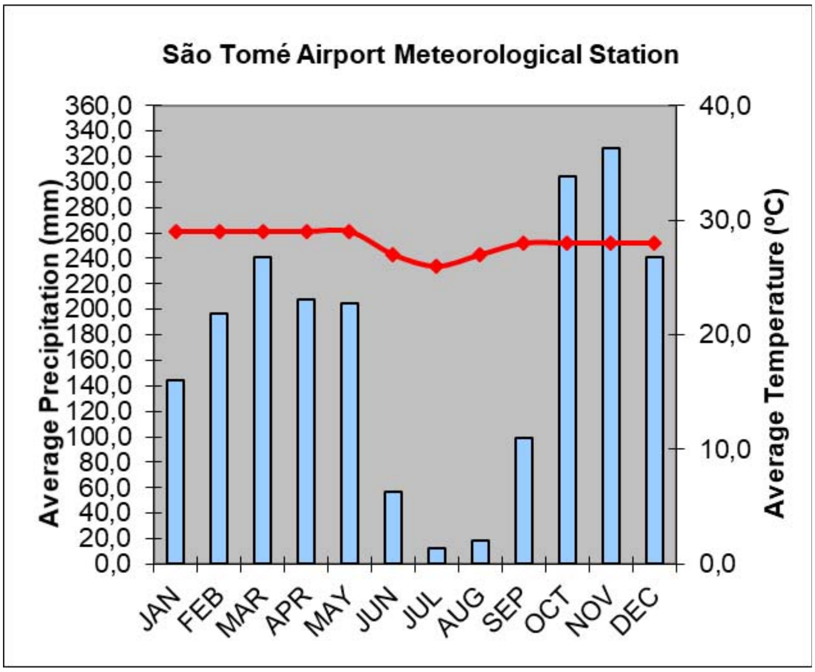
Table 4.1 Mean Monthly rainfall, year 2015, at São Tomé airport.

Month	Precipitation (mm)
January	144,0
February	197,0
March	241,0
April	208,0
May	205,0
June	57,0
July	12,0
August	18,0
September	99,0
October	304,0
November	327,0
December	241,0

Source: NCDC, 2016

The average frequency of sea fog offshore STP is less than 1 per cent in any month. Poor visibility (of less than 8 kilometers) is slightly more common, with around 10 to 15 per cent occurrence in winter and 4 to 6 per cent occurrence in summer (*Hydrographer of the Navy, 2006*).

Figure 4.2 ***Monthly temperature and rainfall, year 2015, at São Tomé Airport meteorological station.***



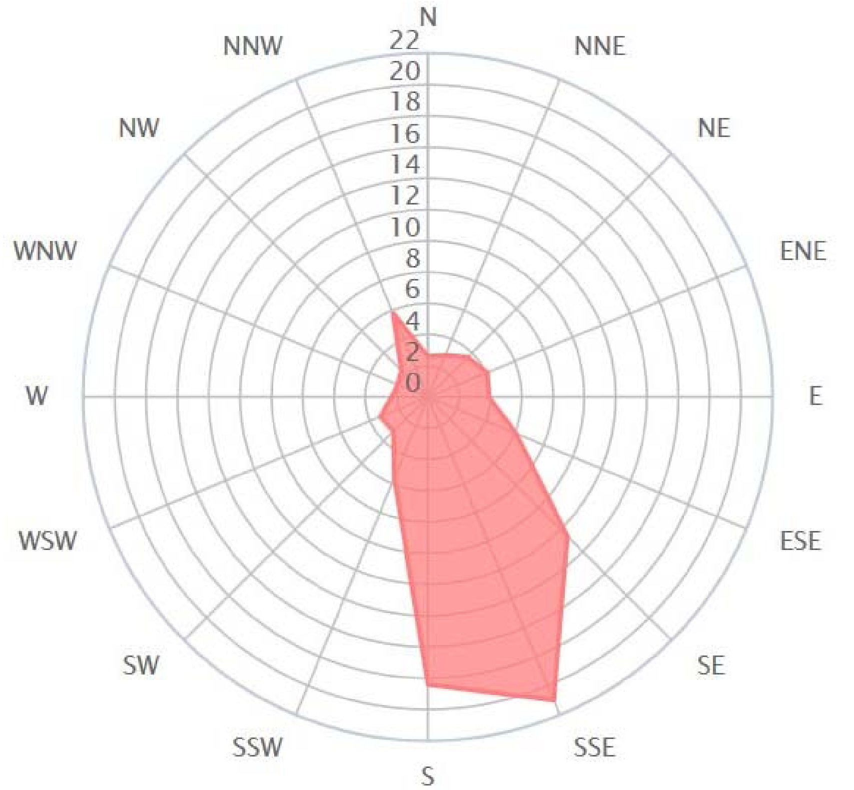
Source: NCDC, 2016.

Winds

The north-east trade winds predominate around August, reaching approximately 3° north (northwest of Príncipe island) by December and January, and retreating north in February. In January, south-west winds prevail and extend north in July. The average strength of these winds is force 1-3 on the Beaufort scale. South of 20° north, the north east trade winds blow hot and dry (known as the "Harmattan") southwards from the Sahara desert, and can extend some 600 miles (966 kilometers) out to sea. Wind strength in July is typically force 1 -3 on the Beaufort scale but can increase up to forces 5 and 6. Gales are rare and very few winds (only 1 -2 per cent) occur at force 7 or above within the study area (*Hydrographer of the Navy, 2006*).

Figure 4.3 presents the average annual wind rose in the São Tomé airport meteorological station, corresponding to the latest data publicly available (period 2010-2017).

Figure 4.3 Annual wind rose at São Tomé Airport meteorological station.



Source: *Windfinder, 2018.*

4.2.2 *Oceanographic conditions*

The information on oceanographic conditions within the Gulf of Guinea and STP waters indicated in the following subsections, correspond to the latest scientific publicly available information.

Currents

The Study Area lies in water depths predominantly beyond the continental shelf, in a region characterized by an anti-cyclonic sub-tropical gyre. The water column is composed of distinct layers that flow in different directions and at different speeds.

Water circulation in the Gulf of Guinea is dominated by the Guinea Current that runs parallel to the coast from Senegal to Nigeria and the South Equatorial or Benguela Current that flows northwards along the coasts of Gabon and then turns westward along the equator.

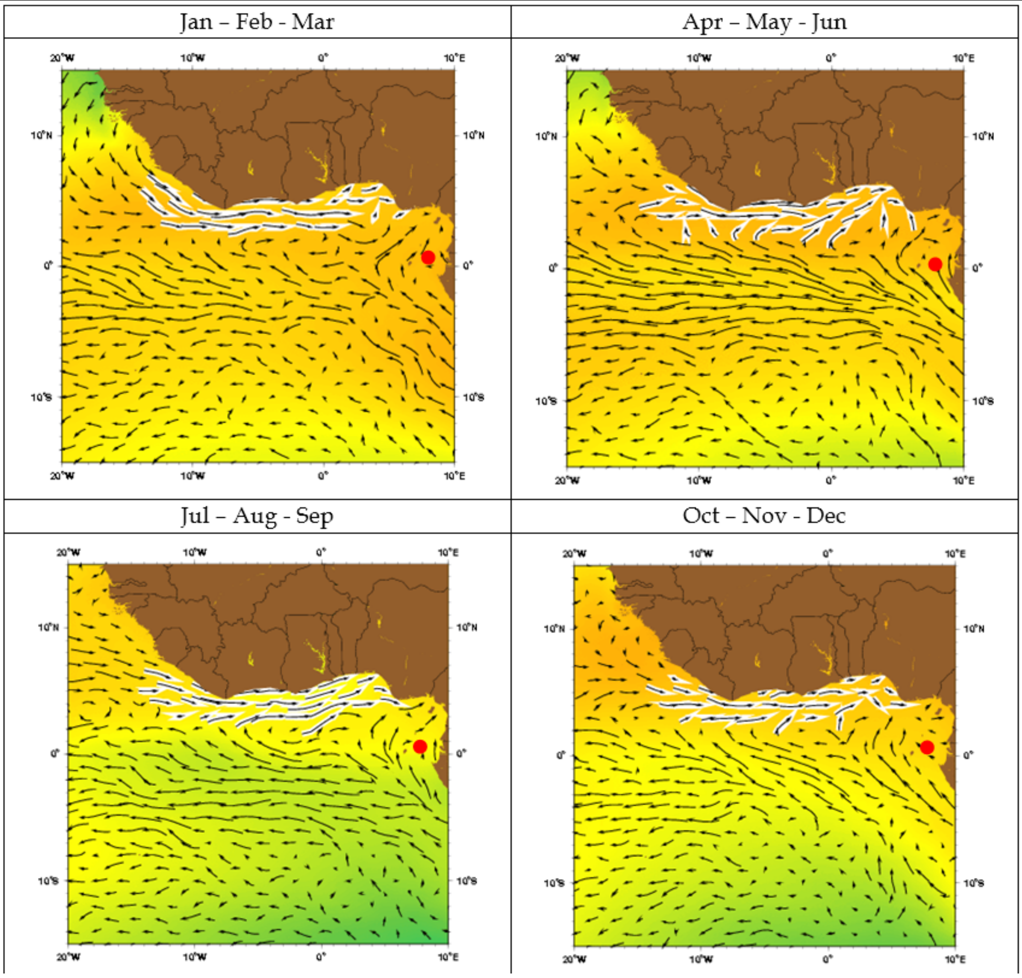
The predominant surface current in Block 6 is therefore the South Equatorial Current (Benguela Current) that flows westwards at a speed of approximately 0.25 m / s (depth of 0 to 100m) (*Findlay et al. 2006*). Records show that the highest current speeds occur in the south during summer and in the north during winter, a pattern that corresponds with seasonal wind fields. The prevailing winds are responsible for strong Ekman transport and the resulting coastal upwelling of cool, nutrient-rich water that stimulates primary productivity (*Boyer et al., 2000, Skogen 1999*).

Beneath the South Equatorial Current, in a southeasterly direction, flows the Gabon-Congo Current with speeds estimated between 0.11-0.23 m/s depending on the precise location and season (*Gyory, 2005*).

As stated by Colin (1988), and supported by several authors (*Longhurst, 1962; Boisvert, 1967*; *Ingham, 1970; Bakun, 1978* and *Richardson and Philander, 1987*) the Guinea Current experiences a minimum intensity period during the winter (November through February) and a maximum during the summer (May through September).

Figure 4.4 shows the seasonal average direction of the Guinea and Benguela Currents.

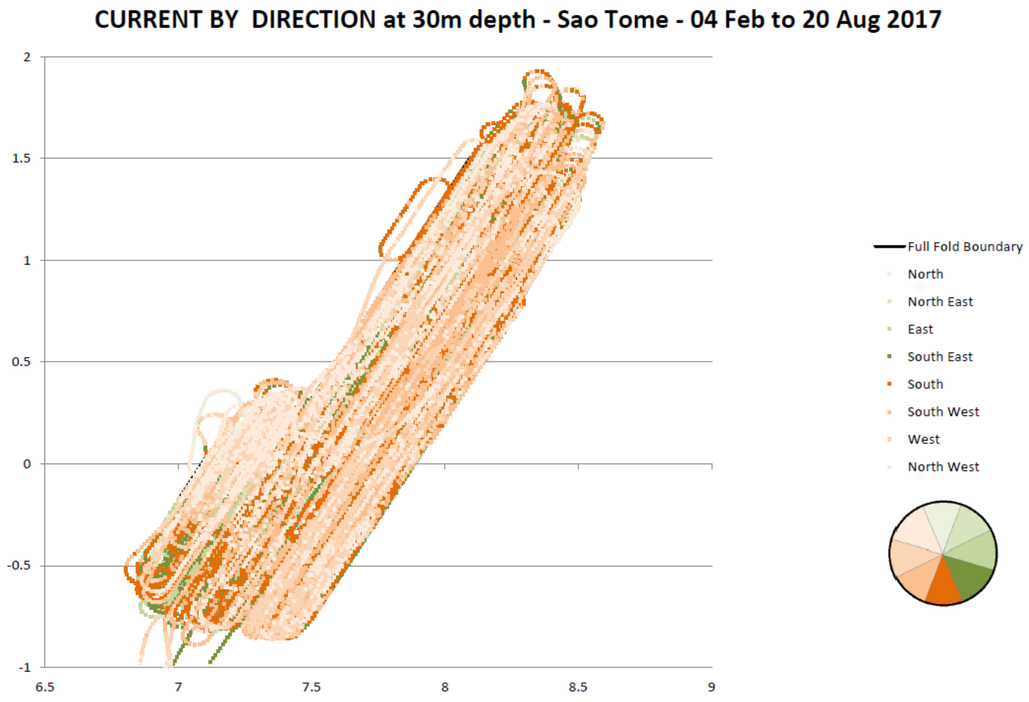
Figure 4.4 ***Average Annual Direction of the Guinea and Benguela Currents.***



Note: arrows shaded in white correspond to the Guinea current while the westward arrows located south of it correspond to the westward section of the Benguela current that lies over the Project location. The red dot represents the approximate location of Block 6 where appraisal and exploratory drilling is planned.
Source: *Gyory, 2005.*

Surface current data (*Figure 4.5*) recorded by Acoustic Doppler Current Profiler (ADCP) along eastern Blocks of STP waters, including Block 6, in 2017 during a 7 months period (February to August). Results revealed that main current directions at 10 and 30 m depth vary from NW to SW, while speeds range between 0,1 to 0,6 knots with occasional peaks of up to 1 knot at 30 m depth and between 0,8 and 1,4 knots at 10 m depth, where the influence of the winds is stronger (*CGG, 2017*).

Figure 4.5 Current directions at 30 m depth along eastern STP Blocks.



Source: *CGG, 2017*

Tides

The tidal streams in the São Tomé e Príncipe islands are semi-diurnal, reversing their direction four times daily, however offshore these tidal streams are negligible and water movement is predominantly dictated by the ocean currents (*Hydrographer of the Navy, 2006*).

Swells

In São Tomé e Príncipe, during winter, southerly to south-westerly swells predominate (82% of all swells). The most frequent height ranges from 0.5 to 2 meters (80% of waves and swells). During the summer when the south to south-westerly swells dominate, with 83% of all swells, swell heights vary slightly, the most frequent heights remain at 0.5 to 2 meters but with marginally higher swells occurring at 2.5 to 3 meters (73% and 10% respectively) (*Hydrographer of the Navy, 2006*).

Upwelling

An upwelling event occurs when cold, nutrient-rich, sub-thermocline water rises to the surface from depth, leading to an increase in nutrient availability and associated increase in biological productivity. These events influence fish migration patterns and fish catches.

There are two important periods of upwelling within the Guinea Current along the continental coasts of Africa, north of São Tomé e Príncipe, which occur from July to September and again with a minor upwelling from December to January, occasionally extending into February (*Abe et al, 2004*). Certain sources claim that Sao Tomé e Príncipe waters experience this phenomenon but it is evident that it is more intense on the coast of Gabon where the continental shelf is wider and shallower.

Seawater temperature and salinity

Sea surface temperatures (SST) along the northeast coast of São Tomé vary between inshore and offshore waters throughout the year. SST average is 27°C for the January-March period. During the summer months, the SST average is 25°C (*Seatemperature.info*).

The surface salinity along the northwest coast of Africa is 35 to 36.5 parts per thousand, exhibiting little annual variation *(Hydrographer of the Navy, 1995).*

4.2.3 Bathymetry and sediments

Bathymetry and submarine topography

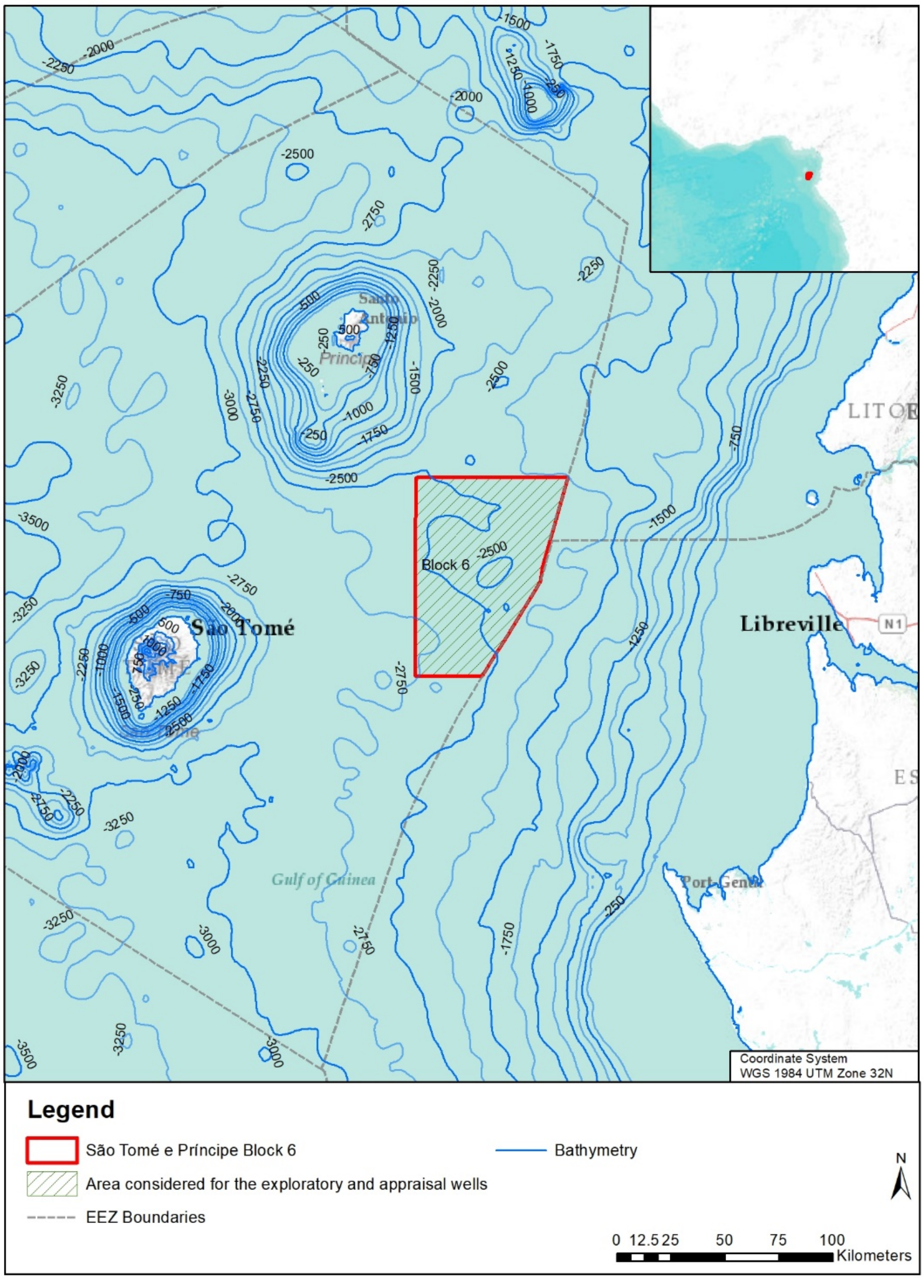
The continental shelf off the coast of northwest Africa is narrow (<50 km in most places) with the 200 m isobaths located at distances between 40 and 60 km offshore. This effect is even more pronounced in the case of STP, where the continental shelf is limited to less than 5 km for São Tomé Island and around 10 km for the eastern coast of Príncipe island.

The area where the proposed appraisal and exploratory drilling wells will be located lies in waters where depths vary between approximately 2,175 m in the northeastern edge of block and 2,800 m in its extreme southwest *Figure 4.6*).

Bathyal seabottoms, that is those located between 1,000 and 4,000 m depth as the ones in Block 6, are generally characterized by being mostly flat with gentle slopes. Only the presence of features such as seamounts and knolls modifies significantly this landscape.

Little is known about detailed seabed topography within the area occupied by Block 6, though it is expected that is formed mainly by a flat sediment plain. The only relevant features currently known, based on bathymetry data collected during the 3D seismic survey along the Block, are a couple of small depressions located in the central-southern section of the Block and a seamount-like feature at the central eastern edge of the Block.

Figure 4.6 Bathymetry of Block 6 Sao Tomé e Príncipe.



Source: ERM, 2018.

Sediments

Generally, and according to the most recent public available information published in 2008, seabed sediments (*Manh Hai LE, 2008*) can be classified as follows:

1. Terrigenous sediments, that come from the erosion of pre-existing rocks transported by the wind or the rivers;

2. Biogenous sediments, resulting from the skeletons of living organisms, plant or animal; and
3. Hydrogenous sediments, precipitation of minerals in sea water (salt, etc.).

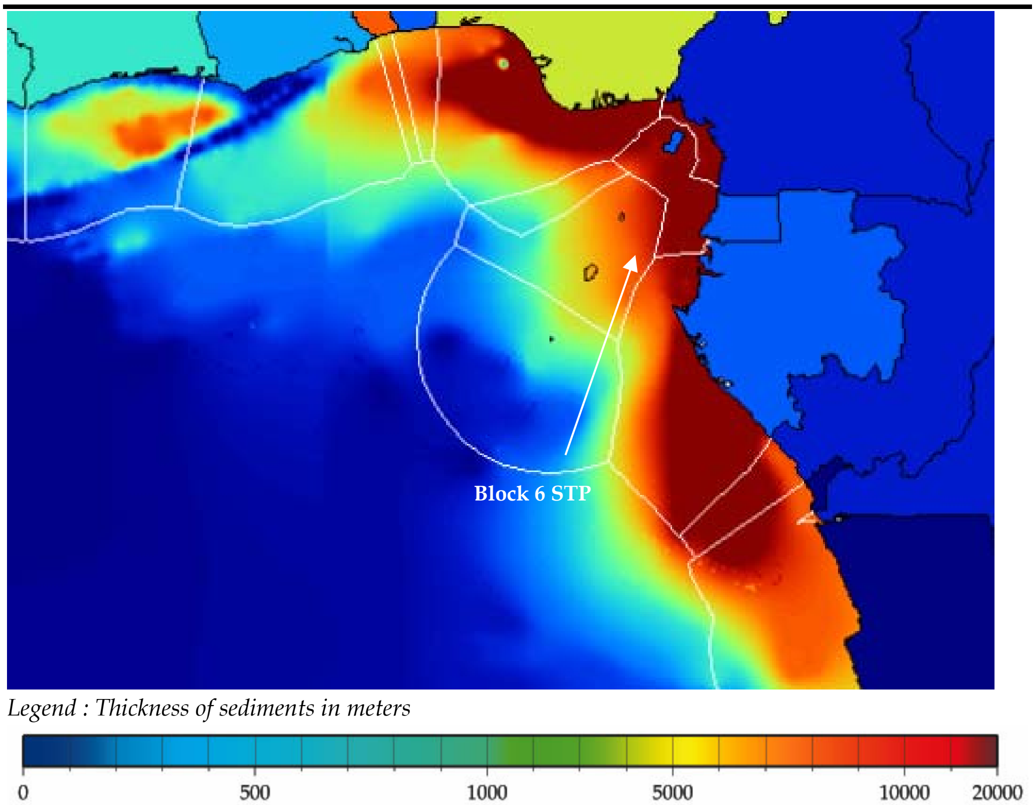
Studies in the Gulf of Guinea at water depths of between 500 m and 2,000 m identified soft sediments with low porosity, consisting of very fine grains (often greater than 80% <40 µm), with an average clay fraction (<2 µm) of between 30 – 40% (*Manh Hai LE, 2008*). In addition, it is also known that the further the location from shore, the smaller the grain size of the sediment tend to be. Therefore, it is expected that the sediments in the Study Area will be soft and with very fine grains.

In sediments of the Gulf of Guinea between 1 - 3 m below the seabed surface, the clay content is between 52 - 60% (*Thomas et al., 2004*) and consists of non-interbedded aggregates of smectite (montmorillonite present between 40 - 50%), kaolinites (approximately 30 - 40%) and illite (< 10%). Secondary minerals are calcite, pyrite, iron oxides, aluminium (gibbsite), and titanium (rutile). Organic material is present as approximately 5% of the mass.

Measurements in the Gulf of Guinea demonstrate fairly homogeneous levels of total organic carbon (TOC), in the order of 2 - 2.5%. Values of carbonate were measured as generally below 15%.

Figure 4.7 shows the total sediment thickness of the West Central Africa.

Figure 4.7 ***Sediment Thickness of the West Central Africa.***



Source : NOAA National Geophysical Data Center (NGDC), 2017.

4.3 *BIOLOGICAL ENVIRONMENT*

Block 6 is located within the Guinea Current Large Marine Ecosystem (GCLME) which extends along the area occupied by the Guinea current and the northern limit of the Benguela current.

This GCLME is characterized by a water column overlying the West African continental shelf which is fed by seasonal upwelling of nutrient rich water, particularly during the rainy seasons as a result of offshore winds. This phenomenon supports high phytoplankton productivity that in turn supports a diverse marine ecosystem and associated fisheries.

The following subsections present the main biological groups that can be reasonably expected to occur in the Study Area. Many of these groups and species are widely distributed and range over relatively wide areas either in migration or daily search for food.

4.3.1 *Plankton*

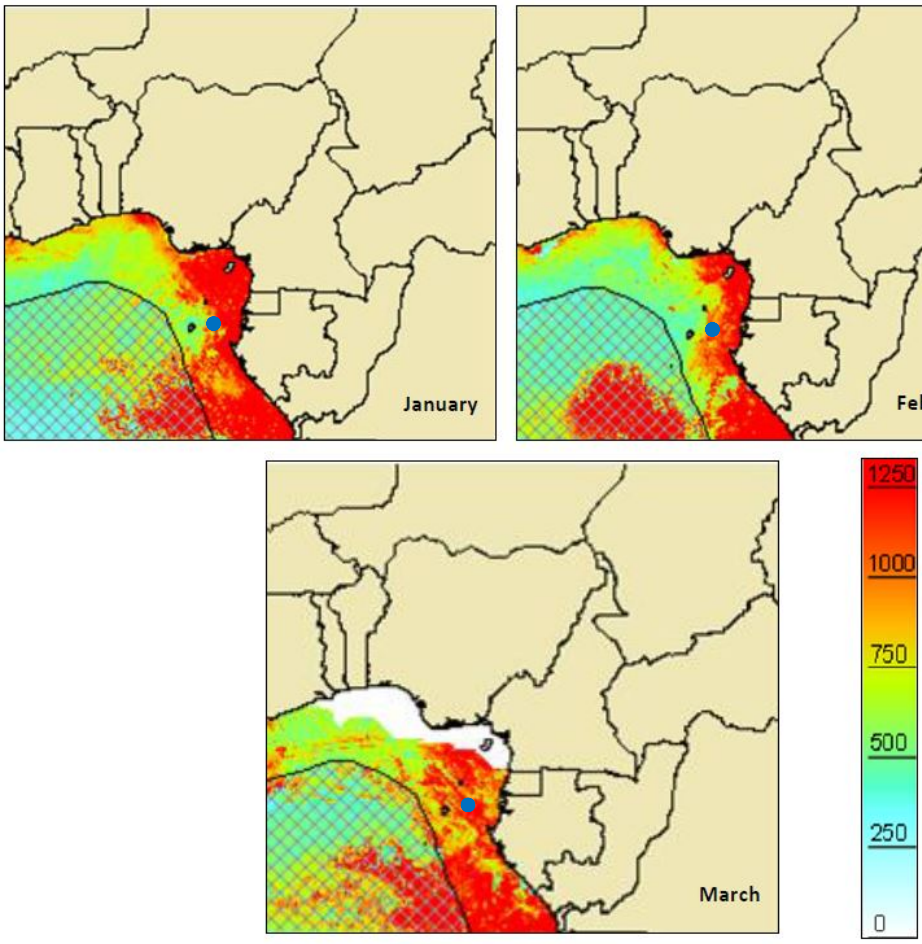
Plankton consists of the autotrophic plants, protists and bacteria (phytoplankton) and heterotrophic animals (zooplankton) which live freely in the water column and drift with the water currents. The plankton not only refers to microscopic organisms but also to larger organisms such as fish larvae and jellyfish, which drift in the water column. There are two types of zooplankton: 1. Species which spend the entirety of their lifecycle in the plankton, and 2. Species which only spend a proportion (usually the larval or juvenile phase) of their lifecycle in the plankton; for example, the larvae of fish, crustaceans and other benthic (seabed) dwelling species which settle on the seabed substratum.

Plankton forms a fundamental link in the flood chain. It is vulnerable to marine pollution. The composition of plankton communities at any time is variable and depends upon the circulation of water, the time of year and nutrient availability. Its abundance is strongly influenced by several factors such as water depth, tidal mixing, temperature stratification and the location and intensity of oceanographic fronts, although, the overriding factor is nutrient availability.

In tropical waters, plankton composition depends on hydrological seasons: stability, upwelling, coastal rains, or the main flood seasons, all of which affect nutrient supply and vertical stratification. Primary productivity is closely linked with upwelling events and in the Gulf of Guinea is most intense between July and September (*Woodside Energy, 2001*).

The GCLME is a Class I highly productive ecosystem (>300 gC/m^2-yr); however this productivity is more generally associated with the seasonal coastal upwellings rather than with deeper offshore areas such as the study area in Block 6. Seasonal oceanic upwelling occurs mainly from August and until January and thereafter occurs primarily in the nearshore waters of the continental coastal waters of Africa. *Figure 4.8* shows the monthly primary production in the Gulf of Guinea between January and March. As can be seen, productivity is generally higher in coastal waters of the African continent when compared to coastal waters of STP. The oceanic waters in Block 6 are in an offshore location but at a relatively short distance from the main upwelling areas in the Gabonese coast, and consequently, they benefit from the influence of the upwelling phenomenon and associated high productivity levels (*Sea Around Us Project, 2013*).

Figure 4.8 ***Monthly Primary Production in the Gulf of Guinea (mg Cm^{-2} month^{-1}), between January and March.***



Note: Blue dot represents approximately the location of Block 6
Source: Sea Around Us Project, 2013.

4.3.2 *Benthos, Coral reefs and Deepwater corals*

The benthos comprises the organisms living at the seabed, including those that live on the surface of seabed (epibenthos), and those that live within the seabed sediments (infauna).

Benthic systems in offshore locations are thought to be strongly influenced by upwelling intensity (*Pfannkuche et al., 1983*) together with the substrata of the area. The West African margin-littoral benthic fauna biodiversity is lower in arid (Mauritania, Angola) or sub-arid climates (Senegal and Gambia, from

Ghana to Benin). It is higher in humid regions (from Guinea-Bissau to Liberia and from Nigeria to Mauritania) and in regions with large rivers (Ivory Coast, Congo) (*Le Loeuff, 1999*). The diversity and abundance of benthic organisms in the coastal areas of the extended study Area of the Project is more likely to be consistent with that of the general eastern Atlantic and increase below cooler water masses (*Le Loeuff & Cosel, 1998*).

The most diverse benthic systems in tropical regions are generally associated with the presence of hard substrates and coral reefs. Coral reefs are underwater bio-constructed structures of calcium carbonate, built by colonies of marine invertebrates that are common features of continental shelves, slopes, banks, ridges and seamounts (*Roberts at al 2006*). These reefs play an important role in the balance of the marine ecosystem as they offer hard substrata for colonization by other encrusting organisms as well as shelter and refuge for a great variety of invertebrates and fish (including commercially important species).

Corals have restricted range of occurrence due to their requirement for specific thermal regimes, salinities, water depths, sedimentation and other physical and chemical characteristics. True reefs do not occur along the West African coast or in the vicinity of the Gulf of Guinea archipelagos, although mature coral communities are found at some discrete locations such as the oceanic islands and rocky mainland coasts, Cape Verde Islands, Gulf of Guinea Islands, Ghana, Gabon and Cameroon (*Well & Bleakley. 2003*).

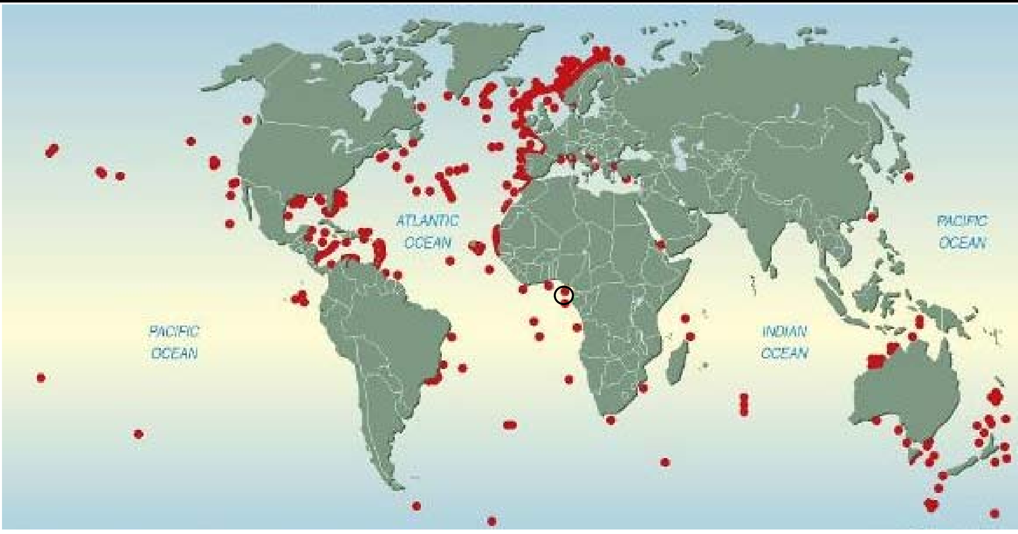
In open water, hermatypic (reef-building) corals are generally temperature limited to depths shallower than 20 meters where light can penetrate, with some exceptions in the off-shore archipelagos. In São Tomé é Príncipe, these reefs are known to be present mainly in the Island of São Tomé, more specifically within the conchas and Lagoa azul beaches. These are dominated by the species *Montastrea cavernosa*, *Siderastrea siderea* and *Porites spp* (*ENPAB II, 2015*). Given the depth of area where the appraisal and exploratory drilling wells are planned (between 2,000 and 3,000 meters) it is not possible that such corals would be present (*Spalding et al., 2001*).

Deep water corals, such as the cold-water corals *Lophelia pertusa, Madrepora aculata, Desmophyllum cristagalli, Dendrophyllia cornigera, Enallopsammia rostata* and *Solensmilia variabilis* have been recorded on offshore seabed features across the Atlantic Ocean (*Tyler-Walters, 2003*). *Lophelia* has been recorded at depths between less than 100 meters to more than 3,000 meters (*Mortensen, 2000*). The presence of strong currents and a good food supply are important and locations where *Lophelia* species are found are also usually associated with banks and sea mounts where they can extend their feeding apparatus into the currents stream in order to ensure feeding from suspended nutrients.

Records of these deep water corals are more common in European waters than in the west of Africa, though this is probably due to different survey efforts (*Figure 4.9*).

The presence of cold water corals in the study area has not been confirmed but cannot be discounted despite the absence of identified seabed features usually associated with them.

Figure 4.9 Global distribution of Cold Water Corals.



Note: the black circle represents the approximate location of the Study Area
Source: UNEP-Grid Arendal, 2004

Other relevant benthic ecosystems known to be present within deep waters of west African equatorial waters include localized rich chemosynthetic biological communities associated with seeps/pockmarks, generally characterized by distinct assemblages and habitats, dominated either by Mytilidae or Vesicomyidae bivalves or by Siboglinidae polychaetes, or bacterial mats. The most active zones for these habitats are usually depressions with abundant carbonate concretions and high methane fluxes where high-density clusters of mussels and siboglinids dominate (*Sibuet M. and Vangriesheim A, 2009*).

Figure 4.10 shows two sea floor pictures taken at 3,150 m depth during a survey carried out between 2000 and 2005 in deep sea waters off Gabon . Although the site where these pictures were taken is located far south of the study area, these give an indication of the characteristics of these particular habitats at these depths (site located at more than 400 km south of the study area).

Figure 4.10 ***Sea floor pictures on a pockmark area at 3,150 m depth.***

Note: Pictures taken at a site situated at 3150 m depth, approximately 400 km south of the study area. The pictures were obtained during the Ifremer BIOZAIRE 2 cruise with the ROV Victor 6000 on board l'Atalante.
Source: Sibuet M. and Vangriesheim A, 2009.

The location of Block 6 characterized by depths over 1,000 m, the presence of a thick sediment layer all along the Gulf of Guinea (*Figure 4.7*) and by a distance to the coast (more than 100 km), that facilitates the dominance of fine grain sediments, indicates that the dominant seabed habitats are deep-sea muds and deep sea muddy sands. These habitats are characterized by sparse benthic populations, relatively low diversity and a high degree of homogeneity.

However, as previously mentioned, the presence of localized areas where other habitats or systems associated to hard substrata or seeps as well as the presence of cold corals within the dominant soft bottoms cannot be discarded.

4.3.3 Ichtyofauna (fish)

The Gulf of Guinea is considered as a highly productive ecosystem and therefore supports several pelagic and demersal fish species particularly around discrete upwelling zones.

A total of 360 fish species have been recorded in the waters of São Tomé e Príncipe (*Fishbase, 2017*). The main source of information on fish species present along the Study Area are the articles by Alfonso *et al*. (1999), *Wirtz et al., (2007)* and Carneiro (2011) using fish records based on fish captured, photographed or observed whilst diving or landed by local artisanal fishermen. The study reports 185 confirmed coastal species representing 67 families; however, *Wirtz et al. (2007)* increased to 244 the number of species in the São Tomé e Príncipe coastal zone, with 28 endemic species (12% endemism rate) from the Gulf of Guinea. Results suggest that the island has a distinct fish community despite their proximity to the African coast.

Demersal fish are commonly distributed according to the location of benthic food sources, whereas pelagic fish in the area tend to be more sensitive to water temperatures and are distributed in line with thermoclines and oceanographic fronts.

Pelagic fish

Pelagic fish species can be found near the sea surface or in the water column of coastal and offshore waters but not at the seabed, where benthic and demersal species are present.

Pelagic fish generally constitute an important fishing resource for local communities and commercial fishing fleets. Among these, the family Clupeidae constitutes the most commercially valuable pelagic resource in the coastal waters of the Gulf of Guinea, including herring (*Clupea harengus*), sardines (*Sardinella spp.*) and anchovies (*Engraulis encrasicolus*) (*Carneiro, 2011*).

Other common pelagic species present in STP waters include scombrids, gobies, flying fish, mullets and members of the *Carangidae* family, such as mackerels (*Trachurus spp*.), and the *Moreidae* family (*Laemonema laureysi*).

Within the GCLME large pelagic fish are common and are targeted commercially, including pelagic tuna species such as skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), big eye tuna (*T. obesus*), marlins (*Istiophoridae* family), billfishes such as the Atlantic sailfish (*Istiophorus albicans*) and the swordfish (*Xiphias gladius*) (*Heileman, 2009*). The big eye tuna and yellowfin tuna are listed as Vulnerable and "Near Threatened" on the IUCN Red List of threatened species, respectively (*IUCN, 2012*). All these species have the potential to inhabit the study area in the block.

Several large pelagic fish are known to spawn in the Gulf of Guinea. The main season for spawning ranges from February to September in the case of the yellowfin tuna, with a peak in February and March. Skipjack tuna spawns opportunistically throughout the year, and big eye tuna also spawns throughout the year, with a peak between November and April.

Demersal fish

The shallow waters surrounding the STP islands are influenced by the diverse coastal habitats that provide spawning and nursery grounds for many fish species. The continental shelf has a considerable presence of demersal fish species due to the shallow water depths and enrichment with organic sediments from rivers.

The Gulf of Guinea demersal fish community is structured by the water depth and the seabed sediment type. Demersal species include cassava croaker (*Pseudotolithus senegalensis*), longneck croaker (*P. typus*) and golden African snapper (*Lutjanus fulgens*) (*Heileman, 2009*). These species along with members of the big eye family (Priacanthidae) and sea bream family (Sparidae) are also targeted by commercial fisheries.

The deep-water demersal fish community in STP is generally dominated by sharks and rays including Carcharhinidae; commonly referred to as requiem sharks such as the sand tiger shark (*Carcharias taurus*), blue shark (*Prionace glauca*), bull shark (*Carcharhinus leucas*), reef sharks, weasel sharks (Hemigaleidae), which are often restricted to water depths of 100 metres, and hammerhead sharks (*Sphyrna lewini*) (*Ministry for Natural Resources and the Environment of São Tomé e Príncipe, 2007*).

According to the Fishbase country database, the species found offshore STP, more specifically in deep waters, include native species such as the small scaled brown slickhead (*Alepocephalus australis*), tripodfish (*Astronesthes caulophorus*), highfin lizardfish (*Bathysaurus mollis*), flying gurnard (*Dactylopterus volitans*) and common Atlantic grenadier (*Nezumia aequalis*) (*Fishbase, 2017*).

Demersal and pelagic species of fish reproduce throughout the year, however the most important period for spawning is during the hot season (October to April), with peaks in reproduction occurring at the end of the hot season, during transitional periods and during the cold season, depending on species. Larvae of small pelagic fish are present mainly during the hot season (October to April) and at the beginning of the cold season (June to August/September), with a minimum during transitional periods.

Protected and/or threatened fish species

In the Gulf of Guinea, 27 species are considered to be threatened according to the IUCN red list of threatened species (*IUCN, 2018*). Those are listed in *Table 4.2*. No marine fish species are designated as protected by Saotomean legislation.

The critically endangered ("CR") *Squatina oculata* is a coastal species found mostly between 50 and 100 meters offshore, and most likely not present within São Tomean waters. The nine endangered species ("EN") are predominantly demersal shallow water species. It is therefore unlikely these species will be found within the study area. Other fish species can be present in deep offshore water.

Table 4.2 *Threatened fish species found in the Gulf of Guinea.*

Common Name	Scientific Name	Red List Category
Whale shark	*Rhincodon typus*	Vulnerable
Monkfish, Smoothback Angel	*Squatina oculata*	Critically Endangered
Spineback Guitarfish	*Rhinobatos irvinei*	Vulnerable
Blackchin Guitarfish	*Glaucostegus cemiculus*	Endangered
White-spotted Guitarfish	*Rhinobatos albomaculatus*	Vulnerable
Common Guitarfish, Violinfish	*Rhinobatos rhinobatos*	Endangered
Guitarfish Spikenose Wedgefish	*Rhynchobatus luebberti*	Endangered
Bottlenose Skate, Spearnose	*Rostroraja alba*	Endangered
Scalloped Hammerhead	*Sphyrna lewini*	Endangered
Common Smoothhound	*Mustelus mustelus*	Vulnerable
Daisy Stingray	*Dasyatis margarita*	Endangered
Spiny butterfly ray	*Gymnura altavela*	Vulnerable
Oceanic Whitetip SharkOceanic Shark, Whitetip Shark	*Carcharhinus longimanus*	Vulnerable
Night Shark	*Carcharhinus signatus*	Vulnerable
Whithound	*Galeorhinus galeus*	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable
Angular Rough Shark	*Oxynotus centrina*	Vulnerable
Common Thresher Shark	*Alopias vulpinus*	Vulnerable
Sandbar Shark	*Carcharhinus plumbeus*	Vulnerable
Sand Tiger	*Carcharias taurus*	Vulnerable
Gobid	*Bathygobius burtoni*	Endangered
West African goatfish	*Pseudupeneus prayensis*	Vulnerable
Madeiran sardinella	*Sardinella maderensis*	Vulnerable
Cassava croaker	*Pseudolithus senegalensis*	Endangered
Dusky grouper	*Epinephelus marginatus*	Endangered
Yellowfin Tuna	*Thunnus albacares*	Near Threatened
Big eye tuna	*Thunnus obesus*	Vulnerable

- The above and below tables do not include species evaluated as "Not Threatened", "Least Concern", "data deficient" and "Lower Risk".
- Threat assessment codes refer to the 2001 IUCN Red List Categories and Criteria version 3.1.
- For more information on IUCN categories, please refer to (available on http://www.iucnredlist.org).
Source: IUCN, 2018.

4.3.4 *Marine mammals*

The Gulf of Guinea and STP waters are considered to be favourable habitat for marine mammals, especially due to the regional seasonal upwelling which boosts productivity and ensures food availability for these species. Although the ranges of marine mammal species are known to include the Gulf of Guinea and STP waters, there is limited knowledge on the distribution, population estimates and ecology of cetaceans in the region.

Marine mammals can be classified into:

- Cetaceans (whales and dolphins), which can be further sub divided into odontocetes (toothed whales and dolphins) and mysticetes (baleen whales);
- Sirenians (manatees and dugongs).

Cetaceans

The distribution and abundance of cetaceans remains poorly documented in the scientific literature for the Gulf of Guinea. The majority of data is based on opportunistic sighting, incidental catches and strandings and data on species abundance in the Gulf of Guinea is particularly poor (*Weir, 2010*).

The São Tomé e Príncipe archipelago is therefore believed to be an important area for cetaceans due to large concentrations of prey and the presence of small bays and shallow water which are used as "resting" sites (*Picanço et al., 2009*). The majority of sightings in the Gulf of Guinea area tend to occur to the south, towards Angola where upwelling of cool water of the Benguela current provide richer feeding grounds compared to the warm coastal waters further north in the Gulf.

According to the data gathered, up to 28 cetacean species could be present, permanent or temporary, in STP waters: 21 species of toothed whales and seven species of baleen whales (Mysticetes) (*Weir, 2010*). Among these, there are eight species whose presence in STP waters is considered more likely (*Weir, 2010*). The full list of cetacean species potentially present, including their conservation status and main habitats, is presented in *Table 4.3*.

The 8 species more likely to be seen in STP waters include: the fin whale (*Balaenoptera physalus*), Bryde's whale (*Balaenoptera brydei*), Humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), killer whale (*Orcinus orca*), short-finned pilot whale (*Globicephala macrorhynchus*), common bottlenose dolphin (*Tursiops truncatus*) and the pantropical spotted dolphin (*Stenella attenuata*).

A whale migration route exists in the Gulf of Guinea with whales moving along the coast from summer feeding grounds in the northern and southern hemispheres to breeding sites near the equator. This is especially true of the humpback whale (*Megaptera novaeangliae*), classified as Least Concern on the IUCN Red List but listed in Annex I of CITES and Appendix I of the CMS Convention.

Other species thought to migrate through waters offshore São Tomé e Príncipe include the blue whale (*Balaenoptera musculus*), fin whale and sei whale (*Balaenoptera borealis*). These species have the potential to be in the Study Area between June and November in the case of the blue whale, and in June July in the case of the fin and sei whales. They are classified as Endangered by the IUCN and listed in Annex I of CITES and Appendix I of the CMS Convention. Data are sparse regarding the abundance of these species offshore São Tomé e Príncipe.

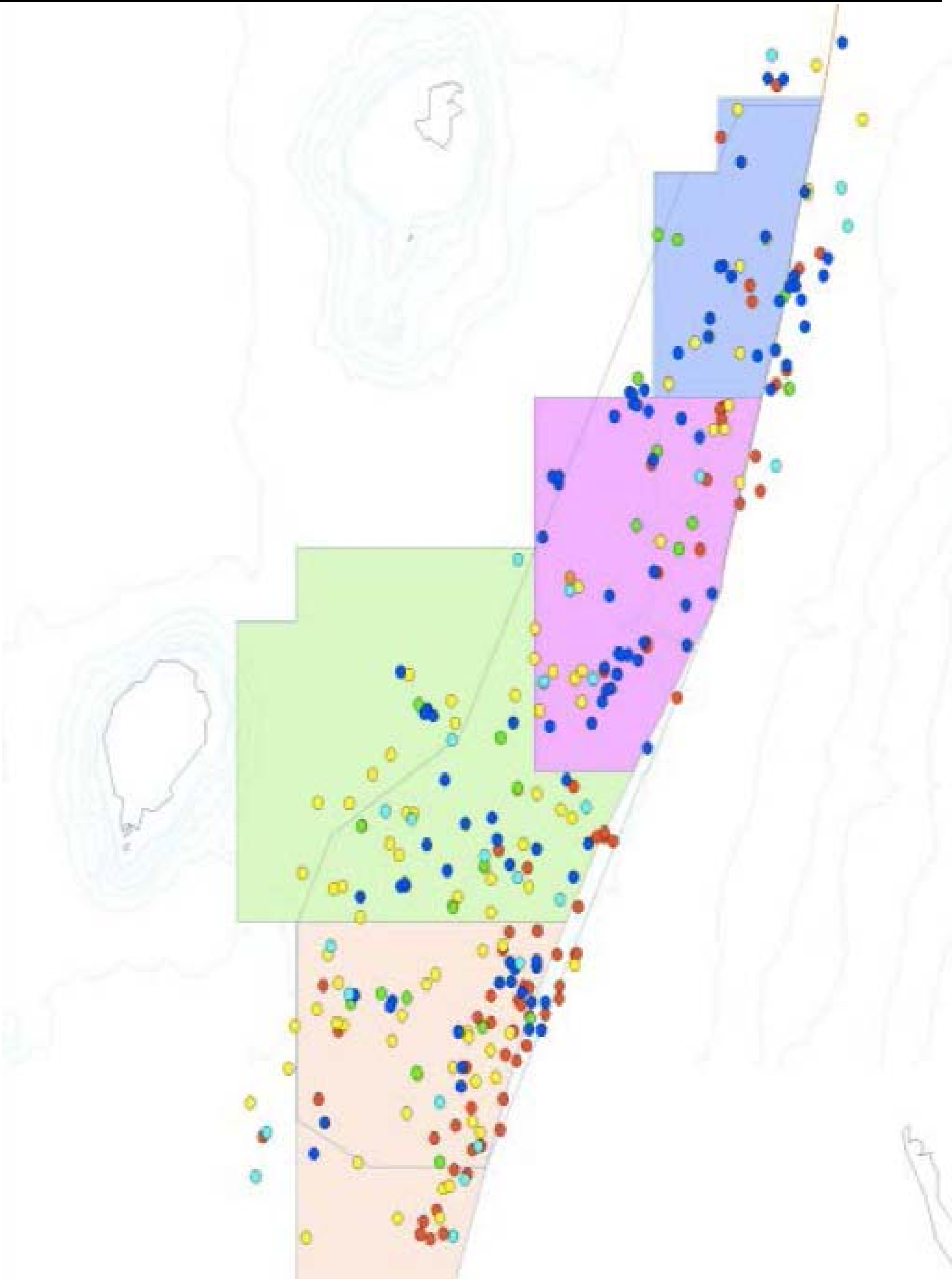
The distribution and abundance of whales in the Study Area varies throughout the year depending on migration of each species. The periods when marine mammals may be present in the Study Area are provided in *Table 4.5*.

In 2017, records of cetacean observations (*Figure 4.13*) were obtained in Saotomean waters by means of visual and acoustic observations during a seismic survey carried out along Block 6 and adjacent blocks. These records resulted in an increase to the number of cetacean species officially recorded within STP waters to 15 species (*RPS, 2017*).

These species are considered more likely to be found in the study area and are discussed below, in approximate order of probability of presence and abundance in the area (ie from most abundant and probable to lowest abundant and probable).

Currently, no marine mammal species is protected under STP regulations, though their conservation is one of the objectives of the National Biodiversity Plan (*ENPAB, 2015*). The conservation status of the different species according to the IUCN is therefore included for the different species in the paragraphs below and in *Table 4.3*.

Figure 4.11 Marine Mammals and Sea Turtles Sightings Along Eastern STP Blocks.



Note: STP Block 6 corresponds to the area shaded in pink;
Legend: Red dots: baleen whale sightings; Yellow dots: dolphin sightings; Green dots: Pilot whales sightings; Orange dot: Sea turtle sightings; Dark Blue dots: Sperm whale sightings; Light blue dots: Unidentified whales.
Source: RPS, 2017.

Mysticetes (Baleen whales)

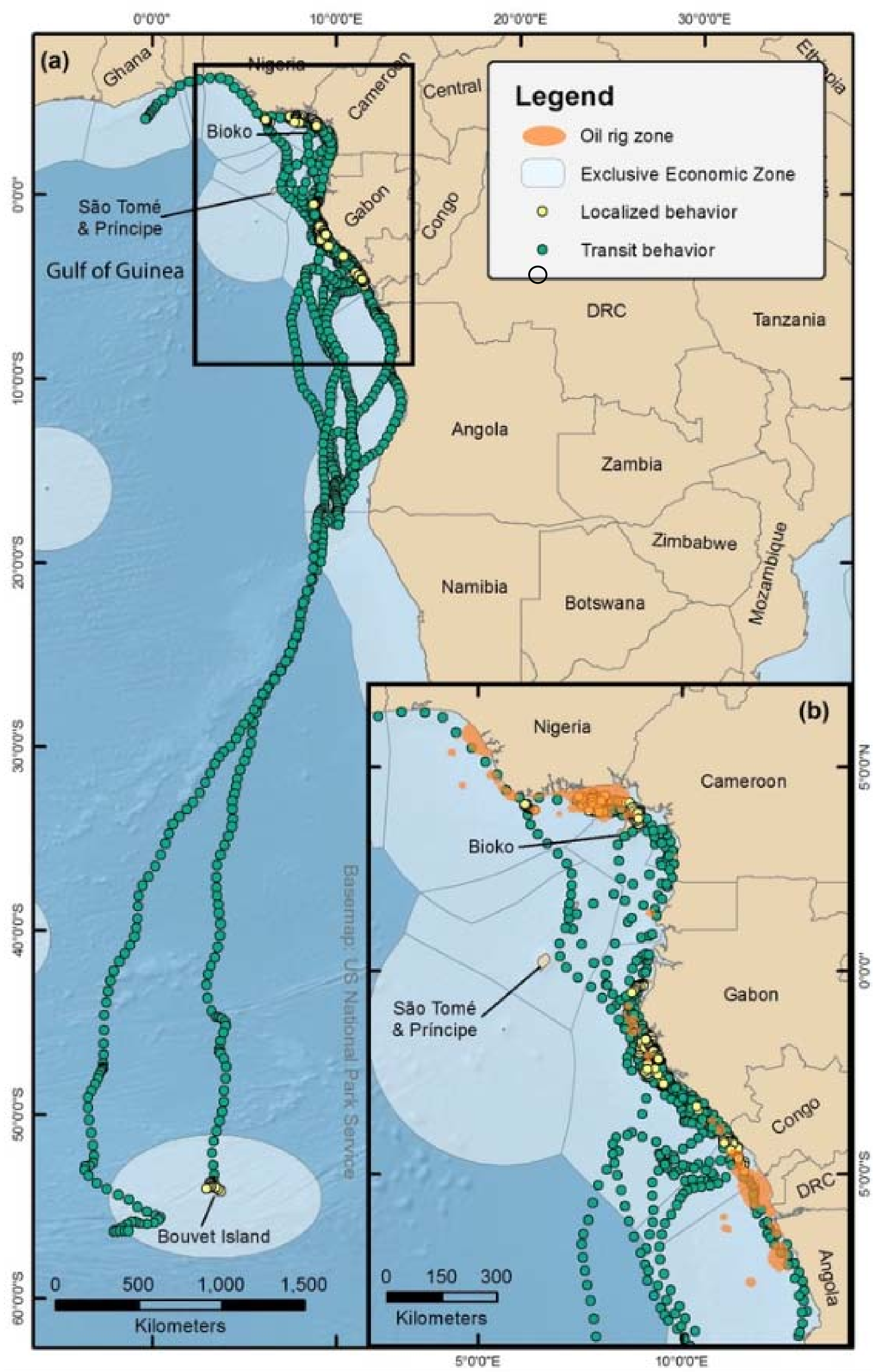
Humpback whale (*Megaptera novaeangliae*)
Humpback whales occur globally and migrate seasonally between low -latitude tropical breeding grounds to high-latitude feeding areas (*Weir, 2010*). In the case of São Tomé, they arrive in the area approximately from July to

November from the Antarctic, with some individuals remaining in the vicinity of either São Tomé and/or Príncipe island. (*Picanço et al., 2009*, *Carvalho et al., 2011, anecdotal whale watching sightings*), while others move eastwards towards the Gabonese shelf or in some cases northwards towards the Gulf of Guinea mating and breeding grounds that extend to the offshore waters of Côte d'Ivoire, Togo and Benin (*Van Waerebeek et al., 2001 & 2002a; Bennett & MacLeod, 2006),* Nigeria and Equatorial Guinea (Bioko island) (*Van Waerebeek et al 2001 & 2002*). The majority of sightings and catches of this species occur over the shelf (*Best et al., 1999; Walsh et al., 2000; Van Waerebeek et al 2001 & 2002; Pican ço et al., 2009; Weir, 2010),* which may be a reflection of observation effort bias. It is, however still reasonable to assume that individuals do migrate through high seas beyond the shelf and therefore through the study area in the Block, although this has not been confirmed.

M. novaeangliae is most likely to use the Study area as passage/transit along a wide corridor comprising coastal and offshore waters (*Figure 4.12)* to recognized breeding areas outside São Tomé e Príncipe territorial waters (e.g. Gabon, where large stretches of the coast have been described as representing critical breeding and calving habitat for humpback whales by Rosenbaum & Collins (2006)).

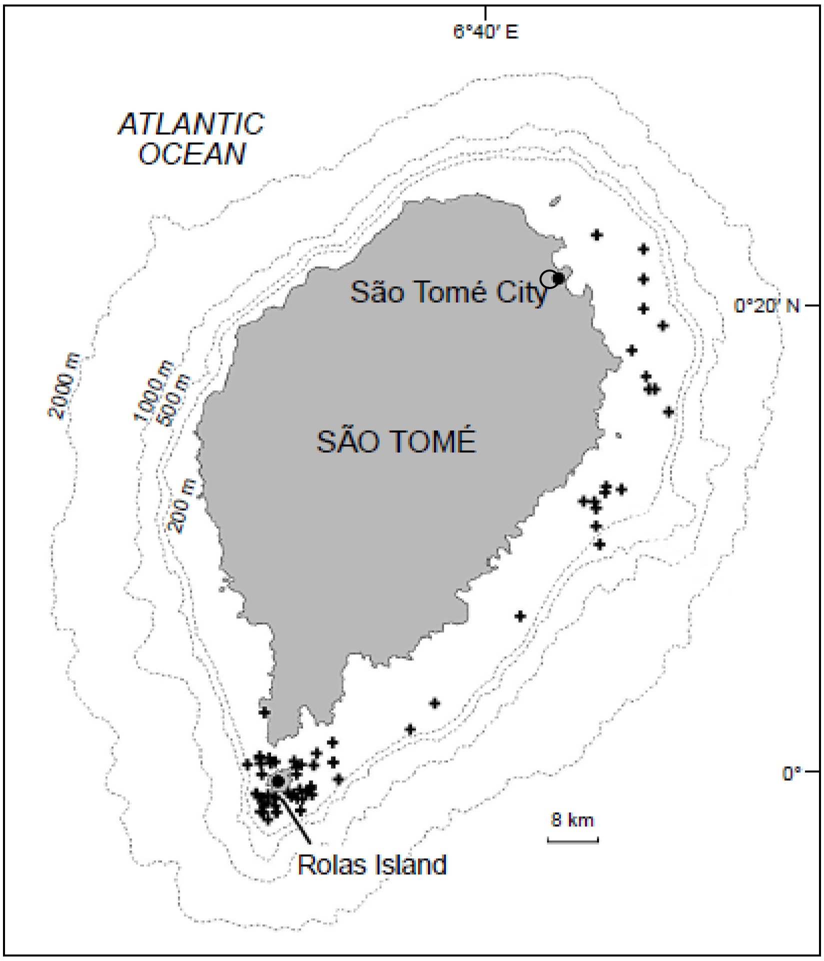
Around São Tomé, a total of 323 humpbacks were captured in 1951 alone (*Budker & Collignon, 1952*) and survey work between 2002 and 2005 found 65 sightings records of this species (*Picanço et al., 2009),* refer to *Figure 4.13*. Given the statistically significant proportion of females and calves in these sightings, it is thought that the archipelago represents calving rather than mating grounds (*Carvalho et al., 2011*) in addition to being an area used as passage/transit. All the sightings mentioned occurred within the 500 m isobaths, even when surveys extended further offshore, suggesting that mothers with calves remain within the protection of nearshore, against rough sea conditions and high seas predators. This behaviour has been seen elsewhere.

Figure 4.12 Observations on tracked humpback whales along Western Africa and Gulf of Guinea.



Source: Rosenbaum et al, 2014.

Figure 4.13 Sightings of humpback whale groups around Sao Tome island (2002-2006).



Source: Carvalho et al., 2011.

In 2017, 48 encounters with migrating humpback whales took place for a cumulative count of 67 individuals along deep offshore areas East of STP, including Block 6 (refer to *Figure 4.11* for sightings locations in relation to Block 6) and at depths ranging from 2,100 to 2,600 m. These sightings included the observation of two calfs on August (*RPS, 2017*).

This species is listed as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Fin whale (*Balaenoptera physalus*)
The fin whale is cosmopolitan in its distribution and is generally found south of 50° South during summer, migrating northwards into West African waters during winter (*Gambell, 1985*). Confirmation of the presence of this species is through targeted or incidental capture off Angola and São Tomé. Sightings are generally found as solitary individuals or pairs in deep-water off the continental shelf edge (*Weir, 2008*). Sightings and whaling records indicate that this species is found in deeper West African waters in winter and spring (August and September) *(Weir, 2010*). No fin whale was observed during a survey along deep offshore areas East of STP, including Block 6, in the period January-august 2017 (*RPS, 2017*).

This species is classified as endangered on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Bryde's whale (*Balaenoptera brydei*)

Bryde's whale is the only baleen whale species which inhabits tropical waters and does not undertake extensive migrations to high latitude cold water feeding grounds (*Best, 2001*). Two species of Bryde's whale have been recognized based on molecular DNA analysis; *B. edeni* and *B.brydei* (*Weir, 2010*). The occurrence of this species is mainly known through whaling records. Records of Sei whale catches from whaling data have recently been identified as Bryde's whales following analysis of their baleen plates and it is considered that this misidentification may be common amongst whaling data (*Weir, 2010*). It is believed that there are two populations of Bryde's whale off the coast of West Africa; one occupying inshore shelf waters (<100 meters depth) and an offshore population in deep oceanic waters (>1,600 meters) (*Best, 1996 & 2001*; *Weir, 2008*). Seasonal migrations of the offshore Bryde's whale population have been observed from Angola during March, northward to São Tomé during April and off Gabon during August to October. This species may therefore be observed offshore between June and November (*Weir, 2008*). One confirmed individual of Bryde's whale was recorded in March 2017 during a survey along deep offshore areas East of STP, including Block 6 (refer to *Figure 4.11* for sightings locations) (*RPS, 2017*). Three additional individuals suspected of being Bryde's whale were also recorded, though the precise species could not be confirmed given the similarities in size and behaviour with the sei whale (*Balaenoptera borealis*) an Endangered species less likely to be present in Saotomean waters.

This species is listed as data deficient on the IUCN Red List (*IUCN, 2018*).

Sei whale *(Baleanoptera borealis)*

Sei whales occur worldwide although the locations of their low-latitude wintering grounds are poorly known (*Gambell, 1985*). This species occurs mainly offshore in deep waters. It is therefore a potential visitor of STP waters during the wintering season of this species (*Van de Weghe, 2007*). Most of the historical observations of sei whales within the gulf of Guinea and tropical waters of West Africa are thought to have been predominantly misidentified Bryde's whales. The only confirmed Sei whale record in the region appears to be the capture of a 14 m female at the Cap Lopez whaling station in Gabon in September 1950 (*Budker 1950*). During a survey conducted in 2017 along deep offshore areas East of STP, including Block 6 (refer to *Figure 4.11* for sightings locations), three individuals were recorded as potentially being either sei or bryde's whales (*RPS, 2017*).

This species is listed as Endangered on the IUCN Red List (*IUCN, 2018*).

Odontocetes (toothed whales)

Sperm whale (*Physeter macrocephalus*)
Although the sperm whale is found globally, there is spatial segregation based on age and sex. Females and immature individuals occur in warm waters while males leave these nursery groups at puberty and migrate to higher latitudes (*Best, 1979*). A total of 53 sperm whales were caught off São Tomé during 1951 (*Budker & Collignon, 1952*) and a single sighting occurred in 2005 (*Picanço et al., 2009*). Many sightings are unverified but immature individuals are more likely to be found in shallower waters and adults may be found in deeper waters. Sperm whales may occur throughout the year in the area; however some seasonality may occur throughout the year with some countries, such as Angola, experiencing some seasonality in abundance (*Weir, 2010*).

As a result of a survey conducted in deep offshore areas East of STP, including Block 6 (refer to *Figure 4.11* for sightings locations in relation to Block 6) 96 sightings of at least 184 individuals of sperm whales were recorded, being the the most frequently sighted cetacean. The records took place throughout the survey period comprised between January and August at depths ranging from 2,100 to 2,600 m (*RPS, 2017*).

This species is listed as vulnerable on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Killer whale (*Orcinus orca*)
Killer whales are the most widely distributed cetacean species worldwide, although they are more frequently observed at high latitudes compared to the tropics (*Dahlheim & Heyning, 1999*). Occasional sightings of this species have occurred offshore of Côte d'Ivoire, Angola and Ghana (*Weir, 2010*). There were six sightings around São Tomé between 2002 and 2004 (*Picanço et al., 2009*). Killer whales in the area occur in small groups off Ghana and Côte d'Ivoire but larger groups (up to nine individuals) have been sighted off Angola (*Weir, 2008*). This species has been found in a variety of habitats; shelf waters, shelf edge, open ocean and around the oceanic islands and they appear to be found throughout the year (*Weir, 2010*). This species may therefore occur in small numbers around the study area in the Block. No killer whale was observed during the survey carried out in 2017 in deep waters East of STP, including the area occupied by Block 6 (*RPS, 2017*).

This species is described as data deficient on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Short-finned pilot whale (*Globicephala macrorhynchus*)
The exact distribution of short finned pilot whale off the west coast of Africa is unclear due to the difficulty in correctly identifying them and the lack of

survey effort (*Weir, 2010*). This species is known to inhabit warm waters worldwide and are known to occur off the coast of Gabon and there is a single record from São Tomé in 2003 (*Walsh et al., 2000; Weir, 2008; Picanço et al., 2009*). Unconfirmed sightings by fishermen have also been made around St Helena (*MacLeod & Bennett, 2006*). Sightings from Angola and São Tomé have been seaward of the shelf edge (*Weir, 2010*) and sightings are often composed of groups of four to 200 animals, particularly offshore of Angola. Available sightings data suggests that this species may be found year round (*Weir, 2010*). During the survey in 2017, 22 encounters with a minimum cumulative count of 337 individuals were recorded. However only 6 of these encounters took place within Block 6 or its immediate surroundings. The observations were made throughout the survey period (January-August) (*RPS, 2017*).

This species is described as data deficient on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Common bottlenose dolphin (*Tursiops runcatus*)
The bottlenose dolphin is found globally in tropical and temperate regions. It is believed that this species inhabits nearshore areas along the entire west coast of Africa (*Jefferson et al., 1997*). Bottlenose dolphins have been targeted and landed at several ports along the West African coast including Côte d'Ivoire, Ghana and Benin. Offshore of Gabon nearshore sightings occurred during November and offshore sightings in September (*Weir, 2008; Weir, 2010*). 42 records of bottlenose dolphin sightings have been made around São Tomé (*Picanço et al., 2009*). Bottlenose dolphins inhabit a variety of habitats including shelf and coastal waters, shelf edge, seamounts and waters around volcanic islands and deeper oceanic waters. They generally have an affinity for coastal waters which makes them more susceptible to entanglement in fishing nets (*Weir, 2010*). Sightings data off Angola indicate this species can be found throughout the year (*Weir, 2010*). This species was recorded seven times during a survey in 2017 along deep offshore waters east of STP, though none of them occurred within Block 6. The species was observed during all months between January and August with the only exception of April and June (*RPS, 2017*).

This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Pantropical spotted dolphin (*Stenella attenuata*)
Pantropical spotted dolphins inhabit tropical and subtropical waters worldwide, however, records from West Africa are rare (*Jefferson et al., 1997*). Records of bycatch of individuals have been found from Ghana, Côte d'Ivoire and offshore of Gabon. 14 sightings of this species have been found from São Tomé between 2002 and 2005 (*Picanço et al., 2009*), five sightings have been recorded from Angola from 2003 to 2006 (*Weir, 2008*) and numerous sightings have been recorded from St Helena (*MacLeod & Bennett, 2006; Weir, 2010*). Sightings of this species at sea are generally seaward of the shelf edge in deep water. Around São Tomé and St Helena this species uses the shallow water to rest before moving into deeper waters to feed (*MacLeod & Bennett,*

2006; Picanço et al., 2009). Although not particularly abundant this species may occur in the vicinity of the study area although given its rarity offshore of West Africa, it is not considered to be significant. The presence of the species in Block 6 was confirmed by one sighting during a survey in 2017 in deep offshore waters east of STP. Four additional sightings were recorded outside of the area occupied by Block 6. In all cases group sizes ranged between 30 and 100 individuals and calves and juveniles could also be observed (*RPS, 2017*).

This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Clymene Dolphin (*Stenella clymene*)
The Clymene Dolphin is found only in the tropical and subtropical Atlantic Ocean, where it is known to inhabit deep water areas being rarely observed near shore. Verified records of the species exists from 14 west African countries, including Ghana, Togo, Benin, Nigeria, Equatorial Guinea and Gabon (Weir, 2014), though none from STP waters. However, during a survey along deep offshore areas East of STP, the Clymene dolphin was the most frequently encountered dolphin species of the survey with 17 sightings recorded, mainly in May and June. Sightings included two large groups of more than 120 individuals as well as juveniles and calves. In terms of individuals this was the most observed species along the referred survey, accounting for a total of 1,570 individuals (*RPS, 2017*).

This species is described as of data deficient on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Rough-toothed Dolphin (*Steno bredanensis*)
The Rough-toothed Dolphin is a tropical to subtropical species, which generally inhabits deep, oceanic waters of all three major oceans. Published records from this species exist from Angola, Gabon and Ghana (*De Boer, 2010*). This records were enlarged by five sightings made during a survey conducted along deep offshore areas East of STP. These sightings took place in early March with groups between 40 and 70 individuals and in August with a group of 10 individuals. No sighting took place, however, within Block 6 area.

This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Stripped Dolphin (*Stenella coeruleoalba*)
A widely-distributed species, found in tropical and warm-temperate waters. They prefer deep waters rarely approaching the shore. Confirmed sightings of the species within the gulf of Guinea come only from Angola and Ivory Coast (*Weir, 2010*). Data from STP waters is limited to the two sightings that occurred during a survey in February and March 2017 in deep offshore waters East of STP, including one record in Block 6 (*RPS, 2017*). This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

False Killer Whale (*Pseudorca crassidens*)
False killer whales are found in tropical to warm temperate zones, generally in relatively deep, offshore waters of all three major oceans. Historical sightings and strandings within the Gulf of Guinea confirmed their presence in Gabon (*Van Waerebeek & De Smet, 1996*), Benin (*Van Waerebeek et al., 2001*) and Ghana (*Van Waerebeek et al., 2009*), though not within STP waters. Despite the absence of previous records, a small group of approximately ten individuals of false killer whales was seen in February 2017 south of Block 6.

This species is described as of data deficient on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Risso's Dolphin (*Grampus griseus*)
A widely-distributed species, inhabiting primarily deep waters of the continental slope and outer shelf, from the tropics through the temperate regions in both hemispheres. Previous records of the species within the Gulf of Guinea are limited to sightings off Angola (*Weir, 2007*) as well as from catches in artisanal fishery of Ghana (*Van Waerebeek et al., 2009*). During a survey developed in 2017 along deep offshore areas East of STP, one sighting of a group of Risso's dolphins was recorded (*RPS, 2017*).

This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Melon Headed Whale (*Peponocephala electra*)
Melon headed whale have a pantropical distribution that seems to be associated with warm waters and with a preference for coastal waters rarely leaving the continental shelf. It is only known to occur in the Gulf of Guinea from bycatches in Ghana (*Van Waerebeek et al., 2009*) together with three sightings off Angola (*Weir, 2007*). The sighting of a single individual of the species on July 2017 constitutes the only confirmed record of its presence within STP waters (*RPS, 2017*). This sighting, corresponding to a juvenile, was considered unusual as the species is gregarious being generally found in large groups.

This species is described as of least concern on the IUCN Red List of Threatened Species (*IUCN, 2018*).

Information on other species of cetacean found in the wider Gulf of Guinea area are summarized in *Table 4.3*. The periods when marine mammals may be present in the Study Area are provided in *Table 4.5*

Table 4.3 Cetaceans potentially present in the study area.

Common name	Scientific name	General Occurrence	IUCN Red List Status	Main Habitat
Mysticeti (Baleen whales)				
Fin whale	*Balaenoptera physalus*	Cosmopolitan in its distribution and is generally found south of 50° South during summer, migrating northwards into West African waters during winter, found in deeper West African waters in winter and spring.	Endangered	Offshore areas
Bryde's whale #	*Balaenoptera edeni*	Inhabits tropical waters and does not undertake extensive migrations to high latitude cold water feeding grounds. Seasonal migrations of the offshore population have been observed from Angola during March, northward to São Tomé during April and off Gabon during August to October.	Data deficient	Coastal and offshore
Humpback whale #	*Megaptera novaeangliae*	Humpback whales occur globally and migrate seasonally between low -latitude tropical breeding grounds to high-latitude feeding areas. From July to November humpback whales are found around the islands of Sao Tome and Príncipe, mainly for breeding and calving.	Least concern	Coastal (potential offshore during migration)
Southern right whale	*Eubalena australis*	Migrates between high-latitude summer feeding grounds and low-latitude winter mating and breeding grounds. Records of sightings and whaling captures from Gabon.	Least Concern	Coastal and offshore
Blue whale	*Balaenoptera musculus*	Worldwide in polar, temperate and tropical waters. In the eastern Atlantic it has been recorded from Antarctica to Angola and Gabon. Records of whaling captures from Angola and Gabon.	Endangered	Offshore areas
Sei whale #	*Balaenoptera borealis*	Worldwide with low-latitude wintering grounds. Generally found in deep water >1,000 m. Whaling records from Gabon and sightings from Angola although there is doubt over misidentification of this species.	Endangered	Offshore areas
Antartic minke whale	*Balaenoptera bonaerensis*	Minke whales are regarded as present but uncommon off western South Africa and Angola. It has been suggested that many sightings are inconclusive in the Gulf of Guinea. Stranding records from Angola.	Data deficient	Coastal and offshore

Common name	Scientific name	General Occurrence	IUCN Red List Status	Main Habitat
Odontoceti (toothed whales)				
Sperm whale #	*Physeter macrocephalus*	Sperm whale is found globally, but there is spatial segregation based on age and sex. Females and immature individuals occur in warm waters. The West African sperm whale stock is described as occurring between 20 ° west and 20° east.	Vulnerable	Offshore areas
Killer whale	*Orcinus orca*	Killer whales are the most widely distributed cetacean species worldwide, has been found in a variety of habitats; shelf waters, shelf edge, open ocean and around the oceanic islands and appear to be found throughout the year.	Data deficient	Coastal and offshore
Short-finned pilot whale #	*Globicephala macrorhynchus*	This species is known to inhabit warm waters worldwide and are known to occur off the coast of Gabon. Sightings from Angola and São Tomé have been seaward of the shelf edge.	Data deficient	Offshore areas
Bottlenose dolphin #	*Tursiops truncates*	The bottlenose dolphin is found globally in tropical and temperate regions. It is believed that this species inhabits nearshore areas along the entire west coast of Africa.	Least concern	Coastal and offshore
Pantropical spotted dolphin #	*Stenella attenuate*	Pantropical spotted dolphins inhabit tropical and subtropical waters worldwide; however records from West Africa are rare. Sightings of this species at sea are generally seaward of the shelf edge in deep water.	Least concern	Offshore areas
Dwarf sperm whale	*Kogia sima*	Nursery groups of females and immature animals occur in the Gulf of Guinea all year round. Calving may occur here during February and March. Generally found in deeper waters seaward of the shelf break. Sightings from Angola peak between January and May. A single capture was made in Ghana.	Data deficient	Offshore areas
Cuvier's beaked whale	*Ziphius cavirostris*	Wide ranging distribution in deep-water tropical and cold-temperate waters. A single sighting only was recorded offshore of Angola.	Least concern	Offshore areas
False killer whale #	*Pseudorca crassidens*	Inhabits tropical and temperate waters but records from West Africa are scarce. Sightings in Angola occur in deep-water >1,400 m. Stranding records from Côte d'Ivoire and Gabon, a single capture from Ghana and sightings from Gabon.	Data deficient	Coastal and offshore
Melon headed whale #	*Peponocephala electra*	Inhabit deep, warm waters worldwide. A single record of an incidental catch from Ghana and single sightings records from Gabon and Angola.	Least Concern	Offshore areas
Atlantic humpback dolphin	*Sousa teuzsii*	Endemic to tropical and subtropical waters worldwide. Found all year round in shallow, coastal waters from Morocco to Angola but with a discontinuous distribution. Stranding records from	Vulnerable	Coastal (continental shelf)

Common name	Scientific name	General Occurrence	IUCN Red List Status	Main Habitat
		Cameroon and sightings from Gabon and Angola.		
Rought-toothed dolphin #	*Steno bredanensis*	Inhabits warm seas worldwide including the west coast of Africa. Primarily found in shelf-edge and deep oceanic waters with bottlenose dolphins off Gabon and short-finned pilot whales off Angola and Gabon. Sightings from Ghana, Gabon, Angola and St Helena and captures from Côte d'Ivoire and Ghana.	Least concern	Offshore areas
Dusky dolphin	*Lagenorhynchus obscurus*	Inhabit cool waters <18°C and therefore found near the cold water Benguela Current further south (southern Angola, South Africa and Namibia). Only two individuals sighted in the south of Angola.	Data deficient	Coastal cold waters
Risso's dolphin #	*Grampus griseus*	Worldwide in tropical and temperate seas, predominantly seaward of the shelf-edge. Occurrence, at least offshore of Angola, is thought to be year- round. Sighting records from Côte d'Ivoire, Gabon and Angola and captures from Ghana.	Least concern	Coastal and offshore
Atlantic spotted dolphin	*Stenella frontalis*	Endemic to tropical and warm temperate Atlantic Ocean but distribution in West Africa is poorly known. Sightings from Benin and capture records from Côte d'Ivoire, Ghana and St Helena (unconfirmed).	Data deficient	Coastal and offshore
Spinner dolphin	*Stenella longirostris*	Tropical and warm temperate waters worldwide, but distribution in West Africa is poorly known. Of the 3 records in the Gulf of Guinea all were in water depths >3,500m. Sightings from Ghana and Angola, capture records from Côte d'Ivoire and Ghana.	Data deficient	Offshore areas
Clymene dolphin #	*Stenella clymene*	Endemic to deep waters of the tropical and subtropical Atlantic Ocean, however there are only 200 records from the Atlantic. Considered to be the most abundant cetacean off of Ghana from bycatch records.	Data deficient	Offshore areas
Striped dolphin #	*Stenella coeruleoalba*	Inhabits warm temperate and tropical waters worldwide. Published records of its presence in West Africa are scarce. Strandings from Côte d'Ivoire and sightings from Angola in water depths from 1,500m to 2,400m.	Least concern	Offshore areas
Common dolphin	*Delphinus Delphis*	Occur throughout the tropical Atlantic. Considered to be some of the most common offshore dolphins in West Africa. Occur in shelf, shelf-edge and deep oceanic waters. Strandings and capture records from Côte d'Ivoire, Gabon and Angola.	Least concern	Coastal and offshore
Common long beaked dolphin	*Delphinus capensis*	Occur throughout the tropical Atlantic. Considered to be some of the most common offshore dolphins in West Africa. Occur in shelf,	Least Concern	Coastal (continental shelf)

Common name	Scientific name	General Occurrence	IUCN Red List Status	Main Habitat
		shelf-edge and deep oceanic waters. Strandings and capture records from Côte d'Ivoire, Congo, Gabon and Angola.		
Fraser's dolphin	*Lagenodephis hosei*	Inhabit deep, tropical and subtropical oceans worldwide in water depths >1,000m but their presence in the Gulf of Guinea has only been recognised recently. May occur all year round but data are too few to confirm this. Strandings records from Angola and Nigeria (unconfirmed).	Least Concern	Offshore areas
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Endemic to the west coast of South Africa and Namibia where it inhabits shelf waters with temperatures <15°C. This species is more likely to be found south of the study area. Sighting and capture records from Angola only.	Data Deficient	Coastal cold waters

Note: Common names in bold make reference to the 15 cetacean species whose presence in STP waters, including the Study Area is considered more likely.

# indicates the 13 species that were recorded by Marine Mammal Observers during a seismic survey in deep offshore waters East of of São Tomé e Príncipe, including Block 6, within the period January-August 2017.

Source: Weir, 2010; RPS, 2017; IUCN, 2018.

Sirenians

The presence of the West African Manatee (*Trichechus senegalensis*), assessed as vulnerable by the IUCN, is known along the tropical coast of Africa, where it inhabits mangrove areas. However, given the offshore location of the study area its presence is considered highly unlikely.

4.3.5 Marine turtles

Five species of marine turtle have been recorded as commonly inhabiting São Tomé´s offshore and coastal waters where they come ashore to nest. They also nest on the Atlantic coastline of Africa. Despite the importance of the area as a habitat for marine turtles, there is little scientific literature on their abundance, distribution and habitat utilization (*Tomas et al., 2010).* Turtles are mainly found in the clear shallow waters of coastal reefs, bays, estuaries and lagoons. However, juveniles spend their first years in the open sea where they float and allow themselves to be carried by the currents before returning to more protected coastal waters.

These circumstances mean that although they have a preference for coastal waters, adult migratory individuals and juveniles also have the potential to be present in waters within the study area in Block 6 (*Godgenger et al., 2010*).

Information on these species, with their IUCN Red List population status as well as their protection status as per Sao Tomé e Príncipe legislation is summarized in *Table 4.4*. Their seasonality in the Study Area is also illustrated in *Table 4.5*.

Four of the sea turtle species (the loggerhead turtle being the exception) are integrally protected and included in the Memorandum of Understanding on measures for the conservation of the sea turtle of the Atlantic Coast of Africa. All five species are listed in Annex I of CITES and Appendix I of the Convention of Migratory Species (CMS Convention). In São Tomé e Príncipe, Decree-Law 6/2014 and the Regional Decree No.3 set the protection framework for sea turtle species, including the ban of its capture and commercialization. All the species, with the only exception of the loggerhead turtle are classified as Endangered at national level.

At international level, Leatherback and hawksbill turtles are considered "critically endangered", green and loggerhead turtles are considered "endangered" and olive ridley turtles are considered "vulnerable" according to the IUCN Red List of threatened species (*IUCN, 2016*).

In Central and Western Africa, sea turtles have been the victims of direct exploitation for centuries and today remain vulnerable to incidental by -catch from industrial fishing fleets (*Billes et al., 2006*). Females are targeted for their meat, eggs and their shell is also used in local craft industries and in some areas of Africa traditional sea turtle fishing still exists (*Billes et al., 2006*). Other threats to the population include severe habitat alteration (particularly development of nesting beaches) and from fishing and pollution including the emerging threat of oil pollution along the West African coast (*Billes et al., 2006; Tomas et al., 2010*).

According to the fourth National Biodiversity Report (2009), *Lepidochelys olivacea* (Olive Ridley) is the smallest of the turtle species. In São Tomé it is called the "lazy turtle" by the fishermen because they are easily caught when they come out onto the beach to lay their eggs. For this reason, the protection of this species constitutes a priority in the conservation of the natural resources of the archipelago. The study conducted by *Carvalho (*2008) for the NGOs MARAPA, reported that the local people captured the turtle for lack of other kinds of easily available meat resource. Eggs and nests are also preyed on for traditional and cultural reasons. Added to this is the lack of knowledge and awareness of the importance of the marine ecosystem and paucity of laws regulating the protection and prohibition of capture and sale of sea turtle products, as well as resources for their implementation.

Table 4.4 Marine turtles potentially present in the study area.

Common name	Scientific name	IUCN Red List Status	STP Protection status	Distribution & Habitat	Diet
Hawksbill turtle	*Eretmochelys imbricate*	*Critically Endangered*	*Endangered*	Circumtropical near coastal reefs, bays, estuaries and lagoons. Nesting on sandy beaches.	Mainly sponges and other reef dwellers
Green turtle	*Chelonia myda*	*Endangered*	*Endangered*	Subtropical species common around oceanic islands and coasts with wide sandy beaches	Grazing herbivores feeding on seagrass and seaweeds
Loggerhead turtle	*Caretta Caretta*	*Endangered*	-	Occupy all ecosystems during their lives: beaches and nearshore coastal areas (adults) oceanic zone/open waters as juveniles.	Carnivorous species feeding mostly on shellfish, crabs, sea urchins and jellyfish
Leatherback turtle	*Dermochelys coriacea*	*Vulnerable* (global population) and *Data Deficient* (Southeast Atlantic subpopulation)	*Endangered*	Oceanic, deep-diving marine turtle inhabiting tropical, subtropical, and subpolar seas. Leatherbacks make extensive migrations between different feeding areas at different seasons, and to and from nesting areas.	Feed predominantly on jellyfishes, salps and siphonophores
Olive ridley turtle	*Lepidochelys olivacea*	*Vulnerable*	*Endangered*	Widely present in tropics and subtropics especially in shallow waters with muddy bottom, high in detritus and low in salinity. Especially prefers nesting beaches backed by mangrove vegetation.	A generalized opportunistic feeder feeding on fish, gastropods, shrimp, oysters and algae.

Source: Seaturtle.org; IUCN, 2018. Threat assessment codes refer to the 2001 IUCN Red List Categories and Criteria version 3.1. For more information on IUCN categories, please refer to (available on http://www.redlist.org)

Leatherback and green turtles are considered to be widespread in Western Africa and their reproduction sites range from Mauritania to Angola (*Fretey, 2001; Billes et al., 2006*). The southern limit for the olive ridley turtle is Angola and the southern limit for the hawksbill turtle is Congo (*Billes et al., 2006)*. Olive ridley turtles nest in practically every country along the West African coast from Guinea -Bissau to Angola (*Billes et al., 2006).* The island of Bioko is considered to be the second most important nesting ground to Gabon for leatherback turtles (*Tomas et al., 2010*).

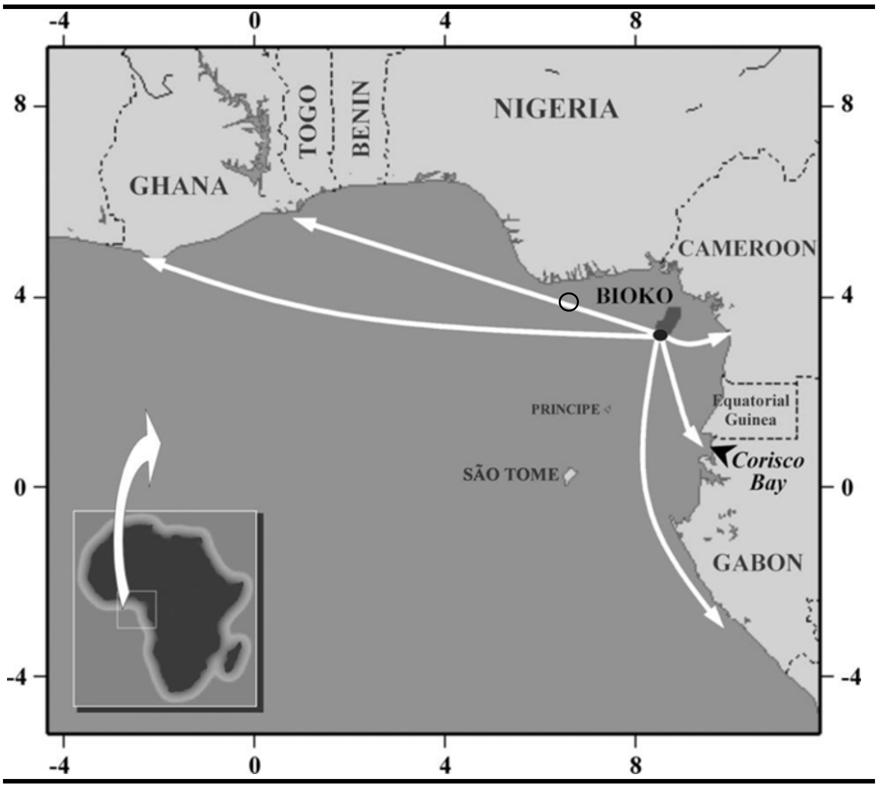
Loggerhead turtles however, are predominantly found in the northern part of the region and only sporadically appear south of the Cape Verde islands. Mating of the loggerhead turtle has been observed in São Tomé waters and incidental capture has also been reported on a number of occasions (*Billes et al., 2006*). Fishermen describe the loggerhead as "rare" and do not believe that it nests in São Tomé (*Graff*, 1996). Juveniles of this species have also been observed in the waters of STP and Gabon, Cameroon and Congo (*Fretey, 2001*). However, according to the Sea Turtle Conservancy (2015), the loggerhead turtle does not nest on equatorial beaches, preferring more subtropical and temperate regions for its reproductive phases.

The gulf of Guinea islands of Bioko and STP are also considered to be important nesting sites for green turtles although this species has also been recorded nesting along all Central African coasts (*Billes et al., 2006*). According to *Girard et al. (*2016) São Tomé e Príncipe beaches constitute the most relevant rookery for the species, accounting for an average estimate of 649 nests laid every year. Seagrasses in the Corisco Bay, between Equatorial Guinea and Gabon, provide an extensive feeding ground for adult green turtles (*Billes et al., 2006*). In STP, *Alexandre et al. (2017)* found the seagrass *Halodule wrightii* in two locations of the northeastern coast of the island of São Tomé: 1) developing throughout an estimated area of 1500 ha surrounding Cabras islet (the area around the Cabras islet is locally known as "Sea of Turtles"as it is an important feeding ground for these animals), at a depth range of 4–10 m, on sandy bottom; and 2) at Santana bay with an area of 1500 m2 at 5–10 m depth, on sandy bottom. A highly morphologically di□erent population of *Halodule wrightii* was found on the northeastern coast of the island of Príncipe, o□ Abade beach, covering an area of 135 m^2 at 4 m depth.

A study by Tomas *et al*. (2010) showed that olive ridley, hawksbill, green and leatherback turtles were all recorded as nesting along the 15 kilometers of black sand beaches of Bioko Island's southern coast. Bioko has therefore been identified as an island of critical importance to sea turtle conservation given its relatively high density of turtles in such a restricted geographic area (*Tomas et al., 2010*). For all four species, the nesting season coincides with the dry season on the island, beginning in late October, peaking in January and extending to the end of March (*Rader et al., 2006*). *Figure 4.14* shows the range of tagged turtles from Bioko recorded by Tomas *et al.* (2010). Available data of tagged turtles (especially leatherbacks) show that those travelling to/from Corisco Bay and Gabon may pass through STP EEZ waters (*Kot et al. 2015*).

Although no similar study has been conducted for turtles in São Tome waters this gives an idea of kind of movement that could be expected.

Figure 4.14 Schematic Trajectories of Tagged Turtles between South Bioko and their Recapture Site.



Source: Tomas et al., 2010.

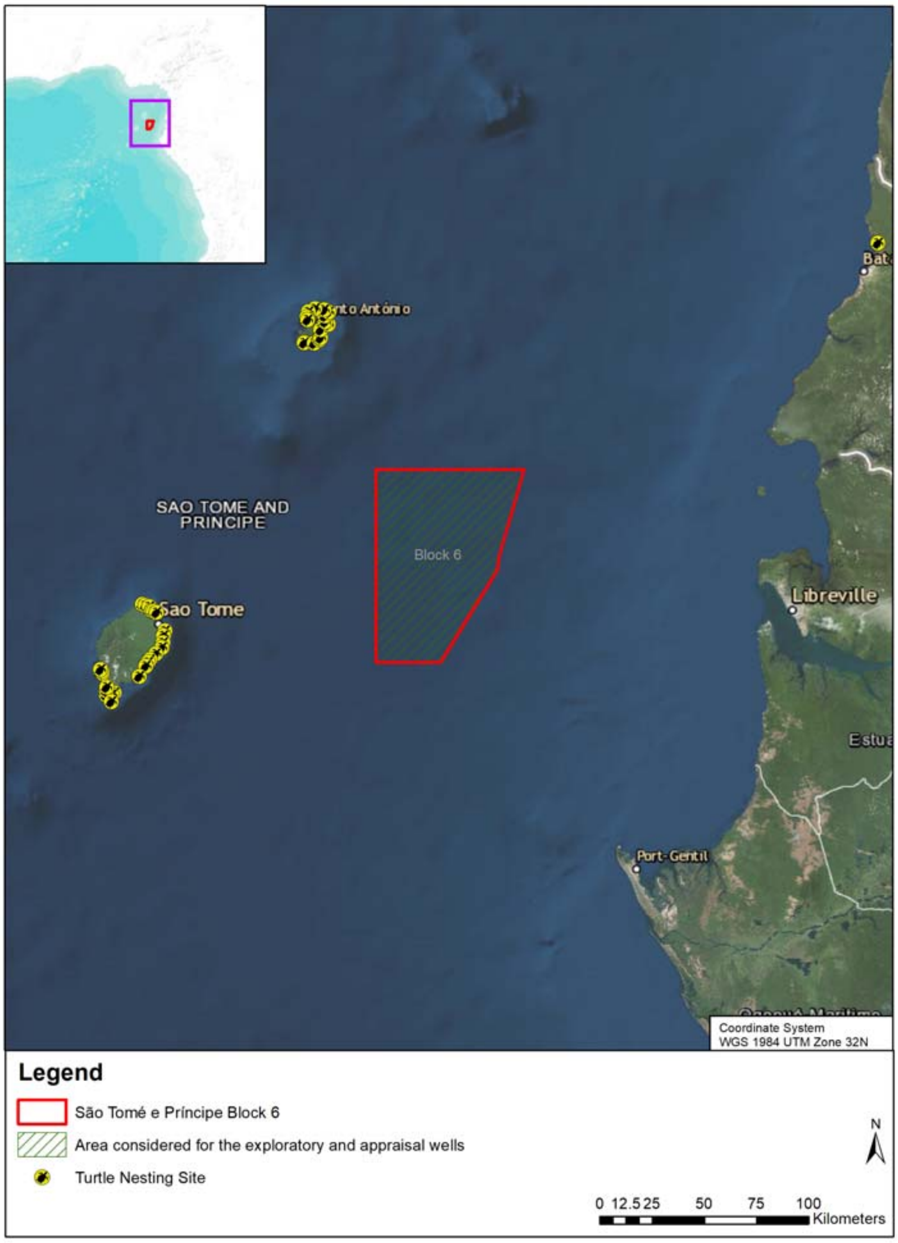
The largest nesting populations of hawksbill turtles are also thought to occur on STP islands and Bioko island, as well as an important year-round population of foraging juveniles, sub-adults and adult males (*Monzón-Argüello et al., 2011*). In particular it has been assessed that on average 152 nests of hawksbill turtles are laid per year on STP beaches, with particular incidence in the eastern side of the islands (*Girard et al., 2016*). Adult females are only considered to be present in this aggregation during the breeding season (November to February) (*Monzón-Argüello et al., 2011*). *Hancock et al. (2015)* indicated for the Olive Ridley that nesting season usually starts as early as August and extends through February each year, with a peak in December and January.

This nesting period in West Africa for hawksbill turtles generally stretches from July to December, with a peak in November (*Armah et al, 1997*). Other specialists suggest that in São Tomé e Príncipe the nesting season coincides with the dry season, beginning in late October, peaking in January and extending to the end of March (*Rader et al., 2006; ENPAB-Marine and coastal ecosystems, 2002, cited in Ministry for Natural Resources and Environment Directorate General for Environment, 2007 ; Girard et al., 2016*). On Príncipe island, the nesting season for hawksbills occurs from November to February (*Monzón-Argüello et al., 2011*).

The main known nesting sites for the turtles in STP are shown in *Figure 4.15*.

During a survey along deep offshore areas East of STP (refer to *Figure 4.11*) one unidentified sea turtle was observed in the area of Block 6 (*RPS, 2017*).

Figure 4.15 Main known nesting sites for the turtles in São Tomé e Príncipe.



Source: Graff, 1996; Nuno et al., 2015; SWOT, 2017..

Most sea turtle species lay multiple clutches of eggs in a nesting season and remain in the vicinity of nesting beaches for several weeks at a time, this is termed the internesting period. Nonetheless, there can be considerable variability in internesting movements among species at different nesting beaches and within the same nesting population *(Godley et al., 2008).*

In most leatherback populations, females cover extensive areas between nesting events, though normally stay within the continental shelf (*Georges et al., 2007).* Some loggerhead and green sea turtle populations demonstrate females making oceanic loops during internesting periods *(Blumenthal et al., 2006)*. However, most hard shelled turtles tend to stay close to their nesting beaches *(Dawson, 2017).*

Dawson (2017) monitored the internesting movements of 21 olive ridley sea turtles from Pongara National Park, one of the largest nesting beaches in Gabon over three nesting seasons (2012, 2013 and 2015). The telemetry tracks indicated that tagged females remained in the vicinity of the nesting beach (<20 km), and spent the majority of their time within the Komo Estuary; with some of the females having remained in the area for over a month before switching to the transiting phase and moving south, likely to known foraging grounds off the coast of Angola. Similar results where obtained by *Maxwell et al. (2011).*

Data on intenesting periods and areas in STP are currently unknown. Nonetheless, *Loureiro et al. (2011)* found that Green turtles nesting at Praia Grande in Principe, had a renesting interval of approximately 12 days. According to monitoring data from Principe Trust (2018), the Green turtle is the most common species nesting in Principe, with over two thousand individuals having nested along the more than 13 monitored beaches during the 2017/2018 season, where monitoring efforts are carried out; half of these occurred at Praia Grande on northeast Principe. Other species with modest nesting behaviour were hawksbill (45 individuals) and Leatherbacks (8 individuals).

Table 4.5 Seasonal Presence of Whales and Turtles within the Gulf of Guinea.

Species	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Potential Species Presence											
Cetaceans												
Blue whale												
Fin whale												
Sei whale												
Humpback whale												
Bryde's whale												
Sperm whale												
Atlantic humpbacked dolphin	Seasonality not known											
Bottlenose dolphin												
Short-beaked common dolphin												
Melon-headed whale												
Rough-toothed dolphin												
Risso's dolphin												
Pantropical spotted dolphin												
Striped dolphin												
Fraser's dolphin	Seasonality not known											
Short-finned pilot whale												
Long-beaked common dolphin												
Killer whale												
False killer whale	Seasonality outside Aug-Nov not known											
Clymene dolphin	Seasonality outside May-Jul not known											
Spinner dolphin												
Dwarf sperm whale												
Pygmy killer whale	Seasonality not known											
Turtles												
Hawksbill turtle	P										P	P
Green turtle											P	
Loggerhead turtle												
Leatherback turtle											P	
Olive ridley turtle	P											P

Nesting periods for certain turtle species are colored in light green. Peak nesting periods are also marked with the letter "P" (Gulf of Guinea and/or STP).
For certain species (colored in dark blue), despite being potentially present within the mentioned periods, there is a more defined period where their presence within STP waters is more likely. These are as follows:
Fin whale:August-September.
Humpback Whale: July-October
Killer Whale: June-September
Sources: Weir, 2010; IUCN, 2018; Monzón-Argüello et al., 2011; Hancock et al. (2015); Rader et al., 2006; Girard et al., 2016.

4.3.6 Seabirds

Given the offshore location of the Block 6, the birds potentially present in the area are seabirds, which are defined as those birds that spend a large part of their time on or over the sea surface. Seabirds are not directly at risk from appraisal and exploratory drilling activities; however they could be affected by the unlikely event of a hydrocarbon spill from Project vessels or the well.

The West African and Mediterranean flyways are major bird migration routes that incorporate the Gulf of Guinea in the journey between breeding and wintering areas. An estimated 300,000 birds use the West African flyway spending time in the wetlands of Gabon (*Findlay et al., 2006*), while several hundred thousand waders alone are estimated to use the wider area of the Gulf of Guinea, including STP islands.

The Gulf of Guinea not only represents an important sector of major flyways but also an important area for mating of seabirds. The zone of West Africa extending from the Tropic of Cancer to Angola, was estimated to host thirteen seabird species mating in the aforementioned area and about 30,000 to 40,000 breeding pairs (*ICBP, 1984*).

As a result, the STP islands have high importance for bird conservation. In a global review of priority areas for bird conservation, Príncipe and São Tomé were both classified as critically important on the basis of the numbers of restricted range bird species occurring together.

The number of species in STP islands is estimated to be 89 species, including 28 endemic and 14 globally threatened species (*Birdlife international, 2018*).

Seabirds that may be present in the Study Area include species that are classified by the IUCN Red List of 2018 as Least Concern (LC), Vulnerable (VU), and Near Threatened (NT). The species considered as potentially present in the Study Area are shown in *Table 4.6*. Only one of these species is protected by STP regulations, the brown booby (*Sula leucogaster*) with the category of Endangered in the country.

Table 4.6 Seabird species potentially present in the Study Area.

Common name	Scientific name	IUCN Red List Status	STP Protection Status	Observations
Loango weaver	*Ploceus subpersonatus*	Vulnerable	None	Coastal species. Rarely seen in STP
Caspian tern	*Hydroprogne caspia*	Least Concern	None	Coastal species
Sandwich tern	*Thalasseus snadvicensis*	Least Concern	None	Coastal and non breeding populations that can be seen further offshore outside of winter season.
Royal tern	*Thalasseus maximus*	Least Concern	None	Coastal species.
Common tern	*Sterna hirundo*	Least Concern	None	Coastal species. Rarely seen in STP
Little tern	*Sternula albifrons*	Least Concern	None	Coastal species. Rarely seen in STP
Damara tern	*Sternula balaenarum*	Near threatened	None	Coastal species. Rarely seen in STP
Black tern	*Chlidonias niger*	Least Concern	None	Coastal species.
Cape gannet	*Morus capensis*	Vulnerable	None	Offshore, foraging up to 120km away from colony. Rarely seen in STP
Arctic tern	*Sterna paradisaea*	Least Concern	None	Offshore. Present during migration towards breeding sites.
Bridled tern	*Onychoprion anaethetus*	Least Concern	None	Offshore areas as it is entirely pelagic. It breeds in STP
Black noddy	*Anous minutus*	Least Concern	None	Coastal and offshore areas of islands. Resident in STP
Brown noddy	*Anous stolidus*	Least concern	Yes - Endangered	Coastal areas of islands. Resident in STP
Madeiran storm petrel	*Hydrobates castro*	Least concern	None	Offshore, rarely approaches land.
White tailed tropicbird	*Phaethon lepturus*	Least concern	None	Coastal and offshore. Not breeder in STP
Brown booby	*Sula leucogaster*	Least concern	None	Coastal and offshore. Resident in STP
Sooty tern	*Onychoprion fuscatus*	Least concern	None	Coastal and offshore

Source: ERM compilation of IUCN, 2018 and Monteiro et al., 1997.

All of the species listed as offshore species, can potentially be present in the study area in Block 6 feeding on fish and other marine fauna such as squid. Tern and noddy species are also reported by IUCN to be found resting on buoys, flotsam, ships, and on the open water. Those species indicated as coastal can also be observed further offshore, but this occurs mostly during migration.

4.4 *PROTECTED AREAS*

The coastline and Exclusive Economic Zone (EEZ) waters of São Tomé and Príncipe as well as the surrounding near shore areas of the Gulf of Guinea countries provide a variety of habitats supporting a rich and diverse wildlife. The main coastal habitats found along the Gulf of Guinea include lagoons, bays, estuaries and mangrove swamps (*Heileman, 2009*). These habitats not only host rich biodiversity, but they also serve as nurseries and breeding grounds for numerous ecologically and commercially important fish and other marine species such as shellfish, seabirds, sea turtles and marine mammals.

The IUCN (the World Conservation Union) defines a protected area as: "*an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means*" (http://www.iucn.org).

Table 4.7 presents the protected areas and shoreline biotopes adjacent to the study area in Block 6, indicating the types of designations (e.g. national/official protection category: National Park/Nature Reserve or international: RAMSAR/IBA). The São Tomean national parks of Obô de São Tomé and Obô de Príncipe have not been considered as they are only terrestrial and therefore the proposed appraisal and exploratory drilling activities do not pose any potential threat. The list also includes the marine protected areas designated in 2017 in Gabon that are closer to the Block 6.

Table 4.7 Coastal and Marine Protected areas in the vicinity of São Tomé and Príncipe.

Name	Type of Protection	Minimum Distance to Block 6
Principe Island	• UNESCO Biosphere Reserve	65 km
Tinhosas Islands	• RAMSAR site • Important Bird Area (IBA)	57.7 km
Annobón Island (Equatorial Guinea)	• Nature Reserve of Equatorial Guinea • RAMSAR site • Important Bird Area (IBA)	278.2 km
Akanda National Park (Gabon)	• National Park (Gabon) • RAMSAR site • Important Bird Area (IBA)	127.0 km
Wongha Wonghe (Gabon)	• RAMSAR Site	153.0 km
Mbanie Island Marine Park (Gabon)	• Marine Park	107.0 km
Pointe Denis Marine Park (Gabon)	• Marine Park	116.3 km
Cape Lopez Marine Parc (Gabon)	• Marine Park	120.3 km
Cape Lopez Canyons Aquatic Reserve (Gabon)	• Aquatic Reserve	32.7 km
Caillou Aquatic Reserve (Gabon)	• Aquatic Reserve	69.6 km
Cape Esterias Aquatic Reserve (Gabon)	• Aquatic Reserve	125.0 km
Mandji-Etimboue Aquatic Reserve (Gabon)	• Aquatic Reserve	102.0 km
Delta de l'Ogooue Aquatic Reserve (Gabon)	• Aquatic Reserve	124.0 km
Pongara National Park (Gabon)	• National Park (Gabon) • RAMSAR site	128.0 km

Sources: *WDPA website, 2018; Ramsar website, 2018 ; Birdlife international web site, 2018.*

The location of the protected and sensitive sites closer to the study area are discussed below and illustrated in *Figure 4.16*. These include coastal National Parks or Nature Reserves, Marine Parks, Aquatic Reserves, coastal Ramsar sites as well as coastal or marine areas important for birds (IBAs). All these protected areas are outside the area of Block 6 where the drilling of the appraisal and exploratory wells is planned, and at a significant distance, with the nearest being the Tinhosas Islands IBA and Ramsar site at 57.7 Km.

There are a number of other protected sites and national parks along the coastlines of the Gulf of Guinea that have not been considered further due to their distance from the Block 6 area or because they lack a marine component.

In addition to the nationally protected sites in the area (National Park, Nature Reserve), other areas of conservation importance are the Ramsar sites and the Important Bird Areas (IBA).

Ramsar sites

'The Convention on Wetlands' (*Ramsar Convention, 1971*) is an international treaty aimed at maintaining the ecological status and sustainable use of designated 'Wetlands of International Importance'. The criteria for identifying Wetlands of International Importance' include: (i) Sites containing representative, rare or unique wetland types; and (ii) Sites of international importance for conserving biological diversity, which includes specific criteria on species and ecological communities, waterbirds and fish (*Wetlands International, 2011*). Ramsar sites are given in *Table 4.7* and shown in *Figure 4.16*.

Important Bird Areas (IBAs)

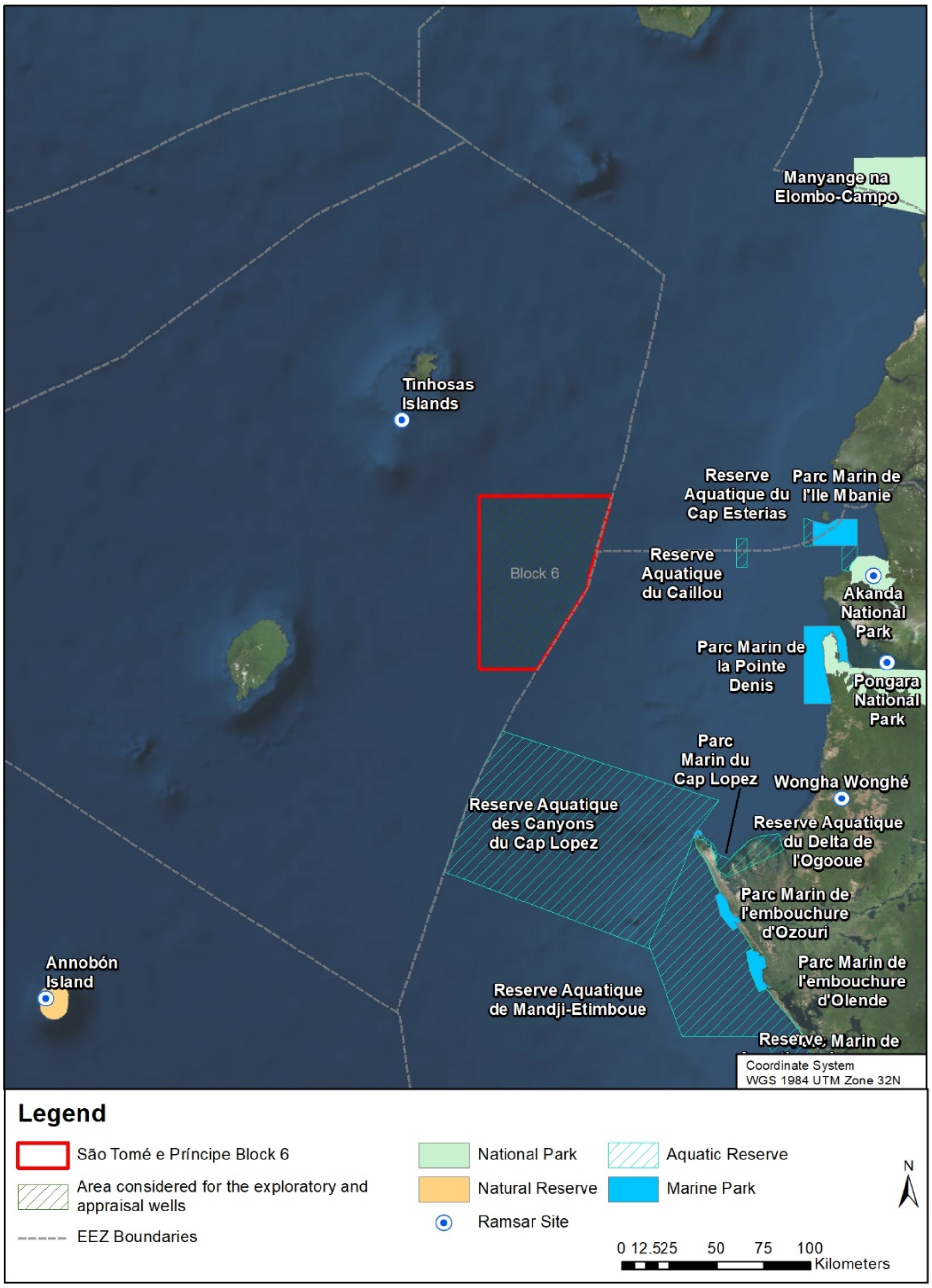
The Important Bird Areas (IBAs) programme is a global effort to identify and protect areas that are of particular importance to bird species globally. The sites are allocated by BirdLife International and are often already part of a protected area network. In order to be selected, sites must do one (or more) of the following:

- Hold significant numbers of one or more globally threatened species;
- Be one of a set of sites that together hold a suite of restricted -range species or biome restricted species; and
- Have exceptionally large numbers of migratory or congregatory species.

There are five IBAs in STP (*Table 4.7*), three in São Tomé (São Tomé Northern Savannahs, São Tomé Lowland Forests and São Tomé montane and cloud forests), one in Príncipe (Príncipe forests IBA) and there is a marine IBA in Tinhosas islands, the latter being the only one where seabirds are expected.

The following paragraphs present a brief description of each of the protected sites including coastal or marine aspects.

Figure 4.16 Coastal and Marine designated areas.



Sources: ERM based on: WDPA website, 2018; Ramsar website, 2018 ; Birdlife international web site, 2018.

Príncipe Island (STP)

The entire island of Principe is considered to be a sensitive area both environmentally and ecologically, as it is an area classified as a Biosphere Reserve by the UNESCO Man and Biosphere Program. This reserve thus constitutes a worldwide network of protected areas that are considered as privileged natural laboratories to test different models of sustainable development capable of reconciling human activities with the defense of biodiversity and terrestrial, aquatic and marine ecosystems.
Despite its proximity to the West African coast, the island's marine ecosystem is characterized by poor ichthyofauna compared to that of continental areas.

However, the smallest diversity is enriched by the existence of several pan-Atlantic species such as: *Bodianus pulchellus, Chromis multilineata, Epinephelus ascencionis, Gnatholepis thomsoni, Mulloidychtis martinicus, Melychthis niger* and *Paranthias furcifer*, which occur in the coastal waters of the eastern Atlantic islands such as São Tomé , Prince, Annobón, St. Helena and Ascension.

Tinhosas Islands (STP)

With a surface area of 23 hectares, the Tinhosas islands (*Figure 4.16*) constitute the first and only Ramsar site present in STP. They are two small rocky islands with an absence of vegetation and permanent human presence, lying about 22 km south-southwest of the island of Príncipe. The site supports an important community of seabirds and serves as a reproduction site for more than 300,000 migratory waterbirds (*Ramsar, 2006*). The site is located approximately 57.7 kilometres North West of Block 6.

The site is also considered to be an Important Bird Area as it shelters the largest seabird colonies in the Gulf of Guinea including species such as the Brown Booby (*Sula leucogastera),* Sooty Tern (*Onychoprion fuscatus*), Brown Noddy (*Anous stolidusfifth),* Black Noddy (*Anous minutus*) and the White-tailed tropic bird (*Phaethon lepturus*), which also breeds regularly at the site in small numbers.

Non-breeding visitors to the islands include, in small numbers, Red-billed tropicbird (*Phaethon aethereus)*, Masked booby (*Sula dactylatra)*, Red-footed booby (*Sula sula)* and the globally threatened Ascension frigatebird (*Fregata aquila)*. These birds are presumed to come from colonies on Ascension Island, 2,500 km to the south-west (*BirdLife International, 2012d*).

Parc National Akanda (Akanda National Park - Gabon)

This National Park and Ramsar site is located in Gabon, approximately 15 kilometres north of the capital Libreville (*Figure 4.16*), surrounded by the Bay of Corisco. It is considered to be the most important site in Gabon for migratory birds (*Ramsar, 2009*). This low-altitude zone is dominated by 35,000 hectares of relatively undisturbed marine mangroves along with swamp forests and grassy savannah (*Ramsar,2009*). It presents a variety of habitats hosting many plant and animal species as well providing nesting areas for migratory birds, including 35,000 to 40,000 Palearctic waders (*Ramsar, 2009*).

In addition to bird fauna, this site is also a significant feeding area for olive ridley and leatherback turtles as they nest in its beaches. It is also a major habitat and breeding ground for fishes (bonga shad; *Ethmalosa fimbriata* and flathead mullet; *Mugil cephalus*) and crustaceans (*Ramsar, 2009*).

Due to the important population of bird species found in the site, it has also been catalogued as an Important Bird Area. Main bird species include the Damara tern (*Sterna balaenarum)*, a common non-breeding visitor between June and November. The site is also frequented by more than 30,000 waders that concentrate in Corisco Bay, including the Lesser sand plover (*Charadrius* *mongolus), Charadrius leschenaultii,* Greater sand plover *(Charadrius asiaticus)* and Eurasian oystercatcher *(Haematopus ostralegus)*.

The site is located approximately 127 kilometres East of Block 6.

Isla de Annobón (Annobón Island – Equatorial Guinea)
This Ramsar protected site is a formed by a 23,000 ha volcanic island belonging to Equatorial Guinea and located southwest of São Tomé island (*Figure 4.16*). It has also been designated as a Nature Reserve for its large number of migratory birds and vascular plants. Originally this island was uninhabited and had a high biological diversity due to its remoteness (*BirdLife International, 2012c*). Main habitats of the site include coral reefs, sandy or pebbly shores, intertidal flats, and at least one permanent lake. Its fauna include some endemic species such as the Annobón white-eye (*Zosterops griseovirescens*), Annobón paradise fly-catcher (*Terpsiphone smithii*) and São Tomé Bronze-naped Pigeon (*Columba malherbii*) (*BirdLife International, 2012c*). The area is also important for tourism, traditional fishing and subsistence agriculture.

The Annobon island is also considered an Important Bird Area due to the nineteen species of birds recorded, of which 12 are thought to be resident. Seabirds present include Black noddy (*Anous minutus*), Brown booby (*Sula leucogaster*), White-tailed tropicbird (*Phaethon lepturus*), Bridled tern (*Sterna anaethetus*) and the Brown noddy (*Anous stolidus*) (*BirdLife International, 2012e*).

The site is located approximately 278.2 kilometres South West from Block 6.

Parc National Pongara (Pongara National Park - Gabon)
The National Park of Pongara is located east of the Congo Basin forest on the southern shores of Gabon estuary (*Figure 4.16*). Its main habitats include mangroves and forests (riverine, swamp, coastal and flooded forests), grassy savannas and several rivers (*Ramsar, 2009*). The flooded areas and riverine network of the park has led to the park also being protected under the Ramsar convention. It hosts a large population of migratory birds and up to 10,000 overwintering Palearctic waders. The area is also an important breeding ground for the critically endangered Leatherback Turtle (*Dermochelys coriacea*). The site serves also as an important habitat for the critically endangered Hawksbill turtle (*Eretmochelys imbricata*), endangered Green turtle (*Chelonia mydas*), and Olive Ridley (*Lepidochelys olivacea*). Among the terrestrial mammals protected living in the site, the most relevant are the gorilla (*Gorilla gorilla*) and African elephant (*Loxodonta africana*) (*Ramsar, 2009*). The site is located approximately 128 kilometres East of Block 6.

Marine Parks of Gabon
In 2017, the government of Gabon designated 9 Marine Parcs, including 3 located approximately at 107 km, 116 km and 120 km from STP Block 6 (Mbanie Island, Pointe Denis and Cape Lopez) that protect approximately 920 km^2. These recently designated areas are mainly focused on the conservation of marine habitats and fisheries resources as well as to protect

breeding areas, spawning grounds and areas of growth and feeding for faunal groups such as marine mammals, fish, crustaceans, birds and reptiles (sea turtles).

Aquatic Reserves of Gabon
In 2017, the government of Gabon designated 11 aquatic reserves, including 4 at a relative short distance from STP Block 6 (Caillou, Cape Lopez, Cape Esterias and Mandji-Etimboue) that protect approximately 14,163 km^2. These recently designated areas are mainly focused on fisheries management in order to ensure the food security for the population as they include fish spawning areas. These locations are also known to host a significant biodiversity and are also important feeding areas for birds and sea turtles.

4.5 SOCIO-ECONOMIC ENVIRONMENT

4.5.1 General characteristics

The Democratic Republic of São Tomé e Príncipe consists of two islands named São Tomé and Príncipe. It is the smallest country in Africa with a surface area of 1,001 km^2 and it is one of the smallest economies in Africa with a Gross Domestic Product (GDP) of $372 million in 2017 (*CWF, 2018*) and a per capita Gross National Income (GNI) of about US$ 1,720 in 2016 (*World Bank, 2018*). The capital is São Tomé.

STP is a Portuguese speaking country that was discovered in 1471 and has been independent since 1975.

According to the World Bank (2016), STP has a small market size, fragile economy and is highly vulnerable to exogenous shocks and climate change, due to its insularity. Nonetheless, STP has significant opportunities to diversify its economy through agriculture, tourism, fisheries, as well as oil and gas production.

This section outlines the existing socio-economic conditions that may be impacted by the project's activities. Although interactions with onshore activities are not expected, interference with shipping and fishing activities will occur throughout the appraisal and exploratory drilling programme. Coastal resources are not expected to be affected by the proposed activities of the project.

4.5.2 Demographics

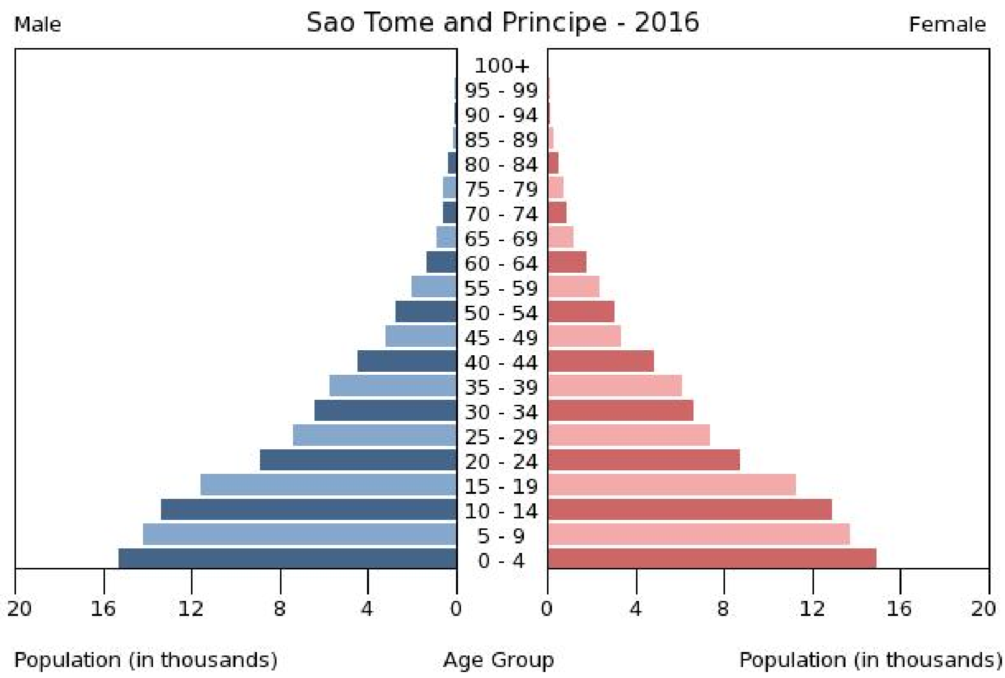
The population of São Tomé and Príncipe descends primarily from the islands' colonial Portuguese settlers, who first arrived in the late 15th century, and the much larger number of African slaves brought in for sugar production and the slave trade. For about 100 years after the abolition of slavery in 1876, the population was further shaped by the widespread use of imported unskilled contract labourers from Portugal's other African colonies, who worked on coffee and cocoa plantations. In the first decades after abolition, most workers were brought from Angola under a system similar to slavery. Other contract workers from Mozambique and famine-stricken Cape Verde first arrived in the early 20th century under short-term contracts and had the option of repatriation, although some chose to remain in São Tomé and Príncipe.

Today's São Tomean population consists of *mesticos* (creole descendants of the European immigrants and African slaves that first inhabited the islands), *forros* (descendants of freed African slaves), *angolares* (descendants of runaway African slaves that formed a community in the south of São Tomé Island and today are fishermen), *servicais* (contract laborers from Angola, Mozambique, and Cape Verde), *tongas* (locally born children of contract laborers), and lesser numbers of Europeans and Asians. (*CWF, June 2018*).

According to the CIA World Factbook, STP has a population of 201,025 (July 2017 est.), with an annual growth rate around 1.72% (2017 est.). The youthful age structure of the country– more than 60% of the population is under the age of 25 – and high fertility rate ensure future population growth. In particular, the age group of population between 0 and 14 years old comprises 41.85% of the population (male 42,781/female 41,354), while is the age group between 25 and 54 years comprises 30.82% (*Figure 4.17*). According to the results of the 2011 census, the population of the Príncipe Island is 6,000 inhabitants (*World Population Review, 2015*).

The country is predominantly urban, with the urban inhabitants making up 72.8% of total population (*CWF, 2018*). While literacy and primary school attendance have improved in recent years, São Tomé is still experiencing difficulties to improve its educational quality and to increase its secondary school completion rate.

Figure 4.17 Population pyramid of Sao Tome and Príncipe in 2016.



Source: CWF, 2018.

4.5.3 *Economy*

According to the CIA World Factbook (2018), the Gross Domestic Product (GDP- official exchange rate) in STP in 2017 is estimated to be 372 million US dollars. The GDP value of STP ranks 209 out of 230 countries in the world's economy.

In 2017, economic growth decelerated to a rate of 3.9%, as the public spending impetus was constrained by reduced external inflows. Year-on-year inflation increased to 7.7% at end of 2017, mainly driven by unseasonal rainfall and one-off factors, such as new import taxes and charges. Efforts are underway to strengthen revenues through collecting tax arrears and introducing a value-added tax (VAT). In 2018, economic growth is expected to stay at around 4% and accelerate gradually in the medium term, supported by externally-financed projects in the construction, agriculture, and tourism sectors.

The economy of the country is mainly represented by the services sector, which constitute 73.4% (est.) of the GDP in 2017, while the agricultural sector accounts for 11.8% and the industry sector for 14.8% (*CWF, June 2018*).

The main crops and agricultural products cultivated on the islands include cocoa, coconuts, palm kernels, copra, cinnamon, pepper, coffee, bananas, papayas, beans; and light construction, textiles, soap, beer, fish processing, timber are the main industries (*CWF, 2018*). In 2014, São Tomé and Príncipe's exports were led by cocoa (beans and preparations) representing 91.4% of the country´s total exports (*ITC, 2015*).

Tourism is a major contributor to the service sector, having contributed approximately 31.0% of the GDP in 2016 (*WTTC, 2017*). One of the main aims of the government development programs, including improvement and organization of the territory's infrastructure, is to facilitate the development of tourism. Other major contributors to economic activity are agriculture and foreign-investment-driven construction. In recent years interest has heightened for acquiring petroleum exploration rights from the country, which will help to boost reserves and deliver more inclusive growth through both the local operations and social project components.

The labour force is mainly engaged in subsistence agriculture and fishing. There is a general shortage of skilled workers. The unemployment rate is estimated at 12.2% for 2017 (*CIA, 2018*).

4.5.4 Ports

There are two main seaports: one at São Tomé city and another at Santo Antonio on Príncipe Island. The main commercial port in the vicinity of the Study Area is the Port of São Tomé, located in Ana Chaves Bay in the northeast of São Tomé Island, at the outskirts of São Tomé city. It is a relatively small port consisting of a wharf and pier. The wharf is 200 meters in length with an alongside depth of three meters. It has a shallow draft and as a result can only accommodate small vessels. Large ships have to anchor over a mile offshore where cargo is unloaded onto small vessels *(ILO, 2010*).

The Port of São Tomé is an open roadstead type harbour, with an anchorage depth between 9.4 m to 10 m, and a cargo pier depth between 1.8 m and 3 m. There is no oil terminal, no dry dock and no railway (*ports.com, 2018*). Santo António, in Príncipe, has a natural coastal type harbour. This takes the form of a very small port, with an anchorage depth of 9.4 m to 10 m, a cargo pier depth between 1.8 m and 3 m. It also has no oil terminal, no dry dock and a maximum draft of 17.9 m (*Searates, 2018*).

In 2006, the port was used by 19 vessels with a total of 153,769 DWT (*Hydrographer of the Navy, 2006*). According to UNCTAD (2018), the national merchant fleet in 2016 comprised 18 ships, with a combined 18,300 DWT. Since 2011, the Angolan state oil company Sonangol has been operating the Port of São Tomé under a 30 year concession contract (*The Economist, 2014*).

In light of the limited port facilities, activities including refuelling, provision of supplies, and transhipment often take place at sea through Ship-to-Ship ("STS") cargo transfer (*Globalsecurity.org, 2018*).

The pier in Neves, where ENCO (the national fuel company) has its main storage facilities, allows tankers to discharge the fuel through "Sealine" hoses. The piers of Porto Alegre, Santa Catarina and Água- Izé are inoperative. (*CGD, 2014*)

In April 2017 works began on upgrading and expanding the container storage area of the Port of São Tomé to end the congestion at the port of Ana Chaves, financed by the European Union with more than 1 million euros.

In 2015 the Government signed a memorandum of understanding with the Chinese company "China Harbor Engineering Company Ltd" to build a deep-water port in the Fernão Dias area, Lobata district, 12 kilometres from the capital of São Tomé and Príncipe, with a total cost of over US$800 million, which would be a world-class port infrastructure and would be developed for the logistical needs of the Gulf of Guinea. However, the IMF did not support the project.

The São Tomean executive decided to replace the project of construction of the commercial port of deep water, by a fishing pier to be built in São Tomé and valued at 70 million euros. In 2017, Prime Minister Patrice Trovoada pointed to China as a new strategic partner that, in the framework of private investment, would shape the implementation of the project ("Tela Non", 2018).

4.5.5 Commercial fisheries

Fisheries in STP represented 4.7% of national GDP in 2012 and employed approximately 15% of the working population (*IMF, 2012*). The fishery sector is dominated by traditional, small scale fishing activity for demersal and small pelagic species on the continental shelf (*Afonso et al., 1999; Carneiro, 2011*), though also semi-industrial and industrial fleets operate in the country. The extended shelf is found south of Príncipe and also surrounds the Tinhosas islets (*Carneiro, 2011*). In the region, the fisheries sector provides a major source of employment and foreign currency since most of the tunas and shellfish are exported (*FCWC, 2012*). For a large part of the population in the surrounding African countries, fish is the only source of animal protein (*FCWC, 2012*).

The fisheries sector is managed by The Ministry of Agriculture and Rural Development and Fisheries (*Alegre, 2010*). The Directorate General of fisheries reports to the ministry on fisheries issues such as highlighting gaps in management, and management of artisanal and semi-industrial fishing fleets. The management of artisanal and semi-industrial fishing fleets involves the registration of vessels and fisherman as well as monitoring of their fishing activities (*Alegre, 2010*).

STP has an abundance of fish and marine resources, as an island economy. In recent years, the fishery sector has seen a high level of government investment. Private operators have been encouraged to enter the fish processing industry to prepare products for export, mainly to European destinations. However, the majority of São Tomé and Príncipe's fish continues to be processed abroad, hindering the country's potential to add value and increase employment (*African Economic Outlook, 2014*). The domestic fishing market is poorly organized mainly because of limited structures for selling fish and because operators in the sector are poorly educated (*IMF, 2012*).

Data from FAO (2007) estimated volumes of exploitable fishery resources in STP to be 12,000 tons per year of coastal species (approximately 4,000 tons of coastal pelagics, 2,000 tons of demersal species, and 6,000 tons of shellfish) and 17,000 tons per year of large pelagic species (*Carneiro, 2011*). Little information is available regarding the biomass in the Exclusive Economic Zone (EEZ) deeper waters, but it is believed that it is mostly composed of large and migratory pelagic species, particularly tuna. Data from DIPA (1994) estimate biomass values varying between 60,000 and 100,000 tons. The country fishes only in the coastal waters of its EEZ, and as a result its potential is underexploited as catches could be doubled in size; thereby improving the domestic market, income at the national level and in particular for the population that lives on fishing activities (*IMF, 2012*).

With regards to large migratory pelagic species, foreign fleets account for the majority of catches. Small pelagics are caught both by São Tomean artisanal fishermen and by foreign industrial fleets, although in the case of the latter, the principal target is large migratory pelagic species.

Artisanal and Semi-industrial Coastal Fishing

The GCLME is regarded as abundant in living marine resources including resident stocks supporting artisanal fisheries (*Heileman, 2009*). Between 1990 and 2005, 85% was produced by poorly equipped artisanal fishermen, with industrial fisheries producing the remaining 15% (*Ovie & Raji, 2006*).

The artisanal sector uses a range of gear to fish (see *Table 4.8*). Artisanal fisherman use boats known as pirogues (see *Figure 4.18*) which range in length from 3.5 to 12 m (*GOVERNO STP, 2009; Carneiro, 2011*) and can support between 1 and 6 fishermen on board. Boat engines (when available) can range between 6.5 and 15 hp (*FAO, 2008; Carneiro, 2011; Belhabib, 2015*). The government of São Tomé and Príncipe classifies fiberglass boats between 12 and 15 m as 'semi-industrial'.

These vessels fish mainly in the richer grounds to the south of Príncipe island. However, a significant proportion of the artisanal fishing fleet comprises dugout canoes with no motors. These vessels are restricted to operating only a few nautical miles from the coastline. The most recent estimates are that there are roughly 4,000 artisanal fishers as well as 5,000 woman engaged in fishing related activities (*Klueh et al., 2007; Belhabib, 2015*). The woman in this sector buy fish from the fisherman and then process and sell these fish in the local markets. Demersal (bottom-dwelling) fish stocks in coastal waters around São Tomé and Príncipe are the main target for artisanal fisherman (*FAO, 2008*).

Table 4.8 Artisanal fishing sector fleet and gear.

Description	Target fishery	No.

Description	Target fishery	No.
Harpoon fishing; divers from beaches or from small canoes.	Demersal fishes and cephalopods; Marine turtles	350 divers
Beach seines, trawling, and seining to beach	Demersal fishes and cephalopods	Unknown
Hand lines and gillnets for both surface and bottom fishing; small wooden canoes (3–6 m) with sail and oars.	Demersal fish species, occasionally small pelagic	10,012
Gillnets for surface and bottom fishing; medium-sized wooden boats (6–8 m) with motor (8–15 hp).	Demersal fish species, occasionally small pelagics	290 boats
Purse seine nets; large wooden boats (8–12 m) with motor (25–20 hp)	Small pelagic fish species	114 boats
Hand line for surface and bottom fishing; large open deck fiberglass boats (8–13 m) with motor	Demersal fish species, occasionally small pelagics	3 boats
Hand line for surface and bottom fishing; large closed deck fiberglass boats (8–13 m) with motor	Demersal fish species, occasionally small pelagics	2 boats

Source: Krakstad, Isebor and Alvheim, 2006.

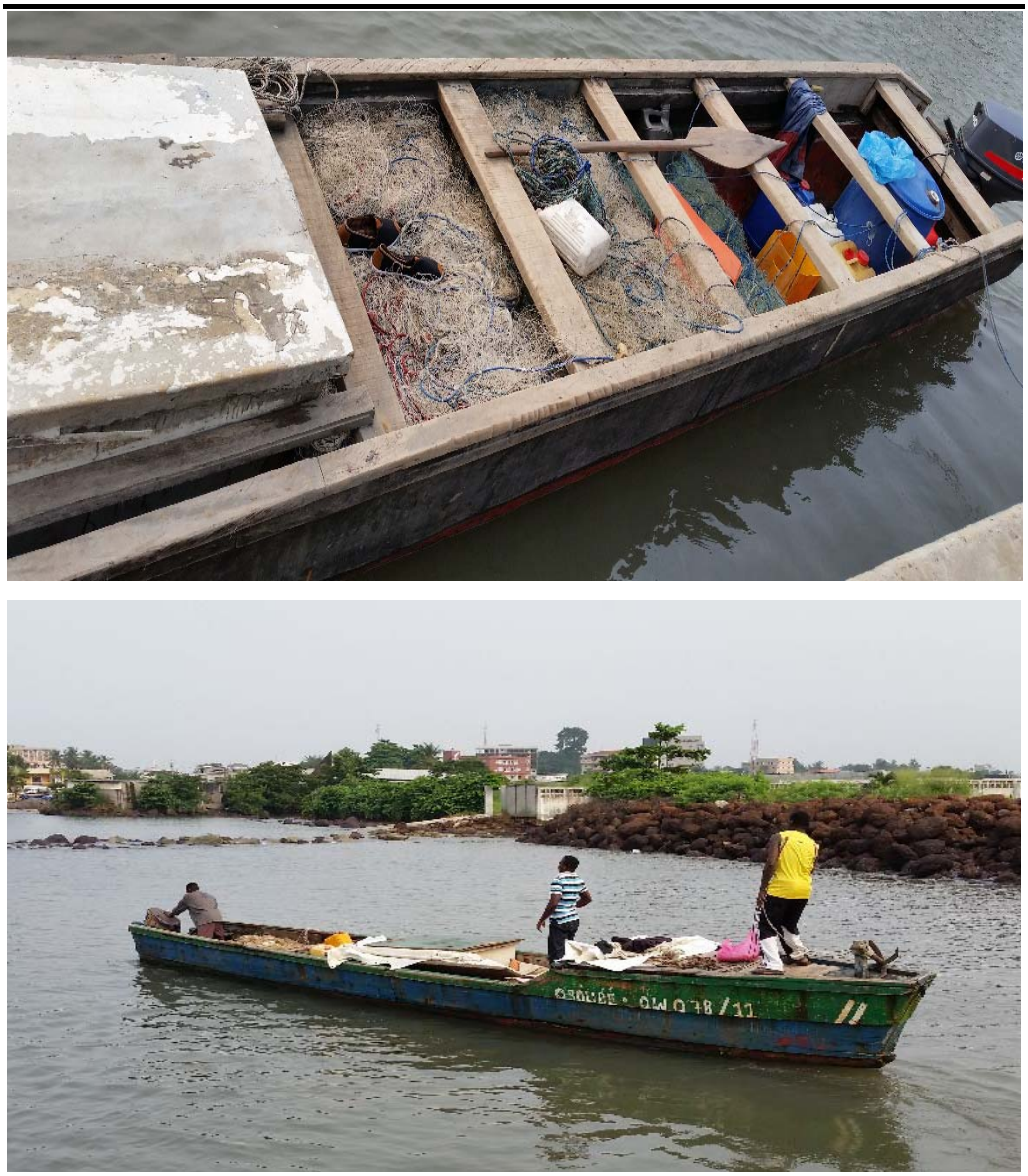
The limited catch information available for artisanal fisheries show that the most commonly caught species are seabreams (*Pagrus spp*), also known locally as 'pargo' and the wreckfish *Polyprion americanus*. Although foreign fleets are responsible for most of the catches of large migratory pelagics, some of the smaller species are frequently caught by local artisanal vessels and are commonly found in São Tomean markets. These include mackerel and round scad, *Decapterus macarellus* and *D. punctatus*; Spanish sardine, *Sardinella aurita*; and different species of carangids and flying fish, *Cheilopogon spp* (*Carneiro, 2011*).

Demersal fish stocks found in the coastal waters of STP, which constitute the mainstay of most artisanal fisheries, combine elements of eastern and western central Atlantic stocks (*Carneiro, 2011*). These are mostly caught nearshore by semi -industrial fishermen using motorized boats with ice. Key caught species include snappers (*Lutjanus spp*.), wet African goatfish (*Pseudupeneus prayensis*), and several types of sparids (*Pagellus coupei, momyros, camariensis, Dentex angolares* and *D. congolensis*) (*DIPA, 1994*).

In some small-scale inshore fisheries operations, small mesh beach or gill nets are used which catch juvenile fishes that have not yet had the chance to reproduce. In addition, the use of chemicals and explosives for fishing are common and have a destructive impact to fish populations (*Heileman, 2009*), particularly if undertaken in inshore nursery grounds. It has been reported that over the past 30 years there has been a reduction in the size and quality of fish catch and there is evidence of reduced economic revenue, employment and conflicts between artisanal and commercial fisheries (*ACOPS/UNEP, 1998; Heileman, 2009*). Overexploitation of straddling and migratory fish stocks by large international fleets may have a detrimental impact on STP artisanal fishing communities, in particular, because of their high reliance on fish for subsistence.

The most recent full catch profile by species available from the FAO, includes information up until 2006. Annual total catches have fluctuated over the years, however the amount of catch is around 4,000 tons per year (*Table 4.9; FAO, 2008*).

Figure 4.18 Examples of pirogues used in the artisanal fisheries.



Source: CapMarine, 2017.

Table 4.9 Artisanal and semi-industrial fishing production.

Year	Artisanal fishing (t)	Semi-industrial (t)	Total (t)
2000	4,000.2	42.7	4,042.9
2001	3,655.5	36.5	3,692
2002	3,790.6	29.4	3,820

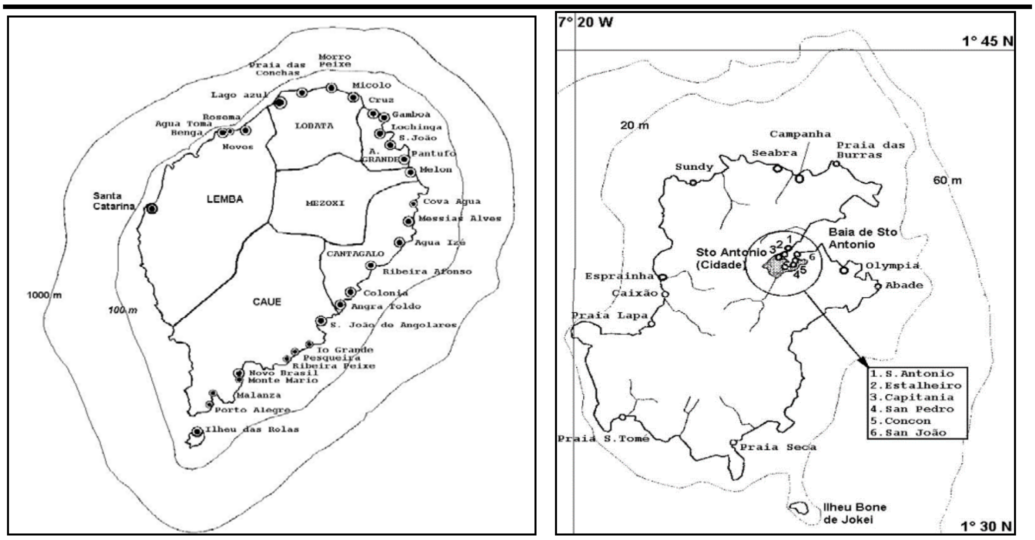
2003	4,005.9	32.1	4,038
2004	4,103.5	37.8	4,141.3
2005	4,025.1	51.7	4,076.8
2006	3,967.3	22.1	3,989.4

Source: FAO, 2008.

Artisanal fisherman in São Tomé and Príncipe operate out of 23 fishing beaches on the coastline and 12 secondary beaches (see *Figure 4.19*; *Belhabib, 2015)*. The catch reconstruction performed by Belhabib (2015) for São Tomé and Príncipe shows that catches in this sector increased gradually from 1,500 tons in 1950 to 4,700 tons in 2002, after which catches fluctuated (*Belhabib, 2015*). This accounts for 90% of STP's total fishing capacity (*FAO, 2008b*).

Artisanal fishermen access fishing locations around the coastline, and those using motorised vessels are able to access richer grounds to the southern side of São Tomé, such as Ilheu das Rolas, Porto Alegre, Monte Mario and Novo Brasil *(FAO 2008; Belhabib 2015; Carneiro 2011*). In Príncipe, fishing grounds are located to the northern parts of the island (*Figure 4.19*) such as Santo Antonio, Estalheiro, Capitania, San Pedro, Concon and Joao *(FAO, 2008*). Areas around the Tinhosas islets, located south of Príncipe, are also popular fishing grounds for subsistence and artisanal fisherman *(Carneiro, 2011; Belhabib, 2015*). Although some of the artisanal fleet are motorized, some authors have noted that this is mostly as a safety precaution and otherwise are not able to access more distant areas (*Carneiro, 2011*), and instead are restricted to a few nautical miles of the coast. Recent data collected by the NGOs ATM and MARAPA by tracking semi-industrial fishermen with a GPS has shown how fishermen from Santana in São Tomé island manage to reach distances of more than 60 km from the coast (*Kikedamungu, 2017*). In case fishermen from Principe have a similar behaviour, they could reach the boundaries of Block 6.

Figure 4.19 Map of artisanal fishing communities of São Tomé (left) and Príncipe (right).



Source: FAO, 2008.

There are also records of artisanal fisherman operating off the coast of Gabon, Cameroon and some instances Equatorial Guinea *(Klueh et al., 2007; Carneiro, 2011*). The semi-industrial fleet may sometimes land in these countries and transfer fish catch, or sometimes transfer fish to other vessels in these regions at sea. The transhipment of catch between countries and in open water further complicates fishery records *(GOVERNO STP, 2009; Carneiro, 2011; Belhabib, 2015*). The semi-industrial fleet is also considered a part of the domestic fishery in Gabon, Cameroon and Equatorial Guinea, regardless of their origin (*Carneiro, 2011*). The only type of monitoring performed in this regard is through "beach chiefs" who collect data on catches. However, this data is not consistent as the collection of data is relied solely on the chief who may not be monitoring catches consistently (*Carneiro, 2011*).

Given the remoteness of the study area from the coast of both São Tomé and Príncipe islands, the interference of the proposed operations with the artisanal fisheries is unlikely, though possible for semi-industrial fishermen.

Industrial Offshore Fishing

Within the GCLME there are large transboundary straddling and migratory fish stocks which are targeted by commercial offshore fishing fleets (*Heileman, 2009*). Exploited species include small pelagics; round sardine (*Sardinella aurita*), European anchovy (*Engraulis encrasicolus*) and jacks (*Caranx spp.),* large migratory pelagic fishes such as tunids (*Katsuwonus. pelamis, Thunnus albacores* and *T. obesus),* crustaceans such as the pink and brown shrimp (*Penaeus notialis* and *Parapenaeopsis atlantica* respectively), cuttlefish (*Sepia officinalis*) and demersal fish species such as the cassava croaker (*Pseudotolithus senegalensis*), longneck croaker (*P. typus*) and the golden African snapper (*Lutjanus fulgens*) (*Mensah & Quaatey, 2002; Heileman, 2009*).

The richest fisheries in the region are however found in the Benguela upwelling area further south towards the coast of Angola. Nigeria and Ghana contribute to about half of the reported landings in the GCLME, while EU countries such as Spain and France as well as Japan which also fish in the area are responsible for the remainder (*Heileman, 2009*).

Although STP has great potential for national commercial fishing within its EEZ, production is limited by technology and infrastructure (*FAO, 2008b*). There are limited facilities such as ice machines for processing fish caught and the cost of fuel on the island is such that most artisanal fishing is carried out by non-motorized vessels (*DTIS 2006; FAO, 2008b*). In addition to this constraint, the main port is small and the road transport to market is difficult (*FCO, 2010; DTIS, 2006*).

Commercial fishing in STP is undertaken by foreign industrial fleets, following bilateral fisheries agreements, such as that with the EU, or by joint ventures or private arrangements. The Fisheries Partnership Agreement with the EU was concluded in 2007. The current Protocol, pending renewal, to the fisheries partnership agreement covers the period 23.5.2014 - 22.5.2018 with a financial contribution of 710 000 € per year during 3 years, and 675,000 € during the 4th year, out of which a specific contribution of 325,000 € is dedicated to the support of the fisheries policy of São Tomé and Príncipe. The agreement has indicative catch allowance of 7,000 tons per year.

This fisheries agreement allows EU vessels, mainly from Spain, Portugal and France, to fish in the São Tomé and Príncipe waters and is part of the tuna network fisheries agreements in West Africa. Its current fishing possibilities includes 34 tuna vessels (28 seiners and 6 long-liners) (*EU, 2018*).

The industrial fleet target species such as yellowfin tuna, *Thunnus albacares*; bigeye tuna, *T. obesus*; skipjack tuna, *Katsuwonus pelamis*; Atlantic swordfish, *Xiphias gladius*; and various species of sharks, such as hammerhead, *Sphyrna* spp.; mako, *Isurus* spp.; and blue shark, *Prionace glauca* (*Carneiro, 2011*). Fleet activity tends to intensify during tuna migration season, between May to mid-October.

As with most oceanic pelagic fisheries there are expected to be numerous species caught other than the target species listed above. A study by Belhabib (2015) which aimed to reconstruct fisheries data found some records of by-catch for the industrial foreign fleets. This by-catch consisted of undersized species of Atlantic blue marlin, sailfish, wahoo (*Acanthocybium solandri*), dolphinfish (*Coryphaena hippurus*), barracudas (*Sphyraena barracuda*), triggerfish (*Balistes capriscus*) and various sharks (*Belhabib, 2015*).

Purse-seine vessels range in length between 25 m and 115 m and have on-board freezing capacity for storage of up to 2,000 tons. Methods used to directly search for and detect tuna schools include the use of high performance binoculars, bird radar, echo sounder, sonars and satellite buoys attached to artificial and natural Fish Aggregating Devices (FADs). Once the fish are localized, the fishing event itself takes no more than a few hours and consists of setting the net, circling the school of fish, pursing and hauling the net, followed by the brailing of the fish on board. The purse-seine net is set at a depth of between 120 m and 250 m from the sea surface and may extend up to 2km in overall length (circumference).

Pelagic long-line vessels set a drifting mainline, up to 50-100 km in length, which are marked at intervals along its length with radio buoys (Dahn) and floats to facilitate later retrieval. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot.

The main justification for fisheries agreements to only cover pelagic migratory species is that these are not targeted by the artisanal fleets of STP. Artisanal fishermen operate predominantly within a few nautical miles of the coast and target mainly demersal and small pelagic species, while the foreign fleet operation zone is beyond 12 nautical miles (22 km) from the coast to the limit of the EEZ (*EC, 2012*).

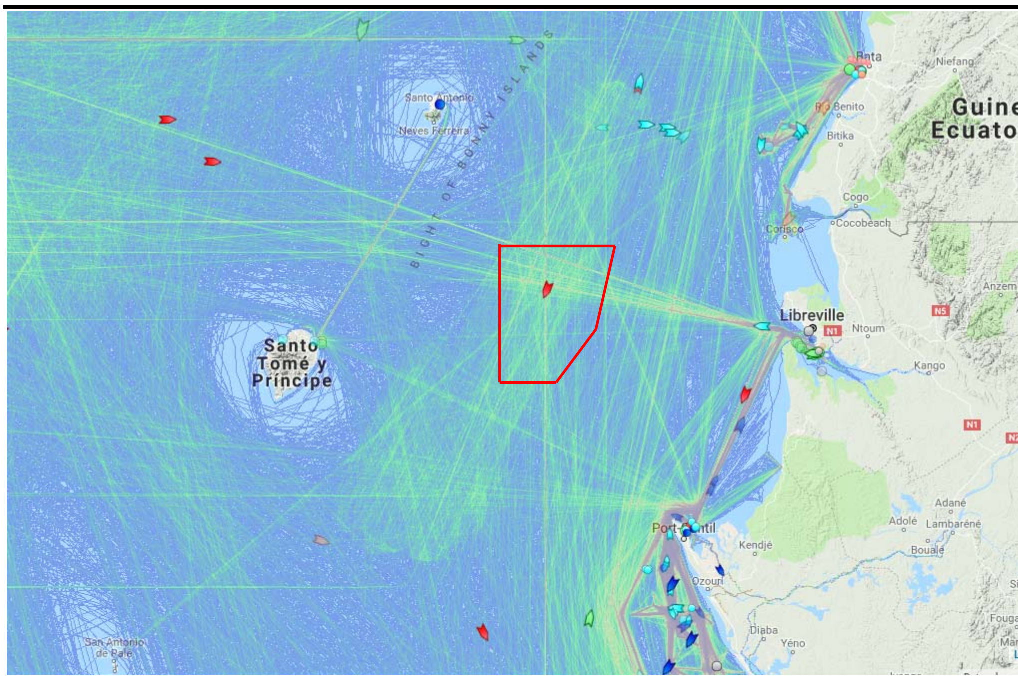
4.5.6 *Maritime traffic*

Shipping density is relatively low in STP waters compared to the shipping traffic across the Gulf of Guinea (*Kaluza et al., 2010; Maritimetraffic.com, 2018*). *Figure 4.20* shows the relative maritime density in the area.

The shipping traffic is influenced by:

- Commercial traffic from Port of São Tomé to the West African countries;
- Commercial traffic from Nigeria, Equatorial Guinea, Cameroon, and Gabon to the rest of the world, via South Africa and South America; and
- Commercial fishing vessels.

Figure 4.20 ***Shipping traffic density in the study area.***



Note: Red polygon represents approximately the location of the Block 6
Source: www.marinetraffic.com, 2018.

4.5.7 *Tourism*

Tourism growth in Africa in 2017 is estimated to be 8%. The region consolidated its 2016 rebound and reached a record of 62 million international arrivals (*UNWTO, 2018*). In 2016, an estimate of more than 52,000 arrivals was recorded in STP, that generated 55 million USD in revenues (*African Statistical Yearbook de 2017, quoted by M.A.E.C.of Spain, 2018*). In 2014, CNN Travel staff elected STP one of their dream destinations (*CNN Travel, 2014*).

The tourism industry has been growing since the 1990s, and is focused in São Tomé and the rocky islands of Rolas, Santana, and Príncipe. As mentioned in *Section 4.5.3*, according to the World Travel & Tourism Council (2017), the total contribution of Travel & Tourism to GDP (including wider effects from investment, the supply chain and induced income impacts) was STD 2,293.5 bn in 2016 (31.0% of GDP) and is expected to grow by 7.5% to STD 2,464.9 bn (31.7% of GDP) in 2017. In 2016 Travel & Tourism directly supported 8,500 jobs (14.2% of total employment). This is expected to rise by 6.9% in 2017 and remain unchanged at 9,000 jobs (11.5% of total employment) in 2027.

Tourist attractions are predominantly based on the islands' tropical weather and unspoiled landscapes. In addition, due to the historic connection, the emerging niche category of visiting the former coffee and sugar plantations designated as 'Roças' has also been an attractive factor (*Euromonitor International, 2013*). The Travel and Tourism boards of São Tomé and Príncipe cite the beaches, mountains, waterfalls as things to see and game fishing, diving, and whale, turtle and bird watching as things to do.

The sector's accommodation capacity was 517 rooms and 842 beds in 30 hotel establishments in 2010 (*IMF, 2012*).

Despite STP tourism potential, limited access to the islands, a shallow water port and reduced number of flights per week are constraints for the development of the industry (*Euromonitor International, 2013* and *African Investor, 2009*).

December to March and June to August are considered the best time of year for diving due to greater water visibility (*African Eden, 2014*). Diving is possible all over the archipelago, but the São Tomé north and northeast coasts are regarded as the best spots. Organized boat trips to the rocky islands are common. Marine fauna observation boat trips occur throughout the year, mostly during whale watching season between mid July to November and during the turtle nesting season between September and March (*Tourism board, 2014*).

STP is also a recognized venue for international game fishing tournaments. Big game fishing for marlin, swordfish, tuna and sailfish is common between May and October (*Tourism board, 2014*), with its peak between July and September, due to the Atlantic Blue Marlin fishing season (*African Eden, 2014*).

4.5.8 *Infrastructure and Industrial Activity*

Infrastructure

São Tomé and Príncipe lacks modern transport infrastructure such as ports, airports and roads which are needed to develop the private sector and to stimulate growth. The STP road network spans about 1,180 km of which 250 are paved (*IMF, 2012*). There is no public transportation on the islands and no railway network. This limitation has an impact on international trade leading to high transportation costs, limiting competitiveness, discouraging domestic and foreign investment, and hindering economic growth (*IMF, 2012*). There are 2 main airports, in São Tomé and Santo Antonio (Príncipe island). Both have recently been modernized (*Nationsencyclopedia, 2015*) but for São Tome airport further modernization and expansion is planned.

However, development actions focused on basic and communications infrastructures are planned. Among these developments is included a fishing pier to be built in São Tomé and valued at 70 million euros, with the help of foreign investments.

São Tomé and Príncipe has practically no medium scale industrial activity, except for cocoa and beer production (*UNEP, 2013*).

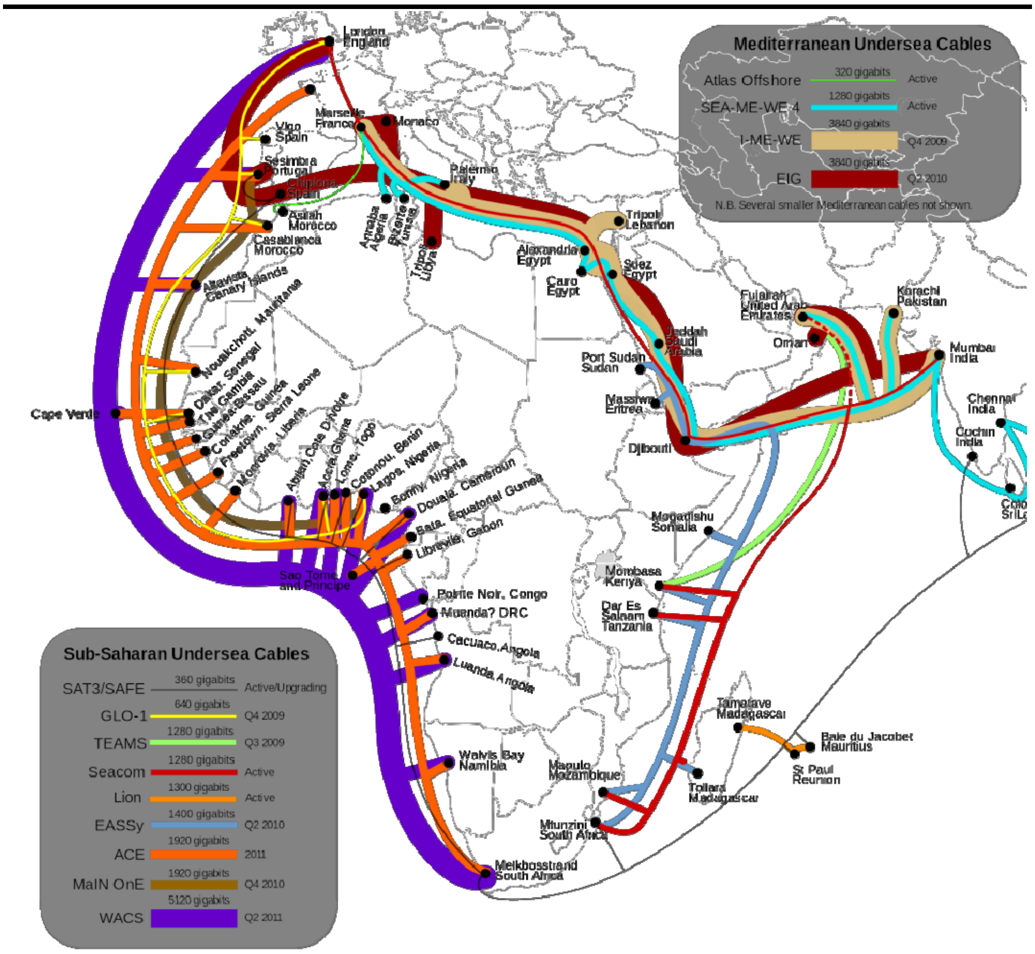
Subsea Cables

Figure 4.21 and *Figure 4.22* show the location of international undersea network cables in Africa and in the Gulf of Guinea respectively.

The ACE (African Coast to Europe) submarine cable runs along the west coast of Africa between France and South Africa, connecting 22 countries. It extends over 17,000 km, and has a potential capacity of 5.12 Tbps. The cable system is managed by a consortium of 19 telecommunications operators & administrations, and the first phase entered service in December 2012, connecting the Melão beach in São Tomé with the main continent. In April 2018, the ACE submarine cable was cut near Nouakchott, Mauritania, resulting in connectivity disruptions to several countries (*ESMF for ACE cable, 2010; Oracle 2018*).

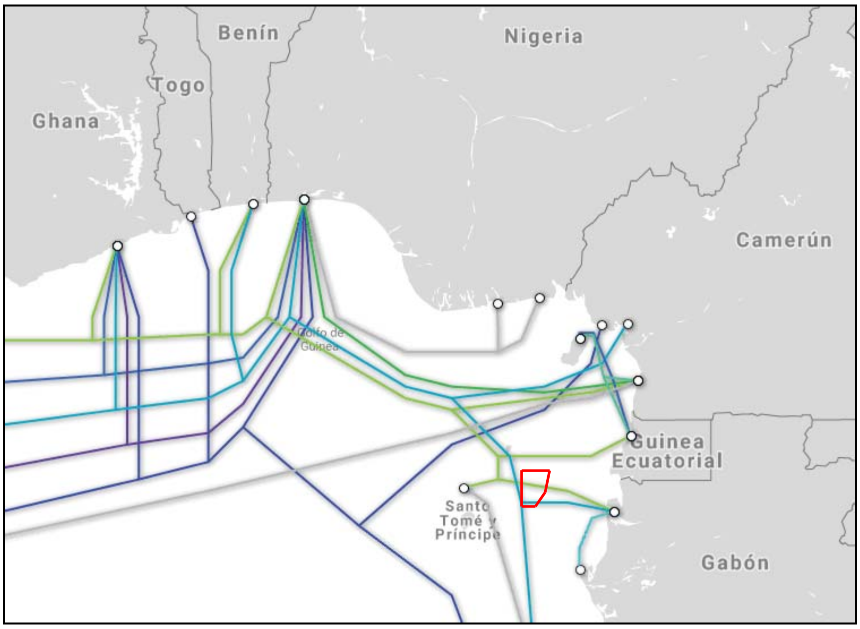
It is unlikely the proposed appraisal and exploratory drilling programme will interfere with the cable network in deep waters given that the final location of the appraisal and exploratory wells will avoid the areas occupied by these cables.

Figure 4.21 Location of international undersea network cables in Africa.



Source: ACE, 2012.

Figure 4.22 Key international subsea cables in the Gulf of Guinea: ACE (green), SAT-3/WASC (light blue), GLO1 (purple), WASC (dark blue) and MaIN OnE (blue).



Note: Red polygon represents approximately the location of the Block 6
Source: http://www.submarinecablemap.com/ (2018)

4.5.9 *Oil and Gas Activity*

The Gulf of Guinea is known for its hydrocarbon resources. Independent oil companies began seeking exploration licences in São Tomé in the 1990s (*HRW, 2010*). The close proximity of São Tomé and Príncipe's offshore waters to the proven hydrocarbon systems in the adjacent territorial waters of Gabon, Cameroon, Equatorial Guinea and Nigeria suggests the potential for hydrocarbons, which is further supported by seismic data and petroleum seeps seen on the island of São Tomé (*ERHC, 2014*).

Currently several firms are exploring the seabed along the 129,000 km^2 of São Tomé and Príncipe EEZ (Exclusive Economic Zone), which is divided into 19 blocks.

The first block auction in the São Tomé EEZ took place in 2010 and in the last eight years the São Tomé government has already signed eight production sharing contracts.

STP's efforts to lay the groundwork for eventual development of offshore resources were initially complicated by a dispute with Federal Republic of Nigeria over the two countries' maritime boundary (*HRW, 2010*). A treaty has been signed between the Nigeria and the Democratic Republic of São Tomé and Príncipe on the Joint Development Zone (JDZ) of petroleum and other resources (such as fisheries). The JDZ is an overlap between the two countries exclusive economic zones (EEZ) and was signed in February 2001, entering into force in January 2003 (*Biang, 2010*). Under this arrangement, São Tomé is to receive 40% of any oil and gas revenue earned from the JDZ and Nigeria 60% (*HRW, 2010*). Oil and gas activity in the JDZ began in 2005 but are currently in the exploratory phase. No commercially exploitable reserves have been found so far. The medium-term program of the government is designed to assume no future oil production as prospects of oil and gas production in the near future are now uncertain, following Total Oil Company's withdrawal from the JDZ in 2013, (*IMF, 2015*).

São Tomé and Príncipe independent EEZ license area is prospective but undrilled (*Figure 4.16*).

4.5.10 *Archaeological resources*

The archipelago has several buildings of religious and military nature, dating from the first phase of Portuguese occupation, that were erected in the two coastal towns and their surroundings, São Tomé and Santo António (Príncipe island), in the sixteenth to eighteenth centuries (*Castaño, 2012*). In addition, its former coffee and sugar plantations are designated as 'Roças' and its current cocoa plantations which one made the island one of the world's largest producers of cacao in the 20th century are both considered to be cultural heritage resources.

On 25 July 2006, the Government of STP officially ratified the UNESCO Convention concerning the Protection of the World Cultural and Natural Heritage, becoming the 183rd State Party to adopt the Convention. STP is a member state of the UNESCO Small Island Developing States (SIDS). However, no World Heritage sites have yet been inscribed on the last Tentative List submitted (*UNESCO, 2016*). In 2015, workshops in STP co-organized by UNESCO have taken place on community-based inventories for a national safeguarding strategy of cultural intangible heritage (*UNESCO, 2016*).

There is no publicly information available on potential submarine archaeological heritage.

4.5.11 *Health sector in São Tomé and Príncipe*

STP has a population of around 201.025 people (2017 est.), with 41.85% under the age of 14 years (male 42,781/female 41,354), and a life expectancy at birth estimated at 67 years for males and 71 years for females in 2016) (*CWF*; *WHO, 2018*).

The health system in STP is almost exclusively provided by public structures, arranged on two levels: central and districts. Serving nationwide, located in the capital city of São Tomé in Agua Grande district, the Hospital Aires de Menezes is focused on secondary health care. It is the only hospital that deals with general and specialized care, and associated hospitalization. The island of Príncipe has the Dr. Manuel Quaresma Dia da Graça Hospital, which provides internal medicine, pediatrics, maternity services and, occasionally, performs surgeries. At the districts level, with a focus on primary health care, there are 7 (including Agua Grande) district health care centers (this includes a health team comprising a general physician, nurses, a pharmacy technician, one epidemiology technician, and social and technical staff support), 28 health centers (base units in the health care structure, each directed by a nurse) and 17 community health units (spread across São Tomé and Príncipe).

With the cooperation of ONG´s and of countries like Portugal, China, and Brasil, amongst others, STP develops various health programs in three main domains: reproductive and sexual health; non-communicable diseases and communicable diseases. It also develops health programs for prisoners, military and paramilitary (*Ministério da Saúde STP,2017*).

STP also has a National Center for Endemic Diseases, which aims to organize and coordinate surveillance, prevention and control of endemic and high-risk epidemics and to combat infectious diseases and other diseases with a public health impact (*Ministério da Saúde STP,2017*). This centers is mainly focused on fighting HIV/AIDS, malaria and tuberculosis.

Brazilian technical cooperation in the health sector allowed the creation and installation of the first national reference laboratory for the fight against tuberculosis. This disease has an incidence rate of around 97 cases/100 thousand inhabitants per year and in 2017 registered new 144 cases, according to the National Program to Fight Tuberculosis.

5 *ENVIRONMENTAL, SOCIAL AND HEALTH IMPACT ASSESSMENT*

5.1 *INTRODUCTION*

This chapter provides an assessment of potential impacts from the planned exploratory and appraisal activities to be undertaken in Block 6 Offshore STP. The assessment considers how the Project has the potential to impact upon receptors in the physical, biological, and human environment within the Project area.

5.2 *METHODOLOGY*

The purpose of the impact assessment is to identify and evaluate the significance of potential impacts on identified physical, biological and social receptors and resources; to develop and describe mitigation measures that will be implemented to minimise potential adverse effects and enhance potential benefits; and to report the significance of the residual impacts that remain following mitigation.

The methodology adopted for this ESHIA is consistent with the methodology being used by GALP and ERM in the environmental and social assessment of potential effects of offshore activities in other areas around the world and in previous activities performed in Sao Tome and Principe.

The impact assessment is undertaken in the following key stages:

- Identification of potential environmental and social receptors;
- Identification of the activities of the proposed exploration and appraisal programme with the potential to contribute to or cause impacts to environmental and social receptors;
- Development of mitigation measures to be applied in order to reduce potential impacts; and
- Assessment of the likely magnitude of the residual impact (depending on its intensity, its duration, its scale, etc.), and the sensitivity of the receiving environment for impact in order to determine its importance.

5.2.1 *Developing Mitigation Measures*

One of the key objectives of an ESHIA is to identify and define environmentally acceptable, technically feasible and cost-effective mitigation measures. Mitigation measures are developed to reduce the significant negative impacts identified during the ESHIA process to a point where they have no adverse effects, and to create or enhance positive impacts such as environmental and social benefits. In this context the term "mitigation measures" includes operational controls as well as management actions.

Where a significant impact is identified, a hierarchy of options for mitigation is explored as follows:

Figure 5.1 Mitigation Hierarchy.

Avoidance at source Develop the project such that the characteristic causing an impact is eliminated at the design stage (elimination of waste materials flow, for example).
Reducing at source Modify the design of the project or of operational procedures in order to reduce the impact. For example, measures used to process effluent and waste materials fall into this category – this is also the case of soft-start procedures for VSP activities.
Reducing at receptor level If an impact cannot be reduced on site, measures can be implemented off site – this is the case for example previous engagement with fishermen to minimize potential interference with fishing activities.
Repairing or correcting Some impacts imply damage to a resource that is unavoidable. Repair mainly involves restoration and re-establishment type measures.
Compensation in kind When other mitigation methods are either not possible or are not entirely efficient, compensation can be adapted, to a certain extent, to losses

Source: ERM, 2018

5.2.2 *Impact Significance*

The purpose of the impact assessment is to identify and evaluate the significance of potential impacts on identified receptors and resources; to develop and describe mitigation measures that will be taken to avoid or minimise any potential adverse effects and enhance potential benefits; and to report the significance of the residual impacts (i.e. after implementation of mitigation measures). The proposed methodology is in line with the ANP-STP 2015 guidelines., that were deemed appropriate for the present Project, where potential impacts are evaluated in accordance with internationally accepted assessment criteria.

Impact Magnitude

The term 'magnitude' covers all the dimensions of the predicted impact including:

- The Type of impact: a description indicating the relationship of the impact to the Project (in terms of cause and effect) e.g. direct, indirect, induced;
- The Extent of the impact: the "reach" of the impact; local, regional, international (for instance if it is confined to a small area around the Project Footprint or it will extend over several kilometres…); and
- The Duration of the impact: the time period over which a resource / receptor may be affected (e.g. Temporary, Short-term, Long-term, Permanent).

The scale of the impact, the likelihood of occurrence and the frequency of the impact will also be used to assess the magnitude of the impact.

An assessment of the overall magnitude of an impact is provided by taking into account all the dimensions of the impact described above to determine whether an impact is of negligible, small, medium or large magnitude.

Receptor sensitivity

The significance of the impacts will depend on the sensitivity (terms such as vulnerability and importance may also be used with defining sensitivity) of resources and receptors to that impact (i.e. the extent to which the receptor will undergo a change – negative or positive – as a result of the Project (e.g. nature of the impact).

The quality or importance of a resource will be judged taking into account, for example, national or international designation, its importance to the local or wider community, its ecosystem function or its economic value. The assessment of the sensitivity of human receptors, for example a fishing community or wider social group, will consider their likely response to the change and their ability to adapt to and manage the effects of the impact.

Evaluation of significance

Most human activities cause some changes to the natural and social environment. The assessment of impacts aims at providing information to decision makers and other stakeholders on the importance of each impact, to facilitate decision-making on the Project, and to facilitate the identification and design of reduction or mitigation measures.

The evaluation of impacts presented in the ESHIA is based on the judgement of the ESHIA team, informed by legal standards, national and regional government policy, current industry good practice and the views of stakeholders. Where specific standards are either not available or provide insufficient information on their own to allow grading of significance, the evaluation of significance has taken into account the magnitude of the impact and the quality, importance or sensitivity of the affected resource or receptor.

Magnitude and receptor quality/importance/sensitivity are looked at in combination to evaluate whether an impact is, or is not, significant and if so its degree of significance (defined in terms of *Beneficial (if positive), Negligible, Minor, Moderate* or *Major).* Impacts classed as *negligible* include those that are slight or transitory, and those that are within the range of natural environmental and social change. This principle is illustrated schematically in Table 5.1 Overall Significance Criteria for Impacts in the ESHIA.*Table 5.1.*

Table 5.1 Overall Significance Criteria for Impacts in the ESHIA.

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

Source: ERM, 2018

The definitions for the four categories of impact significances are the following:

- ***Negligible impact*** is where a resource or receptor will not be affected in any way by a particular activity or the predicted effect is deemed to be "imperceptible";

- ***Minor impact*** is where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity;

- ***Moderate impact*** is an impact within accepted limits and standards. Moderate impacts may cover a broad range, from a threshold below which the impact is minor up to a level that might be just short of breaching the legal limit; and

- ***Major impact*** is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of ESHIA is to reach a position where the project does not have any major impacts, especially any which may endure into the long-term or extend over a large area.

5.2.3 Uncertainty

The prediction methods used are mainly qualitative evaluations based, to the extent possible with specific indicators such as timings, volumes of resources/effluents, etc. This approach allows a reasonable degree of accuracy in predicting changes to the existing baseline and making comparisons with relevant standards. Where assumptions have been made, the nature of any uncertainty that stems from the 'prediction' process is explained. If appropriate, a 'conservative' approach has been adopted.

5.3 *IMPACT IDENTIFICATION*

The first step in impact identification is to identify the various types of activities associated with the exploratory and appraisal campaign that could potentially affect physical, biological and social receptors. Those are identified in *Table 5.2* in the form of a matrix.

5.4 *IMPACT ASSESSMENT STRATEGY*

The overall strategy for identifying the magnitude of the impacts takes into consideration a "conservative" scenario in terms of Project activities, that is, considering that the maximum number of exploration wells are drilled in the block (three), and that at least one of these is subject to appraisal activities. This means that each well is considered to take a maximum of 70 days each (210 days for all the wells) and that appraisal activities at one or two wells would be expected to take a maximum of 60 days (30 extra days at each appraisal well), hence the 270 days overall duration that is considered throughout the assessment.

Table 5.2 Block 6 Exploratory and Appraisal Drilling Campaign Impacts Matrix.

#Sources of Potential impact				Physical Environment			Biological Environment							Social Environment				
				Air Quality and Climate Change	Sea water Quality	Seabed and sediments	Plankton	Benthic communities	Fishes	Sea turtles	Marine Mammals	Seabirds	Sensitive coastal areas	Navigation, traffic and sea users	Fisheries	Local economy, employment and livelihoods	Local Infrastructures and Services	Community and Workers Health and Safety
	Exploratory and Appraisal drilling Campaign Routine Events	1	Mobilization and demobilization of the drillship/SS	**A1**						**T1**	**M1**			**NT1**	**FS1**			
		2	Physical presence of the drillship/SS and support vessels							**T1**	**M1**	**SB1**		**NT1**	**FS1**			
		3	Operation of the support vessels and helicopters	**A1**								**SB1**		**NT1**		**E1**		
		4	Operation of the drilling unit	**A1**					**F1**	**T2**	**M2**			**NT1**	**FS1**	**E1**		
		5	Operation of the onshore facilities (supply base and helibase)										**SA1**			**E1**	**I1**	**C1**
		6	Vertical seismic profiling (VSP) operations					**B2**	**F1**	**T2**	**M2**			**NT1**	**FS2**			
		7	Well testing (flaring)	**A1**														
		8	Use of local goods and services													**E1**		
		9	Waste generation and management including the production of wastewater discharges		**W1**		**P1**		**F2**	**T3**	**M3**	**SB2**			**FS3**	**E1**	**I1**	**C1**
		10	Drill cuttings and muds discharges		**W2**	**B1**	**P1**	**B1**	**F2**	**T3**	**M3**							
		11	Freshwater treatment, storage and consumption													**E1**	**I1**	
	Accidental Events	12	Spills of mud, hydrocarbons from the well bore (e.g. blow-out) or fuel (diesel) spills from vessels or drillship/SS	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**	**AE1**

Source: ERM, 2018

A1	*Impacts on air quality and climate change due to the release of air pollutants*	*M3*	*Impacts on marine mammals due to the change of seawater quality due to effluents and waste to the sea*
W1	*Impacts on seawater quality due to the discharge of effluents and waste to the sea*	*SB1*	*Impacts on seabirds due to the physical presence of the drillship/SS and to the operation of the support vessels*
W2	*Impacts on seawater quality due to the discharge of drill cuttings and muds*	*SB2*	*Impacts on seabirds due to the waste generation and management*
B1	*Impacts on seabed and benthic communities due to the discharge of drill cuttings and muds*	*SA1*	*Impacts on sensitive coastal areas due to the operation of the onshore facilities*
B2	*Impacts on benthic communities derived from the generation of noise emissions during VSP activities*	*NT1*	*Impacts on Navigation and Traffic / Sea users*
P1	*Impacts on plankton due to the change of seawater quality due to effluents and waste to the sea*	*FS1*	*Impacts on Fisheries due to the presence and operation of the drillship/SS and support vessels*
F1	*Impacts on fishes due to the generation of noise emissions during VSP activities*	*FS2*	*Impacts on Fisheries due to the generation of noise emissions during VSP activities*
F2	*Impacts on fishes due to the change of seawater quality due to effluents and waste to the sea*	*FS3*	*Impacts on Fisheries due to the change of seawater quality as a result of effluents discharge to the sea*
T1	*Impacts on sea turtles due to the mobilization, demobilization and presence of the drillship/SS*	*E1*	*Impacts on Local economy, employment and livelihoods*
T2	*Impacts on sea turtles due to the generation of noise emissions during VSP activities*	*I1*	*Impacts on Local Infrastructures and Services*
T3	*Impacts on sea turtles due to the change of seawater quality due to effluents and waste to the sea*	*C1*	*Impacts on Community Health and Safety*
M1	*Impacts on marine mammals due to the mobilization, demobilization and presence of the drillship/SS*	*AE*	*Impacts due to potential accidental events (hydrocarbon spills)*
M2	*Impacts on marine mammals due to the generation of noise emissions during seismic (VSP) activities*		

5.5 *IMPACTS TO THE PHYSICAL ENVIRONMENT*

5.5.1 *Air Quality and Climate Change*

A1: Impacts on air quality and climate change due to the release of air pollutants

A1.1: Impacts on air quality due to the release of air pollutants

Atmospheric emissions will result from the drillship/SS/SS and support vessel engines (including the drilling unit's dynamic positioning thrusters), potential well testing activities, power generation exhausts and helicopter operations. Other emissions to air from point and non-point sources may occur throughout the Project. However, these would be very small in a conservative scenario, and their occurrence will be mitigated via proper maintenance protocols that the Operator will put in place.

The release of gaseous pollutants to the atmosphere has the potential to affect local air quality. However, the source of these emissions (concentrated on drillship/SS location) will be at more than 60 km away from the nearest sensitive receptors (e.g. coastal communities/cities). Emissions will also be released by supply vessels and helicopters along the route between the Project area and supply base/airport, and as such will be of a diffuse nature, which will assist dispersion of pollutants and lessen potential impacts. The dispersion rate of this type of emissions is expected to be high, due to the project's offshore location and the fact that many of the sources are mobile sources.

Effects on air quality will be localized and temporary at the vessels location. In addition, background levels of pollutant concentrations are expected to be reached within tens of meters from the sources, and in any case pollutants are not expected to reach onshore receptors.

In summary, impacts to air quality from Project-related emissions are expected to be unlikely, given the localized nature of emissions, the local aerial dispersion and the absence of human receptors in the vicinity of the Project area.

Project embedded measures to limit atmospheric emissions during the Project operations will include:

- Advanced planning to ensure efficient operations, including the planning of support vessels trips to shore.
- All generators and equipment to be maintained and operated under manufacturer´s standards to ensure working as efficiently as possible.
- Regular monitoring of fuel consumption and engine efficiency, considering potential reductions of greenhouse gas generation.

- Well test duration and volume of produced hydrocarbons will be reduced as much as practical to meet the objectives of the test.
- High efficiency (i.e., low NOx) burners will be used.
- The flare will be visually monitored to ensure efficient combustion as well as for unburned hydrocarbons in case of malfunction of drop out capture.
- A system to record flared hydrocarbons will be implemented and all emissions registered as part of the environmental management program for the project or operation.
- The number of helicopter flights to be limited to those strictly necessary, without compromising operations or safety.
- Subject to availability at onshore base port, the use of low-sulphur fuel where possible will be favoured (compliance with Tier II of revised MARPOL 73/78 Annex VI which sets limits on sulphur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances).

Taking into consideration the implementation of Project mitigation measures and embedded controls inherent in the project design, together with the localized nature of emissions, the sensitivity of the offshore environment and the expected dispersion rate, the resulting residual impact on air quality is assessed as **Negligible.**

A.1.2: Impacts on climate change due to the release of air pollutants

São Tomé e Príncipe prepared in 2006 its National Adaptation Program of Actions (NAPA) and Nationally Determined Contributions (NDCs), and has recently developed, with the support of the World Bank, a comprehensive multisector investment plan to identify and prioritize its climate actions. The Ministry of Finance, Commerce and Blue Economy, and the Ministry of Infrastructure, Natural Resources and Environment are currently leading important climate initiatives. In addition, to promote cross cutting strategies, the country created the National Committee on Climate Change (CNMC) and the National Council for Prevention and Disasters (CONPREC).

According to the last national GHG inventory developed in 2005, removals of GHGs were higher than emissions. Total emissions were 99.2 ktCO2e (thousand metric tons of carbon dioxide equivalent) whilst GHG removals were 629.3 ktCO2e, resulting in net removals of 530.2 ktCO2e. Energy accounted for 71.41 percent of total emissions, followed by agriculture (14.71 percent), industrial processes (6.73 percent), and waste (6.68 percent).

Scope of the Assessment and Methodology

An estimate of the emissions from the engine and generator operations during the mobilization and demobilization and for drilling operations within Block 6 is presented in *Table 5.4.*

An estimate of the total fuel use has been made based on the following assumptions:

- One drillship/SS vessel has been considered.
- Average daily fuel use for the drillship/SS vessel while is estimated as 18 tonnes/day (aprox. 50 m^3/day) during transit and drilling activities (at a fixed location).
- Mobilization and demobilization between the project area and the onshore supply base is unlikely to exceed 5 days.
- The duration of the exploratory and appraisal drilling program is expected to last, approximately, 270 days depending on final configuration. This estimate considers the drilling of three exploration wells (70 days maximum each) and two of these being tested (ie appraisal well) (30 days each maximum).
- Three support vessels have been considered for the assessment and the average daily fuel consumption is estimated to be 5 tonnes per day (approx. 15 m^3/day) for each supply vessel.
- For emissions calculations relevant to well testing of a single appraisal well, GALP assumes up to 20,000 BOPD for 72 hours (3 days) plus 4,000,000 scf/hr (96 MMSCF/D) methane gas for 72 hours (3 days). These rates are based on the maximum capacity for typical temporary flaring / well testing equipment.

The estimated fuel consumption is shown in *Table 5.3.*

Table 5.3 ***Estimated fuel consumption of Project vessels for 270 days.***

Vessel	Activity	Average fuel consumption (tonnes/day/vessel)	Total Fuel consumption (tonnes)
1 Drillship / SS	Mobilization to and from Project area and supply base port and drilling activities	18	4,860
3 Supply vessel	Supply activities between base port and Project area	5	4,050
Total			**8,910**

Source: GALP and ERM, 2018

Estimation of the predicted associated emissions has been calculated using emission factors based on methodology proposed by the International Association of Oil and Gas Producers (IOGP) (former E&P Forum/ *UNEP, 1997*).

Table 5.4 Total air emission estimates.

Vessels			
Emission Gas	**Emissions Factors (Sea transport)**	**Gas Emitted (tonnes)***	**Global Warming Potential (t CO_2e)**
CO_2	3.186	28,387	28,387
CO	0.008	71	n.a
NO_x	0.059	526	n.a.
SO_2	2xS(1)	72	n.a.
CH_4	0.00027	2.4	60
VOCs	0.024	214	n.a
Flaring (emission factors from IFC Carbon Emissions Estimator Tool CEET)			
CO_2	3,101	40,000	124,445
CH_4	0.00027	226,017	472
		TOTAL	**153,364**

*: tonnes emitted from fuel consumption during a 270 day drilling operations (with 72 h of flaring).

Note: S(1) Assumes a sulphur content for marine diesel of 0.4% by weight.

Source: Tonnes emission / tonne fuel. OGP (Former E&P Forum, 1994). Methods for Estimating Emissions from E&P Operations. Report 2.59/197. Table 4.11.

The total GHG emissions related to the project are estimated at about 153,364 tCO_{2eq} for drilling activities for the entire Project duration (maximum duration assumed 270 days for 3 wells, with well testing potentially conducted in two of the wells).

Taking into account that the national emissions of STP were 196.63 $GgCO_2eq$[5] in 2006 (based on STP second national communication), the Project's emissions represent 0.0002% of the Country's total emissions. As so, the resulting impact on climate change is assessed as **Negligible**.

5.5.2 *Noise*

This section analyses all underwater noise related impacts from project activities. This includes several impacts as indicated in *Table 5.1*, as those produced by the mobilization and operation of the project vessels and the drilling itself and those derived from the performance of the vertical seismic profile.

Table 5.5 shows noise sources and sound levels likely to be associated with Project activities. This information forms the basis of the assessment of noise impacts on receptors including fish, marine mammals and turtles.

[5] These national emissions did not take into account forestry degradation emissions (Climate Action Tracker). .

Table 5.5 Typical Underwater Noise Levels and Frequencies

Source	Noise Level (dB re 1µPa)	Noise Frequency (Hz)
	Ambient noise	
Calm Seas	60	
Moderate waves/surf	102	100-700
Biological origin (fin whales)	160-186	20
	Drilling-related noise	
Drillship/SS	145-190 at 1 m from source	10–10,000
Supply vessels	170-180 at 1 m	10-100
Vertical Seismic Profile (VSP)	185-195 at 1 m	0-50

Sound pressure is expressed on a decibel scale (dB) and referenced to 1 micro Pascal at 1 m from the source (dB re 1 µPa @ 1m)
Sound frequency is expressed in Hertz. Only the approximate range of peak frequencies is presented, frequencies outside this range are likely to exist but be lower in sound level.
Source: CEAA, 2004; OSPAR, 2009

The following paragraphs will analyse the potential effects of the expected noise levels on the different receptors.

F1: Impacts on fishes due to the generation of noise emissions

The noise levels produced by drilling operations have the potential to affect the behaviour of some species of fish that are sensitive to sound, namely 'hearing specialists'.

Behavioural effects in fish have been observed between 182-207 dB re 1 µPa (rms) and between 160 - 186 db re 1 µPa (peak) (Pearson et al. 1992, McCauley et al. 2000, Wardle et al. 2001).

Such sounds levels are only expected very close to Project activities and especially during the development of the VSP (Vertical seismic profiling), estimated to last between 24 and 48 hours. In any case it is expected that noise levels will decrease to levels unlikely to have effects on fish within 1 to 3 km from the source.

Among the commercially important species in the area, the bigeye tuna (*Thunnus obesus*); skipjack tuna (*Katsuwonus pelamis)* and yellowfin tuna (*Thunnus albacares*) are known to use the Gulf of Guinea as spawning grounds throughout the year, especially for the bigeye and skipjack which have multiple spawns, whilst yellowfin usually spawns from January to April, and are therefore likely to be present during the exploration and appraisal activities. Potential impacts on these species and other large pelagic species can include aggressive behaviour and disrupted schooling structure when exposed to boat noise as recorded by *Sarà et al*. 2007 for the bluefin tuna. However, yellowfin tuna have been observed to be attracted to vessel presence and in a few cases have even remained associated with the vessel as the vessel accelerated rapidly away (*Dagorn et al.* 2001) showing no effect from its noise.

With regards to potential auditory trauma, according to Popper (2014), the threshold for recoverable injury is more than 207 dB Peak re 1 μPa2 s, 0-p or 203-20/ SEL cum, which implies that a fish to be suffer auditory trauma should be exposed to such noise level for hundreds of hours, and therefore any effect is considered unlikely, especially considering the duration of the VSP activities.

In addition, the continuous nature of noise produced by vessel and drillship/SS engines also reduces the chances of startle reactions in fish, which could occur during the VSP. The adoption of the soft start procedures as recommended by the JNCC (2017) on VSP operations may also contribute to avoid the presence of fish in the vicinity of the source during that period by giving them time to swim away or avoid proximity to the noise source as the levels increase progressively.

Impacts to fish are therefore expected to be limited to the duration of activities and localized in the vicinity of the vessels and the well. Considering also the implementation of the JNCC recommendations and good maintenance procedures on vessel engines, the impact of noise on fish is assessed as **Negligible**.

T2: Impacts on Sea Turtles derived of the generation of noise emissions

As indicated in *Table 5.5* main noise source from Project activities are expected to be the VSP activities. During these operations an airgun cluster will be used. The airguns are similar to the ones used during standard seismic surveys but in this case the operation takes place exclusively at the well site and is limited to a typical duration of 8-12h to complete.

The noise source production level pressure of VSP is expected to be 2,000 psi with a frequency range of 0-250 Hz, and the amplitude spectrum peaks between 184.5 and 196.5 decibels (dB) re 1μPa / Hz at 4.5 m within a frequency range of 0-50 Hz.

Little is known about marine turtle hearing ability or their dependency on sound (passive or active) for survival cues (*Croll et al. 1999; Bartol and Ketten 2006*), but studies show that turtles can detect low frequency sounds (*Ridgway et al., 1969; Bartol et al., 199*9) and mainly between 100 Hz and 800 Hz depending on the type and age of the turtle, based on a precautionary extension of the most sensitive range investigated by *Moein Bartol and Ketten* (2006). The studies conducted by *Popper* (2014), stablished the noise level criteria for permanent threshold shift or PTS for sea turtles in 207 dB Peak. Any noise below this level would not result in auditory damage on sea turtles.

It is though likely that marine turtles would be able to hear seismic survey noise and possibly experience some disturbance but not auditory trauma.

Noise can result only on modifications of behavioural patterns such as changes of route patterns and feeding habits of individuals moving near the drillship/SS area.

Given that noise from the Project will only approach the levels likely to result in impacts on marine turtles within a few metres of the vessel or drilling activity and that main frequencies of VSP are outside the hearing range of turtles, it is unlikely that turtles will be seriously affected by underwater noise from the Project, apart from avoidance behaviour, especially during the limited hours where the vertical seismic profile is being carried out.

Mitigation measures to be implemented by the Project to reduce potential impacts on sea turtles will include conducting the VSP using a soft start or ramp up procedure and have onboard a Marine Fauna Observer during VSP activities, as recommended by the Joint Nature Conservation Committee (JNCC, 2017) guidelines for minimizing the risk of injury and disturbance.

Taking these measures into account, the impact of underwater noise to marine turtles has been assessed as **Negligible.**

M2: Impacts on Marine Mammals derived of the generation of noise emissions

Twenty eight species of marine mammals are known to be potentially present in STP waters. The cetacean species more likely to be seen in STP offshore waters include baleen whales such as the fin whale (*Balaenoptera physalus*), Bryde's whale (*Balaenoptera brydei*), humpback whale (*Megaptera novaeangliae;* whom has a migration route in the Gulf of Guinea with whales moving along the coast from summer feeding grounds in the northern and southern hemispheres to breeding sites near the equator); and toothed whales such as sperm whale (*Physeter macrocephalus*), and short-finned pilot whale (*Globicephala macrorhynchus*); Pantropical spotted dolphin (*Stenella attenuata*) and Clymene dolphin (*Stenella clymene*).

Marine mammals rely on sound for echolocation, detection of predators and prey, and communication within or between social groups. As a result the existence of anthropogenic noise sources could lead to several effects on these species, including:

- Disruption of behaviour (e.g., feeding, breeding, resting, migrating);
- Masking of important sounds (e.g., communication signals);
- Temporary or permanent hearing loss;
- Physiological stress or physical injury; and,
- Ecosystem changes that result in reduction of prey availability.

Baleen whales (whales that do not possess teeth), given they communicate at low frequency sounds, are more sensitive to noise than other cetacean species. According to several studies these species show avoidance behaviors from non pulse sounds at levels between 120 and 150 dB (Southall et al 2007), only some species in some circumstances begin to be affected at levels above 120 dB.

Toothed whales, also known as mid-frequency cetaceans, despite not being so sensitive to noise, can also be affected. Haley et al. (2010) stablished a criterion of 160 dB re 1 µPa (rms) above which behavioural effects like avoidance of an area could be observed on these species.

The noise generated by the support vessels between 170 and 180 dB, and the tone of the rotation of the blades is around 10 – 11 Hz, which is a low to moderate frequency and similar to the noise generated by other small to medium sized vessels traveling through Project area. Drillship/SS noise is expected to be also at low frequencies but at slightly lower sound levels. All these noises will be continuous along the Project duration and will take place mainly at the well location. Drillship/SS Dynamic Positioning thrusters produce higher intensity noise (up to 190 dB) with similar frequencies than normal transport engine blades. Considering the above, noise levels over Project related activities like support vessels operation, drilling and the drillship/SS dynamic positioning are likely to cause disturbance to marine mammals leading to potential behavioural effects, particularly to low-frequency cetaceans, with somewhat less pronounced impact on mid-frequency cetaceans. The noise generated imply that noise levels above 120 dB (which is the most conservative of the behavioural thresholds), will be limited to an extent of less than 10 km from the source. The noise levels capable of producing effects on toothed whales or mid-frequency cetaceans will be limited to a range of less than 300 m from the source.

The VSP will also generate low frequency underwater noise audible to marine biodiversity and especially by low frequency cetaceans, up to 185 dB rms. Research has shown that seismic airgun noise can be detectable up to 15 km from the source (Madsen et al., 2006), while the studies summarized by Southall *et al* (2007) found that whales show extremely variable avoidance reactions at ranges between 120 and 180 dB, and potentially at distances of less than 10 km from this seismic source. Species showed different responses when migrating, feeding and reproducing.

Based on noise levels expected, noise propagation and the behaviour impacts threshold of 120 dB, any individual marine mammal is considered potentially to display behavioural avoidance reactions to the VSP within 10 km from the source. However VSP will only take place during a very short period of time (8 to 12h).

Noise generated by routine project activities is not expected to cause auditory trauma as the studies carried out by Southall et al. (2007) indicate that in order to cause instantaneous injury, known as permanent threshold shift (PTS), to marine mammals resulting in a permanent loss in hearing ability, the sound level must exceed a peak 230 dB re 1 micro Pascal (µPa).

Considering that the prospective technical specifications for the airguns to be used for the VSP are expected to range between 185-195 dB re 1 µPa at 1 m distance from the source, this is below the injury criteria of 230 dB re 1 µPa specified by Southall *et al* (2007). As such, the potential for instantaneous auditory injury (PTS) to marine mammals is not considered likely.

Considering the short duration of the VSP (8-12 hours) and the relatively local scale of the impact (less than 10 km for the most conservative of the behavioural responses) compared within the overall range of the species concerned and their mobility, the impact magnitude of noise on marine mammals is considered to be small.

In addition and to reduce the likelihood and extent of any potential impacts the Project will implement soft start or ramp up procedures and have an onboard a Marine Fauna Observer, as recommended by the Joint Nature Conservation Committee (JNCC, 2017) guidelines for minimizing the risk of injury and disturbance to marine mammals from seismic surveys when conducting the VSP. Similarly, the Project will include maintenance procedures to ensure proper functioning of the engines that allow maintaining noise levels within expected noise levels.

As some of the marine mammals potentially present in the area are included in the IUCN Red list, their conservation being one of the objectives of the National Biodiversity Plan as endangered or vulnerable, and considering the importance of sounds in the ecology of these species, the impact of underwater noise on marine mammals is evaluated to be **Minor**.

B2: Impacts on benthic communities derived of the generation of noise emissions

Most marine benthic invertebrates have poorly developed mechano-sensory systems and would not be expected to be affected by the sound generated during the vertical seismic profile activities.

The research on noise effects on benthic communities is limited and focused on the noise from seismic survey activities as these are the only ones considered to have noise levels capable of affecting these communities at great depths. These studies have focused on species of commercial importance. Different experiments have been unable to show significant effects on prawn catch rates before, during and after seismic surveys. Data on the impacts of seismic sound on macro invertebrates (scallop, sea urchins, mussels, periwinkles, shrimp, gastropods, cephalopods) show no significant increase in mortality below sound levels of 220 dB re 1µPa@1m. Some show no mortality at 230 dB re 1µPa@1m (*Royal Society of Canada, 2004*). For bottom-dwelling species, these data suggest no significant impact for seismic surveys, provided the water depth is greater than about 20 m.

Considering the duration of proposed seismic vertical profile (8-12 hours), the depth of the well location and the available information on effects of noise on benthic communities, the potential impact of noise from project related activities is assessed as **Negligible**.

5.5.3 *Mud and Drill Cuttings Discharge*

During drilling operations, one of the activities with most potential to lead to impacts is related to the management and discharge of the cuttings and muds. This discharge can have effects not only on the physical environment (seabed and water quality) but also on the biological environment through direct impacts on the benthic communities and secondary impacts on other biological receptors through changes in water quality.

This section presents the assessment of the impacts to the seabed and communities living on the seabed (i.e., benthos) that given their direct interrelation will be examined together.

As part of the assessment of this impact, a modelling study has been conducted to examine the behaviour of drill cuttings and muds discharge.

This modelling was performed to determine three key endpoints:

- The amount of suspended sediment concentrations added to water column background concentrations;
- The seabed accumulation (thickness) of the adhered muds and drill cuttings over an area of seafloor (the footprint) for assessment of impacts to benthic organisms; and
- The amount of the organic phase (NADFs) of the muds settled upon the seafloor.

The methodology and the results of the modelling are summarised below and are used to assess impacts to benthic fauna.

Drill cuttings and muds discharge modelling results

B1: Impacts on seabed and benthic communities due to the discharge of cuttings and muds

As the drillship/SS will be dynamically positioned, with no anchoring on the seabed and the installation of well infrastructure will have a minimal footprint on the seabed derived from the installation of the well head, the impacts on the seabed and benthic communities are derived from the discharge of cuttings and muds.

The generation of rock cuttings, plus residual mud adhering to them constitutes the major waste product from drilling operations.

Cuttings are small fragments of inorganic material generated during drilling and are representative of the geological strata through which the well is being bored. The muds are used for several purposes, from lubrication and cooling to control downhole pressure.

As described in the Project Description Chapter (see *Chapter3*), the cuttings and WBM used in the drilling of the upper well sections before the installation of the riser will be directly discharged to the seabed. The rest of the well sections will be drilled using NADF that will be recovered together with the cuttings. In this case cuttings will be treated and NADF separated for further use. It is expected less than 7% in weight of cuttings will have NADF adhered to it that will not be removed during the treatment. These wastes will be discharged directly from the drillship/SS into the sea. The discharge will take place at a sufficient depth (10 m) to avoid impact to sea surface waters through a sub-sea caisson.

A specific cuttings modelling has been developed, based on two locations and for two different well designs. The main findings are presented in a specific Memo presented as an addendum to the present ESHIA.

A short overview of the results are presented, and are assumed applicable to any of the 3 wells potentially drilled, the mud programme proposed by GALP foresees the direct discharge of:

- Approximately 954 m^3 of Pump and Dump (PAD) WBM;
- Between 948 to 1,034 m^3 of cuttings will be discharged (amount varies according to different well designs and to a limited extent on specific location);
- Between 371 to 558 m^3 of cuttings discharged directly onto the seabed during the riserless drilling phase;
- Between 476 to 577 m^3 of cutting discharged from the NADF drilling (with riser);
- Between 50 to 61 m^3 of adhered NADF corresponding to a maximum of 6.9% by weight of muds adhered to cuttings produced during the sections with the riser after treatment at the drillship/SS.

In addition to mud and cutting discharges, a small proportion of cement used (<5 m^3) will reach the environment and any leaching into the seawater will be such a slow process that non-sediment dwelling organisms will not be at significant risk to exposure to concentrations above respective thresholds. In reality, during drilling operations the zone within which the cement discharges will occur will not be attractive to benthic organisms as it will be at the centre of the cuttings pile resulting from top-hole drilling.

The potential environmental effects of the drill cuttings and muds discharged to the seabed can be divided in:

- Chemical effects: water and sediment contamination due solely to the drilling chemicals as the cuttings are small fragments of inorganic material generated during drilling; and
- Physical effects: increased turbidity of the water column and physical smothering of seabed communities.

Chemical effects

The constituents of the WBM discharges primarily consist of inert solids, water-soluble salts and organic constituents. The water-soluble constituents are likely to rapidly dilute with the solids settling out.

The final list of constituents and additives of the WBM to be used in the Project are not available at the moment of writing this report. However, as indicated in the Project Description, the additives most commonly used include Bentonite, Guar Gum and Barite. All of them are included in the OSPAR´s PLONOR list which contains substances whose use and discharge offshore from assessment of their intrinsic properties, the OSPAR Commission considers that they Pose Little Or No Risk to the environment. Other commonly used components include Caustic Soda and Xantam Gums, which are categorized as the least hazardous components by the OSPAR HOCNS (Category E, which considers toxicity for the element at concentrations above 1,000 mg/l).

Considering the essentially non-toxic composition of the WBM there is no predicted chemical impacts associated with this discharge. WBM discharge impacts are primarily physical.

The precise composition of the NADF to be used is not known at the moment, but as the ones to be used are virtually free of Polycyclic Aromatic Hydrocarbons (PAHs) the toxicity is still considered relatively low (EPA, 1996). They will always be Category III of OSPAR/OGP non aqueous fluids, i,e with less than 1/1000 of PAHs and less than 0.5 /100 of total aromatics and with a composition including only the following type of chemicals: PLONOR or Non-CHARMABLE (C, D or E) as per the OSPAR Offshore Chemical Notification Scheme (OCNS). The commercial NADF system that is expected to be used on this case, considering deepwater drilling offshore experience in West Africa is the ESCAID 110 enhanced mineral oil based fluid; which is a Group III non-aqueous fluid (e.g. low to negligible aromatic content).

In line with the GALP's principles main mitigation measure will be to treat the cuttings to recover and recycle the NADF for further reuse and avoid its discharge to the sea. Only a small proportion of it that remains adhered to the cuttings and limited to a maximum of 6.9% in weight will be discharged.

Beyond the specific quantities and composition of muds, GALP, as established in the corporate HSE Standards and best practices in the industry, aims to minimize the number and quantities of additives in all muds to the extent possible. Complementarily, the additives selection will take into account the environmental performance of different additives available at the moment of defining the detailed drilling program, choosing those considered as the most respectful with the environment (i.e. PLONOR list additives will be prioritized).

Physical effects

With respect to physical effect drill cuttings will potentially led to the formation of piles on the seabed. This will result in physical damage and habitat loss over a defined and limited area of the seabed. One of the potential impacts is burial by drilling muds and cuttings that may cause physical impacts upon benthic communities. The specific thickness of burial which may cause an impact can vary depending on the benthic species and the amount of oxygen depletion which may occur, causing anoxic conditions beneath the depositional layer.

The severity of burial impacts depends on the sensitivity of the benthic organism, the thickness of deposition, the amount of oxygen depleting material, and the duration of the burial. Thickness thresholds vary by species and sediment impermeability. A suggested threshold thickness value of 50 mm above a substratum for a month deposition impacting benthic communities is recommended (by *Ellis and Heim* (1985) and *MarLIN* (2011)). Smaller threshold values as low as 1 mm have been reported (e.g., Smit et al., 2006), however they are associated with instantaneous burials on benthic species, not gradual smothering effects.

In order to predict the fate of discharged cuttings in the marine environment, cuttings dispersion modelling has been undertaken as presented in the previous section. The modelling results provide the spatial extent of impacts, allowing their magnitude to be determined, which, together with the conservation value of seabed habitat and species, allows significance of the residual impact to be evaluated.

The discharge of cuttings and water based muds may affect seabed habitats only through physical smothering, since this type of mud is considered non-toxic. The constituents of the WBM discharges primarily consist of inert solids, water-soluble salts and organic constituents.

The expected volume of cuttings discharged directly onto the seabed during the riserless drilling phase is 371-558 m^3 per well. Given that the discharges from these upper sections include only WBM, considered non-toxic, the potential affection to seabed and benthic communities will be limited by the following factors:

- The primary drilling fluids will be water and seawater and the primary chemical additives will be Barite, a dense sulphate mineral and Bentonite, an inert natural clay product. Other chemicals used will be of inherent low toxicity to marine life and included as a preference in the PLONOR list. Reactivity and dissolution of chemicals into seawater is therefore expected to be limited;
- Specific seabed habitats in the drilling site and immediate area of influence are not known. Based on the existing information (see *Chapter 4* for details) and well depth, habitats and species are expected

to have a widespread distribution with limited biodiversity as is general within bathyal benthic habitats; and

- Re-colonisation of any benthic fauna affected by cuttings is expected to be rapid, as has been demonstrated at other drilling locations around the globe (*e.g.* the Gulf of Mexico).

The remaining well sections are planned to be drilled using NADF. During this phase of the drilling the expected volume of cutting discharged is 476-577 m^3, per well together with 50-61 m^3 per well of residual NADFs coating the cuttings after treatment at the drillship/SS.

These discharges will traverse the water column and deposit on the seabed. The speed of deposition will depend mainly on the particle size, with the finer fraction remaining longer in the water column and dispersing over a wider area.

The results of the modelling performed on cuttings for the two well designs (and under minimum and maximum monthly-averaged and depth-averaged currents at the well location) indicated that at each well site depositional thickness areas of more than 50 mm may range between 1,600 to 2,850 m^2 and are confined within a 50-75 m radius around the well. Maximum depositional thickness is expected to range between 85-200 mm and located at close proximity to the well. This depositional mound is primarily due to the cuttings and muds discharged during the jetting and drilling of the two top sections.

The sediment mounds around the well are the areas of most significant deposition, and smothering of seabed species will cause potential mortality in benthic species primarily through the clogging of respiratory and feeding apparatus.

The deposited drill cuttings will also alter the particle size distribution in the sediment substrate, *i.e.* it will physically alter the habitat and with a possible influence on how benthos re-colonises the affected area.

The re-colonization of the areas affected by the deposition of the cuttings with NADF are considered to be more difficult due to the nature of the muds (organic compounds), as their slow degradation may generate anaerobic conditions and therefore influence the re-colonization process. These areas correspond to those located further from the well given the dispersion process related to the discharge below sea surface.

Studies conducted on benthic recolonization in areas where NADF has been used have shown that changes in the benthic ecology may happen. These changes may include an increase in the number of individuals and the biomass present through a shift in the communities with lower diversity and the prevalence of individuals of opportunistic species such as some polychaetes (*Trannum et al. 2011; Tait et al. 2016*).

Current existing data on benthos habitats in the wider study area indicate that there's potential for the presence of sensitive benthic communities (e.g. chemosynthetic biological communities associated with seeps/pockmark, cold water coral colonies -*Lophelia pertusa*- and crinoid fields).

The model results on total suspended solids (TSS) near the seabed as a result of the discharges may be initially high at the point of release, although it will occur in water depths below the photic zone in areas where light inhibition is not a concern and the population of biota is relatively low.

It must be noted that benthic communities tolerate certain levels of TSS as revealed by the fact they live within the nepheloid layer, a layer of water just above the sea bottom where the concentration of suspended solids is significantly higher than in above waters, usually related to the existence of fine particles and some current levels. Benthic communities are therefore expected to tolerate elevated temporary turbidity levels and particle deposition. All the above considerations combined with the low cuttings volumes and the short-term duration of the drilling activity constitute a low magnitude and localised impact.

In any case, provided the absence of site specific information, GALP will perform a seabed survey using ROV and other techniques to establish the presence/distribution of habitats at the drilling sites and areas of potential influence. Should localized sensitive habitats be found, the drilling site would be evaluated and to the extent feasible shifted to minimize impacts.

Other mitigation measures to be implemented to minimize the risk of impacts related to the discharge of cuttings and muds include:

- The volume of discharged cuttings and drilling muds will be monitored on a regular basis.
- Lowest feasible toxicity NADF will be selected by GALP and used during drilling activities for all drilling sections.
- GALP will aim to minimize the number and quantities of additives and will prioritize the selection of additives with a better environmental behaviour (i.e. elements included in the PLONOR list).
- Visual inspections of the general pattern of the seabed sediments distribution around the drilling point will be conducted before and after the drilling operations using an ROV. This seabed imagery will be taken as part of GALP's monitoring system and thus the images will be taken in the near vicinity of the wells. The seabed imagery conducted will be documented and shared with STP authorities.
- Drill cuttings from the sections where NADF is used will be treated onboard to ensure a maximum content of 6.9% in weight of muds within the cuttings to be discharged.
- There shall be no discharge to sea of free oil coming from drilling fluids and cuttings (as determined by the static sheen test).

- The NADF used will be recycled and reused. Once the drilling is finished the spare muds will be stored and sent ashore for return to supplier or appropriate disposal at authorized facilities.
- The composition of the NADF to be used will be virtually free of Polycyclic Aromatic Hydrocarbons (PAHs) and therefore considered of relatively low (EPA, 1996). They will always be Category III of OSPAR/OGP non aqueous fluids, i.e. with less than 1/1000 of PAHs and less than 0.5 /100 of total aromatics and with a composition including only the following type of chemicals: PLONOR or Non-CHARMABLE (C, D or E) as per the OSPAR Offshore Chemical Notification Scheme (OCNS).
- The discharge of the cuttings from the drillship/SS will take place at a sufficient depth to avoid impact to sea surface waters through a submerged caisson (10m minimum).

In summary the impacts on benthic communities from the discharge of cuttings and associated muds can be considered as **Negligible**. This must be considered as a preliminary assessment prior to confirmation of absence of sensitive benthic communities in the surroundings of the well and areas affected by increased TSS and cuttings and muds deposition. In case of presence of such communities, if drilling site cannot be changed to a nearby location, this impact would need to be re-assessed.

5.5.4 *Seawater quality*

W1: Impacts on seawater quality due to the discharge of effluents and waste to the sea

Project activities which may impact water quality include:

- Discharge of black water (sewage), grey water (showers, sink, etc.) and food waste from project vessels;
- Deck drainage and bilge water discharge;
- Ballasting activities;
- Direct discharge of muds and cuttings (see impact W2); and
- Accidental events (further discussed at *Section 5.9*)

The potential impacts of each of those effluent and waste streams will be analyzed independently in the following paragraphs.

Black Water, Grey Water and Food Waste

Black water can contain harmful microorganisms, nutrients, suspended solids, organic material with chemical and biological oxygen demand (COD and BOD) and residual chlorine from sewage treatment, which could lead a decrease in water quality, a depletion of oxygen content, visual pollution and even to health hazards if discharged without previous treatment.

In order to minimize the potential impacts, all black water will be treated on board all project vessels (support vessels and drillship/SS) in a sewage treatment plant in full compliance with the requirements of MARPOL Annex

IV (International Maritime Organization (IMO) Marine Environment Protection Committee (MEPC) resolution 159(55) – Standards provided in *Table 5.6*).

Table 5.6 IMO Sewage Treatment Plant Effluent Standards.

Pollutant	**Standards for plants installed on board after 1st January 2010**
Faecal coliforms (units per 100 ml)	100
Suspended solids (mg/l)	35
Biochemical Oxygen Demand – BOD (mg/l)	25
Chemical Oxygen Demand – COD (mg/l)	125
pH	6.0-8.5

Source: IMO MEPC Resolution 159(55)

Treated sewage or black water will be discharged into the water at the drillship/SS location during operations or by vessels on movement at a maximum rate of 25 m^3 per day, based on a maximum crew of 250 people (200 on the drillship/SS and 50 on board three supply vessels).

Discharges will be intermittent and of relatively small volumes and are expected to dilute and disperse quickly in the offshore environment resulting in a temporary and localized reduction to water quality. Black water may only be discharged more than 3 nautical miles from land under MARPOL Annex IV.

Grey water includes drainage from baths, showers, laundry, wash basins and dishwater, and is not required to be treated before discharge under MARPOL regulations. However, the potential presence of organic content in grey water from the galleys (solid or semi solid food waste) may lead to an increase in BOD in water. Similarly, and to minimize potential effects from organic (food) waste material, MARPOL Annex V requires that food waster to be discharged will be macerated to a point it can pass through a 25 mm mesh to facilitate its dilution and ensure no visible floating solids are present within the discharge effluent. In addition, these discharges will take place more than 3 nm from the nearest coastline and while the vessel is *en route*.

The magnitude of impact on water quality due to sewage and grey water discharge is small. No additional mitigation is required and adverse residual effects are not anticipated and as a result, impact on water quality from discharge of black water is assessed as **Negligible**.

Deck Drainage and Bilge Waters

Drainage and bilge water is likely to become contaminated with low levels of oils and lubricants from machinery space. If discharged without previous treatment, this effluent can locally affect water quality with secondary impacts on marine fauna.

To minimise this risk, the drainage system will collect water streams generated from the drillship/SS washing and the storage areas containing cleaning chemicals as well as trace amounts of mud, lubricants and residual chemicals resulting from small leaks or spills and rainfall from open deck areas. All this water will then be directed into a holding tank and routed through an oil / water separator and monitored for oil concentration.

Treatment will ensure compliance with MARPOL 73/78 Convention, Annex I. All discharges will not exceed the maximum concentration of 15 parts per million (ppm) of oil content. At this concentration, any impact will be temporary and localized, with no visible sheen and quick dilution in the marine environment.

In addition, an Oil Record Book will be maintained by the Project vessels in accordance with MARPOL 73/78 requirements. The book will be used to record how, when and where sludge, oil, bilge water, waste oil, etc., are disposed of. Discharges of bilge water overboard will be recorded in the vessel's logbook.

Considering the relatively small volumes of discharge expected, the treatment adopted and the high dilution factor in the marine environment, impacts on water quality from the discharge of deck drainage and bilge water is assessed as **Negligible**.

Ballast waters

Ballast waters, taken onboard to maintain safe operation and maneuvering of vessels, could potentially contain harmful micro-organisms, marine organisms from other locations (potentially including invasive species) and contaminated sediments in suspension.

The discharge of ballast water into the marine environment is controlled by the International Convention for the Control and Management of Ship's Ballast Water and Sediments (2004). The drillship/SS and the support vessels involved in the Project will undertake ballast operations in accordance with this convention. As a result:

- All ballast water will be stored in specifically designated tanks to avoid cross contamination and remain free of oil;
- Ballast water discharges will be continuously monitored for oil sheen and in case of visibly oil contaminated ballast water discharges will be stopped;
- Ballast water exchange will take place at least 200 nautical miles from nearest land and at depths over 200 m;
- Any ballasting operations will be logged in a record book; and
- The vessels will have a Ballast Water Management Plan (BWMP) in place.

No further mitigation is required additional to legal compliance and adherence to industry good practice, therefore the residual impact on water quality derived from the discharge of ballast water is assessed as **Negligible**.

W2: Impacts on seawater quality due to the discharge of muds and cuttings to the sea

As already presented in *Section 5.5.3*, the potential environmental effects of the drill cuttings and muds discharged to the seabed include potential water pollution due to the chemicals present in the drilling muds and physical effects leading to increased turbidity on the water column.

For the present project, two types of discharges are considered, with different effects given the different location of discharge and the nature of the constituents. Initially there will be a discharge of cuttings and WBM directly on the seabed in piles close to the well location. The second discharge will occur from the drillship/SS and will be formed by cuttings with a maximum of 6.9% in weight of NADF adhered to them.

Because WBM released close to the seabed are essentially non-toxic (see *Section 5.5.3)*, there is no predicted water quality or secondary ecological impacts associated with this discharge in chemical terms. WBM impacts on water quality are primarily physical due to increased suspended solids and associated turbidity.

The direct release of cuttings and WBM on the seabed will result in a plume of increased suspended sediment. However, due to low deep-ocean current speeds, the plume is expected to stay close to the seafloor and is not expected to increase the amount of suspended solids in the water column, especially when considering the potential presence of a nepheloid layer (a layer just above the seafloor with a variable thickness that contains significant amounts of suspended solids).

These cuttings discharged to the sea from the drillship/SS can be divided physically into two types:

- Coarser material that will sink quite rapidly and have a short residence time in the water column; and
- Finer material that will have a longer residence time in the water column, increasing the total suspended solids (TSS).

As a result, the discharge will pass down through the water column and gradually be dispersed depending on material size before settling on the seabed.

Generally, most of the material, approximately 60%, is coarser and will deposit within a few hours of release. The remaining particles will reside in the water column for multiple days and be transported further away from the drillship/SS. The latter will affect the water column by the increase in Total Suspended Solids (TSS) above background concentration that may lead to an increase in turbidity and consequently to a reduction of light penetration potentially affecting phytoplankton and primary productivity.

The increase in TSS due to the discharge of muds and cuttings is expected to occur at the point of discharge. Results of the model have been compared to a threshold value of 35 mg/l of TSS, which is commonly used guidance value for TSS effluent discharges in the marine environment recommended by MARPOL (*IMO, 2006*).

The modelling results showed that the highest TSS concentration is likely to occur during jetting and top hole drilling near the seafloor. The 35 mg/L threshold was exceeded both at the surface and near bottom in both scenarios modelled (i.e. using minimum and maximum currents). Maximum area of exceedance at the surface occurs at the surface under minimum currents and ranged between 0.7 to 1.4 km^2, where inhibition of photosynthesis would be a concern. At the sea floor, a maximum area predicted to show concentrations that exceed the 35 mg/L threshold ranged between 0.018 to 0.056 km^2. These maxima occur at the sea floor and are below the photic zone, where high TSS could impact some organisms, therefore the inhibition of light is not a concern. This occurs primarily around the point of discharge in a localized area.

The organic nature of the NADF may also lead to an increase in the oxygen demand on the areas where it is discharged and the subsequent potential for anoxic conditions. The mud on larger particle sizes will, however, settle to seabed and therefore, toxicity effects to the water column are considered small or negligible.

Given the small quantities of NADF that will remain adhered to cuttings, the extremely low aromatic and oil content of NADF, and the depth discharge location it is unlikely that substantial concentrations of NADF will 'wash off' the cuttings and accumulate at the surface to cause a visible sheen affecting secondarily to plankton and fish.

Mitigation measures adopted to ensure impacts from drill cuttings and muds discharges on seawater quality are minimized include:

- NADF on cuttings will be reduced as far as is achievable with current technology. Mud on cuttings will not exceed an average of 6.9% before disposal.
- The usage and discharge of drilling muds and fluids during drilling activity will be regularly monitored.
- Lowest feasible toxicity NADF will be selected by GALP and used during drilling activities for all drilling sections.
- Optimise operation of solids control system to maximise the useful life of drilling fluids by effective liquid/ solids separation and to minimise the quantity of fluid "lost" overboard with the cuttings.
- Cuttings will be discharged by a caisson located at a sufficient depth to avoid impact to sea surface waters (10 m minimum).

The impact on water quality from discharged drilling fluids and increased turbidity from cuttings discharge has been assessed as of **Negligible** significance.

5.6 *IMPACTS TO THE BIOLOGICAL ENVIRONMENT*

5.6.1 *Plankton*

P2: Impacts on plankton communities due to the change of seawater quality due to effluents and waste to the sea

The discharge of routine waste effluents from the drillship/SS and support vessels from the drilling of a total of 3 wells may result in a temporal increase in organic matter in the surroundings of the drillship/SS as well as along the sites traversed by the vessels. Expected volumes of effluents considering the maximum personnel requirements of 250 people (200 onboard the drillship/SS and 50 on all supply vessels) include 55 m^3 of grey waters, 25 m^3 of treated black water and 250 kg of food organic wastes (i.e food, assuming 1 kg per person a day).

Considering these limited volumes, the constant movement of Project vessels throughout the Project area and the adherence to MARPOL practices (as described in water quality impacts section – see *Section 5.5.4*), an increase in organic matter is considered not significant as it will not disrupt natural phytoplankton cycles in the area (e.g. red tides) and will be limited to a temporary increase in plankton communities along a limited surface.

With regards to the discharge of the cuttings and associated muds, those originated in the upper sections of the well will pose no threat to the planktonic communities as they will directly deposited in the seabed at more than 2,200 m depth. The cuttings from the lower well sections will result on a temporary increase of turbidity which could affect the photosynthesis of the phytoplankton. The discharge will be made, however at sufficient depth below sea surface, limiting the extent of this impact.

Similarly, considering that the amount of muds adhered to the cuttings after treatment will not exceed the 6,9% content in weight, the use of low toxicity additives in muds and the quick downfall expected for these residues that will limit exposure time, the overall significance of impacts from waste discharges on phytoplankton is assessed as **Negligible.**

With regards to ballast waters, if the project vessels are not local and come from other marine areas could result in the introduction of invasive or alien species into STP waters.

Alien species have the potential to create changes to ecosystem by modifying the trophic chain and even lead to the local extinction of certain species, presenting therefore a threat to biodiversity and impacting human health due to consumption of contaminated seafood. These risks are generally much lower in deep offshore waters, where the Project is located, than in coastal areas, estuaries and ports.

In order to reduce this possibility, GALP and its contractors will adhere to IMO Guidelines for the Control and Management of Ship's Ballast Waste and Sediments (BWM Convention) which will be communicated to contractors supporting the Project as part of their contractual obligations. According to BWM convention, all vessels constructed after 2012 will have to include a ballast water treatment, while other vessels are obliged to include it since 2016 depending on their capacity.

Due to the embedded controls for the Project, including adherence to IMO guidelines, the impact of ballast water discharge, not only on plankton but on the marine wildlife in general, is predicted to be **Negligible**.

5.6.2 Fishes

F1: Impacts on fishes due to the generation of noise emissions, including the performance of Vertical Seismic Profile (VSP)

This impact has been analysed under the noise impact section (see *Section 5.5.2*) and assessed as **Negligible**.

F2: Impacts on fishes due to the change of seawater quality due to effluents and waste to the sea

The discharge of effluents from Project vessels, including the drillship/SS may lead to temporary changes on the distribution of fish species due to opportunistic feeders being attracted to organic discharges as a potential source of food.

Any change derived from this is considered to be small and within natural variation given the limited amount of the organic content introduced and the expected absence of significant changes in planktonic communities.

Other effects on fish could be related to toxicity from the depletion of oxygen as the biological demand increases, from the residual chlorine content from black waters or from any hydrocarbon content from treated deck drainage and bilge waters.

However, given the mitigation and control measures for discharges (see *Section 5.5.4* – impacts on water quality), the relatively small volumes discharged, their rapid dilution and dispersion in the marine environment (leading to predicted significance of negligible impacts on water quality), and the ability of mobile fish species to avoid polluted waters, the impact is considered **Negligible**.

5.6.3 *Sea turtles*

T1: Impacts on Sea Turtles derived of the physical presence of the drillship/SS, its mobilization and demobilization and the movement of the support vessels

The presence and movements of the drillship/SS and support vessels (exclusive of noise) may cause disturbance to turtles by causing behavioural effects that can include changes in feeding or breeding habits as well as an avoidance of the area occupied by the drillship/SS.

Given the prospective locations of the proposed wells (either exploratory or appraisal, limited to within the limits of Block 6), this impact will occur primarily in the offshore environment, where turtles are expected to be widely dispersed due to their solitary nature, and restricted to tens of metres around drillship/SS location. As a result the potential impact on turtle behaviour is expected to be limited to few turtle individuals, if any, and the most likely effect will be a general avoidance of the area, especially during the more intense project phases of drilling.

Another potential effect derived from the presence of the drillship/SS is the attraction that sea turtles, and specially hatchlings, feel towards artificial light sources. It is known that onshore lighting has the potential to reduce the reproductive success of marine turtles by deterring females from nesting on lighted beaches (though it is likely that experienced nesters may continue to use the nesting beaches they know; being the first-time nesters (new recruits) that may be deterred from nesting), as well as disorienting hatchlings on the beach. Considering the Project area is over 60 km from the closest point to the STP coastline it is considered highly unlikely that the artificial light associated with the Project vessels' activities would be visible from any turtle nesting/ foraging areas, thus no impacts are expected to turtles nor hatchlings (once they are in the water, they orientate by wave fronts and do not appear to rely on visual cues). In the offshore areas in the vicinity of the drillship/SS, it is possible that a small proportion of hatchlings may be exposed to the lights from the Project vessels, potentially becoming entrapped in the light spill, which increases predation risk. Nonetheless, lighting from structures from vessels operating offshore are considered to have a low impact to turtle hatchlings due to the short-term nature of the activities, the expected dispersion of hatchlings at over 60 km from the shore and that hatchlings may passively be transported by ocean currents.

Regarding the risk of vessel strikes to sea turtles, there is some evidence that sea turtles do not detect fast moving vessels early enough to allow them move out of the path of the vessel to avoid collisions. Project support vessels will travel typically at speeds lower than 12 knots, though still faster than the precautionary speed required to ensure all turtles are able to avoid collisions, stablished on 2 knots according to Hazel *et al*. (2007).

The chances of collisions between vessels and turtles are considered to be relatively low in offshore areas, though the risk increases from October to

March when turtles usually aggregate in the Gulf of Guinea (especially for hawksbill turtles in STP) prior to moving to nesting beaches. In coastal waters, the risk of a collision would be highest within these months, specifically on the approach to Port on African mainland when the support vessels will be closer to the coast. The consequence of a vessel collision with a turtle may range from minor disturbance or injury to a worst case of fatality to an individual, though the increased risk of collision is considered to be low considering the project related traffic will be approximately one daily trip.

To reduce the potential impact derived from the presence and movement of project vessels and drillship/SS, the following mitigation measures will be implemented:

- A Marine Fauna Observer onboard the drillship/SS will maintain watch for sea turtles during VSP operations.
- Supply vessel operators should maintain a watch for marine mammals and sea turtles and take avoidance action if a collision seems likely, if safe to do so.
- To the extent feasible, GALP will reduce lighting spill. Furthermore, lighting on vessels at night will be kept to a minimum for safe operations.
- Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals).
- Applicable embedded measures related to water quality will apply.
- Documentation and sharing with the STP authorities of relevant and applicable marine environmental data and opportunistic sightings of marine fauna.

Given the relatively low volume of Project-related traffic (less than one trip per day between well site and onshore port), the expected limited duration of the Project (maximum of 270 days), the offshore location of the Project and the adoption of the above mentioned mitigation measures, the residual impact to sea turtles from the presence of drillship/SS vessels is considered as **Minor.**

Marine environmental data such as opportunistic marine fauna sightings will be documented and shared with relevant STP environmental authorities to deepen the knowledge of the STP offshore environment.

T2: Impacts on Sea Turtles derived of underwater noise, including the performance of Vertical Seismic Profile (VSP)

This impact has been analysed under the noise impact section (see *Section 5.5.2*) and assessed as **Negligible**.

T3: Impacts on sea turtles due to the change of seawater quality due to effluents and waste to the sea

Sea turtles could be affected by the change of seawater quality as a result of project discharges if these were toxic or included solid elements where individuals could get entangled limiting their capacity to feed and reproduce.

As already considered in *Section 5.5.4* effluent discharges are not expected to lead to significant changes on seawater quality and the amount of potential toxic elements (mainly hydrocarbons and additives from NADFs adhered to cuttings and oil from routine vessel discharges) are expected to be discharged in reduced amounts and rapidly dilute or be deposited in the seabed, leading to a reduced risk of harming any sea turtle individual.

Similarly, the Project adherence to IMO principles, including MARPOL Annex V, that prevents the discharge of any solid garbage to the sea will, together with good maintenance practices onboard, ensure that no floating solids will be discharged leading to no risk of sea turtles entanglement with Project wastes.

In consequence the impact on sea turtles derived of Project wastes management and discharges is assessed as **Negligibl**e.

5.6.4 Marine mammals

M1: Impacts on marine mammals derived of the physical presence of the drillship/SS, its mobilization and demobilization and the movement of the support vessels

Aside from the noise generated by these vessels and the drilling ship, their physical presence and movements could have potential impacts on marine mammals.

Vessels that will be involved in the drilling operation comprise the drilling unit, which will for the most part remain stationary using its dynamical positioning system, and up to three supply vessels. Approximately one trip per day between the well site and the onshore port base is expected.

The presence and movement of vessels during Project activities (exclusive of noise) are likely to have very small zones of influence, only metres or tens of metres in most cases.

In case of occurring, the effects derived of the presence of the drillship/SS and supply vessels can be in the form of behavioural modifications such as avoidance of areas of vessels presence, obstruction of normal movement patterns, mother-calf separation and interrupted feeding.

Apart from that, there is also the risk of collisions between project vessels and mammals. Collisions have been known to occur worldwide and also in West Africa (*Félix and Van Waerebeek 2005; Van Waerebeek et al 2007*).

Project associated traffic will be very limited and the increase in risk of vessel collision with cetaceans is not significant. Furthermore, cetaceans are generally sufficiently mobile to avoid vessels in their path or moving towards them so the likelihood of cetaceans being struck by Project vessels is considered to be low.

Both, behavioural effects and risk of collisions are usually most profound in the case of small fast-moving vessels which frequently change direction, in contrast to the large and relatively slow moving support vessels associated to the Project.

It must be noted, however, that the West African manatee (*Trichechus senegalensis)* is a low speed moving species, (approximately 4.8-8 kph with short bursts of up to 32 kph if threatened (Save the Manatee Club, 2012)), and therefore may not be able to avoid the supply vessels should this species be present in vicinity of the selected onshore port base. This species has nocturnal habits which difficult its observation to avoid any collision.

The manatee habitat is however restricted to coastal waters, and therefore the risk of collision will be limited to the moment when supply vessels are approaching or leaving the selected onshore port base.

Measures to be implemented by the Project to mitigate disturbance impacts and reduce the risk of collision with marine mammals include the following:

- Vessels will use designated and relevant navigation channels where possible;
- A Marine Fauna Observer onboard the drillship/SS will maintain watch for marine mammals during VSP;
- Supply vessel operators should maintain a watch for marine mammals, and take avoidance action if a collision seems likely, if safe to do so;
- GALP will limit the transit of supply vessels in coastal waters (< 12 Nm) at night hours to the extent possible, and in case this is not possible, speeds at coastal waters will be reduced at night time;

With these mitigation measures in place, the residual impact to marine mammals from the physical presence of the Project and collision risk with Project vessels is considered as **Minor**, especially considering the presence of protected and endangered marine mammal species.

Marine environmental data such as opportunistic marine fauna sightings will be documented and shared with STP environmental authorities to deepen the knowledge of the STP offshore environment.

M2: Impacts on marine mammals derived of underwater noise, including the performance of Vertical Seismic Profile (VSP)

This impact has already been analysed under the noise impact section (see *Section 5.5.2*) and assessed as **Minor**.

M3: Impacts on marine mammals due to the change of seawater quality due to effluents and waste to the sea

Potential degradation on water quality derived from the discharges of routine effluents from Project vessels (black and grey waters, deck drainage and bilge waters and ballast waters) as well as from the discharge of cuttings could lead to harmful effects to marine mammals depending on the toxic elements (oil and additives to the muds adhered to the cuttings) and if ingested by them.

However, as already analysed within *Section 5.5.4*, the project discharges will be limited in amount and will have a reduced content of potentially harmful elements due to treatment applied to effluents and cuttings leading to not significant and temporary changes in seawater quality.

Similarly, secondary impacts could arise if plankton or fish communities are affected by these changes as that could lead to potential feeding problems or intoxication from polluted preys. Nevertheless the effects of changes in water quality on plankton and fish (see *Sections 5.6.1 and 5.6.2*) have been assessed as negligible and no changes in fish or plankton populations are expected.

As a result and considering the mitigation measures in place, like the adherence to MARPOL requirements the potential direct and secondary impacts on marine mammals derived from changes in water quality due to project discharges and wastes are assessed as **Negligible**.

5.6.5 Seabirds

SB1: Impacts on seabirds derived of the physical presence and movements of the drillship/SS, support vessels and helicopters

The presence and movement of vessels and helicopters involved in Project activities may lead to disturbance to seabirds that can result in behavioural changes, causing them to be attracted to the area or either avoiding it.

In particular, there may be impacts on birds due to artificial lighting present on the vessels as these lights may attract migrating birds. Research has shown that the attraction of artificial light could disorient nocturnally migrating birds resulting in the depletion of their energy reserves and the death (*Poot, 2008*). The level of impact, however, is dependent on the location of offshore lighting, time of year, and weather conditions. For example, birds tend to be attracted to offshore lighting during poor weather, *i.e.* overcast nights (*OSPAR, 2009*). *Van de Laar* (2007) specified that birds may be attracted by the lights during nights with fog and/or >80% cloud cover, leading to an increase in energy expenditure, although the frequency and duration of periods when this impact may occur will be limited.

Light emissions from Project vessels during the night may be visible at considerable distances, depending on weather and sea conditions. The project may include activities to test the well and therefore, flaring may represent a major source of lighting.

On the other hand it is also known that the presence of the drillship/SS may serve to seabirds as a refuge or a place to rest in bad weather conditions.

Disturbance will be localized, only affecting a small number of birds offshore considering the reduced bird density expected at more than 60 km from the coast where the well is planned, and will be short term, occurring periodically throughout the Project. Considering the Gulf of Guinea falls within one of the major migratory flyways, there may be times of year (spring and autumn) when a higher number of migratory birds are present in the area (though main bulk of migratory birds will be onshore or in continental coastal areas) and therefore the likelihood of this impact occurring is greater in those periods.

Helicopters and support vessels passing through and near coastal areas may also be a source of disturbance to sea and coastal birds due to the aerial noise generated or by their mere presence, especially if close to or within sensitive coastal habitats such as mangrove areas used to feed, rest and breed. The use of the helicopter will be however limited to 6 trips per week and the time spent flying within sensitive areas (if any) will be short.

The Project will implement the following measures to mitigate disturbance impacts:

- Helicopter route will be designed so as to minimize impacts and travel time over sensitive biological areas.
- When large aggregations of seabirds or coastal birds are observed on the sea surface or on coastal wetlands, the helicopter will avoid flying over these sites to the extent possible.

Given the potential existence of protected bird species, the small number of Project vessels likely to be offshore at any one time, the reduced number of helicopter trips planned and the distance of the Project area from the coast, the impact to seabirds is assessed as of **Minor** significance.

SB2: Impacts on seabirds due to the change of seawater quality due to effluents and waste to the sea

Changes in seawater quality from Project discharges and waste management could lead to direct and secondary impacts to seabirds in the form of intoxication from polluted food or by direct contact with oil in the sea surface among others.

The assessment of the impacts on seawater quality and on fish from routine discharges has been assessed as of negligible significance, and as a result potential secondary impacts on seabirds are unlikely. In addition, given the offshore location of Project area, the amount of seabirds expected in the site is reduced and limited to few species. Similarly, the mitigation measures in place (i.e. the adherence to MARPOL requirements) will ensure no discharges from Project vessels take place within 3 nm from the coast.

Based on the considerations above, the impacts on seabirds due to changes on water quality are assessed as **Negligible**.

5.6.6 *Sensitive coastal areas*

SA1: Impacts on sensitive coastal areas due to the operation of onshore facilities (supply base and helibase)

As described in the baseline chapter, the closest protected area is located about 60 km from Block 6. All identified areas are of a coastal nature, with limited formal protection of underwater biodiversity, as most of them are sites of importance to seabird populations (impacts of artificial light on seabirds have already been assessed in *Section 5.6.5*). No significant impact is foreseen on bird species in protected areas or their marine ecosystems from exploratory and appraisal drilling activities, including in particular artificial lighting.

The helibase will be located in STP where the activity will be limited to maintenance and refuelling of the helicopter that will be used to transfer crews to and from the drillship/SS.

Activities performed on the helibase are neither expected to have no impact on sensitive coastal areas apart from the potential and temporary disturbance of birds while flying, an impact already assessed at *Section 5.6.5*.

In summary, the impact of the onshore activities associated to the exploratory and appraisal drilling on sensitive coastal areas is assessed as **Negligible**.

5.7 *IMPACTS TO THE SOCIAL ENVIRONMENT*

5.7.1 *Navigation, traffic and sea users*

NT1: Impacts on Navigation, traffic and sea users

The movement taking part as part of project activities will increase shipping traffic in the area, which could increase the risk of collision between vessels; and the presence of a 500 m radius exclusion zone around the drillship/SS may potentially interfere with shipping and navigation.

Shipping density is relatively low in STP waters compared to the shipping traffic across the Gulf of Guinea (Kaluza et al., 2010).

Shipping traffic in STP waters is influenced by:

- Commercial traffic from Port of São Tomé to the West African countries;
- Commercial traffic from Nigeria, Equatorial Guinea, Cameroon, and Gabon to the rest of the world, via South Africa and South America; and
- Commercial fishing vessels.

Movements of drillship/SS will be limited to mobilisation and demobilisation while support vessels movement will be limited to less than one trip per day from and to African mainland Port. The potential impacts on other sea users are then estimated to be limited. With regards to the physical presence of the drillship/SS, the potential impacts on other sea users are also estimated to be limited due to the small extent of the exclusion zone.

To reduce the potential for this impact, the following mitigation measures will be implemented:

- Notification to relevant marine authorities and advanced notice to mariners prior to commencement of the drilling program including notification of the establishment of the 500 m exclusion zone.
- Vessels will use designated and relevant navigation channels where applicable and comply with designated exclusion zones.
- Navigational marks and lights on the drill ship;
- Safety exclusion zone will be monitored for the safety of the facility and other users of the area.
- Ensure that vessels are equipped with collision risk reducing devices i.e. navigational lights and beacons, marker buoys, etc.

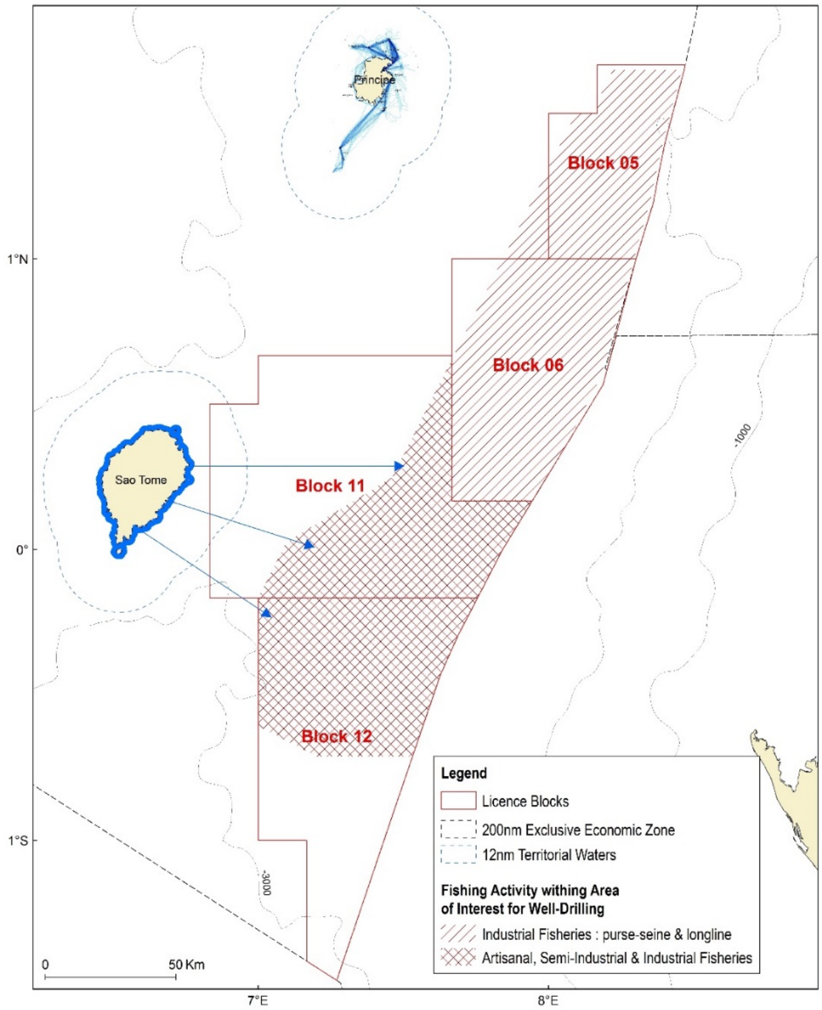
Considering the limited number of vessels movements, the limited duration of the project (approximately 270 days), the existence of a moderate shipping traffic in the area, and the application of the above-mentioned mitigation measures, project impact on navigation, traffic and sea users is considered to be **Negligible**.

5.7.2 Fisheries

FS1: Impacts on Fisheries due to the presence and operation of the drillship/SS and support vessels

Marine resources obtained by fishing represent an important source of livelihood and nutrition for the people of STP. Artisanal fishing is known to occur mainly in the first 6 miles from the shoreline, semi-industrial may extend up to 20-60 miles; while industrial fishing occurs between 6 to 200 miles, where Block 6 lies (*Figure 5.2*).

Figure 5.2 Fishing activity (artisanal, semi-industrial and industrial) with respect to the areas of interest for well-drilling within each of Sao Tome and Principe's offshore licence blocks 5, 6, 11 and 12. The range of artisanal fishing activity is shown in blue.



Source: CAPFISH, 2018

The most likely potential interference to artisanal fishing activities may occur when support vessels navigate between the onshore ports (in African mainland and Neves in Sao Tome island) and the Project area; where these may encounter fish aggregating devices (FADs). It is expected that the likelihood of such interactions is limited and can be minimized through engagement with fishing associations and local fishery administration to gain advance knowledge of where rafts are most likely to be encountered. Considering that support vessels movement will be limited to less than one trip per day, project activities are anticipated to have little impact on artisanal fishing activities.

The presence of a 500 m radius exclusion zone around the drillship/SS will condition industrial fishing vessels from using fishing grounds, should those grounds occur within the vicinity of the well location. Block 6 is located in a tuna fishing area whose fishing season takes place between May and mid-

October (concomitant with tuna migration seasons). The size of the area which the Project will restrict from industrial fishing is small relative to available fishing areas; and the duration of the project is limited to 270 days.

In addition to mitigation measures for NT1, the following mitigation measures will be applied:

- Engagement with fishing associations and STP fishery authorities will be undertaken.
- Communicate with any fishing vessels or other navigators that are present in the vicinity of the exclusion zone around the drillship/SS, ensuring that such vessels are able to alter their course in complete safety.
- Ensure procedures are in place for dealing with claims in the event of damaged fishing gear due to the movement of support vessels.
- Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals).
- Applicable embedded measures related to water quality will apply.

Taking into account the limited support vessels movement, the small area excluded to fishing activities, the relatively duration of the drilling activities (approximately 270 days), and the abovementioned mitigation measures, it can be concluded that the potential impacts of the project activities on fisheries is expected to be **Negligible**.

FS2: Impacts on Fisheries due to the generation of noise emissions during seismic (VSP) activities

Noise effects on fish have been assessed in impacts F1 and F2. These impacts, including potential behavioural short term effects, which may re-distribute fishes making them temporarily unavailable to fishermen, are considered negligible. Moreover, the wells are to be located at several miles from the coastal areas where major part of artisanal fishing occurs.

With those two circumstances combined, the impact on local fisheries resulting from noise is expected to be **Negligible**.

FS3: Impacts on Fisheries due to the change of seawater quality as a result of effluents discharge to the sea

Wastewater discharge may affect seawater quality, and indirectly impact fisheries. The impact could occur at a local level and in the long term (bioaccumulation) but the estimated volumes of wastewater will be small, produced during a relatively short periods at the different well sites and compliant with MARPOL. This includes the absence of visible floating solids or discolouration of surrounding water and the presence of less than 15 parts per million (ppm) oil content. Moreover, water depth, distance offshore and hydrography in the area provides a high level of dilution and dispersion.

In addition to mitigation measures considered for impact W1, the following mitigation measures are proposed:

- Compliance with MARPOL requirements and good industry practice; and
- Operational controls contained in Waste Management Plan or other suitable plan or procedure.

Considering the wastewater discharge practices, the hydrography of the project area and the application of the above mitigation measures, the potential impact on fisheries due to change of seawater quality is considered **Negligible**.

5.7.3 *Local economy, employment and livelihoods*

E1: Impacts on Local economy, employment and livelihoods

The closest coastline from Block 6 is located over 60 and 100 km from Príncipe and São Tomé islands respectively. As mentioned in *Section 5.7.2*, the only potential interference to artisanal fishing activities would be expected to occur when the Project vessels navigate between the onshore ports and the Project area; but it is considered very limited.

The project will result in direct and indirect employment opportunities in the areas where onshore base and helibase will be located. It is estimated that overall at least than 10 local people would be hired. With regards to indirect employment opportunities, they cannot be estimated but they are expected to be limited. GALP will maximise local hiring wherever practicable. GALP will provide where relevant and appropriate training to local staff.

Taxes and purchase of local goods and services may also impact local economy. All this activities are considered to be of minor significance to the local economy and to STP’s gross domestic product (GDP), but it will represent an important source of income for those households who are able to take advantage of the opportunities.

In addition to mitigation measures considered for Impact FS1, a Stakeholder Engagement Plan will be developed and implemented, including the implementation of a grievance mechanism with affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner.

Considering the mitigation measures stated above, the impact on Local economy, employment and livelihoods is considered to be positive and **Minor**.

5.7.4 *Local Infrastructures and Services*

I1: Impacts on Local Infrastructures and Services

Project activities may potentially impact submarine structures during drilling operations, local water network as a result water consumption and health infrastructures.

According to the available information[6] on active submarine cables in the footprint of Block 6 no impact on submarine cables is expected to occur since these will be avoided.

Approximately 4,000 m^3 for each well of water will be abstracted from the local water network, and transported offshore from the onshore Port to project location by support vessels.

Considering that the logistic base will not be in STP, the approximately 30 workers estimated for the onshore base are not expected to use the Health facilities of STP. In the case of the support vessels (50 workers), workers from offshore drillship/SS (200 workers) and STP helibase will use either onshore port or STP health infrastructures in case of need till they are in conditions to be moved to their home countries. There will be medical services at the drillship/SS. In addition and if needed Medevac will be undertaken to STP, afterwards, and in case by case assessment, it will be defined the medical transfer location.. Therefore, it is expected that local health infrastructures will only be used in case of emergency, and impact will be limited (considered **Negligible**).

Mitigation measures applicable to E1 are also relevant for this impact.

5.7.5 *Community and Workers Health and Safety*

C1: Impacts on Community and Workers Health and Safety

Three potential sources of impacts due to the Project are covered in this section:

- Worker-community interactions resulting in increased transmission of sexually transmitted infections (STIs) and communicable diseases;
- Worker-community interactions resulting in lack of appreciation of local customs; and
- Use and handling of hazardous materials.

The interaction of the workforce, in particular the non-local workforce with the local community has the potential to increase the transmission of communicable diseases (i.e. TB and pneumonia) and STIs (i.e. HIV/AIDS).

[6] http://www.cablemap.info/

Living in close quarters such as on a drillship/SS could facilitate the spread of communicable diseases and STIs internally and then onwards into the community. Taking into account the size of the workforce, the previous experience in the 2017 3D seismic survey, the fact that they will mainly be housed offshore, that the logistic base will be out of STP and the potential stay (if any) of workers onshore in STP will be very short, , the opportunities for interaction will be limited.

As main work will be performed offshore and there are no communities in the surroundings, mitigation measures will be mainly focused on workers health and safety:

- Regular health screening will be provided for all workers.
- Training will be provided to all workers to improve awareness of transmission routes and methods of prevention of communicable diseases, STIs and vector borne diseases (i.e. malaria), as part of induction.
- The Project workforce will be briefed on appropriate local code of conduct matters.
- Cultural Awareness / Grievance Mechanism as part of Contractor HSSE Mobilization.
- Program of stakeholder engagement including implementation of a grievance mechanism with Project-related affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner.

Considering the above mitigation measures, impacts on Community Health and Safety in considered to be **Minor**.

5.8 SUMMARY OF IMPACTS FROM ROUTINE EVENTS

The evaluation of impacts associated with routine events is presented in *Table 5.7*

Table 5.7 Evaluation of the Significance of Potential Environmental Impacts associated with the Block 6 exploration activities (Routine Activities).

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
Impacts from Routine Activities				
Air Quality and Climate Change	Routine drillship/SS operation, support vessel and helicopter trips to shore	• Potential reduction in localized air quality and contribution to greenhouse gases	• Advanced planning to ensure efficient operations, including the planning of support vessels trips to shore. • All generators and equipment to be maintained and operated under manufacturer´s standards to ensure working as efficiently as possible. • Regular monitoring of fuel consumption and engine efficiency, considering potential reductions of greenhouse gas generation. • Well test duration and volume of produced hydrocarbons will be reduced as much as practical to meet the objectives of the test. • High efficiency (i.e., low NOx) burners will be used. • The flare will be visually monitored to ensure efficient combustion as well as for unburned hydrocarbons in case of malfunction of drop out capture. • A system to record flared hydrocarbons will be implemented and all emissions registered as part of the environmental management program for the project or operation. • The number of helicopter flights to be limited to those strictly necessary, without compromising operations or safety. • Subject to availability at onshore base port, the use of low-sulphur fuel where possible will be favored (compliance with Tier II of revised MARPOL 73/78 Annex VI which sets limits on sulphur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances).	**Negligible**
Seawater Quality	Routine and operational discharges during the project (*i.e.* black and grey water,	• Potential localized reduction in water quality, including increased turbidity and	• The vessels will be equipped with a sewage treatment unit compliant with MARPOL Annex IV regulations, with International Sewage Pollution Prevention Certificate (“ISPPC “).	**Negligible** (routine effluents and ballast waters)

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
	bilge water, ballast, etc.). Drilling and installation of well infrastructure, including the discharge of cuttings and muds	BOD • Potential introduction of alien invasive species from ballast water discharges	• Discharges will comply with MARPOL Annex IV. • Food waste discharges will comply with MARPOL Annex V requirements (discharges of comminuted waste always more than 3 nm from the coast and while navigating). • Bilge and drainage water will be directed to an oil-water separator and treated to a level of <15ppm oil in water (compliance with MARPOL 73/78 Convention, Annex I). • Maintenance of an Oil Record book and a vessel's logbook. • All Ballasting activities will comply with the International Convention for the Control and Management of Ship's Ballast Waste and Sediments (BWM Convention), including: o all ballast water will be stored in specifically designated tanks to avoid cross contamination and remain free of oil; o ballast water discharges will be continuously monitored for oil sheen and in case of visibly oil contaminated ballast water discharges will be stopped; o ballast water exchange will take place at least 200 nautical miles from nearest land and at depths over 200 m; o any ballasting operations will be logged in a record book; and o the vessels will have a Ballast Water Management Plan (BWMP) in place. • NADF on cuttings will be reduced as far as is achievable with current technology. Mud on cuttings will not exceed an average of 6.9% before disposal. • The usage and discharge of drilling muds and fluids during drilling activity will be regularly monitored. • Lowest feasible toxicity NADF will be selected by GALP and used during drilling activities for all drilling sections. • Optimise operation of solids control system to	**Negligible** (discharge of cuttings and muds)

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
			maximise the useful life of drilling fluids by effective liquid/ solids separation and to minimise the quantity of fluid "lost" overboard with the cuttings. • Cuttings will be discharged by a caisson located at a sufficient depth to avoid impact to sea surface waters (10 m minimum).	
Seabed and Benthic communities	Drilling and installation of well infrastructure, including the discharge and deposition of cuttings and muds Vertical Seismic Profile activities.	• Generation of noise emissions • Loss of seabed, habitats and benthic fauna in the direct footprint of the well and where cuttings and cement are deposited • Potential localized and short term increase in total suspended solids (TSS) in the water column and near the seabed • Impacts on sediment quality and benthic organisms from contaminants contained in WBM directly discharged to seabed and NADF coated in cuttings discharged from the drillship/SS	• The volume of discharged cuttings and drilling muds will be monitored on a regular basis. • Lowest feasible toxicity NADF will be selected by GALP and used during drilling activities for all drilling sections. • GALP will aim to minimize the number and quantities of additives and will prioritize the selection of additives with a better environmental behaviour (i.e. elements included in the PLONOR list). • Visual inspections of the general pattern of the seabed sediments distribution around the drilling point will be conducted before and after the drilling operations using an ROV. This seabed imagery will be taken as part of GALP's monitoring system and thus the images will be taken in the near vicinity of the Block 6 wells. The seabed imagery conducted will be documented and shared with STP Authorities. • Drill cuttings from the sections where NADF is used will be treated onboard to ensure a maximum content of 6.9% in weight of muds within the cuttings to be discharged. • There shall be no discharge to sea of free oil coming from drilling fluids and cuttings (as determined by the static sheen test). • The NADF used will be recycled and reused. Once the drilling is finished the spare muds will be stored and sent ashore for return to supplier or appropriate disposal at authorized facilities. • The composition of the NADF to be used is not known at the moment, but as the ones to be used are virtually free of Polycyclic Aromatic Hydrocarbons (PAHs) the toxicity is still considered relatively low	**Negligible** (noise) **Negligible** (change in water quality)

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
			(EPA, 1996). They will always be Category III of OSPAR/OGP non aqueous fluids, i.e. with less than 1/1000 of PAHs and less than 0.5 /100 of total aromatics and with a composition including only the following type of chemicals: PLONOR or Non-CHARMABLE (C, D or E) as per the OSPAR Offshore Chemical Notification Scheme (OCNS). • The discharge of the cuttings from the drillship/SS will take place at a sufficient depth to avoid impact to sea surface waters through a submerged caisson (10m minimum).	

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
Plankton	Routine and operational discharges during the project (organic liquid/solid discharges)	• Potential localized increase in organic matter and reduction in water quality	• Applicable embedded measures related to water quality will apply	**Negligible**
Fish	Routine operation of drillship/SS and support vessels. Vertical Seismic Profile activities.	• Impacts due to the generation of noise emissions • Secondary impacts due to changes in water quality	• Applicable embedded measures related to Noise generation will apply (see summary of impacts on marine mammals); • Applicable embedded measures related to water quality will apply	**Negligible**
Sea Turtles	Physical presence of the drillship/SS and support vessels, including their movements Operation of drillship/SS and support vessels Vertical Seismic Profile activities.	• Disturbance from the presence of Project vessels; • Potential collision risk with Project vessels; • Impacts due to the generation of underwater noise emissions • Secondary impacts due to changes in water quality	• A Marine Fauna Observer onboard the drillship/SS will maintain watch for sea turtles during VSP operations. • Supply vessel operators should maintain an awareness for marine mammals and sea turtles and take avoidance action if a collision seems likely, if safe to do so. • To the extent feasible GALP will reduce lighting spill. Furthermore, lighting on vessels at night will be kept to a minimum for safe operations. • Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals). • Applicable embedded measures related to water quality will apply. • Documentation and sharing with STP authorities' of relevant and applicable marine environmental data and opportunistic sightings of marine fauna.	**Minor** (physical presence and risk of collision) **Negligible** (noise and secondary impacts due to changes in seawater quality)
Marine Mammals	Physical presence of the drillship/SS and support vessels, including their movements Operation of drillship/SS and	• Disturbance from the presence of Project vessels; • Potential collision risk with Project vessels; • Impacts due to the generation of underwater noise emissions	Embedded measures related to noise generation: • Implementation of soft start or ramp up procedure for VSP activities and have onboard a Marine Fauna Observer, as recommended by the Joint Nature Conservation Committee (JNCC, 2017) guidelines during VSP activities; • Good maintenance procedures on vessel engines.	**Minor** (physical presence, risk of collision and noise generated by VSP) **Negligible** (secondary impacts due to changes in

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
	support vessels Vertical Seismic Profile activities.	• Secondary impacts due to changes in water quality	Measures related to rest of identified impacts: • Vessels will use designated and relevant navigation channels where possible; • A Marine Fauna Observer onboard the drillship/SS will maintain watch for marine mammals during VSP; • Supply vessel operators should maintain awareness for marine mammals, and take avoidance action if a collision seems likely, if safe to do so; • GALP will limit the transit of supply vessels in coastal waters (< 12 Nm) at night hours to the extent possible, and in case this is not possible, speeds at coastal waters will be reduced at night time; • Applicable embedded measures related to water quality will apply.	seawater quality)
Seabirds	Operation of Project vessels and helicopters	• Disturbance from the presence and movements of Project vessels and helicopter flights. • Secondary impacts due to changes in water quality	• Helicopter route will be designed so as to minimize impacts and travel time over sensitive biological areas. • When large aggregations of seabirds or coastal birds are observed on the sea surface or on coastal wetlands, the helicopter will avoid flying over these sites to the extent possible. • Applicable embedded measures related to water quality will apply.	**Minor** (physical presence and helicopter flights) **Negligible** (secondary impacts due to changes in seawater quality)
Sensitive coastal areas	Onshore operations	• Disturbance to sensitive coastal areas from onshore activities	• Applicable embedded measures related to water quality will apply.	**Negligible**
Oher Marine Users	Project vessels movements	• Impacts to maritime traffic • Increase of collision risk	• Notification to relevant marine authorities and advanced notice to mariners prior to commencement of the drilling program including notification of the establishment of the 500 m exclusion zone. • Vessels will use designated and relevant	**Negligible**

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
			navigation channels where applicable and comply with designated exclusion zones. • Navigational marks and lights on the drill ship; • Safety exclusion zone will be monitored for the safety of the facility and other users of the area. • Ensure that vessels are equipped with collision risk reducing devices i.e. navigational lights and beacons, marker buoys, etc.	
Fisheries	Physical presence and operation of Project vessels Vertical seismic profile	• Impacts due to the presence of drillship/SS and associated exclusion area for fisheries • Impacts due to the generation of underwater noise emissions • Secondary impacts due to changes in water quality	• Engagement with fishing associations and STP fishery authorities will be undertaken. • Communicate with any fishing vessels or other navigators that are present in the vicinity of the exclusion zone around the drillship/SS, ensuring that such vessels are able to alter their course in complete safety. • Ensure procedures are in place for dealing with claims in the event of damaged fishing gear due to the movement of support vessels. • Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals). • Applicable embedded measures related to water quality will apply. • Compliance with MARPOL requirements and good industry practice. • Operational controls contained in Waste Management Plan or other suitable plan or procedure.	**Negligible** (presence of Project vessels) **Negligible** (impacts from underwater noise and from water quality changes)
Local Economy	Project activities in general	• Impacts on local economy, livelihood and employment	• Stakeholder Engagement Plan will be developed and implemented, including the implementation of a grievance mechanism with affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner. • Implement local employment and skills development policies where possible.	**Minor (positive)**

Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Impact Significance
			• Employment opportunities will be advertised widely and requirement practices will be based on relevant labour legislation and organizational policies and strategies. • Implement local content strategy, which is aimed at building capacity and capability of Saotomean businesses to support the long-term development of the oil industry. • Develop contract conditions to ensure the requirement for local content and procurement is passed to contractors. • Applicable embedded measures related to fisheries impacts will apply.	
Local Infrastructure and Services	Onshore operations Drilling activities	• Impacts on submarine infrastructures (i.e. marine cables) • Impacts on local water network	• Applicable embedded measures related to local economy impacts will apply	**Negligible**
Community and Workers Health & Safety	Project activities in general	• Increased transmission of sexually transmitted infections (STIs) and communicable diseases; • worker-community interactions resulting in lack of appreciation of local customs; • use and handling of hazardous materials.	• Regular health screening will be provided for all workers. • Training will be provided to all workers to improve awareness of transmission routes and methods of prevention of communicable diseases, STIs and vector borne diseases (i.e. malaria), as part of induction. • The Project workforce will be briefed on appropriate local code of conduct matters. • Cultural Awareness / Grievance Mechanism as part of Contractor HSSE Mobilization. • Program of stakeholder engagement including implementation of a grievance mechanism with Project-related affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner.	**Minor**

5.9 *ACCIDENTAL EVENTS: OIL SPILLS*

5.9.1 *Introduction*

Accidental events occur under abnormal operations and present non-routine and unplanned environmental risks. Prevention is the primary emphasis in any discussion of the potential environmental impacts of accidental events and it is important to consider the likelihood of an event as a key factor.

The risk of an oil spill into the marine environment is inherent in all offshore oil developments. As a result, this section addresses the potential impacts for unplanned events, which for purposes of this assessment, include the following scenarios:

- Scenario 1: Spill of 1000 $m^3$of Marine Diesel (e.g. a vessel collision resulting in diesel spill);
- Scenario 2: A continuous release (constant flow rate) of 5,000 barrels per day of crude oil over a 10 day period. Total spill is 50,000 barrels of crude oil (e.g. subsurface blow-out for a period of 10 days); and
- Scenario 3: A continuous release (constant flow rate) of 35,000 barrels per day of crude oil over a 30 day period. Total spill is 1,050,000 barrels of crude oil (e.g. subsurface blow-out for a period of 30 days).

5.9.2 *Approach Overview*

When considering very infrequent but potentially high impact scenarios such as oil spills, the term *environmental risk* is preferable to *environmental impact* and is typically defined as follows.

Environmental Risk = Frequency of Spill Event x Consequences of Event (which in turn relates to *Volume* and *Type* of oil spilled, *Weather Conditions* and *Receptor Sensitivity*)

Assessing the environmental risk of oil spills begins by firstly describing the characteristics of the oil. This will be a key factor in determining the oil's behaviour in the environment and the associated response. Potential oil spill scenarios are then defined based on a comprehensive risk assessment.

Potential oil spill scenarios identified in the risk assessment are then selected for spill modelling taking into account the site weather and sea conditions, including any seasonal variations. The results of the modelling not only give an indication of the size and dispersion of oil spill events, but also identify the likely zone of effect.

The software system GEMSS® (Generalized Environmental Modelling System for Surface waters) and its oil spill module, COSIM (Chemical/Oil Spill Impact Module), was applied to predict the transport and fate of oil from a potential spill. A short memo outlining the main outcomes of these modelling are presented as an addendum to the present ESHIA.

5.9.3 *Discussion of probability/frequency for each scenario*

The factors that contribute to the frequency of accidental events, and in particular to the ones selected as project specific scenarios for this ESHIA are well understood. For this reason it is important to highlight that prevention is the primary importance in any discussion of the potential environmental impacts of any oil spill. In this sense, GALP's primary focus in planning its activities is to ensure that all practicable measures are taken to prevent the occurrence of accidental events.

The spill analysis considers hazards arising from a range of potential events, and the likelihood of occurrence/frequency of the different events considered is based on historical and published data from international organizations and databases.

The frequency of the accidental events during drilling operations is very low and the frequency of the extreme situations is exceptionally low due to the design controls and physical pressure control hardware which are an integral part of present-day drilling operations.

Analysis of historical data of reported oil spills (all oil types including diesel) from drilling rigs on the United States (USCS) indicate that the most common platform spill is of between 1 to 5 barrels, with an average volume of 2 barrels (BOEM, 2016). In the period 2001 -2015, the number of USCS spills of the minimum registered spills (from 1 to 5 barrels) represented over 50% of the total but less than 3% of the volume spilled (estimate not including spill volume estimated for the Deepwater Horizon incident).

With respect to major diesel spills resulting from marine accidents on rig or ship collisions, according to the Regional Marine Pollution Emergency Response Centre for the Mediterranean (REMPEC), between 1992 and 2003 no spillage over 2,000 tonnes occurred in the Mediterranean Sea; the quantities of oil spilled as a result of collisions dropped drastically, and to a smaller extent so did the quantities attributable to groundings. This is probably attributed to the improvements in terms of ship design.

Statistically spoken, blow-out accidents are rare. The combined figures derived from offshore oil/gas operations in the Norwegian sector (NCS), UK sector and the US sector of the Gulf of Mexico (GOM) which forms the most reliable statistical data available, places the risk of blow-out accidents per year in production per oil/gas well at an average rate of 0.000047. The risk of blow-out per drilled and completed production well is 0.00327 and for drilling an exploration well is 0.00516 (ibid 73-74). The probability of ignition of oil/gas that are leaking out during a blow-out is on average 0.136 per blow-out (*Holand, 2006*).

The chances of a well blowout is highly unlikely, fundamentally due to the numerous precautions in place to prevent a loss of well control (shallow gas survey, well design and engineering, mud programme, well monitoring programme, blow-out preventers, well control training, emergency drills, etc.)

With these considerations the following frequencies have been assigned to the selected hypothetical accidental events:

- Large diesel spill scenario (LD): this type of scenario can happen as a result of marine accidents (e.g. collision) on the drillship/SS, and its frequency category is considered unlikely; and
- Blowout scenarios (BO): its frequency category is considered highly unlikely.

5.9.4 Risk Assessment

The severity of potential environmental effects will depend on a range of factors, such as the size and duration of the spill, the duration of exposure, the time of year, weather and sea conditions and the extent of weathering of the oil. These factors affect the toxicity of the diesel/oil and how amenable it is to natural and chemical dispersion, and to clean-up once on shore. In addition, the general condition and life stages of individuals potentially affected at the time will influence the resilience they exhibit to possible oiling, and the speed and extent of recovery.

The following assessment is based on a general understanding of known oil spill effects on the types of habitats, communities and species that occur in the region.

Evaluation of Potential Consequences

In the event of a well blowout or a diesel spill, the marine environment offshore and coastal shoreline of STP (especially the southeastern coasts of São Tomé and Príncipe islands) as well as the coast of Equatorial Guinea, Cameroon, and Gabon) would be impacted. Offshore, there will be localized impacts to water quality, however, the more significant impacts would be to marine biodiversity, and in particular those species that frequent the sea surface, including seabirds, marine mammals and turtles. Fish species and larger invertebrates in deeper water will tend to avoid the sea surface or leave the impacted area in the event of a spill. Onshore, impacts could include contamination of sensitive habitats such as mangroves, wetlands, lagoons and turtle nesting beaches and impacts on species that frequent such habitats such as coastal birds and fish.

The next sub-sections describe how spills may impact individual receptors.

- *Seabirds and Coastal Birds*

Direct mortality of birds in the event of an oil spill is often the most widely perceived risk. While impacts to birds can occur offshore in the marine environment, the more pronounced impacts are often experienced if oil reaches coastal waters. Spills affecting coastal waters near major bird colonies during the breeding season can be particularly severe since birds are feeding intensively and often dive through the surface oil to feed on fish. Birds are affected by oil pollution in the following three key ways.

- Stains of oil on the plumage may destroy the insulating and water repelling properties which may ultimately cause the death of the bird.
- Toxic effects after the ingestion of oil during preening, ingestion of oiled prey, inhalation of oil fumes or absorption of oil through skin or eggs may also lead to death.
- Indirect effects may result from destruction of bird habitats or food resources.

- *Marine Mammals*

The marine environment in offshore STP is known to support significant marine mammal populations, as discussed in the *Baseline Section 4.3.4* of this document. Many of the species found in STP waters are listed by the IUCN (International Union for the Conservation of Nature), including the Fin, Blue and Sei Whale (all endangered) and Sperm Whale and West Africa Manatee (both vulnerable).

Marine mammals are generally less sensitive to oil spills than seabirds as they will tend to avoid and move away from affected areas and avoid any breaching or feeding behaviours, thus reducing direct physiological impacts, and returning as the environment recovers. However, marine mammals are still sensitive to impacts from oil spills, and in particular from the hydrocarbons and chemicals that evaporate from the oil, particularly in the first few days following a spill event.

In this context, acute narcotic effects could be therefore caused by sustained exposure to dissolved compounds from the liquid oil droplets, especially the soluble aromatics. Acute impacts are typically defined as occurring within four days. Ingestion or contact with tiny liquid droplets may cause additional stress or mortality upon the organisms in this region. Dilution and biodegradation will typically reduce these concentrations to sub-lethal levels within days to weeks. However, even at sub-lethal levels, impacts may occur due to chronic impacts from prolonged exposure to these dissolved concentrations.

Symptoms of acute exposure to oil include irritation to the eyes and lungs, lethargy, poor coordination and difficulty with breathing. Individuals may then drown as a result of these symptoms, as shown by studies carried out with seals.

- *Marine Turtles*

Turtles are sensitive to the effects of oil spills at all life stages: eggs, post hatchlings, juveniles and adults. Several aspects of sea turtle biology place them at particular risk. These include a lack of avoidance behaviour, indiscriminate feeding around the sea surface and large pre-dive inhalations at the sea surface. Potential direct impacts from oil spills to sea turtles include:

- Increased egg mortality and developmental defects;
- Direct mortality due to oiling in hatchlings, juveniles and adults; and
- Negative impacts to skin, blood, immune systems and salt glands.

In addition, sea turtles are sensitive to potential secondary and longer term impacts, which are generally less obvious than the short term impacts immediately following a spill. These impacts include:

- Behavioural effects (e.g. disorientation) resulting from loss of smell sensors;
- Contamination of food supply and reduction in available food levels; and
- Influences on sea turtle development and behaviour caused by subtle changes in sand temperature color and when spills impact the shoreline (e.g. because sex determination in turtles is temperature dependent, shifts in sand temperature caused by oiling could potentially change hatchlings sex ratios).

- *Coastal Habitats*

Along the shores of STP, the different coastal areas ((sandy and rocky marine shores, coastal lagoons, estuarine wetlands and mangrove forests) are at risk. Each type of coastal habitat is considered sensitive to oil spills, however, lagoons and wetland habitats are considered particularly sensitive as they tend to support higher levels of biodiversity, and be the place of fish nurseries that allow the stocks to be replaced, and bird feeding areas.

If an oil spill reaches the shore in these areas toxic concentrations of oil may develop in the shallow water and given the long persistence time of the oil effects may be encountered for a long period. If oil enters into an open lagoon or wetland it is expected that oil components will adhere to the flat substrate and remain for long periods there affecting the whole ecosystem, as these areas are characterized by having low removal rates due to the absence of waves.

In mangrove stands, oil slicks may enter the mangroves when the tide is high and be deposited on the aerial roots and sediment surface as the tide recedes. The oil clogs the pores in the aerial roots and if many roots are oiled, the respiratory system collapses and the trees die.

- *Fish Stocks*

The offshore and coastal waters in STP support a significant diversity of fish species, many of which are targeted by the artisanal and commercial fisheries. Most fishing activities occur from the coast to the edge of the continental shelf. Fish nursery areas that exist along the coastline are vital at sustaining fish stocks in coastal areas.

Typically, adult fish are not considered highly sensitive to impacts from oil spills. Adults are mobile and generally able to detect heavily contaminated areas or areas of low water quality. In open waters, fish have the ability to move away from an area of pollution, and are therefore either unaffected by oil or affected only briefly. As such, it is unlikely that fish are significantly affected by oil in open water.

Fish kills may occur, however, as a result of high exposure to emulsified oil / freshly spilled diesel in shallow waters (such as in lagoons) and oil pollution may clog fish gills causing asphyxiation.

At the population level effects can be short lived due to the death of affected individuals and the persistence of healthy individuals unaffected by contamination. Non-lethal negative effects are more usual and fish can be affected in the long term in some circumstances, especially when oil spills reach shallow or confined waters. Fish exposed to elevated concentrations of hydrocarbons absorb contaminants through their gills, accumulating it within their internal organs which can lead to long-term, sub-lethal effects. In addition, spilled oil in confined and shallow waters, such as lagoons, poses a threat to fish eggs and larvae which cannot actively avoid oil. Fish eggs and larvae are mostly in the upper planktonic layers, and hence are affected and heavy mortalities often result. Lethal effects on the population as a whole are rare but can be long-term, sub-lethal effects are possible, particularly if a major spawning area is affected.

In terms of the vulnerability of impacts to fish stocks from an oil spill, while fish in open waters are not particularly sensitive, the species found in coastal lagoons are highly sensitive. These areas are spawning grounds and nursery areas for young fish.

- *Fisheries*

STP waters are particularly rich in commercially relevant species and the fishing activities along the coast are important from a socio-economic perspective (fish exports, employment and source of food).

In the event of an oil spill reaching either coastal waters, or beaches within coastal lagoons, fisheries are usually temporarily banned by the regulatory authorities to avoid contamination of fish being lifted through the slick on the surface waters, to prevent gear contamination, and more important to prevent the introduction of polluted fish into markets. Fishing therefore becomes difficult or impossible in areas directly affected by an oil spill as gear will be smeared in oil and the catch might be spoiled. The fishermen might for a period be forced to stop or temporarily move to other fishing grounds free of oil slicks. Fishing communities along the coastline will therefore be affected on their livelihood during the closure, resulting in a reduction in both food and economic resources.

In addition, tainting of fish will reduce the quality of the fish landed and sold to traders, leading to a reduction in prices or even to health problems.

Given the importance of artisanal fishing along the STP coast, fisheries are considered highly sensitive to impacts resulting from an oil spill that reaches coastal waters.

Risk level Assessment

The magnitude of the environmental consequence has just been discussed so the likelihood needs to be added to the assessment. The probability criteria for the considered scenarios were determined as: unlikely for the LD (Large diesel spill scenario) and highly unlikely for the BO's (both Blowout scenarios). Environmental risk is a combination of the likelihood of the spill occurring and the magnitude of consequence (considering sensitivity/value of receptor and size of the potential event), as seen in *Table 5.8.*

Table 5.8 Overall Environmental Risk Matrix

Potential Consequence	Frequency of Occurrence				
	1. Highly unlikely	2. Unlikely	3. Possible	4. Probable	5. Likely
1. Major	BO's (yellow)	(yellow)	(yellow)	(red)	(red)
2. Moderate	(green)	LD (yellow)	(yellow)	(yellow)	(red)
3. Minor	(green)	(green)	(yellow)	(yellow)	(yellow)
4. Negligible	(green)	(green)	(green)	(yellow)	(yellow)

Colour Code:	
(red)	Intolerable and must be reduced
(yellow)	ALARP Zone: need to demonstrate that likelihood of occurrence has been reduced to as low as reasonably practicable and that contingency measures are in place to minimize consequence
(green)	Continuous improvement

Source: ERM, 2017

It must be noted that the results obtained by the oil spill modelling presented in the addendum consider the absence of mitigation measures after the event, which would be part of the OSCP. That is done on purpose in order to better plan the details of the OSCP. Under normal conditions, and as part of the OSCP, oil and diesel recovery would be attempted and/or the use different and effective spill response devices such as chemical dispersants (once approved by authorities) as well as containment domes which would reduce the impact from that predicted by the model.

Control / Mitigation Measures

In order to achieve the objectives of 'As Low As Reasonably Practicable' (ALARP), GALP will implement a range of prevention measures designed to minimise the risk of any oil spills.

A number of design measures will be introduced to reduce the risk of spill from operations such as leaks from on-board the drillship/SS, releases of hydrocarbons from vessel collision and refuelling etc. Design measures will also be introduced to reduce the risk of blow-out. A summary of the mitigation measures to be implemented by GALP during the exploration and appraisal drilling program is provided below:

- Following established drilling safety standards to manage potential drilling hazards and minimize the risk of control loss.
- Comprehensive operational planning, risk assessment and provision of suitably specified equipment for drilling.
- Blow Out Preventors (BOPs) will be installed during the drilling activities.
- An Oil Spill Contingency Plan (OSCP) and Emergency Response Plan (ERP) will be implemented.
- Reporting of any spill to the environment to STP authorities together with response action taken.
- Handling and deployment of oil spill response equipment training for vessel personnel, as appropriate.
- Drillship and vessels will comply with IMO codes for prevention of oil pollution and have onboard Shipboard Oil Pollution Emergency Plans (SOPEPs).
- Approach procedures and poor weather operational restrictions.
- HSE capabilities of the drillship/SS and vessels contractors will be reviewed.
- Regular maintenance and inspection of equipment and high spill risk points.
- Procedures in place for bunker transfer to minimize the risk of spillage.
- Use of bulk handling methods and non-return valves for diesel.
- Lube and hydraulic oil will be stored in tanks or sealed drums and will be well secured and stored in bunded areas.

Despite comprehensive prevention measures in place, the residual risk of an oil spill remains. An approved Oil Spill Contingency Plan (OSCP) will be in place for the proposed drilling operations, including access to Tier 1 and 2 resources, such as use of containment domes, use of floating barriers/skimmers, use of approved dispersants etc., as well as Tier 3 equipment provided by international providers.

Residual Risk

The risks of these individual activities may affect the biophysical and human environment in various ways, but are expected to be '**Tolerable if ALARP' (As Low As Reasonably Practicable)**" for the three spill scenarios on the basis that:

- The most likely spills associated with the project would be small scale.
- These likely spills can be mitigated via the project oil spill response measures.
- Large oil spills are highly unlikely to occur.

5.10 CUMULATIVE IMPACTS

Cumulative impacts are the result of the combined effect of individual impacts, which may be of no significance when taken individually, but which can have a non-negligible cumulative impact.

The potential for the Project to have cumulative impacts with other activities and with known or committed developments taking place in the area at the same time have been considered. This Section presents the assessment of the cumulative impact risk associated with the main receptors assessed in the previous sections.

Activities in the vicinity of the offshore Project area have the potential to cause cumulative impacts. The activities considered in assessing offshore cumulative impacts include:

- oil and gas exploration activities in the vicinity of the Project area; and
- shipping and fishing related traffic in the Project area.

Interference with shipping and navigation of other sea users

The vessels taking part in the Project activities will increase shipping traffic in the area, which could increase the risk of collision between vessels. The prospective onshore port to be used in African mainland is expected to harbour significant O&G related maritime traffic from other geographies along the west Africa coast. No particular mitigation or management measures are required to address this cumulative impact.

Noise disturbance to marine fauna

Cumulative impacts linked to submarine engine noise could be large scale if there was a large amount of shipping traffic in the Project area, or if seismic acquisition surveys were taking place in neighbouring blocks over the same period. It is expected that seismic acquisition campaigns in Blocks 10 and 13 may be conducted in 2019 (Block 10 is adjacent to the western section of Block 6); however, noise disturbance to marine fauna caused by the drilling Project will be localised, considering a maximum of three drilling sites and temporary nature of the activities, in addition to the relatively low traffic in the Project area, these cumulative impacts are not considered to be significant.

Atmospheric Emissions

Atmospheric emissions result from the combustion of diesel fuel by the various vessels taking part in the Project. Taken separately, these emissions are small, intermittent and localised and will not constitute any significant deterioration of the air quality in the Project area.

Other possible contributors to air emissions are the other vessels crossing the area. However, the cumulative impact of emissions generated by all shipping traffic in the area should not lead to any significant deterioration of the air quality and no particular mitigation or management measures are required to address this cumulative impact.

The emissions of the project alone are estimated to represent 0.0002% of the country's yearly GHG emissions (see *A.1.2: Impacts on climate change due to the release of air pollutants*).

Waste Generation and Effluent Discharge

The Project's waste generation (including both liquid and solid waste, whether hazardous or not) will be localised, of small scale, and limited in time. No other significant waste generators have been identified in the vicinity of the Project area and the cumulative impacts linked to the generation and management of waste by other sea users is considered to be Not Significant.

5.11 *SUMMARY OF IMPACTS FROM ACCIDENTAL EVENTS*

The evaluation of impacts associated with accidental events is presented in *Table 5.9.*

Table 5.9 Evaluation of the Significance of Potential Environmental Impacts associated with Block 6 exploration activities (Accidental Events)

Receptor	Project Activity	Impact Description	Impact Significance	Mitigation and Control Measures	Residual Risk
Impacts from Accidental Events					
Seabirds and Coastal Birds	Crude Oil and Diesel Spill	• Stains of oil on the plumage may destroy the insulating and water repelling properties which may ultimately cause the death of the bird. • Toxic effects after the ingestion of oil during preening, ingestion of oiled prey, inhalation of oil fumes or absorption of oil through skin or eggs may also lead to death. • Indirect effects may result from destruction of bird habitats or food resources.	**Major**	• Following established drilling safety standards to manage potential drilling hazards and minimize the risk of control loss. • Comprehensive operational planning, risk assessment and provision of suitably specified equipment for drilling. • Blow Out Preventors (BOPs) will be installed during the drilling activities. • An Oil Spill Contingency Plan (OSCP) and Emergency Response Plan (ERP) will be implemented. • Reporting of any spill to the environment to STP authorities together with response action taken. • Handling and deployment of oil spill response equipment training for vessel personnel, as appropriate. • Drillship and vessels will comply with IMO codes for prevention of oil pollution and have onboard Shipboard Oil Pollution Emergency Plans (SOPEPs). • Approach procedures and poor weather operational restrictions. • HSE capabilities of the drillship/SS and vessels contractors will be reviewed. • Regular maintenance and inspection of equipment and high spill risk points. • Procedures in place for bunker transfer to minimize the risk of spillage. • Use of bulk handling methods and non-return valves	**Tolerable if 'ALARP'**
Marine Mammals	Crude Oil and Diesel Spill	• Symptoms of acute exposure to hydrocarbons and chemicals from oil spills include irritation to the eyes and lungs, lethargy, poor coordination and difficulty with breathing. Individuals may then drown as a result of these symptoms.	**Moderate**		**Tolerable if 'ALARP'**
Marine Turtles	Crude Oil and Diesel Spill	• Increased egg mortality and developmental defects; • Direct mortality due to oiling in hatchlings, juveniles and adults; and • Negative impacts to skin, blood, immune systems and salt glands. • Behavioural effects (e.g. disorientation) resulting from loss of smell sensors; • Contamination of food supply and reduction in available food levels; and • Influences on sea turtle development and behaviour caused by subtle changes in sand temperature color and when spills impact the shoreline (e.g. because sex determination in turtles is temperature dependent, shifts in sand temperature caused by oiling could potentially change hatchlings sex ratios).	**Major**		**Tolerable if 'ALARP'**
Coastal Habitats	Crude Oil and	• Toxic concentrations of oil may develop in the shallow water	**Major**		**Tolerable if 'ALARP'**

Receptor	Project Activity	Impact Description	Impact Significance	Mitigation and Control Measures	Residual Risk
	Diesel Spill	• Long persistence time of the oil effects may be encountered for a long period. • Destruction of lagoon or wetlands as there is no wave action to remove the oil and oil components tend to adhere to the flat substrate preventing removal by tides. • Destruction of mangrove stands – exposure of aerial roots to oil clogs the and if many roots are oiled, the respiratory system collapses and the trees die		for diesel. • Lube and hydraulic oil will be stored in tanks or sealed drums and will be well secured and stored in bunded areas.	
Fish Stocks	Crude Oil and Diesel Spill	• Clog fish gills causing asphyxiation • Fish exposed to elevated concentrations of hydrocarbons absorb contaminants though their gills, accumulating it within their internal organs which can lead to long-term, sub-lethal effects. • Smothering of fish eggs and larvae	**Moderate**		**Tolerable if 'ALARP'**
Fisheries	Crude Oil and Diesel Spill	• Loss of revenue from fishing bans • Damage to fishing vessels and equipment • Reduction in both food and economic resources	**Major**		**Tolerable if 'ALARP'**

6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

6.1 INTRODUCTION

This chapter provides a description of how the mitigation measures identified in *Chapter 5 Impact Assessment* will be incorporated into the Project design and subsequently implemented throughout the duration of the exploratory and appraisal drilling programme.

The ESMP identifies actions required, assigns responsibilities and sets timings for completion. The plan will be incorporated into the overall environmental and social management of the project and will be incorporated into the corresponding contract agreements (e.g. drilling and vessel contractors). The plan will act as a "live" document to track progress through to completion of the drilling programme. The plan also provides a mechanism for monitoring the environmental performance of the contractor, and where required instigating further remedial action as required.

The mitigations measures and the parties responsible for their implementation are summarised below and presented in *Table 6.1*

6.1.1 ESMP Objectives

The ESMP is designed to serve as the connection between the mitigation and management measures identified in this ESHIA and the drilling programme execution with the following main objectives:

- Providing the mechanism to ensure compliance with STP legislation, GALP HSE policies, management system and procedures, international law and standards, and good Oil & Gas industry best practices; providing the mechanism for ensuring that all proposed mitigation measures identified in the ESHIA to mitigate potentially adverse impacts are implemented;
- Providing a framework for mitigating impacts that may be unforeseen or unidentified;
- Evaluating effectiveness or inefficiency of these mitigation measures and, if required, modify them or include new mitigation/preventive measures; and
- Establishing a monitoring programme and record-keeping protocols so that pertinent additional information that was not available during the compilation of the ESHIA can be collected in order to provide quality assurance for the conclusions of the ESHIA.

The ESMP is an integral part of the system that also has the longer term objectives of:

- Ensuring that health, safety, social and environmental issues are integrated into the business risk management and decision-making process;
- Rationalising and streamlining health, social and environmental activities throughout the lifetime of the Project to add value and efficiency;
- Encouraging and achieving the highest environmental performance and response from all employees and contractors;
- Providing the standards for overall planning, operation and review; and
- Enabling management to establish environmental priorities.

In addition, the ESMP serves as a set of contractual clauses and specifications that define the Contractor's (e.g. drilling and vessel contractors) environmental and social responsibilities at the tendering stage. The present ESMP, covering the exploratory and appraisal drilling activities along Block 6, is in line with the ESMPs developed for activities in Blocks 5, 11 and 12 that are included in the correspondent standalone ESHIAs.

6.2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

GALP as a licence holder for Block 6 will have an overall and ultimate responsibility for the proposed operations.

The environmental management of the proposed drilling programme will be conducted within a framework comprising:

- The Health, Safety, and Environment (HSE) Policy of GALP and HSE Management System which provides a framework through which health, safety and environmental priorities, responsibilities, and risks are systematically managed.

6.3 OPERATIONAL CONTROLS AND MITIGATION PROCEDURES

6.3.1 GALP Standards

GALP is committed to conducting its activities in a manner that incorporates health, safety, and environmental protection as core values. As part of the HSE Management System, GALP has developed the G+ System to be applied to all E&P projects and activities based on International standards in order to ensure a consistent approach across all operations (*Figure 6.1*). In all cases, operations must comply with the applicable legislative and local regulatory and international requirements.

Figure 6.1 GALP's HSE Management System

Source: GALP, 2018

Furthermore, GALP will apply its "Internal Guide of Integrating Biodiversity into Environmental and Social Impact Assessments Conducted in Connection with Upstream Projects", guidelines for integrating Biodiversity issues into Environment and Social Impact Assessments (ESIA) conducted in connection with Oil & Gas (O&G) projects.

6.3.2 *Other Standards, Guidelines and International Conventions*

GALP will comply with the requirements of applicable international and national maritime law and will follow best industry standards such as those promulgated by the International Marine Organisation (IMO), the International Association of Oil and Gas Producer s (IOGP, formerly E&P Forum) as well as the São Tomé and Príncipe Authorities.

More specifically, the following standards/guidelines/conventions will be followed:

- Environmental Standards and Guidelines applicable in São Tomé and Príncipe, such as the Health, Safety and Environment provisions in the Regulation of Petroleum activities of 2010 applicable within the Economic Exclusive Zone (EEZ);
- Convention for Cooperation in the Protection, Management, and Development of the Marine and Coastal Environment of the Atlantic Coast of the West, Central and Southern Africa Region (Abidjan Convention);
- African Convention on the Conservation of Nature and Natural Resources (the Algiers Convention, 1968);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, 1973);
- Convention of Biological Diversity (CBD, 1992);
- Basel Convention Controlling Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention, 1989);

- Bamako Convention on the ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa (Bamako Convention, 1991);
- Convention on Wetlands of International Importance (Ramsar Convention, 1971);
- Protocol of 27th November 1992 modifying the international Civil Liability Convention of 1969 and concerning oil pollution damage;
- International Convention for the Prevention of Pollution from Ships (MARPOL, 1973);
- United Nations Convention on the Law of the Sea (UNCLOS) (Montego Bay Convention, 1982);
- International Convention for the Safety of Life at Sea (SOLAS, 1974);
- Convention on the International Regulations for Preventing Collisions at Sea (COLREGs, 1972);
- United Nations Framework Convention on Climate Change, 1992;
- Kyoto Protocol, 1997;
- Vienna Convention for the Protection of the Ozone Layer, 1985 (Vienna Convention); and
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987).

In addition to the international conventions listed above, GALP will also consider, where appropriate, adhering to international standards including International Finance Corporation (IFC) guidelines, World Bank Environmental, Health and Safety (EHS) guidelines, IPIECA guidelines, Joint Nature Conservation Committee (JNCC) guidelines; International Atomic Energy Agency (IAEA) guidelines and topic-specific conventions that are not restricted to a specific geography or ratified by STP, such as the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM, 2004).

6.3.3 *Consultation and notifications*

It is important that the drilling contractor maintains regular communication with the relevant regulatory authorities as well as relevant stakeholders such as the Ministry of Infrastructure, Natural Resources and Environment (MINRE), the National Petroleum Agency (ANP-STP), maritime and port authorities, fisheries, shipping and other sea users.

Prior to the commencement of the drilling program, notification of drilling vessels details will be sent to ANP-STP and MINRE. These organisations will inform the relevant regional agencies and sub -departments concerned.

All appropriate environmental permits and any attached conditions will be obtained from MINRE. GALP will provide the drilling contractor with details on the environmental sensitivities within the project area and the procedures and mitigation measures to be applied while operating in these waters.

6.3.4 *Mitigation Framework*

The mitigation measures and the parties responsible for their implementation are summarized below and presented in *Table 6.1*.

All crew members, including any support craft, will be made aware of the standards and controls applicable to the conduct of the drilling programme before operations commence.

All equipment on board the vessels (including engines, compressors, generators, solids separation equipment, sewage treatment plant, oily water separators) will be regularly checked and maintained in accordance with manufacturer's guidelines in order to maximize efficiency and minimize malfunctions and unnecessary discharges to the environment during the drilling activities.

Wastes will be minimized, appropriately segregated and stored onboard prior to disposal at authorized and adequately equipped port reception facilities.

Clear lines of communication and operational procedures will be established between the drillship/rig and accompanying vessels before the start of the drilling activities.

6.4 *POTENTIAL IMPACTS AND MITIGATION MEASURES*

6.4.1 *Overview of Impacts Considered*

The ESHIA considered the following potential impacts from the proposed Project activities:

- Potential reduction in localized air quality and contribution to greenhouse gases as a result of emissions from mobilization and demobilization of the drillship, operation of the drilling unit, well testing (flaring), operation of the PSV and helicopter;
- Degradation of water and sediment quality as a result of routine and operational discharges of effluents and wastes to the sea (i.e. black and grey water, bilge water, ballast, etc.);
- Degradation of water and sediment quality as a result of the discharge of mud and cuttings;
- Impacts on seabed and benthic communities due to operation of the drilling unit, installation of well infrastructure, discharge and deposition of drill cuttings and muds and the performance of seismic activities (VSP) generating noise emissions;

- Impacts on plankton due to the change of seawater quality resulting from effluents and waste discharges to the sea as well as potential introduction of invasive or alien species into STP waters;
- Impacts on fish resulting from the noise emissions generated during seismic (VSP) activities and from the change of seawater quality due to the discharge of effluents and waste to the sea;
- Impacts on sea turtles and marine mammals resulting from the mobilization/demobilization and presence of the drillship, the potential collision risk with Project vessels, the generation of underwater noise emissions during seismic (VSP) activities, and impacts due to the change of seawater quality resulting from the discharge of effluents and waste to the sea;
- Impacts on seabirds resulting on disturbance due to the physical presence and movements of the drillship and the operation of the support vessels and helicopters as well impacts due to changes in water quality resulting from the effluent and waste discharges to the sea;
- Impacts on sensitive coastal areas resulting from the operation of the onshore facilities;
- Impacts on other sea users, increase of collision risk and disturbance of marine traffic resulting from project vessel movements;
- Impacts on fisheries, commercial and artisanal fishing activities resulting from the presence and operation of Project vessels and associated exclusion area for fisheries, the generation of underwater noise emissions due to VSP activities, and the changes in water quality;
- Positive socioeconomic impacts on the local economy, employment, and livelihoods as a result of project activities in general;
- Impacts on local infrastructure and services resulting from drilling activities and onshore operations;
- Impacts on community and workers' health and safety resulting from increased transmission of sexually transmitted infections and communicable diseases, increased worker-community interactions, and use and handling of hazardous materials; and
- Damage to receptors and resources as a result of accidental events – impacts resulting from accidental events including fuel spills from vessels, hydrocarbon or crude spills as a result of well blow-out and loss of radiation emitting well logging tools.

6.4.2 Issue Specific Management Plans and procedures

In support of the drilling operations and as per the standard practice in the offshore O&G industry, a number of management plans and procedures will be develop prior to the start of the drilling activities. These will serve to address key areas of potential environmental/social impact requirement and therefore are being mentioned along the relevant sections of the ESMP.

This section summarises the requirements for these issue specific management plans[1]:

- Waste Management Plan (WMP) (including Cuttings & Mud Management).
- Ballast Water Management Plan (BWMP).
- Emergency Response Plan (ERP).
- Oil Spill Contingency Plan (OSCP).
- ShipBoard Oil Pollution Emergency Plan (SOPEP).

A summary of the objectives and contents of the plans are summarized in the following sections.

Waste Management Plan (WMP)

A Waste Management Plan (WMP) will be developed for the Project to establish waste streams, procedures for the storage, packaging and labelling of waste, including liquid and solid waste and hazardous and non-hazardous wastes, define transportation procedures for final disposal, and to define the responsibilities associated to waste management activities. This plan also includes procedures for the management of drill cuttings and muds.

The following activities are developed in the waste management plan:

- Waste generation at the drilling unit, supply vessels, and onshore logistics base.
- Temporary waste storage at the drilling unit, supply vessels, and onshore logistics base.
- Waste sea transportation from offshore to the onshore base.
- Waste unloading at the onshore base.
- Waste land transportation from the onshore base to the final destination of the waste.
- Supervision of the contractors that will be in charge of waste treatment and management.

The final onshore destination for disposal of the waste will be included in the plan. Good international practice requires a commitment to adopt the various measures aimed at preventing inappropriate discharges of wastes at sea. These measures must be put into practice on the drilling unit, PSVs and onshore support facilities. As so, the project's waste management first

[1] It should be noted that these plans are not part of the ESHIA Report but management plans that need to be in place prior to the start of the operations.

reference will be the STP Legislation, international legislation and GALP Standards.

Ballast Water Management Plan (BWMP)

The discharge of ballast water into the marine environment is controlled by the International Convention for the Control and Management of Ship's Ballast Water and Sediments (2004). Even though STP is not signatory of this convention, the use of an onshore base in an African mainland port, the drillship and the support vessels involved in the Project will undertake ballast operations in accordance with this convention. As so each Project vessel will have a Ballast Water Management Plan.

The function of the Ballast Water Management Plan is to assist in complying with measures intended to reduce the harmful effects on the marine environment that are spread through aquatic microorganisms transferred from one area to another through ballasting operations of the ship, while maintaining ship safety.

The BWMP will include the following elements:

- A description of the ballast water management system on each vessel, and how it operates.
- Procedures for monitoring and reporting including STP regulatory compliance requirements.
- Operational along with the method to be used for ballasting as well as safety aspects.
- The locations at different coastal water for ballast exchange.
- Sampling point and treatment method.
- Roles and responsibilities of the personnel on board for carrying out ballast operation.

Emergency Response Plan (ERP)

The purpose of the ERP is to assist the GALP Emergency Response and Incident Management Teams (ERT and IMT respectively) of Block 6 to prepare for and respond quickly and safely to any incident within the Block 6 onshore and offshore operational boundaries, regardless of incident type and size.

The specific objectives of the Block 6 ERP are the following:

- Define notification, activation and mobilization procedures of the ERT-IMT to be followed when an incident or threat of an incident occurs.
- Describe positions on the ERT and IMT and define the roles and responsibilities of team members, including organizational structure and lines of responsibility to be adhered to during an incident response.

This plan shall contain procedures applicable to foreseeable incident scenarios for the Block 6 drilling activities. The plan shall define the emergency response organization, the incident notification procedure, the assessment process of an incident, the emergency team activation process, the response planning, the incident stand down as well as training and emergency exercises requirements and objectives.

Oil Spill Contingency Plan (OSCP)

Specific to the emergency scenario of an oil spill risk, a Block 6 Oil Spill Contingency Plan will be developed, as per relevant best practice guidelines.

The oil spill contingency plan will provide a detailed oil spill response and removal plan that addresses controlling, containing, and recovering an oil discharge in quantities that may be harmful to navigable waters or adjoining shorelines.

It will include:

- A definition of the authorities, responsibilities, and duties of all entities involved in oil removal operations.
- Procedures for early detection and timely notification of an oil discharge.
- Assurance that full resource capability is known and can be committed following a discharge.
- Actions for after discovery and notification of a discharge.
- Procedures to facilitate recovery of damages and enforcement measures.

With regards to GALP's Oil Spill Response Strategy, GALP adopts the internationally recognised Tiered response system for assessing the severity of an oil spill. The purpose of the three levels is to establish, as soon as possible, what is the correct level response to combat the spill. The severity of the spill depends on the size of the spill, the complexity of the response, and the potential socioeconomic consequences for people and for the environment.

Shipboard oil Pollution Emergency Plan (SOPEP) and Shipboard Marine Pollution Emergency Plan (SMPEP)

Regulation 37 of MARPOL Annex I requires that all ships of 400 gross tonnage and above carry an approved Shipboard Oil Pollution Emergency Plan (SOPEP). The purpose of a SOPEP is to assist personnel in dealing with unexpected discharge of oil, to set in motion the necessary actions to stop or minimize the discharge, and to mitigate its effects on the marine environment. This regulation requires the SOPEP to include the following as a minimum:

- The procedure to be followed by the master or other persons in charge of the ship to report an oil pollution incident, as required in article 8 and

Protocol I of the MARPOL Convention, based on the guidelines developed by the IMO.

- The list of authorities or persons to be contacted in the event of an oil pollution incident.
- A detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of oil following the incident; and
- The procedures and point of contact on the ship for coordinating shipboard action with national and local authorities in combating the pollution.

Each vessel used by the Project, including the drilling unit and the PSV's, will have a SOPEP that is suitable to respond to its own specific risk inventory.

Regulation 17 of MARPOL Annex II applies if the drilling unit carries drilling muds in bulk. It stipulates that every ship of 150 gross tonnage and above that is certified to carry noxious liquid substances in bulk shall carry on board a Shipboard Marine Pollution Emergency Plan (SMPEP) for noxious liquid substances approved by the Administration. The SMPEP should consist of at least the following:

- The procedure to be followed by the master or other persons in charge of the ship to report a noxious liquid substances pollution incident, as required in article 8 and Protocol I of the present Convention, based on the Guidelines developed by the IMO;
- The list of authorities or persons to be contacted in the event of a noxious liquid substances pollution incident;
- A detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of noxious liquid substances following the incident; and
- The procedures and point of contact on the ship for coordinating shipboard action with national and local authorities in combating the pollution.

MARPOL dictates that the SMPEP may be combined with the SOPEP. A Shipboard Marine Pollution Emergency Plan will be prepared by GALP for the Project's drillship/rig.

6.5 RESPONSIBILITIES

GALP's Role and Responsibility

GALP will ensure that the project is carried out in accordance with GALP HSE Policy and in line with the GALP Health, Safety, and Environmental Management System. Although contractors will carry out most of the HSE critical activities GALP will retain the overall responsibility and accountability for managing the Contract, including HSE (Health, Safety and Environment).

The different roles within GALP organization are explained below.

GALP Drilling Manager

The Drilling Manager will be the GALP Representative. He/she will be based in GALP's onshore offices either in STP or Lisbon, and will be responsible for ensuring all operations are performed consistently with the performance objectives detailed in the ESMP; for reporting all incidents through to GALP and notifying relevant authorities as required, as well as for ensuring all personnel receive GALP's environmental training prior to commencement of drilling and immediately notifying the Incident Management Team of any spills when appropriate.

GALP Drilling Supervisor (Company Man)

While the rig is drilling at any GALP drilling location, the Drilling Supervisor (DSV) will provide any relevant assistance or advice to the Rig OIM, regarding the health, safety & welfare of personnel on board.

The Drilling Supervisor will be responsible for:

- Ensuring all activities are carried out in a safe and efficient manner at the drilling location and for proactively promoting health, safety and welfare of all personnel on the Rig;
- Ensures that all work programs are carried out to the appropriate standard, and in a timely manner, without injury or risk to any person working offshore, whilst giving due consideration to GALP's Reputation;
- Responsible for the safe implementation of the drilling program through the Senior Toolpusher and service company personnel;
- Reports directly to the GALP Drilling Manager;
- Ensures that the HSE Bridging and interface document requirements including training and safety meetings are fully implemented during work activity;
- Exercises the authority and responsibility to stop any work that they feel could result in injury or destruction of equipment or property.
- The DSV will not be a GALP employee, but a consultant with relevant experience for the project or a KOSMOS employee.

Offshore Installation Manager (Drilling Contractor Offshore)

The Offshore Installation Manager (OIM) is the highest authority on the drilling unit and will be responsible for ensuring all operations aboard the drilling unit is carried out in a manner consistent with the ESMP. He/she will ensure that GALP's HSE policy is followed, and for monitoring performance against relevant environmental procedures, legislative requirements, commitments and conditions applicable to the drilling program. He/she is charged with ensuring all personnel are adequately trained and is responsible for notifying the GALP Senior Drilling Supervisor of any incidents arising from operations that may have an adverse impact on the performance objectives in the ESMP.

The OIM has the authority to overrule a decision made by the Drilling Supervisor if not in accordance with drilling contractor HSE policy or could expose rig personnel or rig equipment to a risk that has not been mitigated in a proper and adequate way.

GALP HSE Coordinator (Onshore)

The GALP HSE Coordinator will be responsible for providing expertise on safety issues that may arise during the conduct of emergency response operations as well as for managing all environmental matters. He / she will be responsible for reviewing the drilling contractor's HSE management plans for acceptability and ensuring compliance with the GALP ESMP, reviewing environmental audits to ensure compliance with the agreed environmental performance objectives and providing advice in the event of an oil spill or other environmental incidents. He / she will receive support from the GALP HSE Supervisor on the drilling unit and GALP Shore Base HSE Supervisor.

GALP Rig HSE Supervisor (Rig and Shore)

The HSE Supervisor (rig and shore) will be responsible for:

- Provide analysis tracking of HSE hazards as part of Pre-Start Safety Reviews, Mechanical Integrity & Critical Equipment inspections, and Incident investigation processes. Review and follow up.
- Liaise with Contractors HSE representatives.
- Assure that all Personnel have completed the required HSE training prior to work onsite. Record Personnel onsite along with required records and documentation for regulatory compliance.
- Participate as the Onsite Safety Advisor for Tactical Management Team as part of the Emergency Management Plan.
- Support field execution of contractors Health Safety and Environment program. Assist with implementation of Contractor HSE bridging document requirements.
- Advising rig and shore base supervisors and personnel on safety, health, and environmental related issues.
- Conduct worksite inspections, coaching and mentoring to ensure compliance with safe working practices and in particular all applicable regulations and requirements.
- Conduct Health, Safety, and Environment inspections as stated in GALP and local regulations.

- Assist in conducting emergency training exercises as needed at the rig and/or shore base.
- Ensure reporting of contractor incident, accident, and safety indicators.

Drilling Contractor Requirements

The ESMP will be the overarching contractual document for all environmental and social management requirements to which all contractor and subcontractor plans and documents will be aligned. It will be provided to all relevant contractors for the project, who will be required to include the following provisions to ensure that the ESMP is effective:

- Clearly defined roles and responsibilities for the execution of the ESMP.
- Ensure that all crew and supply base staff or contractors are familiar with GALP's Norms and Standards.
- Appropriate reporting and remedial action procedures to ensure that any incidents are reported promptly and dealt with effectively.
- Review, assessment and revision of the ESMP as required.

All contractor documentation used to bridge to the main ESMP, and hence facilitate the implementation of its requirements, will be subject to review and approval by GALP.

6.6 REPORTING

In addition to daily technical and drilling progress reporting required by GALP, it is recommended that the drilling contractor carries out the following reporting/documentation:

- Daily contact with the relevant port in the drilling area to update on survey progress and vessel position.
- Logging of all sightings and contacts with other vessels (e.g. fishing or cargo vessels).
- Logging of all health, safety and environmental accidents and incidents, including any incidents involving cargo or fishing vessels in STP waters.
- End of drilling programme report to include the final HSE report with details of HSE accidents and incidents and environmental performance, and fishing equipment removed as described above.

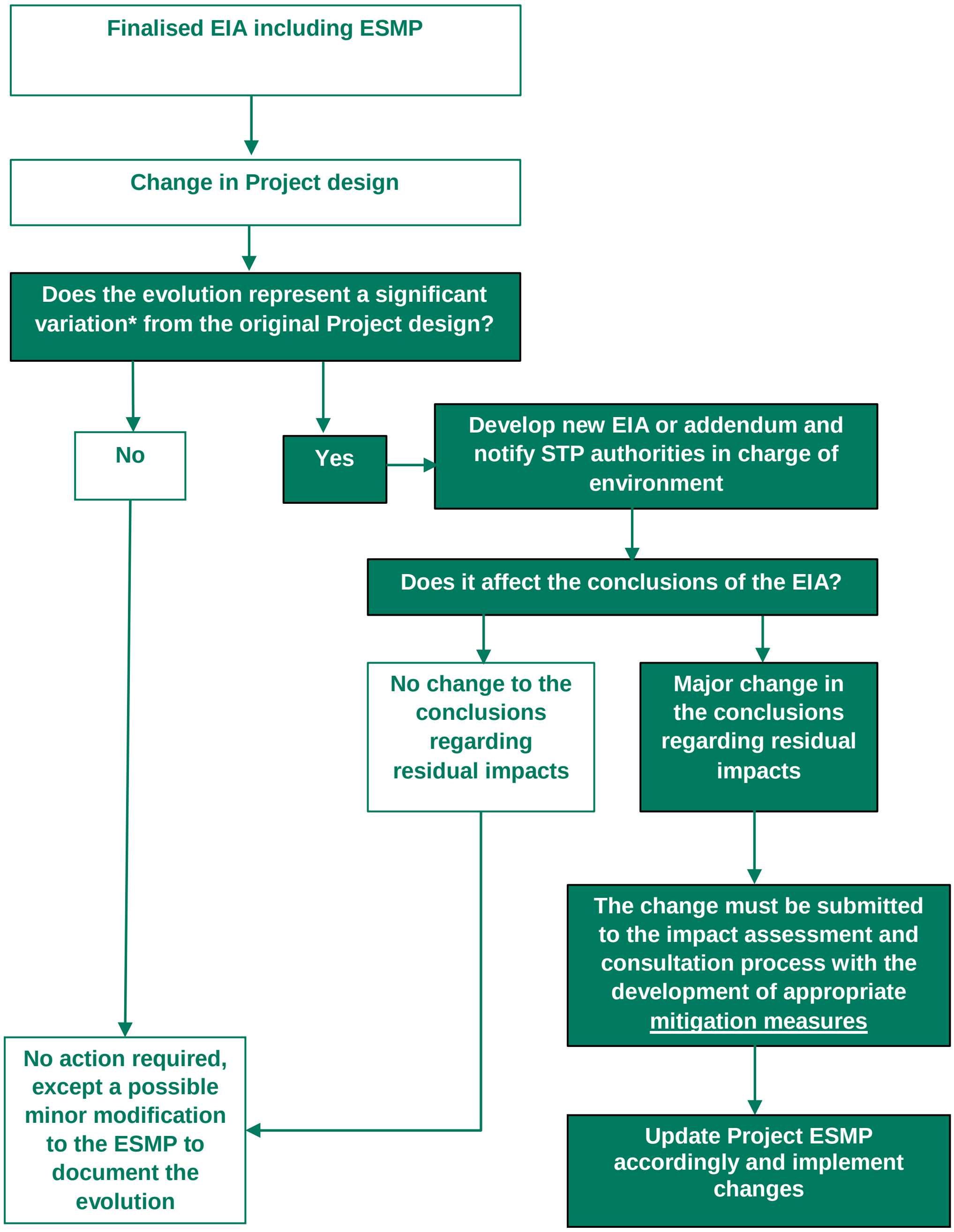
Incase of any HSE incidents, GALP will conduct a proper incident investigation and prepare a respective report detailing the events and corrective and preventative measures implemented. All incidents where local regulatory standards are exceeded will be reported to the authorities in STP.

6.7 *MANAGEMENT OF CHANGE*

In an operation with this dimension and duration there are uncertainties and changes that need to be addressed in a structured and transparent manner

As a result, GALP will implement a clear and transparent management of change procedure, in order to identify gaps, evaluate risks and uncertainties and to take them into account in line with its Internal Management of Change Documentation and Procedure. The procedure to manage this subject is shown in *Figure 6.2*. This procedure will be applied in case of changes from the original scope of work (e.g. equipment, operating procedures, materials and operating conditions) which would require to develop additional/ amended programs and/or add cost form the original estimated expenditure. Whenever these changes are planned or if they occur out of operational necessity, the Management of Change procedure will be implemented prior to the change.

Figure 6.2 Process for the management of change relating to the Project



*Source: GALP, 2018 (*a significant variation is considered to be one where the risk level of the Project changes).*

6.8 SUMMARY OF MITIGATION TO BE IMPLEMENTED AS PART OF THE PROJECT

A summary of the ESMP with its corresponding recommended measures is presented in *Table 6.1* below.

This section and *Table 6.1* is intended to be read in conjunction with the full text of the accompanying ESHIA document, which provides important context and background, as well as describing the impacts which the listed measures aim to mitigate or manage, and the residual impact which may remain.

Table 6.1 Summary of mitigation and monitoring measures to be implemented as part of the ESMP.

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring/ Recordkeeping Requirement	Reporting Requirements	Frequency/ Timing
Routine Events								
1	**Air Quality and Climate Change**	Routine drillship/SS operation, support vessel and helicopter trips to shore	• Potential reduction in localized air quality and contribution to greenhouse gases	• Advanced planning to ensure efficient operations, including the planning of support vessels trips to shore. • All generators and equipment to be maintained and operated under manufacturer´s standards to ensure working as efficiently as possible. • Regular monitoring of fuel consumption and engine efficiency, considering potential reductions of greenhouse gas generation. • Well test duration and volume of produced hydrocarbons will be reduced as much as practical to meet the objectives of the test. • High efficiency (i.e., low NOx) burners will be used. • The flare will be visually monitored to ensure efficient combustion as well as for unburned hydrocarbons in case of malfunction of drop out capture. • A system to record flared hydrocarbons will be implemented and all emissions registered as part of the environmental management program for the project or operation. • The number of helicopter flights to be limited to those strictly necessary, without compromising operations or safety. • Subject to availability at onshore base port, the use of low-sulphur fuel where possible will be favored (compliance with Tier II of revised MARPOL 73/78 Annex VI which sets limits on sulphur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances).	Drilling contractor; PSV contractors; Helicopter contractor	• Monitor and record fuel consumption weekly • Maintenance record – as required • Verification of maintenance of equipment • Record of Low sulphur fuel use • Volume (mmscfd/bbls) of hydrocarbons flared during well testing • Visual monitoring of flare to ensure efficient combustion	N/A	Weekly when drilling unit and/or PSVs and/or helicopters are active. Drilling Rig HSE review prior to operations to verify all relevant systems Prior to start of activities and during well testing
2	**Seawater Quality**	Routine and operational	• Potential localized	• The vessels will be equipped with a sewage treatment unit compliant with MARPOL Annex IV	Drilling contractor; PSV	• Maintain an Oil Record Book	N/A	At all times when drilling

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
		discharges during the project (*i.e.* black and grey water, bilge water, ballast, etc.). Drilling and installation of well infrastructure, including the discharge of cuttings and muds	reduction in water quality, including increased turbidity and BOD • Potential introduction of alien invasive species from ballast water discharges	regulations, with International Sewage Pollution Prevention Certificate ("ISPPC "). • Discharges will comply with MARPOL Annex IV. • Food waste discharges will comply with MARPOL Annex V requirements (discharges of comminuted waste always more than 3 nm from the coast and while navigating). • Bilge and drainage water will be directed to an oil-water separator and treated to a level of <15ppm oil in water (compliance with MARPOL 73/78 Convention, Annex I). • Maintenance of an Oil Record book and a vessel's logbook. • All Ballasting activities will comply with the International Convention for the Control and Management of Ship's Ballast Waste and Sediments (BWM Convention), including: o all ballast water will be stored in specifically designated tanks to avoid cross contamination and remain free of oil; o ballast water discharges will be continuously monitored for oil sheen and in case of visibly oil contaminated ballast water discharges will be stopped; o ballast water exchange will take place at least 200 nautical miles from nearest land and at depths over 200 m; o any ballasting operations will be logged in a record book; and o the vessels will have a Ballast Water Management Plan (BWMP) in place. • NADF on cuttings will be reduced as far as is achievable with current technology. Mud on cuttings will not exceed an average of 6.9% before disposal. • The usage and discharge of drilling muds and fluids during drilling activity will be regularly monitored. • Lowest feasible toxicity NADF will be selected by	contractors	and a vessel's logbook • Record or estimate volume of sewage discharge – daily • Record /consignment note of wastes transferred to shore • Record estimates of food waste generation – daily • Monitor oil content of deck drainage prior to discharge - continuous • Daily visual inspection of discharge point to ensure absence of floating solids and discoloration of the water • Detailed Ballast Water Logbook – as required. • Ballast Water Management		unit and/or PSVs are active.

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
				GALP and used during drilling activities for all drilling sections. • Optimise operation of solids control system to maximise the useful life of drilling fluids by effective liquid/ solids separation and to minimise the quantity of fluid "lost" overboard with the cuttings. • Cuttings will be discharged by a caisson located at a sufficient depth to avoid impact to sea surface waters (10 m minimum).		Plan for each Project vessel • All applicable monitoring requirements for drill cuttings and mud discharge included under No. 3		
3	**Seabed and Benthic communities**	Drilling and installation of well infrastructure, including the discharge and deposition of cuttings and muds Vertical Seismic Profile activities.	• Generation of noise emissions • Loss of seabed, habitats and benthic fauna in the direct footprint of the well and where cuttings and cement are deposited • Potential localized and short term increase in total suspended solids (TSS) in the water column and near the seabed • Impacts on sediment quality and	• The volume of discharged cuttings and drilling muds will be monitored on a regular basis. • Lowest feasible toxicity NADF will be selected by GALP and used during drilling activities for all drilling sections. • GALP will aim to minimize the number and quantities of additives and will prioritize the selection of additives with a better environmental behaviour (i.e. elements included in the PLONOR list). • Visual inspections of the general pattern of the seabed sediments distribution around the drilling point will be conducted before and after the drilling operations using an ROV. This seabed imagery will be taken as part of GALP's monitoring system and thus the images will be taken in the near vicinity of the Block 6 wells. The seabed imagery conducted will be documented and shared with STP authorities'. • Drill cuttings from the sections where NADF is used will be treated onboard to ensure a maximum average content of 6.9% in weight of muds within the cuttings to be discharged. There shall be no discharge to sea of free oil coming from drilling fluids and cuttings (as determined by the static sheen test). • The NADF used will be recycled and reused. Once the drilling is finished the spare muds will be stored and sent ashore for return to supplier or appropriate	Drilling contractor; GALP	• Documentation of seabed features and benthic ecology findings • Measurement of oil on cuttings (OOC) prior to discharge – regular • Monitor continuously for visible oil sheen on the sea surface – continuous • Monitor and record volume (m^3), rate (bbls hr/hr) and type of drilling fluids and cuttings discharged into the sea	• Sharing marine environmental data including seabed features and benthic ecology findings with relevant STP authorities. • Contractor reports inventory of chemicals used and discharged at the end of drilling operations to GALP	At all times when drilling unit is active

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
			benthic organisms from contaminants contained in WBM directly discharged to seabed and SBM coated in cuttings discharged from the drillship/SS	disposal at authorized facilities. • The composition of the NADF to be used is not known at the moment, but as the ones to be used are virtually free of Polycyclic Aromatic Hydrocarbons (PAHs) the toxicity is still considered relatively low (EPA, 1996). They will always be Category III of OSPAR/OGP non aqueous fluids, i.e. with less than 1/1000 of PAHs and less than 0.5 /100 of total aromatics and with a composition including only the following type of chemicals: PLONOR or Non-CHARMABLE (C, D or E) as per the OSPAR Offshore Chemical Notification Scheme (OCNS). • The discharge of the cuttings from the drillship will take place at a sufficient depth to avoid impact to sea surface waters through a submerged caisson (10m minimum).		• Record of testing of cuttings mud residual volumes prior to discharge (Static Sheen Test) • Record /consignment note of cuttings transferred to shore • Record of composition and volume of mud additives used (for each section)		
4	**Plankton**	Routine and operational discharges during the project (organic liquid/solid discharges)	• Potential localized increase in organic matter and reduction in water quality	• Applicable embedded measures related to water quality will apply.	Drilling contractor; PSV contractors	See monitoring requirements specified under No. 2	N/A	At all times when drilling unit and/or PSVs are active
5	**Fish**	Routine operation of drillship/SS and support vessels. Vertical Seismic Profile	• Impacts due to the generation of noise emissions • Secondary impacts due to changes in water quality	• Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals). • Applicable embedded measures related to water quality will apply.	Drilling contractor; PSV contractors	See monitoring requirements specified under No. 3	N/A	At all times when drilling unit and/or PSVs are active

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
		activities.						
6	**Sea Turtles**	Physical presence of the drillship/SS and support vessels, including their movements Operation of drillship/SS and support vessels Vertical Seismic Profile activities.	• Disturbance from the presence of Project vessels; • Potential collision risk with Project vessels; • Impacts due to the generation of underwater noise emissions • Secondary impacts due to changes in water quality	• A Marine Fauna Observer onboard the drillship/SS will maintain watch for sea turtles during VSP operations. • Supply vessel operators should maintain awareness for marine mammals and sea turtles and take avoidance action if a collision seems likely, if safe to do so. • To the extent feasible GALP will reduce lighting spill. Furthermore, lighting on vessels at night will be kept to a minimum for safe operations. • Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals). • Applicable embedded measures related to water quality will apply. • Documentation and sharing with STP authorities' of relevant and applicable marine environmental data and opportunistic sightings of marine fauna.	Drilling contractor; PSV contractors	See monitoring requirements specified under No. 3 and No. 7	N/A	At all times when drilling unit and/or PSVs are active
7	**Marine Mammal s**	Physical presence of the drillship/SS and support vessels, including their movements Operation of drillship/SS and support vessels Vertical Seismic Profile	• Disturbance from the presence of Project vessels; • Potential collision risk with Project vessels; • Impacts due to the generation of underwater noise emissions • Secondary impacts due to changes in	Embedded measures related to noise generation: • Implementation of soft start or ramp up procedure for VSP activities and have onboard a Marine Fauna Observer, as recommended by the Joint Nature Conservation Committee (JNCC, 2017) guidelines during VSP activities; • Good maintenance procedures on vessel engines. Measures related to rest of identified impacts: • Vessels will use designated and relevant navigation channels where possible; • A Marine Fauna Observer onboard the drillship will maintain watch for marine mammals during VSP; • Supply vessel operators should maintain awareness for marine mammals, and take avoidance action if a collision seems likely, if safe to do so; • GALP will limit the transit of supply vessels in	Drilling contractor; PSV contractors	• See monitoring requirements specified under No. 3 • Record of marine fauna observations during VSP activities • Maintenance record – as required	Sharing data of marine environmental data including marine fauna observations with relevant STP authorities	At all times when drilling unit and/or PSVs are active

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
		activities.	water quality	coastal waters (12<Nm) at night hours to the extent possible, and in case this is not possible, speeds at coastal waters will be reduced at nighttime; • Applicable embedded measures related to water quality will apply.				
8	**Seabirds**	Operation of Project vessels and helicopters	• Disturbance from the presence and movements of Project vessels and helicopter flights. • Secondary impacts due to changes in water quality	• Helicopter route will be designed so as to minimize impacts and travel time over sensitive biological areas. • When large aggregations of seabirds or coastal birds are observed on the sea surface or on coastal wetlands, the helicopter will avoid flying over these sites to the extent possible. • Applicable embedded measures related to water quality will apply.	PSV contractor; Helicopter contractor	• Record of accepted navigation and helicopter routes • Monitoring requirements specified under No. 3 relative to water quality also apply	N/A	At all times when PSVs and/or helicopters are active
9	**Sensitive coastal areas**	Onshore operations	• Disturbance to sensitive coastal areas from onshore activities	• Applicable embedded measures related to water quality will apply.	GALP	• Verification of maintenance of equipment.	N/A	Prior to Project activities and in line with emergency response planning
10	**Other Marine Users**	Project vessels movements	• Impacts to maritime traffic • Increase of collision risk	• Notification to relevant marine authorities and advanced notice to mariners prior to commencement of the drilling program including notification of the establishment of the 500 m exclusion zone. • Vessels will use designated and relevant navigation channels where applicable and comply with designated exclusion zones. • Navigational marks and lights on the drill ship; • Safety exclusion zone will be monitored for the safety of the facility and other users of the area. • Ensure that vessels are equipped with collision risk reducing devices i.e. navigational lights and beacons, marker buoys, etc.	GALP; Drilling contractor; PSV contractors	• Monitoring of safety exclusion zone • Bridge logs (date, time, location) of encounters with vessels. • Records of vessel inspections • Records of incidents and near miss	Contractor notifies GALP in case of incident	Prior to the start of the drilling program At all time when drilling unit and / or PSVs are active

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
						events • Record and notification of presence of suspicious vessels		
11	**Fisheries**	Physical presence and operation of Project vessels Vertical seismic profile	• Impacts due to the presence of drillship/SS and associated exclusion area for fisheries • Impacts due to the generation of underwater noise emissions • Secondary impacts due to changes in water quality	• Engagement with fishing associations and STP fishery authorities will be undertaken. • Communicate with any fishing vessels or other navigators that are present in the vicinity of the exclusion zone around the drillship, ensuring that such vessels are able to alter their course in complete safety. • Ensure procedures are in place for dealing with claims in the event of damaged fishing gear due to the movement of support vessels. • Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals). • Applicable embedded measures related to water quality will apply. • Compliance with MARPOL requirements and good industry practice. • Operational controls contained in Waste Management Plan or other suitable plan or procedure.	GALP Drilling contractor; PSV contractors	• Keep logs (date, time, location) of encounters with fishing vessels. • Records of grievances / complaints received, actions taken, and responses provided	N/A	Prior to the start of the drilling program At all time when drilling unit and / or PSVs are active Recording of grievances ongoing
12	**Local Econom y**	Project activities in general	• Impacts on local economy, livelihood and employment	• Stakeholder Engagement Plan will be developed and implemented, including the implementation of a grievance mechanism with affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner. • Implement local employment and skills development policies where possible. • Employment opportunities will be advertised widely and requirement practices will be based on relevant labor legislation and organizational policies and strategies. • Implement local content strategy, which is aimed at	GALP	• Record of training of employees • Records and Minutes of Meetings of engagement with stakeholders. • Records of grievances / complaints	N/A	Ongoing activities

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
				building capacity and capability of Saotomean businesses to support the long-term development of the oil industry. • Develop contract conditions to ensure the requirement for local content and procurement is passed to contractors. • Applicable embedded measures related to fisheries impacts will apply.		received, actions taken, and responses provided		
13	**Local Infrastructure and Services**	Onshore operations Drilling activities	• Impacts on submarine infrastructures (i.e. marine cables) • Impacts on local water network	• Applicable embedded measures related to local economy impacts will apply.	Drilling contractor	• Records of incidents involving submarine infrastructure or local water network	• Contractor notifies GALP and GALP notifies relevant STP authorities.	At all time when drilling unit is active
14	**Community and Workers Health & Safety**	Project activities in general	• Increased transmission of sexually transmitted infections (STIs) and communicable diseases; • worker-community interactions resulting in lack of appreciation of local customs; • use and handling of hazardous materials.	• Pre-employment fit-to-work screening protocols will be implemented for all workers. • Regular health screening will be provided for all workers. • Training will be provided to all workers to improve awareness of transmission routes and methods of prevention of communicable diseases, STIs and vector borne diseases (i.e. malaria), as part of induction. • The Project workforce will be briefed on appropriate local code of conduct matters. • Cultural Awareness / Grievance Mechanism as part of Contractor HSSE Mobilization. • Program of stakeholder engagement including implementation of a grievance mechanism with Project-related affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner.	GALP	• Record of fit-to-work screening • Record of training programs and attendance • Monitor emergence of major pandemics through WHO alerts • Record stakeholder grievances received, actions taken, responses provided	N/A	Ongoing activities

Ref. No.	Receptor	Project Activity	Impact Description	Mitigation and Control Measures	Responsibility	Monitoring / Recordkeeping Requirement	Reporting Requirements	Frequency / Timing
Accidental events								
15	Seabirds and Coastal Birds Marine Mammals Marine Turtles Coastal Habitats Fish Stocks Fisheries	Crude Oil or Diesel Spill	• Symptoms of acute exposure to hydrocarbons and chemicals from oil spills • Impact on coastal habitats ecosystem • Loss of revenue from fishing bans • Damage to fishing vessels and equipment • Reduction in both food and economic resources	• Following established drilling safety standards to manage potential drilling hazards and minimize the risk of control loss. • Comprehensive operational planning, risk assessment and provision of suitably specified equipment for drilling. • Blow Out Preventors (BOPs) will be installed during the drilling activities. • An Oil Spill Contingency Plan (OSCP) and Emergency Response Plan (ERP) will be implemented. • Reporting of any spill to the environment to STP authorities together with response action taken. • Handling and deployment of oil spill response equipment training for vessel personnel, as appropriate. • Drillship and vessels will comply with IMO codes for prevention of oil pollution and have onboard Shipboard Oil Pollution Emergency Plans (SOPEPs). • Approach procedures and poor weather operational restrictions. • HSE capabilities of the drillship and vessels contractors will be reviewed. • Regular maintenance and inspection of equipment and high spill risk points. • Procedures in place for bunker transfer to minimize the risk of spillage. • Use of bulk handling methods and non-return valves for diesel. • Lube and hydraulic oil will be stored in tanks or sealed drums and will be well secured and stored in bunded areas.	Drilling unit contractor, PSV contractors	N/A	Incident Report Notification to competent authority in line with spill reporting requirements	At all times when drilling unit and / or PSVs are active

Source: ERM, 2018.

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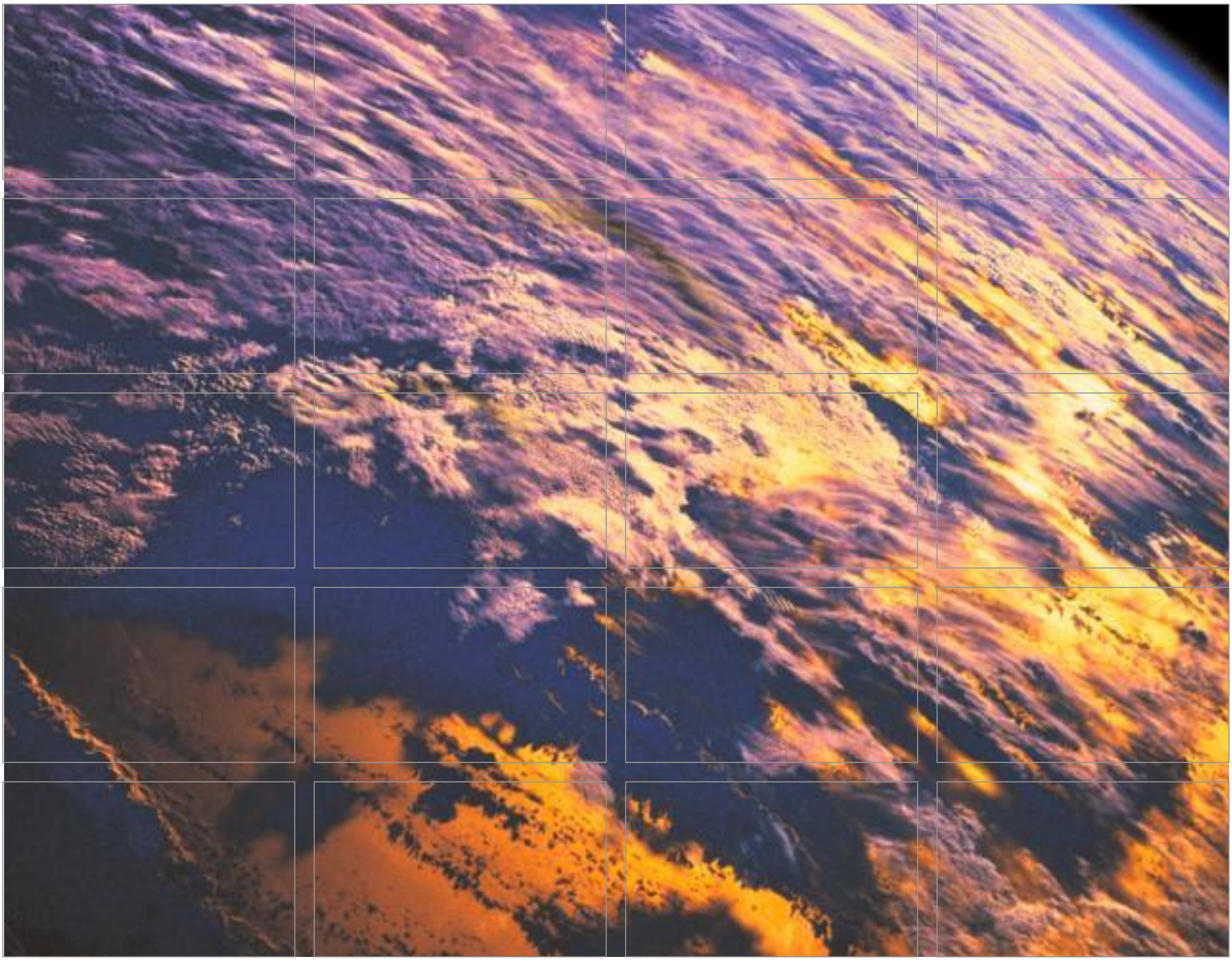
Annex A

Oil Spill and Drill Cuttings Deposition Modelling



Addendum

Modelling Technical Report Summary:

Blocks 5, 6, 11 and 12, São Tomé e Príncipe

Oil Spill and Drill Cuttings Deposition Modelling

September 2018

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1. SUMMARY MEMO

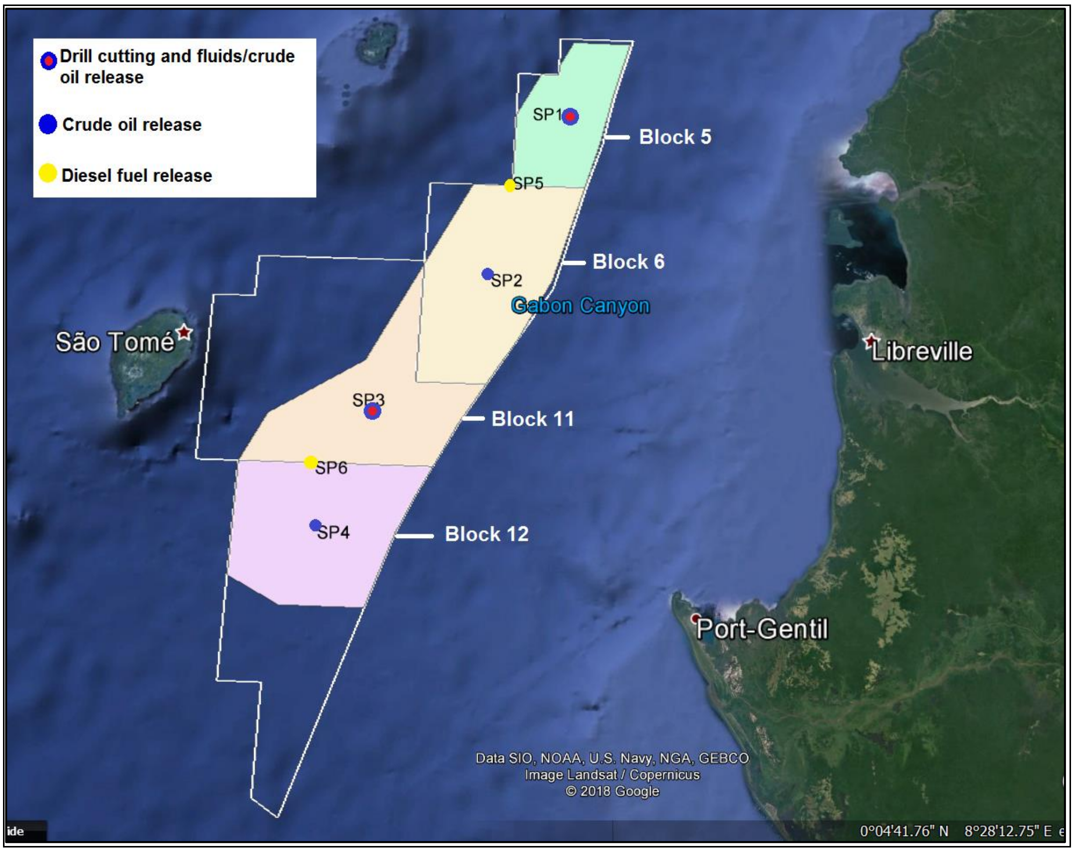
GALP/KOSMOS Energy instructed ERM to conduct specialist studies as input to the Environmental, Social and Health Impact Assessment (ESHIA) for planned drilling within Blocks 5, 6, 11 and 12 offshore São Tomé and Príncipe. Modelling was performed to assess potential impacts related to plan releases from the discharge of drill cuttings and drilling fluids, and unplanned (accidental) hydrocarbon releases.

Modelling was performed at hypothetical well locations selected within Blocks 5, 6, 11, 12. The evaluation of environmental impacts was conducted using a comprehensive modelling approach that relies on a single modelling system, GEMSS® to connect various modules for simulating the transport and fate of the released oil (the Chemical / Oil Spill Impact Module, COSIM) and deposition of drill cuttings and drilling fluid (the Generalized Impact Fate and Transport module, GIFT).

Although the exact well locations are still to be defined, hypothetical well locations were selected within Blocks 5, 6, 11 and 12 to represent wells for each type of modelling study (*Figure 1.1*).

- Because of similarities in bathymetry and currents, location SP1 was chosen to represent the location for modelling planned releases of drill cuttings and drilling fluid in both Blocks 5 and 6.
- Similarly, location SP3 was chosen to represent the location for modelling planned releases of drill cuttings and drilling fluid in Blocks 11 and 12.
- SP1 was chosen to represent the location of unplanned crude oil releases in Block 5.
- SP2 was chosen to represent the location of unplanned crude oil releases in Block 6.
- SP3 also was chosen to represent the location of unplanned releases of crude oil in Block 11.
- Location SP4 was chosen to represent an unplanned release of crude oil in Block 12.
- SP5 was chosen to represent an unplanned release of marine diesel fuel in Blocks 5 and 6, and
- SP6 was chosen to represent an unplanned release of marine diesel fuel in Blocks 11 and 12.

Figure 1.1 Location of the Blocks 5, 6, 11 and 12 with Modelling Locations



Source: ERM, 2018

1.1 *DRILL CUTTINGS DEPOSITION MODELLING*

Modelling of the disposal of cuttings and drilling muds were performed to assess the concentration of total suspended solids (TSS) and thickness of material deposited on the seafloor. The increased TSS concentrations were compared to a threshold value of 35 mg/L based on limits set by the International Maritime Organization (IMO)[i]. The thickness of deposits were compared to a 5 cm/month guidance values based on publications by Ellis and Heim (1985)[ii] and MarLIN (2011)[iii].

For location SP1 (*Table 1.1*), the top hole will be drilled with gelled seawater to a 42" diameter. This will be followed by one section using Pump and Dump (PAD) mud drilling a 24" diameter hole. Cuttings will be directly discharged on the seafloor. A dump of 6,000 bbl of PAD mud 10 m below the surface may occur after drilling of the riserless section. During drilling with the riser, one section 1,000 m deep will be drilled followed by a final section 1,565 m deep, drilled using Non-aqueous Drilling Fluids (NADF). The diameters of these sections are 17.5" and 12.25", respectively. The NADF will not be directly disposed at sea. Instead, the cuttings with NADF mud will be brought back to the surface and processed to separate the mud from the cuttings. The cuttings with a maximum of 6.9% by wet weight retained oil on cuttings (ROC) will be released 10m below the surface during drilling of these lower well sections.

For the second modeled location, SP3 (*Table 1.2*), there are additional sections drilled with the riser. Similar to SP1, the top hole will be drilled with gelled seawater to a 36" diameter followed by drilling another section using PAD mud to a 26" diameter. All cuttings during the two riserless sections will be discharged directly to the seafloor. The 6,000 bbl PAD mud dump 10 m below the surface was also assumed in the model. This will be followed by four sections ranging from 575m to 1,400 m deep with diameters ranging from 22" to 12.25"using NADF. Cuttings and adhered muds will be released 10 m below the surface during drilling of these lower well sections.

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i IMO. 2006. International Regulations (MARPOL 73/78). "Revised Guidelines on Implementation of Effluent Standards and Performance Tests for Sewage Treatment Plants." Annex 26. Resolution MEPC.159(55). Adopted on 13 October 2006. MEPC 55/23.

ii Ellis, D., C. Heim. 1985. Submersible surveys of benthos near a turbidity cloud. Marine Pollution Bulletin, 16(5), 197-203

iii Marine Life Information Network (MarLIN). 2011. Benchmarks for the Assessment of Sensitivity and Recoverability. The Marine Biological Association of the UK, Citadel Hill, Plymouth, Devon, U.K. URL: http://www.marlin.ac.uk/sensitivitybenchmarks.php (Accessed April 2011).

Table 1.1 Discharge Description for Scenario 1 (Location SP1)

Section	Hole Diameter (inches)	Drilling Interval (m below mud line)	Volume of Cuttings Discharged (m^3)	Volume of Mud to be Discharged (m^3)	Type of Mud	Estimated Drilling Duration (days)
1	42 (top hole)	85	125	0.0	GSW	0.3
2	24	900	433	954	PAD[1]	2.0
3	17 ½	1000	256	27	NADF	2.9
4	12.25	1565	220	23	NADF	5.7
	TOTAL	**3550**	**1,034**	**1004**	**-**	**10.9**

[1]PAD discharged at the surface 14 days after end of the 24" section is drilled
GSW: Gelled seawater is used as the lubricant for drilling
PAD: Pump and dump water-based mud
NADF: Non-aqueous Drilling Fluid
Source: GALP/KOSMOS, 2018

Table 1.2 Discharge description for Scenario 2 (Location SP3)

Section	Hole Diameter (inches)	Drilling Interval (m below mud line)	Volume of Cuttings Discharged (m^3)	Volume of Mud to be Discharged (m^3)	Type of Mud	Estimated Drilling Duration (days)
1	36 (top hole)	81	53	0.0	GSW	0.5
2	26	619	318	954	PAD[1]	2.0
3	22	900	265	28	NADF	2.0
4	16 ½	800	132	14	NADF	4.0
5	12 ¼	1,400	128	14	NADF	3.0
6	12 ¼	575	52	6	NADF	3.0
	TOTAL	**4,375**	**948**	**1,015**	**-**	**14.5**

[1] PAD discharged at the surface 14 days after end of the 24" section is drilled
GSW: Gelled seawater is used as the lubricant for drilling
PAD: Pump and dump water-based mud
NADF: Non-aqueous Drilling Fluid
Source: GALP/KOSMOS, 2018

For the sections with the riser, the drill cuttings with remaining mud attached to them will be discharged 10m below the water surface.

For Scenario 1 (location SP1), the model simulation was run for 17 days. This includes the duration of drilling discharges as listed in *Table 1.1*, totalling 10.9 days, plus one day intervals between each hole section to allow time for particles to settle before the next simulated discharge takes place. The model does not simulate long periods of time during the drilling process when no discharges are taking place for computational speed and model efficiency.

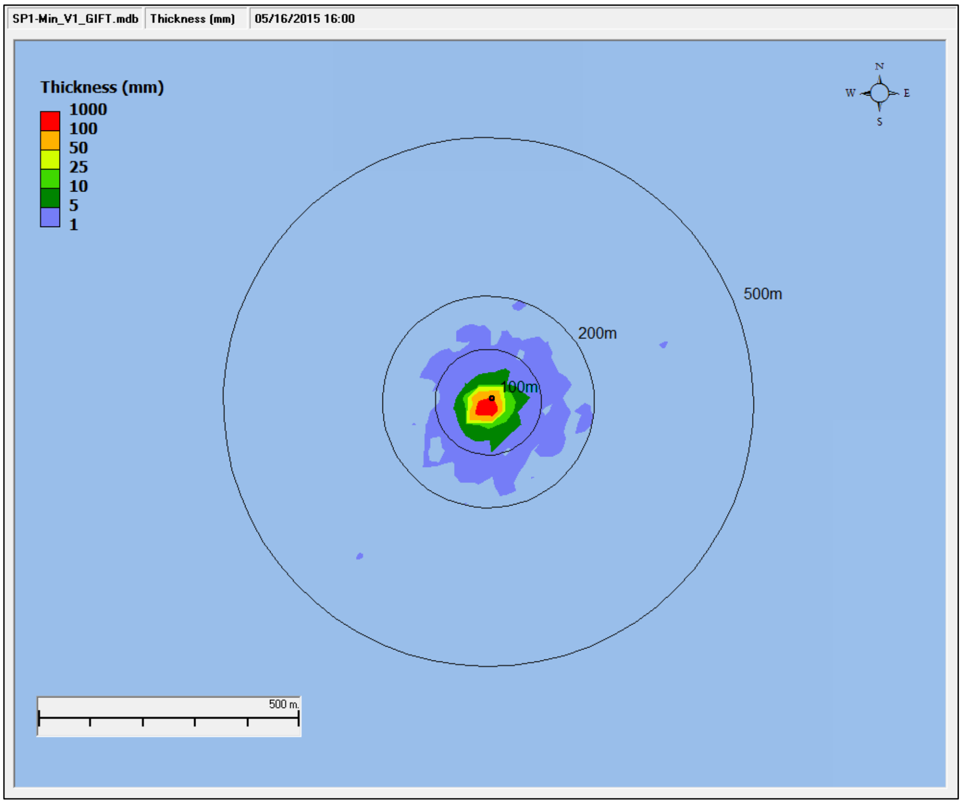
For Scenario 2 (location SP3), the model simulation was run for 22 days. This includes the duration of drilling discharges as listed in *Table 1.2*, totalling 14.5 days, plus one day intervals between each hole section to allow time for particles to settle before the next simulated discharge takes place.

The model results indicate that the deposition thickness of drill cuttings and muds on the seafloor exceeds the 5 cm depositional thickness threshold value in all simulations limited to a region surrounding the well. For Scenario 1 (SP1), the maximum area exceeding 5 cm was 2,843 m^2 under the minimum current conditions. For Scenario 2 (SP3), the maximum area exceeding 5 cm was 1,638 m^2, under minimum current conditions. In both Scenarios, the exceedance of the 5 cm threshold was limited to area within approximate a 50 m radius of the drill center. An example plot of depositional thickness and TSS under minimum current conditions is presented in *Figure 1.2*.

The maximum TSS concentration for Scenario 1 was 5,291 mg/L related to top-side discharges associated with drilling with a riser in Sections 3 and 4 under minimum current conditions. The largest region in which TSS exceeded the 35 mg/L threshold for Scenario 1 was ~1.4 km^2 in the same simulation. The maximum TSS concentration for Scenario 2 was 8,789 mg/L related to top-side discharges associated with drilling with a riser in Sections 3 and 4 under minimum current conditions. The largest TSS region for Scenario 2 was ~0.7 km^2 related to top-side discharges under minimum current conditions.

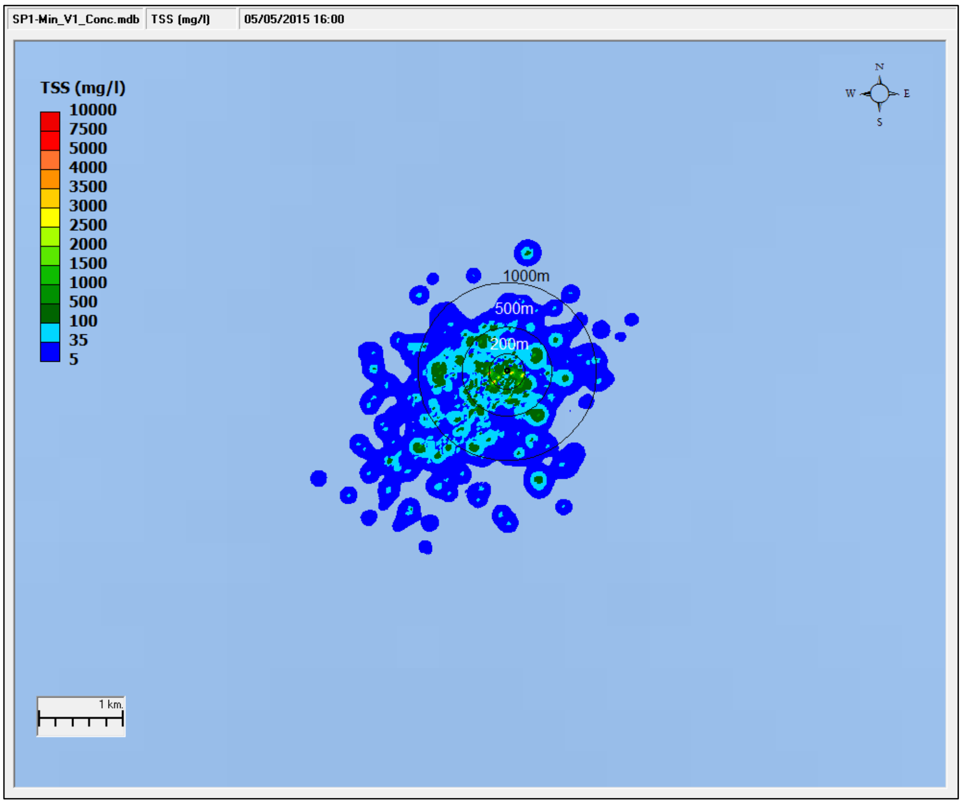
For both scenarios, the largest TSS impacts were related to top-side discharges. The discharges are limited in duration and are expected to have minimal impacts to the aquatic population including temporary light inhibition (associated with limiting photosynthesis in the epipelagic zone), nuisance conditions which may cause motile biota to avoid the area, or cause physical stress to aquatic biota, such as clogging fish gills. Overall, because of the short duration and the spatial limitation, negligible effects on fish and other marine population are expected. Example model output are shown in *Figure 1.2*.

Figure 1.2 Example of model output, SP1 - Depositional Thickness under Minimum Current Conditions



Source: ERM, 2018

Figure 1.3 Example of model output, SP1 - TSS (from Surface Discharge) under Minimum Current Conditions (



Source: ERM, 2018

Results of the simulations are summarized in *Table 1.3* and *Table 1.4*.

Table 1.3 Model Output: TSS above 35 mg/L for SP1 and SP3

Location in Block 5	Currents	Depth	Max TSS (mg/L)	Area(km^2)
SP1	Min	Bottom	2,024	0.056
SP1	Min	Surface	5,291	1.400
SP1	Max	Bottom	1,086	0.034
SP1	Max	Surface	1,176	0.336
Location in Block 11	**Currents**	**Depth**	**Max TSS (mg/L)**	**Area(km^2)**
SP3	Min	Bottom	639	0.018
SP3	Min	Surface	8,789	0.731
SP3	Max	Bottom	1,056	0.036
SP3	Max	Surface	1,506	0.237

Source: ERM, 2018

Table 1.4 Model Output: Area with Deposition Thickness above 5 cm for SP1 and SP3

Location in Block 5	Currents	Area(m^2)
SP1	Min	2,843
SP1	Max	2,336
Location in Block 11	**Currents**	**Area(m^2)**
SP3	Min	1,638
SP3	Max	1,597

Source: ERM, 2018

1.2 OIL SPILL MODELLING

The main objective of this oil spill modelling study was to assess potential environmental impacts resulting from unplanned releases of hydrocarbons associated with drilling activity. Models were used to predict the spatial extent of oil spillage associated with three scenarios representing a small, medium, and large spill event:

- Scenario 1: A vessel collision releasing 1,000 m^3 of marine diesel (6,290 bbl) at the surface;
- Scenario 2: A continuous release (constant flow rate) of 5,000 barrels per day of crude oil over a 10 day period at the surface. The total spill volume is 50,000 barrels of crude oil;
- Scenario 3: A blowout at the seafloor causing a constant release totalling 1,050,000 bbl of crude oil over 30 days.

These three spill scenarios were modeled in order to simulate the:

- Spill trajectories;
- Thickness of the surface slicks;
- Travel times for the slick to arrive at various locations; and
- Magnitudes of oil's dissolved-phase aromatic hydrocarbon (DAH) component concentrations.

For the oil spill modelling, various scenarios were evaluated using release dates every month within the period from 1 January 2013 through 31 December 2017. A summary of these oil spill modelling scenarios is presented in *Table 1.5*. Note in Scenario 3, for the blowout case, the volume of dissolved gases (typically ethane, methane, and propane, carbon dioxide, and nitrogen gases) were separated from the liquid fraction. The modelling performed tracked the remaining liquid portion that would arrive at the surface to form a slick or potentially contact shorelines. Using an oil formation volume fraction on 1.35 provided by GALP and KOSMOS, the liquid fraction remaining under "stock tank" conditions at atmospheric pressure was computed to be 777,778 bbl of liquid oil (total oil divided by the formation volume fraction) was used in the model.

Table 1.5 Oil Spill Modelling Scenarios

Scenario and Well Location	Oil Type	Volume (bbl)	Release Depth	Release / Simulation Duration
S1-SP5	Diesel	6,290	Surface	1hr / 14 d
S1-SP6	Diesel	6,290	Surface	1hr / 14 d
S2-SP1	Crude Oil	50,000	Surface	10 d / 24 d
S2-SP2	Crude Oil	50,000	Surface	10 d / 24 d
S2-SP3	Crude Oil	50,000	Surface	10 d / 24 d
S2-SP4	Crude Oil	50,000	Surface	10 d / 24 d
S3-SP1	Crude Oil	777,778	Bottom	30 d / 44 d
S3-SP2	Crude Oil	777,778	Bottom	30 d / 44 d
S3-SP3	Crude Oil	777,778	Bottom	30 d / 44 d
S3-SP4	Crude Oil	777,778	Bottom	30 d / 44 d

Source: ERM, 2018

The time-varying data including historical wind velocity (speed and direction), ocean current velocity, air temperature, water temperature, and salinity, were obtained for the region offshore of Cameroon, in the Gulf of Guinea from the period Jan 01, 2013 through Dec 31, 2017.

Time varying air temperature was obtained from the US National Oceanographic and Atmospheric Administration (NOAA) National Centers for Environmental Prediction (NCEP).

Depth-varying and time-varying values for currents, salinities, and water temperatures in on a three-dimensional grid were obtained from the HYCOM (HYbrid Coordinate Ocean Model) generalized ocean model (www.hycom.org).

Wind data were gathered from the Blended Sea Winds database, a product of the U.S. National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC).

For each model simulation, an assessment is made for the "significant surface oiling," defined as any oil having a thickness above the minimum thickness threshold, delineating where oil becomes visible and below which aquatic biota are at near zero risk of smothering from contacting the oil. The first clearly visible oil appears as a silvery sheen at thicknesses between 0.04 µm to 0.3 µm based on values cataloged in the 2006 Bonn Agreement Oil

Appearance Code (BAOAC)[iv]. *Table 1.6* summarizes the thickness descriptors represented by the BAOAC standard color designations.

Table 1.6 Oil thickness descriptions

Color	**Thickness (µm)**
Silver sheen	0.1 – 0.3
Rainbow sheen	0.3 – 5
Metallic	5 – 50
Discontinuous true color	50 – 200
Continuous true color	200 and up

Source: ERM, 2018

A minimum threshold thickness value has been defined by ERM as 0.1 µm. Oil at this thickness may be visible and potentially wash upon the shore as a silver sheen, but is not expected to cause physical injury (e.g., oiling, smothering) to wildlife contacting it. Model output of the surface oiling and arrival time is filtered to remove oil thinner than 0.1 µm.

Research has been done in estimating exposure thresholds for birds and mammals contacting an oil slick. Peakall *et al*. (1985)[v] and French (2009)[vi] found that oil slicks less than 1 µm were not harmful to seabirds. However, the oil can aggregate over time into tar balls, or accumulate on a shoreline. Therefore visible oil between 0.1 µm and 1 µm was chosen as the low risk exposure thickness range. Additional studies found that aquatic birds and marine mammals may be affected at slick thicknesses in the range of 10 µm and 25 µm [Engelhardt (1983)[vii], Clark (1984)[viii], Geraci and St. Aubin (1988)[ix],

[iv] Lewis, A. 2007. "Current status of BAOAC (Bonn Agreement Oil Appearance Code)." Report to the Netherlands North Sea Agency. January 2007.

[v] Peakall, D.B., Wells, P.G., Mackay, D. (1985). "A Hazard Assessment of Chemically Dispersed Oil Spills and Seabirds – A Novel Approach", in Proceedings of the 8th Technical Semi Annual Arctic Marine Oil Spill Program, Environmental Canada, Edmonton, 78–90 pp.

[vi] French-McCay, D.P. 2009. State-of-the-Art and Research Needs for Oil Spill Impact Assessment Modelling. In Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada, pp. 601-653.

[vii] Engelhardt, F. R. (1983) Petroleum effects on marine mammals. Aquatic Toxicology, 4: 199-217.

[viii] Clark, R. B. (1984). "Impact of oil pollution on seabirds". Environ. Poll., 33A, 1-22.

[ix] Geraci, J.R., and D.J. St. Aubin. 1988. "Synthesis and effects of oil on marine mammals". Washington, D.C.: US. Department of Interior, Minerals Management Services. OCS Study/MMS 88-0049.

Jenssen (1994)[x], and Scholten *et al* (1996)[xi]]. Thus, a moderate exposure threshold is defined as oil with a thickness between 1 µm and 10 µm, while a high exposure threshold is defined as any oil with a thickness above 10 µm.

A threshold value was also applied to dissolved concentrations. According to ANZECC and ARMCANZ (2000)[xii] and French (2000)[xiii], dissolved aromatic 96-hour LC50 values range between 100 and 1,000 ppb. Low Reliability Triggers, concentrations below which no toxic effects would be expected (effectively a No Observable Effects Concentration or NOEC), are assumed to be 10 to 100 times less than the 96-hour LC50. To enable a significant margin of safety, a highly conservative value of 5 ppb was chosen as a 96-hour Low Reliability Trigger threshold for sensitive organisms.

In summary, two critical threshold assumptions are used in the design of the models and interpretation of results. These assumptions address critical thresholds for oil slick thickness and DAH concentrations and relate directly to the ecological effects. *Table 1.7* summarizes these assumptions.

Table 1.8 summarizes the spill modelling results.

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[x] Jenssen BM (1994). Review article: "Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds". Environmental Pollution. 86:207–215.

[xi] Scholten M.C.Th., Kaag N.H.B.M., Dokkum, H.P. van, Jak R.G., Schobben H.P.M. and Slob W., (1996). "Toxische effecten van olie in het aquatische milieu". TNO report TNO-MEP – R96/230

[xii] ANZECC & ARMCANZ. 2000. Australian and New Zealand guidelines for fresh and marine water quality. October 2000. National Water Quality Management Strategy Paper No. 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra, Australia.

[xiii] French, D.P. 2000. Estimation of Oil Toxicity Using an Additive Toxicity Model. In Proceedings, 23rd Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, June 14-16, 2000, Vancouver, Canada, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Table 1.7 Threshold assumptions

Assumption	Value	Importance	Source
Significant slick thickness	0.1 µm and 1.0 µm	Visibility of oil (spill response) and minimum thickness for smothering of aquatic organisms and wildlife. Range of 1-10 µm minimum smothering thicknesses cited in the literature.	Peakall *et al*. (1985); French-McKay (2009)
DAH critical concentrations	5 parts per billion (ppb)	Conservative threshold 1 to 2 orders of magnitude below LC50 (50% mortality) for acute narcotic impacts to sensitive aquatic organisms.	ANZECC and ARMCANZ (2000) and French (2000)

Table 1.8 Spill Model Output Summary

Scenario Name / Well Location	Frequency of Shoreline Contact with Oil (%)	Most Shoreline Oiling (Metric Tons)	Most Shoreline Oiled Length (km)	Shortest Time for Oil to Contact Shoreline (d)	Max. Surface Area Oil > 1.0 µm (km²)	Worst Cases DAH Areas Above 5 ppb (km²)
Diesel: 1hr surface spill / 14 day simulation						
S1-SP5	33.3	0.44	85	4	1,885	21,693 - 30,841
S1-SP6	45.0	0.39	250	2	1,995	11,083 - 41,437
Crude: 10 day surface spill / 24 day simulation						
S2-SP1	100.0	1.40	411	4	18,055	9,219 - 12,025
S2-SP2	96.7	1.00	316	3	13,228	8,217 - 12,125
S2-SP3	93.3	1.01	371	3	14,029	1,904 - 21,946
S2-SP4	88.3	0.97	411	3	13,729	9,019 - 10,522
Crude: 30 day blowout / 44 day simulation						
S3-SP1	100.0	4.86	1,039	4	131,979	2,618 - 3,467
S3-SP2	100.0	4.58	1,154	4	173,063	1,068 - 2,453
S3-SP3	100.0	4.08	1,616	3	160,163	1,271 - 2,939
S3-SP4	98.3	4.69	1,039	3	219,460	823 - 1,489

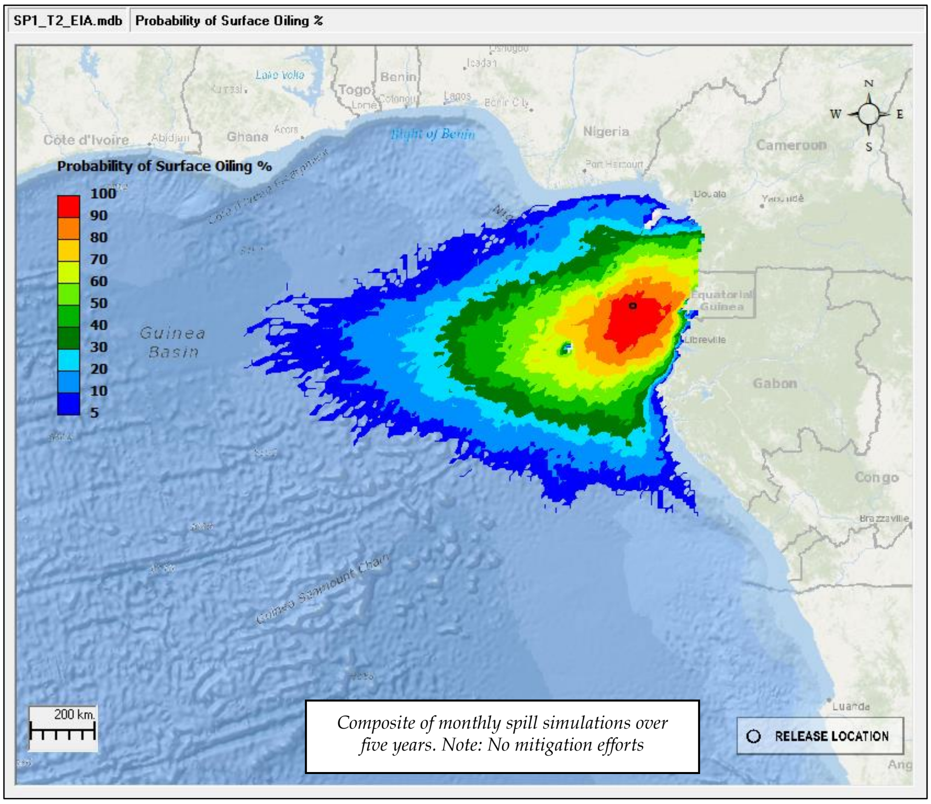
Source: ERM, 2018

Table 1.8 describes the model output summarizing three worst case conditions from the five years of monthly spill simulations. Each simulation that was run beginning on different start date for the same scenario is called an iteration. The **frequency of shoreline contact with oil** provides the number of iterations in which oil contacts a shoreline as a percent of the total number of spill iterations performed for that scenario. The **most shoreline oiled** value provides the maximum oil mass reaching shorelines from this worst case iteration. The **oiled shoreline lengths** for this case is also provided. A separate worst case iteration was selected for the case in which shorelines are contacted the fastest. The **shortest time to reach the shoreline** for each scenario is identified. For the iteration in which the most amount of water surface is contacted by the floating oil at any time during the simulation period, the **maximum surface area oiled** is provided. This area is limited to oil having a thickness above the 1.0 µm minimum threshold for potentially harming birds and wildlife. For dissolved aromatic hydrocarbons (DAH) concentrations above the 5 ppb threshold for potential acute toxicity, the range of areas across these three worst case iterations described was provided. These areas represent the DAH plume typically near the surface (top 3 m).

Example probabilistic output of these simulations are provided for Scenario 2 and Scenario 3. *Figure 1.4* through *Figure 1.7* (Scenario 2) and *Figure 1.12* through *Figure 1.15* (Scenario 3) depict the likelihood of a spill contacting locations on the water surface. *Figure 1.8* through *Figure 1.11* (Scenario 2) and *Figure 1.16* through *Figure 1.19* (Scenario 3) depict the probability of oil reaching shorelines.

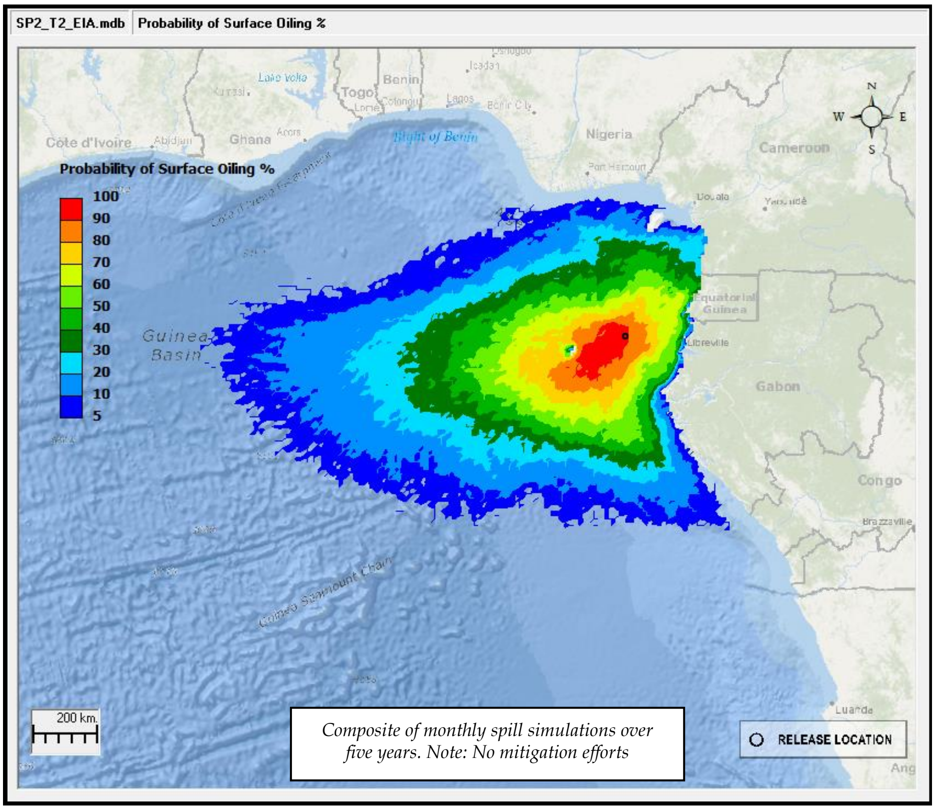
<u>It is important to note</u>: these figures do not depict all the places where the oil will spread in the event of a spill, but rather the probability of oil reaching these various locations. Also note well that these simulations assume no mitigation efforts have been implemented which may have removed oil, restricted its motion, or accelerated its weathering.

Figure 1.4 Scenario 2 SP1 - 10-Day Crude Spill Scenario – Probability of Surface Oiling



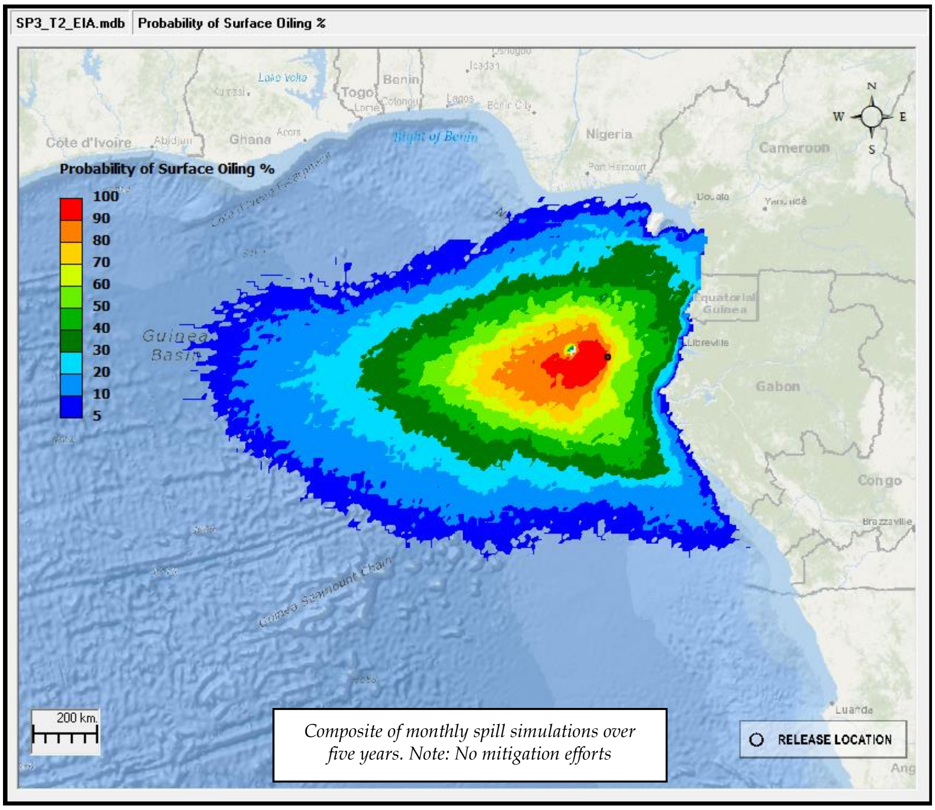
Source: ERM, 2018

Figure 1.5 Scenario 2 SP2 10-Day Crude Spill Scenario – Probability of Surface Oiling



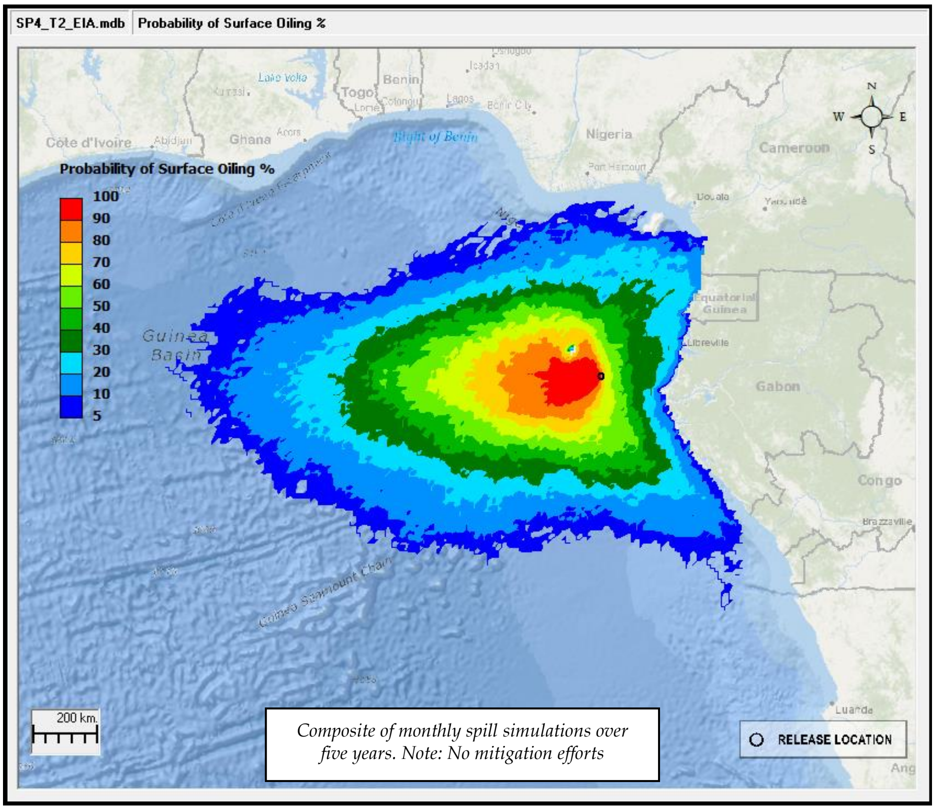
Source: ERM, 2018

Figure 1.6 Scenario 2 SP3 10-Day Crude Spill Scenario – Probability of Surface Oiling



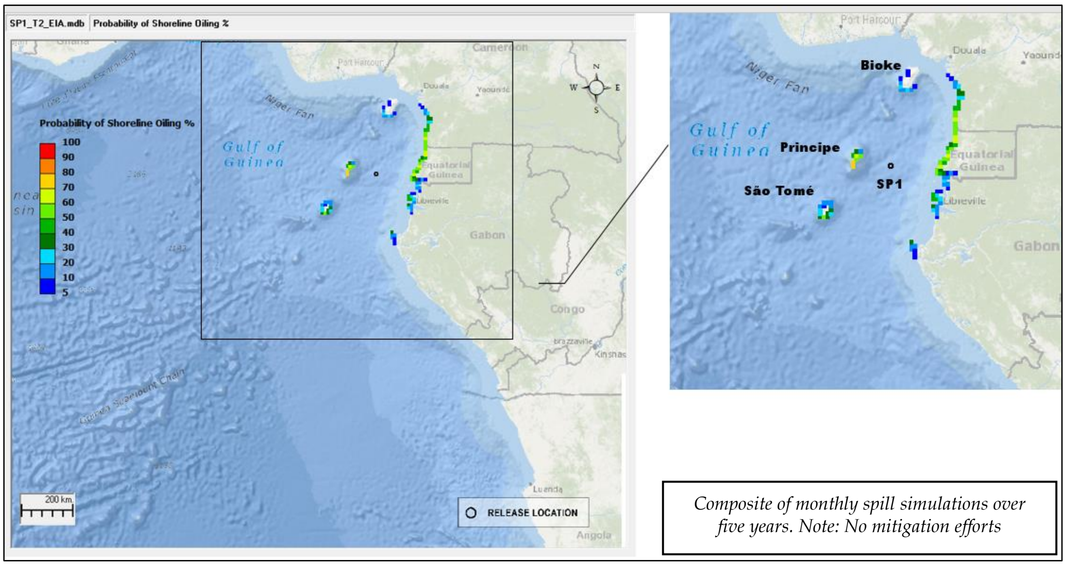
Source: ERM, 2018

Figure 1.7 Scenario 2 SP4 10-Day Crude Spill Scenario – Probability of Surface Oiling



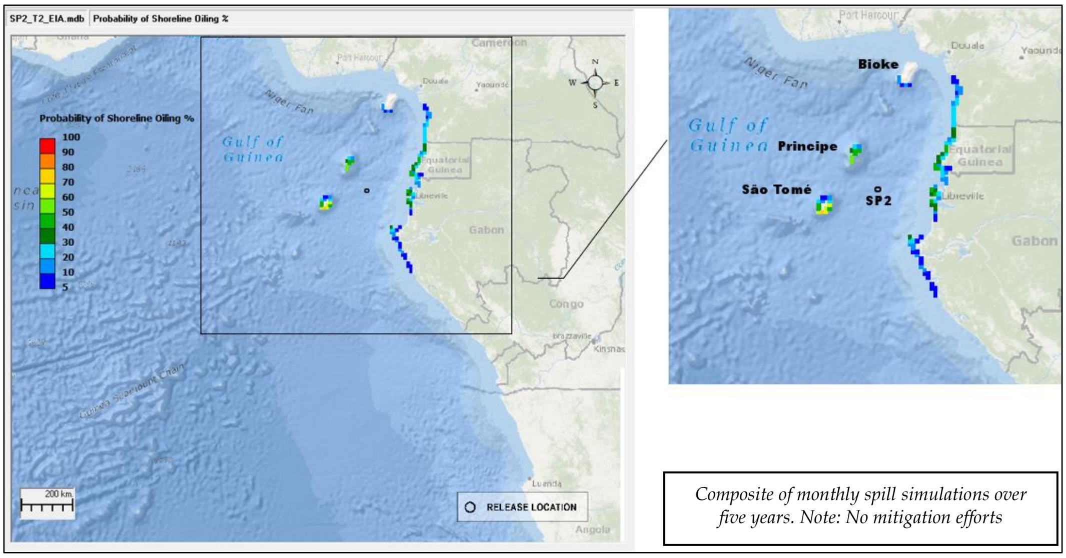
Source: ERM, 2018

Figure 1.8 Scenario 2 SP1 10-Day Crude Spill Scenario – Probability of Shoreline Oiling



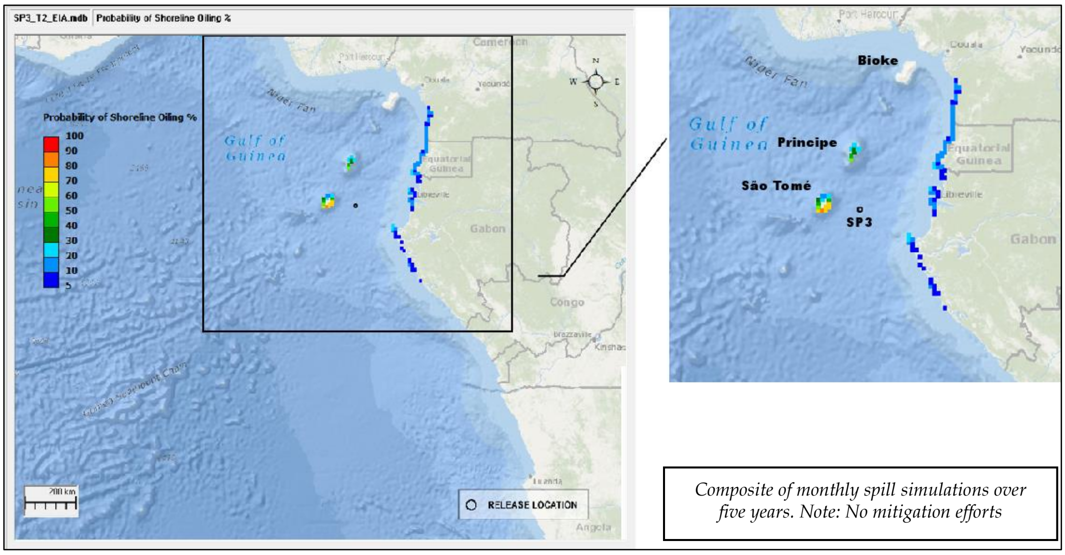
Source: ERM, 2018

Figure 1.9 Scenario 2 SP2 10-Day Crude Spill Scenario – Probability of Shoreline Oiling



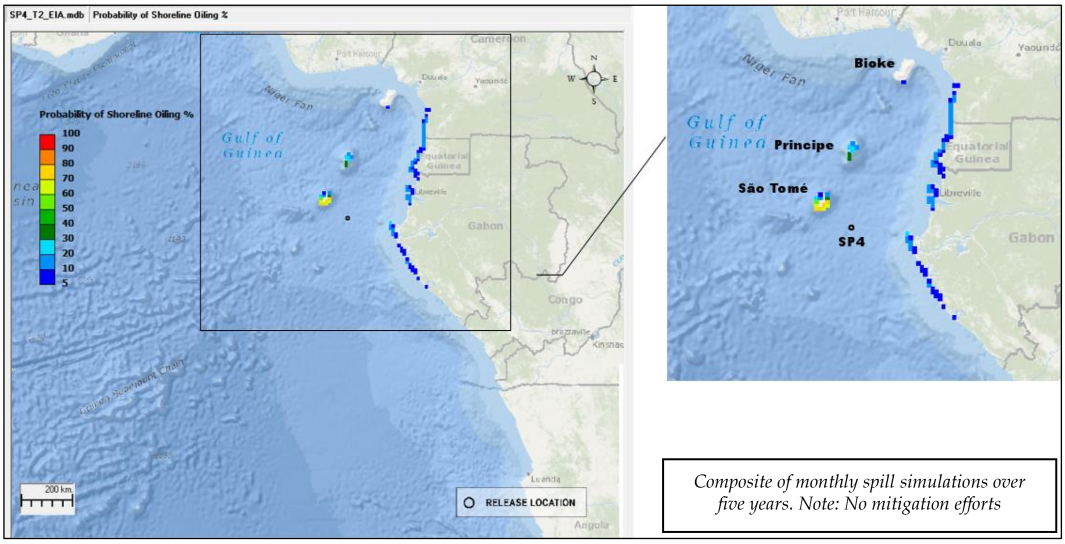
Source: ERM, 2018

Figure 1.10 Scenario 2 SP3 10-Day Crude Spill Scenario – Probability of Shoreline Oiling



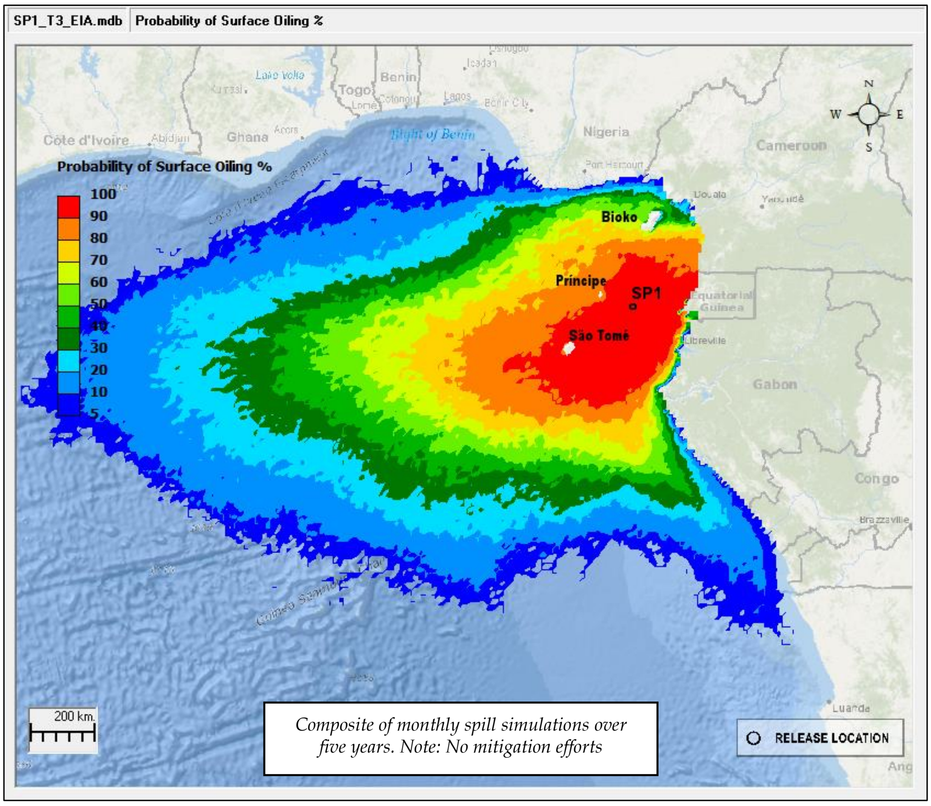
Source: ERM, 2018

Figure 1.11 Scenario 2 SP4 10-Day Crude Spill Scenario – Probability of Shoreline Oiling



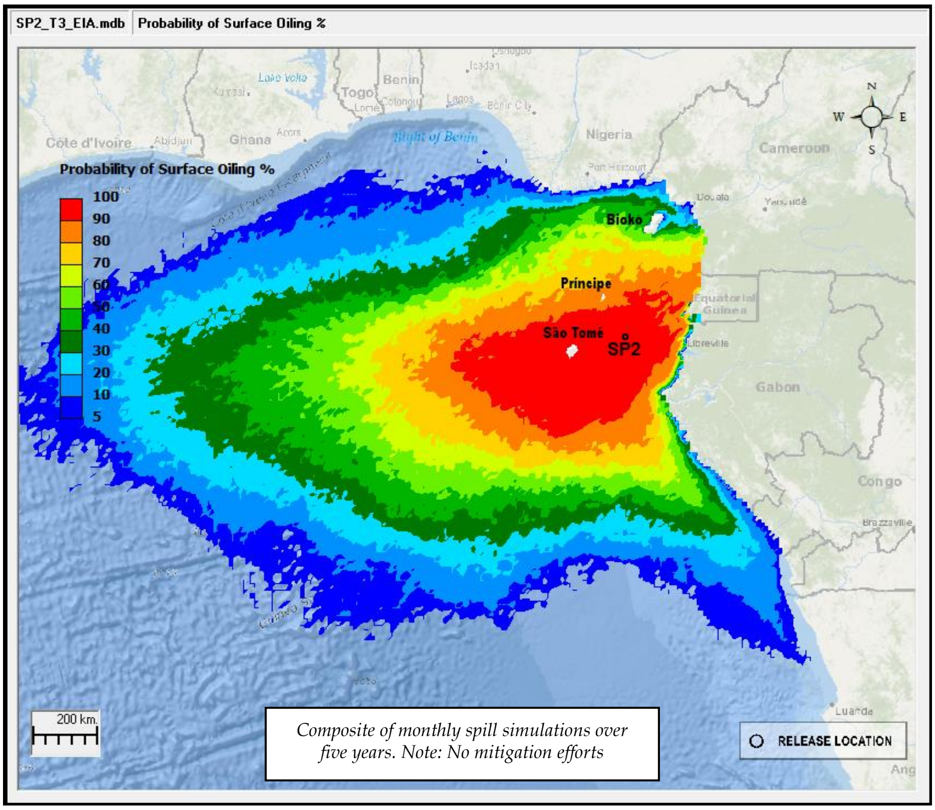
Source: ERM, 2018

Figure 1.12 Scenario 3 SP1 - 30-Day Blowout Scenario – Probability of Surface Oiling



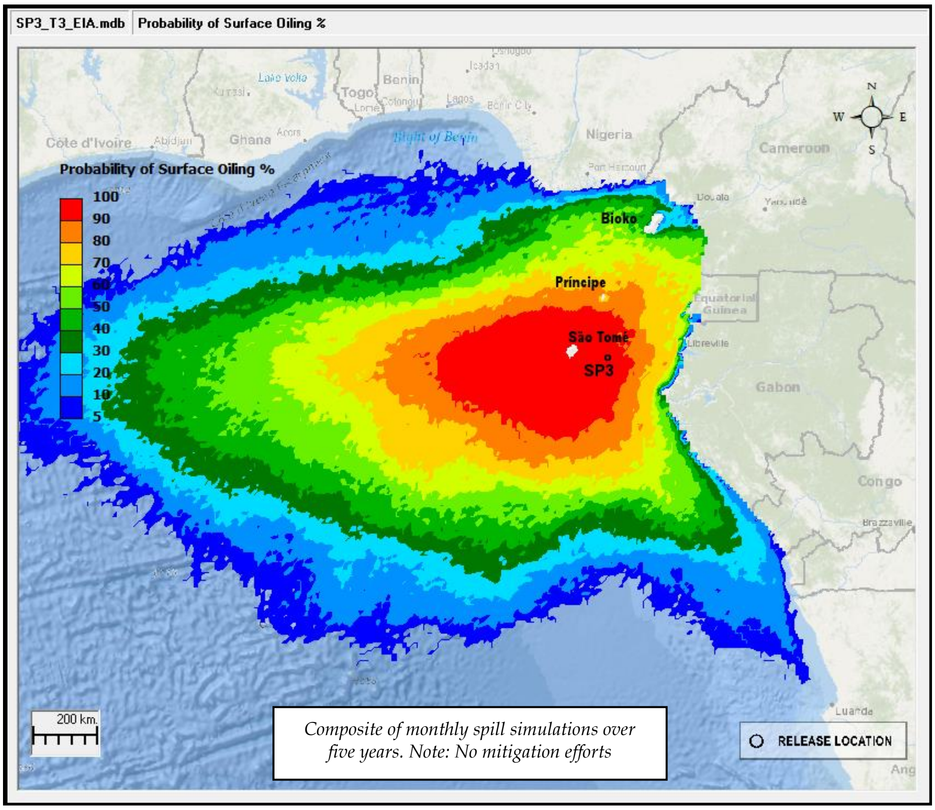
Source: ERM, 2018

Figure 1.13 Scenario 3 SP2 30-Day Blowout Scenario – Probability of Surface Oiling



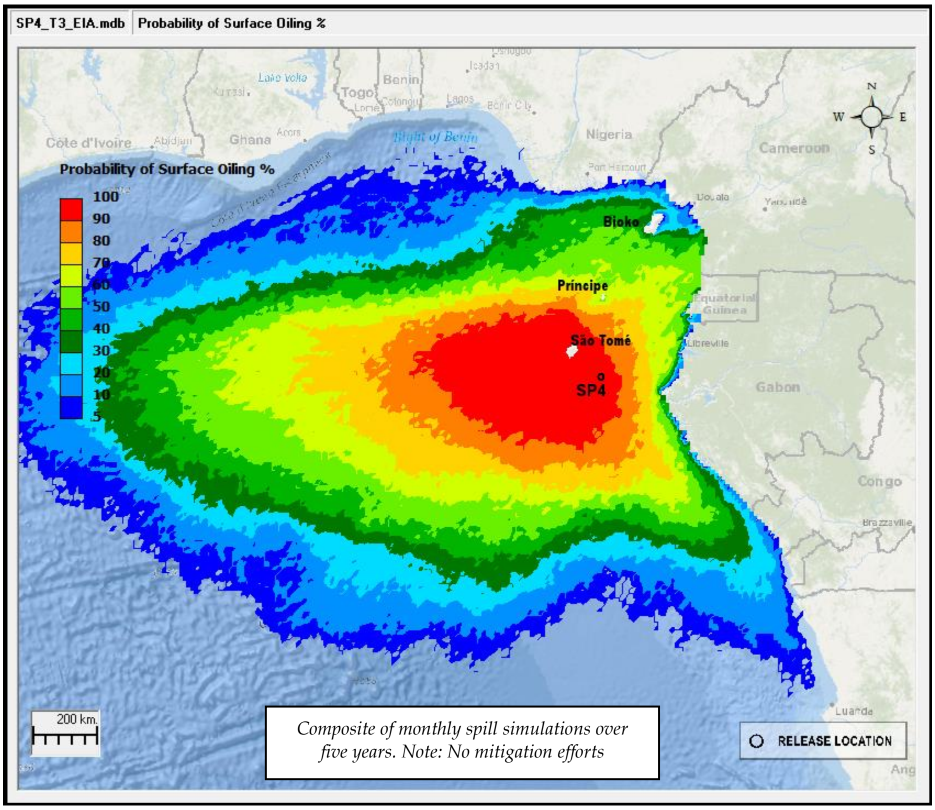
Source: ERM, 2018

Figure 1.14 Scenario 3 SP3 30-Day Blowout Scenario – Probability of Surface Oiling



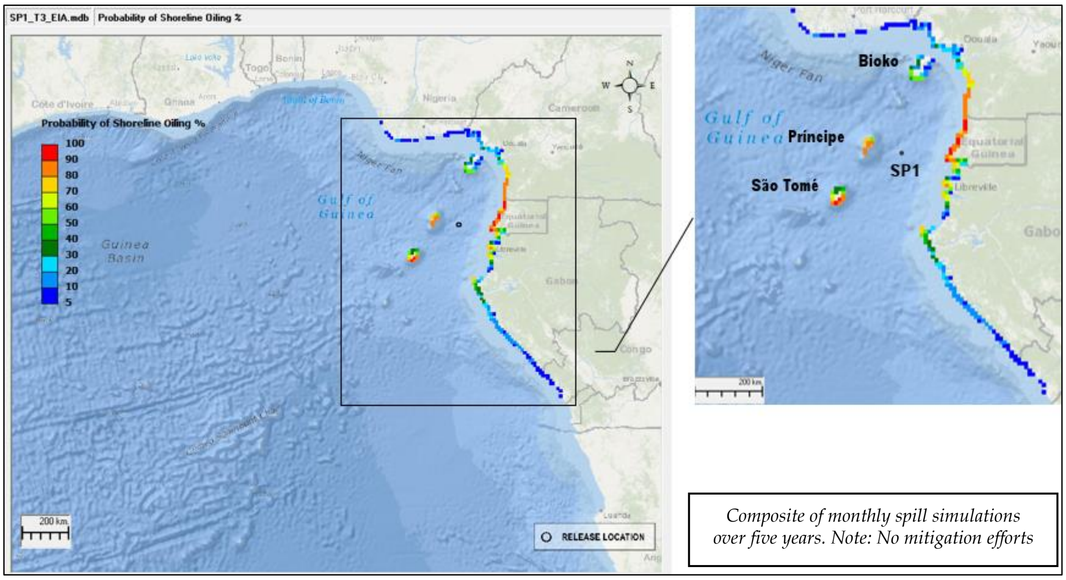
Source: ERM, 2018

Figure 1.15 Scenario 3 SP4 30-Day Blowout Scenario – Probability of Surface Oiling



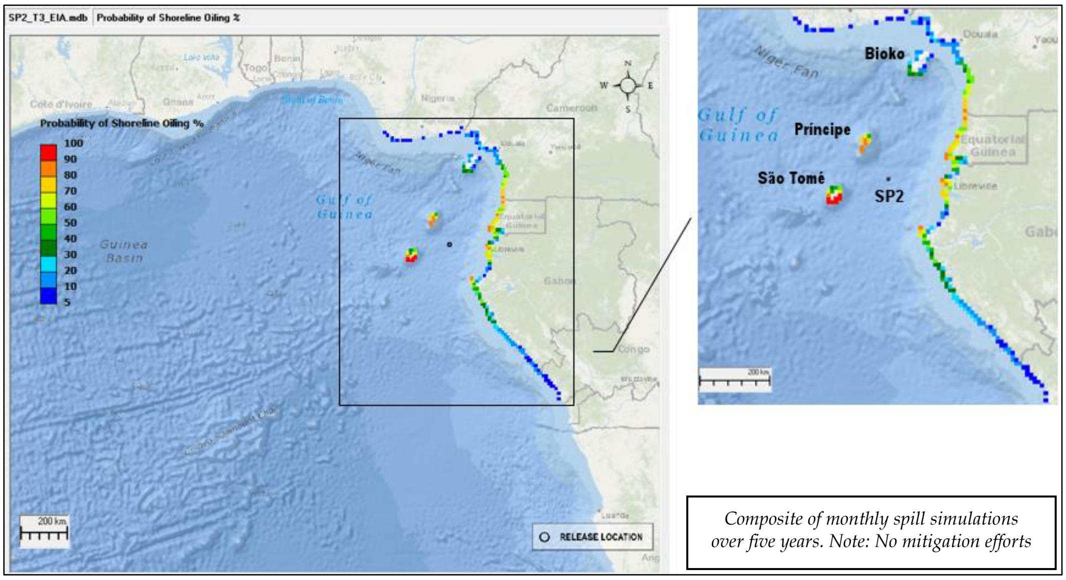
Source: ERM, 2018

Figure 1.16 Scenario 3 SP1 30-Day Blowout Scenario – Probability of Shoreline Oiling



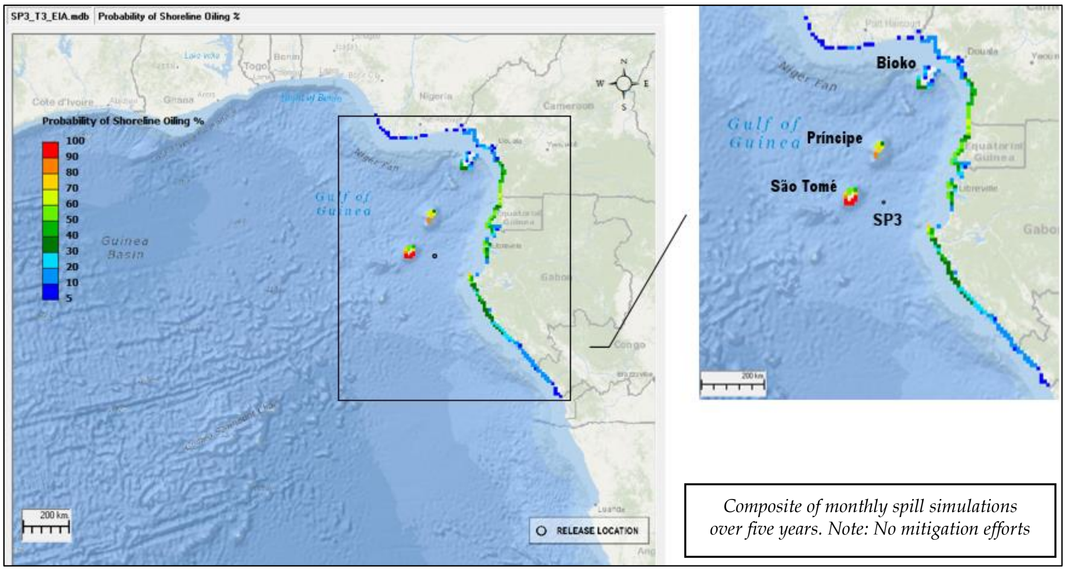
Source: ERM, 2018

Figure 1.17 Scenario 3 SP2 30-Day Blowout Scenario – Probability of Shoreline Oiling



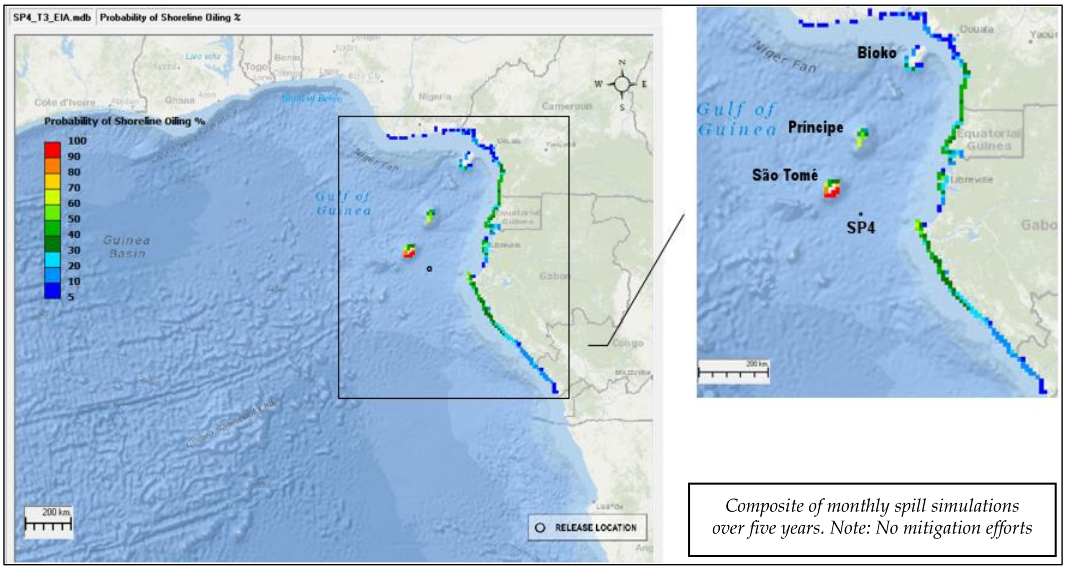
Source: ERM, 2018

Figure 1.18 Scenario 3 SP3 30-Day Blowout Scenario – Probability of Shoreline Oiling



Source: ERM, 2018

Figure 1.19 Scenario 3 SP4 30-Day Blowout Scenario – Probability of Shoreline Oiling



Source: ERM, 2018

The primary direction of a spill is towards the west out into the ocean away from the shorelines. However, the major islands in the vicinity of the lease blocks (São Tomé, Principe, Bioko Island), are at risk of oil reaching the shorelines in the event of a spill, with first contact occurring within two to four days after the release. On the mainland, the shorelines of Nigeria, Cameroon, Equatorial Guinea, Gabon, and Congo are at risk. The highest risks are along the shores of Cameroon, Equatorial Guinea, and Gabon which may be contacted by oil typically after two weeks following a release, but on rare occasions as quickly as over one week in some locations. It is important to note again that these risks are assessed in the absence of any response efforts.

The release from SP4 had the lowest risk of shoreline oiling in the four scenarios, with the least likelihood of contacting Bioko Island (up to 30%

chance), Principe (up to 70% chance) and the mainland (up to 50% chance). The blowout release from SP1 had the most likelihood of impacting the shorelines to the east, especially Equatorial Guinea where the maximum probability exceeds 90%. However, as it is the scenario with a release farthest north, it also had the greatest risk (over 50% chance) of contacting Bioko Island.

1.2.1 *Mitigation Scenarios*

Though the impact assessment generally focuses on worst case scenarios, such that the spill simulations are made absent of any cleanup and response efforts to mitigate the impacts, two additional scenarios were run to examine the effect of dispersant application upon a spill. For this effort, the worst case from Scenario 3 was selected in terms of shoreline oiling of the mainland and major islands off the Cameroon coast. It was determined that the release at SP1 in Scenario 3 would be selected for the mitigation scenarios. The criterion for the selection was the high probability of oil contacting shorelines on both the islands and mainland. In addition, the worst case for "most shoreline oiling" from a release SP1 resulted in the most shoreline oiling mass out of the four release locations examined.

The two mitigation scenarios, S3-M1 and S3-M2, were run identical to the worst case iteration for "Most Shoreline Oiling" in S3-SP1 except for the application of dispersants on the surface (S3-M1 and S3-M2) and subsurface (S3-M2). For the surface application, it was assumed that a practical application would last two hours, be capable of affecting an area 10 km by 10 km, and each flight has a maximum dispersant capacity of 15,000 L. Due to the time for a flight to travel to the site, apply dispersants, return and refuel and obtain more dispersants, two two-hour applications per day (during daylight hours) were assumed. Other dispersant application assumptions are summarized in *Table 1.9*.

Table 1.9 ***Dispersant Model Input Parameters***

Parameter	Surface S3-M1	Subsurface S3-M1	Surface S3-M2	Subsurface S3-M2
Start Time	Day 4	N/A	Day 4	Day 7
Application Duration	31 Days	N/A	7 Days	24 Days
Dispersant : Oil Ratio	1:20	N/A	1:20	1:100
Effectiveness	80%	N/A	80%	80%

The results of the dispersant application model showed changes in terms of the surface oil thickness, amount of oil reaching shorelines, the time for the oil to first reach a shoreline, and the dissolved oil concentrations. The application of dispersants decreases the liquid droplet sizes, increasing dissolution via the increased surface area of the droplets. The smaller droplet sizes decreases the rate in which the droplets rise to the surface such that small droplets can be trapped beneath the surface for long periods of time. Dispersant application to the subsurface in Scenario S3-M2 proves to be more effective than just application of dispersants on the surface in S3-M1. The surface area above the visible threshold decreases by 18% in S3-M1 and by 41% in S3-M2. Similarly, the surface area above the 1µm bird and wildlife impact threshold decreases by 11% in S3-M1 and by 45% in S3-M2. The shoreline oiling mass decreased by 31% in S3-M1 and by 46% in S3-M2. Though the fastest time for shoreline oiling contact in Scenario S3-SP1 is 4 days (*Table 1.8*), for the worst case "most shoreline oiling" iteration used here, first contact occurs in 10 days. First contact with shoreline occurred later with dispersants, increasing from 10 days without dispersants to 11 days in S3-M1 and 14 days in S3-M2. However the footprint of dissolved aromatics above the 5 ppb threshold increased by33% in S3-M1 and by 168% in S3-M2.

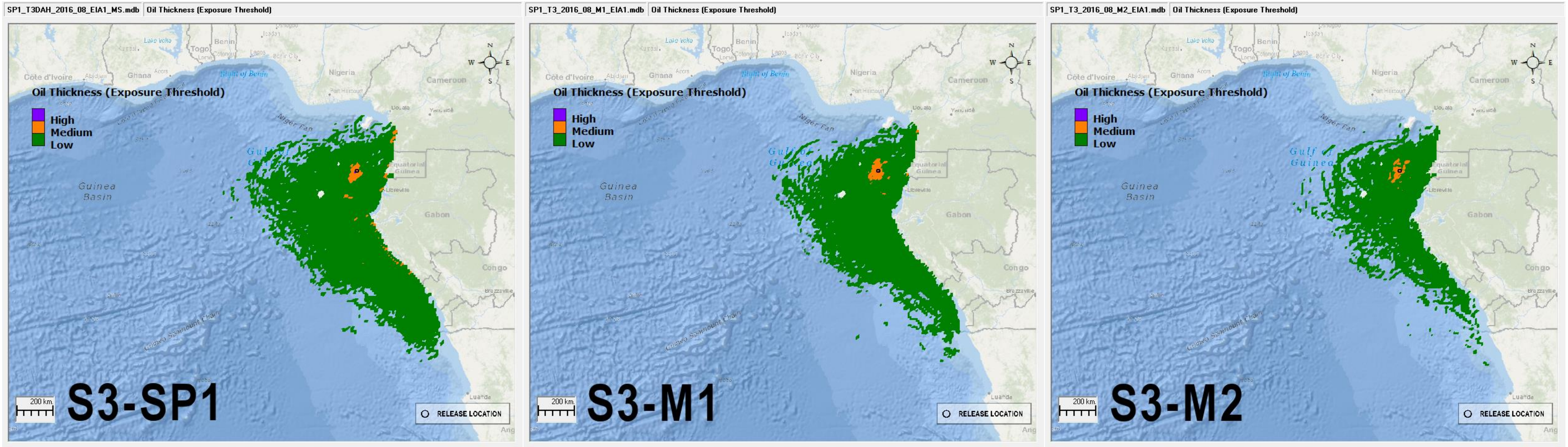
The comparison between Scenario S3-SP1 and the two mitigation scenarios S3-M1 and S3-M2 are provided in *Table 1.10* and *Figure 1.20*. Note that the values in *Table 1.10* apply to the values specifically for the worst case: most shoreline oiling iteration for S3-SP1.

Table 1.10 Dispersant Model Results

Parameter	**S3-SP1***	**S3-M1**	**S3-M2**
Shoreline Oiling (MT)	4.86	3.37	2.63
Time to First Contact (days)	10	11	14
Surface Area >1.0 µm (km²)	6,326	5,609	3,510
Oiled Shoreline Length (km)	1,039	1,048	962
DAH >5ppb (km²)	2,618	3,492	7,022

*Worst case: Most Shoreline Oiling iteration

Figure 1.20 Comparison of Surface Thickness between Scenario 3 SP1 and two Mitigation Scenarios, S3-M1 and S3-M2



Annex B

Public Disclosure Process. Blocks 5, 6, 11 and 12, São Tomé e Príncipe.

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Annex #B

Public Disclosure Process:

Blocks 5, 6, 11 e 12, São Tomé and Príncipe

January, 2019

The business of sustainability

1 INTRODUCTION

On the 28th of November and 30th of November of 2018, two separate Public Consultation sessions were held on the "Environmental, Social and Health Impact Assessment Study of the Drilling Campaign in Blocks 5, 6, 11 and 12", on the island of São Tomé and the island of Príncipe respectively.

Section 2 of this document provides an overview of the main subjects discussed during these meetings, along with key questions raised by interested stakehoklders and the Project proponents answer (i.e. Question and Answers Q&A document); as well as the list of participants.

Section 3 presents the answers to the "Joint Position Document" sent by the Federation of NGOs of STP in response to their review of the Block 11 ESHIA.

Final section details specific information on the Consultancies involved in the ESHIA report preparation as well as the key consultants involved with details on their experience.

2 PROJECT PRESENTATION

The following Powerpoint presentation was presented at each of the meetings, detailing:

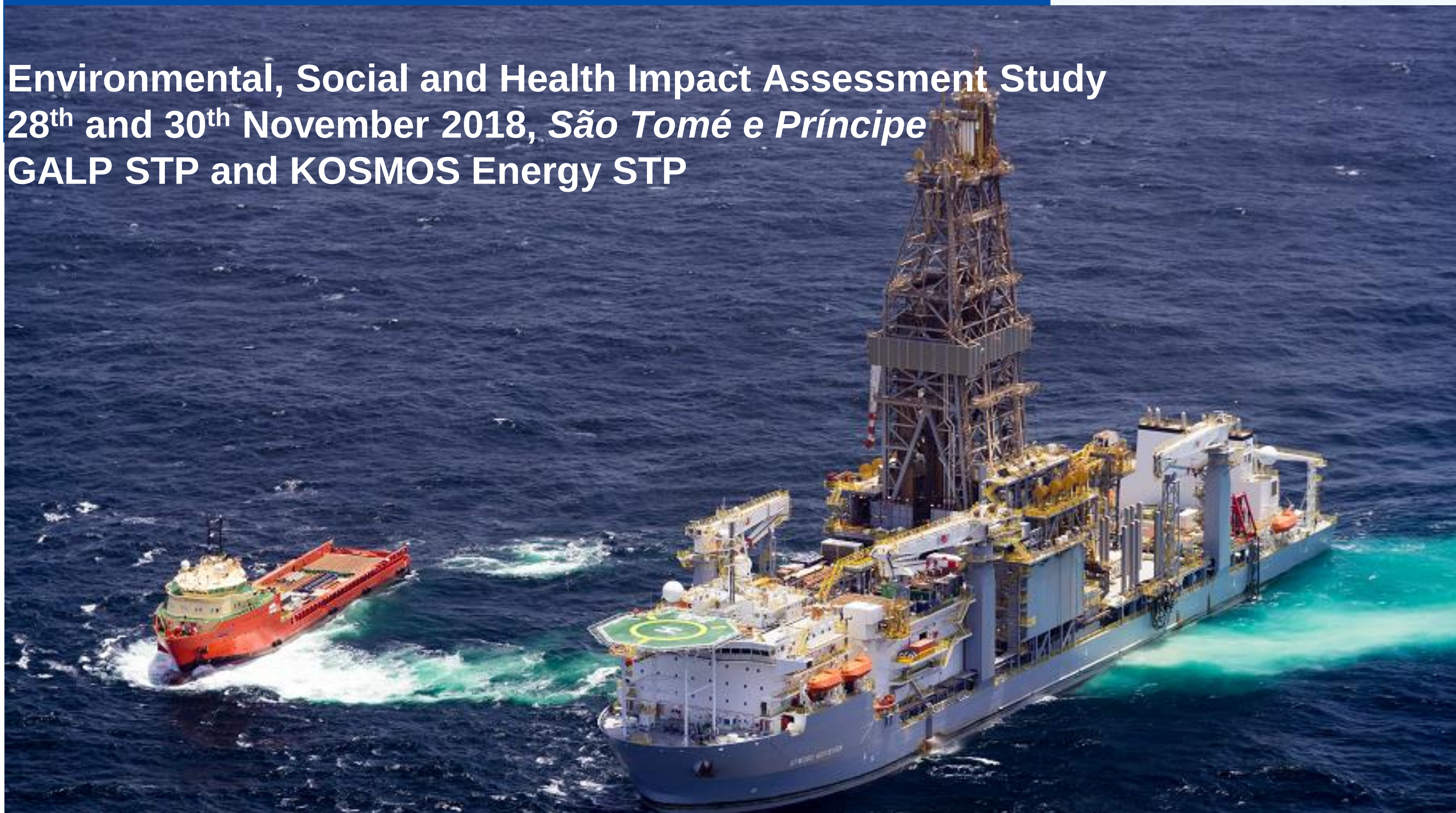
- Presentation of Project proponents
- Galp and Kosmos Energy operations in STP
- Project description
- ESHIA development process
- Description of the source information
- Summary of the Environmental, Social and Health baseline
- Impact assessment methodology
- Identified physical, biological and social impacts; Accidental Events
- Environmental Management Plan
- Conclusions

After the presentation concluded, the meeting ended with a Questions and Answers session, where stakeholders whom attended the meeting raised their concerns and doubts in regards to the Project. All questions where answered during the meeting and a copy of these are presented in the present Section.

ESHIA for a Drilling Campaign
São Tomé e Príncipe
Blocks 5, 6, 11 and 12

ANP-STP galp KOSMOS ENERGY

Environmental, Social and Health Impact Assessment Study
28th and 30th November 2018, *São Tomé e Príncipe*
GALP STP and KOSMOS Energy STP



Presentation Summary

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

Presentation of Participants

Galp and Kosmos Energy in Sao Tome and Principe

Project Description

The ESHIA Process

Description of Information sources

Overview Environmental and Social baseline results

Impact significance

Impact Matrix

Physical impacts
Biological impacts
Noise modelling
Social impacts

Accidental events

Environmental and Social Management Plan

Conclusions

Q&A

Participants of the ESHIA development

Integrated Oil & Gas company focused on Exploration and Production.

In this business segment Galp explores, develops and produces oil and natural gas, being present in 45 projects across 8 countries in Europe, America, Africa and Asia.

The activity of Exploration & Production began in Angola in 1982, and since then the portfolio has grown with highlight projects such as the entry in 1999 in Brazil.

Exploration activities of Galp are rapidly expanding, especially in Brazil, where the size of the discoveries in the Santos basin placed Galp within a circle of operators with highly successful exploration programs.

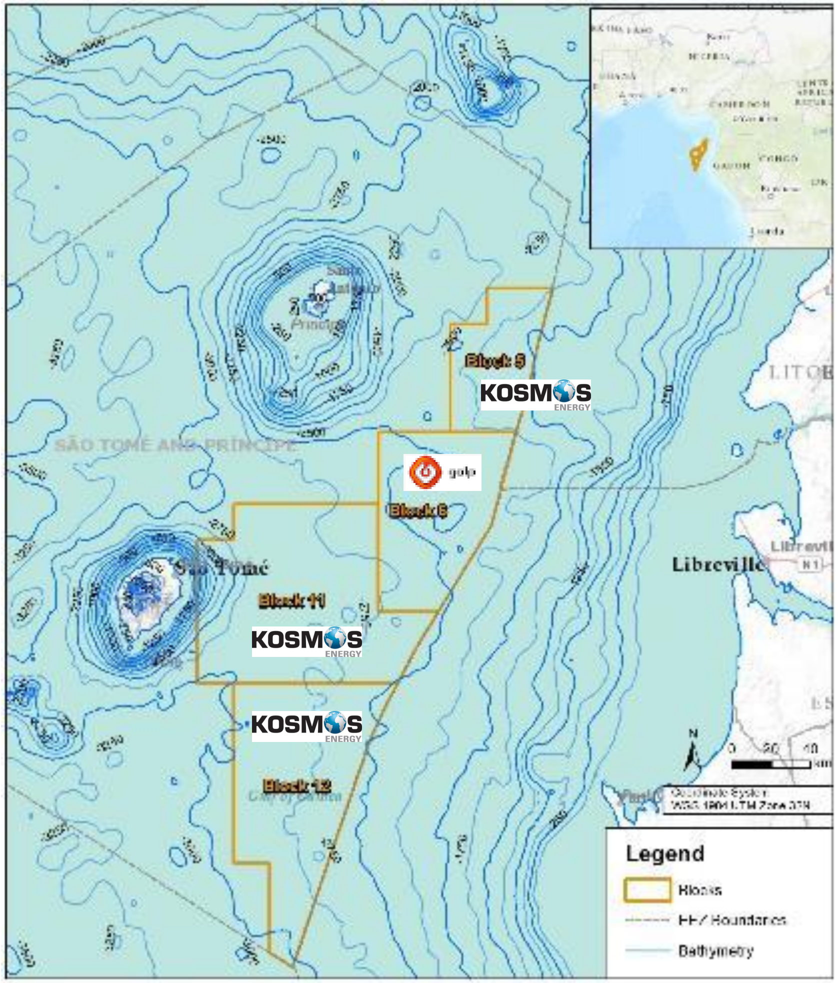
Founded in 2003, Kosmos is a well-capitalized, pure play deepwater oil & gas company with growing production, a pipeline of development opportunities and a balanced exploration portfolio along the Atlantic Margins. Our assets include growing production offshore Ghana, Equatorial Guinea and US Gulf of Mexico, a competitively positioned Tortue gas project in Mauritania and Senegal, and a sustainable exploration program balanced between proven basins (Equatorial Guinea), emerging basins (Mauritania, Senegal and Suriname) and frontier basins (Cote d'Ivoire and Sao Tome and Principe).

Global environmental consultancy Leader (5000 people in more than 160 offices).

The experience of ERM in Africa includes many sectors, such as oil and gas, mining and energy.

Local Partner in São Tomé e Príncipe: Ana Semedo

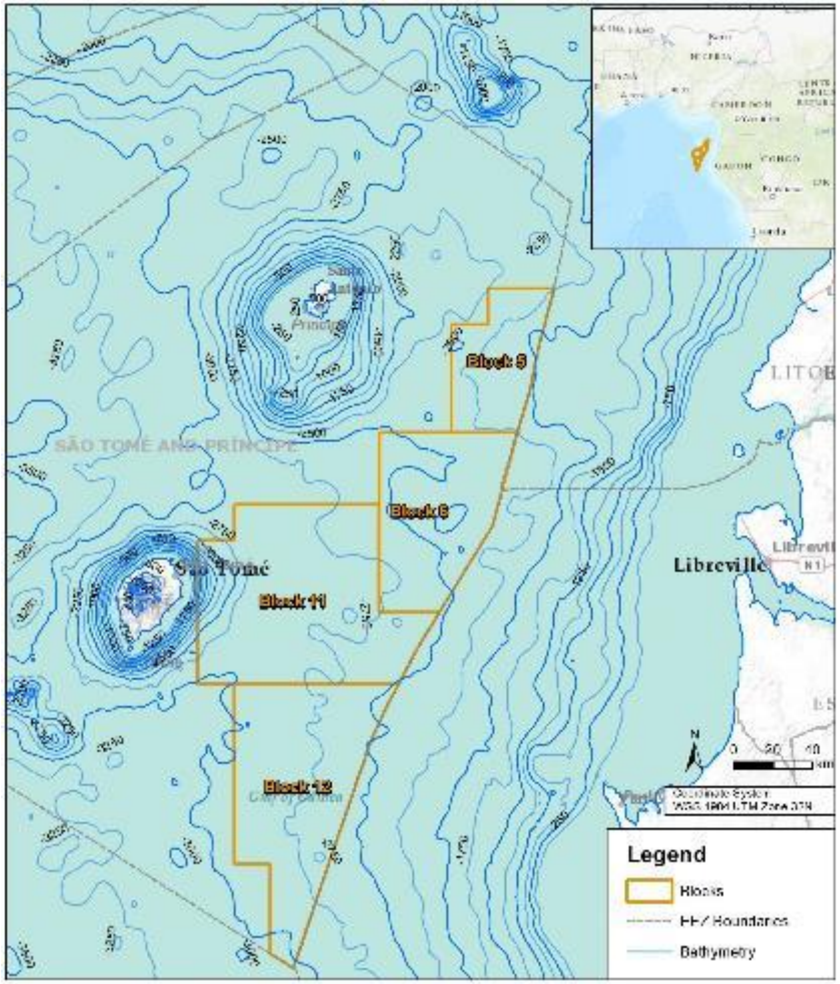
Galp and Kosmos Energy in *São Tomé e Príncipe*



- In 2015, GALP reached an agreement with the Government of Sao Tome and Principe and Kosmos Energy for the award of Block 6, offshore Sao Tome and Principe. Block 6 is located in the country's Exclusive Economic Zone.
- In October 2015, KOSMOS acquired acreage offshore Sao Tome and Principe in Blocks 11 and later closed its acquisition of Block 12 and 5. In 2016, KOSMOS/Galp conducted a 3-dimensional (3D) seismic data survey in the four Blocks.
- The drilling campaign could be carried out sequentially along the four blocks and will involve the drilling of initially up to three exploration wells in each of the Block Concessions offshore STP. An ESHIA for each Block is required to obtain the environmental license for drilling in each Block.

Project Description

Exploratory and appraisal drilling programme



Key features:

- Combined exploratory and appraisal drilling programme
- Project will fully comply with legislation requirements and will follow the best practices and international standards.

Block	Depth (m)	Surface (km^2)
5	2,150-2,450	2,844
6	2,275-2,590	5,024
11	1,250-2,750	8,941
12	2,500-3,000	7,011

Main Project Phases:

- Rig Mobilization, Pre-drilling activities
- Drilling and well construction
- Plugging & Abandoning of the well, Demobilization

Schedule:

- Programme is currently scheduled to start late 2019. Depending on the results and performance, the drilling program for the 4 blocks is planned to last up to 3 calendar years.

Project Description
Project Activities

- Wells will be drilled with either a drillship or a semi-submersible (SS) rig. It will remain on station during drilling using a system of dynamic positioning (DPS).
- Platform Support Vessels (as best case three PSVs) will transport supplies between the drillship/SS and the onshore supply base.
- The total number of people aboard the drillship/SS is estimated to be 200 and 50 aboard the support vessels.
- 2 helicopters will be available for staff transfers and MEDEVAC.
- The onshore logistic support base for the drilling activities will be located at in a neighboring country.
- Specific Emergency Response Plans will be developed, in accordance with international standard practices.
- Waste management will comply with local STP legislation, MARPOL convention and other international standard practices.

Example of a 5th Generation Ultra-Deepwater DP Drillship

Example of a semi-submersible (SS) rig

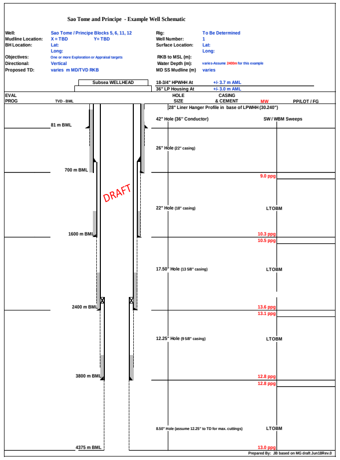
Example of a PSV

Project Description

Principles of Drilling Process

- Drilling machinery within either type of vessels include a rotary system called “Top Drive”, moving up and down with a drilling cable hooked up to a drum.
- Drilling the well will be done by applying rotation and weight on the bit. Heavy hollow drill collars, located just above the bit, are used to apply weight on it.
- Wells are drilled using multiple casing sections, with the diameter of each casing section decreasing as depth increases.
- The lengths and diameters of each casing section of the well are established prior to drilling and depend on the geological conditions of the well area.
- Drilling each well take approximately 70 days.

Example of a Top Drive.



Well schematic example.

The Environmental, Social and Health Impact Assessment Process
Purpose and approach

Purpose

- Provide a **description of the proposed Project activities** and the **existing physical, biological, socio-economic and human environment** that these activities may interact with;
- **Assess applicable national and international legislation, standards and guidelines**, considering the requirement of Santomean legislation and internationally accepted environmental guidelines;
- Assess the **potential environmental and social impacts** resulting from the Project activities and identify viable mitigation measures and management actions;
- Provide an **Environmental and Social Management Plan (ESMP)** to manage the potential residual impacts and how mitigation measures will be implemented.

Methodological approach

- Identify and evaluate the significance of potential environmental and social impacts on identified receptors and resources;
- Develop and describe mitigation measures that will be taken to avoid or reduce any potential adverse effects and enhance potential benefits;
- Report the significance of the potential residual impacts that remain after mitigation measures are in place.

Environmental and Social Information sources

Previous ESHIA studies

- ESHIAs for 3D Seismic acquisition offshore block 5, 11 and 12 Sao Tomé and Principe. Kosmos Energy, 2016.
- ESHIA for 3D Seismic acquisition on offshore block 6 Sao Tomé and Principe. GALP, 2016.

Operator information

- GIS information datasets
- HSE documentation

Public sources

- Birdlife International
- International Union for the Conservation of Nature (IUCN)

Scientific literature

- Over 130+ scientific journal references

Technical Guidelines

- The Oil and Gas Industry: Operating In Sensitive Environments (IPIECA, 2003)
- IOGP: Environmental management in oil and gas exploration and production (1997) and others

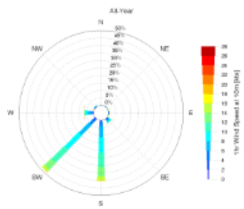
Note: non exhaustive list of sources

Environmental and Social Baseline

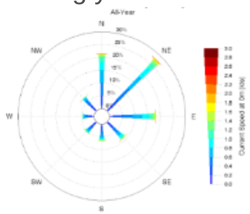
Physical aspects

Climate

- Tropical climate with wet (Oct-May) and dry (June-Sept) seasons.
- Infrequent offshore fogs (<1% occurrence).
- Maximum and minimum monthly temperatures range between 18-21 and 30-33°C. Very stable along year.



wind conditions



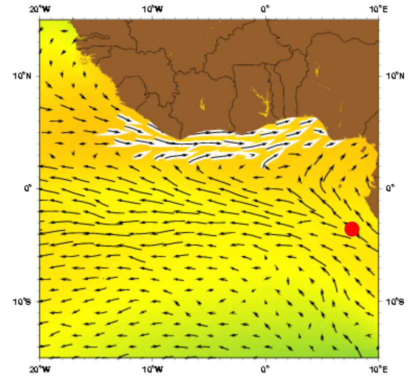
surface current conditions

COMBINED PERIOD (1990 to 2012)	Significant Wave Height [m]			
	MIN	MEAN	MAX	STD DEV.
January	0.58	0.99	1.88	0.18
February	0.60	1.04	2.01	0.20
March	0.57	1.10	1.89	0.19
April	0.72	1.21	2.26	0.23
May	0.72	1.34	2.40	0.26
June	0.82	1.42	2.41	0.25
July	0.64	1.47	2.34	0.27
August	0.78	1.48	3.11	0.31
September	0.80	1.39	2.65	0.27
October	0.79	1.24	2.38	0.23
November	0.65	1.14	2.12	0.21
December	0.60	1.01	1.65	0.17
All Year	0.57	1.24	3.11	0.29

Significant Wave Height

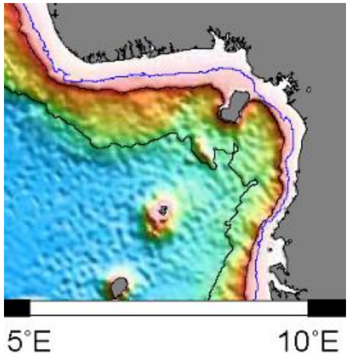
Marine Hydrology

- Water circulation in offshore São Tomé and Príncipe is dominated by the Guinea and Benguela Currents.
- Surface currents (0-100 m depth) along Blocks flow predominantly westwards, with speeds of 0.25 m/s .
- Sea surface temperatures (SST) average 27ºC in the study area for the January-March period. During the summer months, SSTs decreases to 25ºC
- Surface salinity along the West coast of Africa is 35 to 36.5 parts per thousand, exhibiting little annual variation.



Bathymetry

- Continental shelf off the coast of São Tomé and Príncipe is very narrow, the 200 m isobaths being less than 5 km in São Tomé and 10 km in Príncipe.
- Shelf is characterized by being slightly hilly, slopes gently with an average gradient of 2° from the shore to water depths of 200-300 m.
- The continental slope is very steep, reaching more than 2,000 m depth in few kilometers.



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Environmental and Social Baseline

Biological aspects

Marine Mammals

- Existence of a migration route that runs parallel to the coast along the Gulf of Guinea. São Tomé and Príncipe archipelago offers resting and breeding sites (i.e humpback whale).
- Seven baleen whale (Mysticeti) species are considered to be potentially present in the study area. Three of them (Fin, Sei and Humpback whales) are more likely to be present in STP waters.
- Sei, Fin and Blue whales are the most endangered species.
- The most sensitive period for mysticetes is between July and October.
- Another 21 species belonging to toothed whales group (Odontoceti) could be present in the study area. Five of them can be considered as resident in STP waters where they are commonly observed and are present throughout the year.

Turtles

- 5 sea turtle species are inhabiting São Tomé´s offshore and coastal waters: the loggerhead (*Caretta caretta*), the hawksbill (*Eretmochelys imbricate*), leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempii*) and green turtle (*Chelonia mydas*), all listed as Vulnerable, Endangered or Critically Endangered (IUCN).
- Except loggerhead turtle, all species are nest in STP beaches.
- Main sensitive period (nesting) extends approximately between October and March

Seabirds

- Seabirds are abundant over the continental shelf but their presence is reduced further offshore.
- Several seabird species could potentially be present along the four Blocks, such as species spending long periods offshore.
- Typical species that may be found offshore are Black noddy (*Anous minutus*), Storm petrel (*Hydrobates castro*), Brown booby (*Sula leucogaster*) and Bridled tern (*Onychoprion anaethetus*) as well as other Terns, Petrels and Gulls.

Environmental and Social Baseline

Biological aspects

Small Pelagic Fish

- Small pelagic fish constitute an important fishery resource in the area, both in terms of biomass and in economic revenues
- The main species of small pelagic fish that are the main targets for fishery activities in Sao Tomé e Principe are the herring (*Clupea harengus*), sardines (*Sardinella spp.*) and anchovies (*Engraulis encrasicolus*).
- Other small pelagic species also present in STP are mackerels (*Trachurus spp.*) and Guinean codling (*Laemonema laureysi*)
- Reproduction occurs throughout the year.

Large Pelagic Fish

- Large pelagic fish are common in the Gulf of Guinea and are targeted commercially mainly by industrial fisheries.
- The main species of large pelagic fish include skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), big eye tuna (*T. obesus*), marlins (*Istiophoridae* family), billfishes such as the Atlantic sailfish (*Istiophorus albicans*) and the swordfish (*Xiphias gladius*).
- Several species spawn in the area throughout the year.

Demersal species

- The main representative species of the demersal community in STP are cassava croaker (*Pseudotolithus senegalensis*), longneck croaker (*P. typus*) and golden African snapper (*Lutjanus fulgens*),
- Reproduction occurs throughout the year.
- 26 fish species are considered to be threatened according to the IUCN, mainly sharks and rays.
- One of them(*Squatina oculata*) is assessed as Critically endangered by the IUCN, though it does not inhabit depths below 100 m.

Environmental and Social Baseline

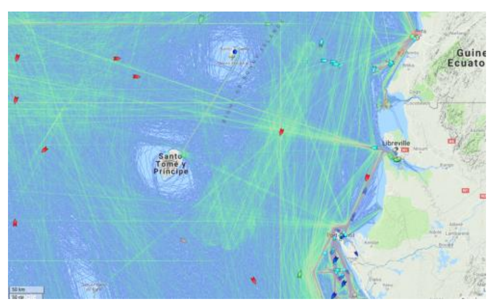
Socioeconomical aspects

Commercial fisheries

- Fisheries in STP represented 4.7% of national GDP in 2012 and employed approximately 15% of the working population.
- Fisheries are exploited through artisanal, semi-industrial and industrial fleets.
- For a large part of the population in the surrounding African countries, fish is one of the main source of animal protein.
- Artisanal and semi-industrial fleet based out of 23 small ports (launching sites) and focuses on coastal areas (up to 20 m depth) targeting pelagic and demersal species and shrimps.
- Industrial fleet is focused mainly on small and large pelagic fishes and crustaceans offshore waters, several kilometers from the shoreline, and tends to intensify during tuna migration season, between May and mid-October.

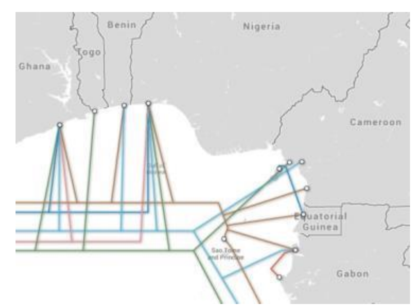
Maritime traffic

- Gulf of Guinea sees an important passage of oil tankers and cargo ships throughout the year.
- Main traffic close to the Blocks is located between Libreville and Port Gentil in Gabon.
- Shipping density is relatively low in STP waters compared to the shipping traffic across the Gulf of Guinea.
- No major shipping route crosses the Blocks.
- Most traffic in blocks is related to the STP-Continental Africa shipping routes.



Infrastructures

- There are two main seaports: one at São Tomé city and another at Santo Antonio on Príncipe Island.
- Pier and container storage areas are present in the islands; a fishing pier is to be built in São Tomé.
- Several submarine cables cross the offshore Blocks.



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The Environmental, Social and Health Impact Assessment Process

Impact significance

Reporting the significance of a potential residual impact in the ESHIA is based on the combination of two factors:

i) The **quality/importance/sensitivity** of the receptor

ii) The assessed **magnitude** of an impact, taking into consideration all the mitigation measures (based on the nature of the impact, its extent and its duration).

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

Constraints arising from applicable regulations and standards are taken into account in the evaluation of potential residual impacts and their acceptability

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Potential Impacts

The impact matrix

The sources of potential impact have been identified as originating from routine project activities as well as accidental events that may arise as part of the drilling operations.

The components of the Project taken into account in the assessment are:

- the drillship/SS and its operations; and
- the support vessels and associated operations.

				Ambiente Físico			Ambiente Biológico							Ambiente Social				
				Mudanças Climáticas e na Qualidade do Ar	Qualidade da Água do Mar	Leito do mar e sedimentos	Plâncton	Comunidades bênticas	Peixe	Tartarugas marinhas	Mamíferos Marinhos	Aves Marinhas	Áreas costeiras sensíveis	Navegação, tráfego e utilizadores marítimos	Pesca	Economia, emprego e meios de subsistência a nível local	Infra-estruturas e Serviços Locais	Segurança e Saúde da Comunidade e dos Trabalhadores
#Fontes de Potenciais Impactos	Eventos de Rotina do Programa de Perfuração Exploratória e de Avaliação	1	Mobilização e desmobilização do navio-sonda/sonda	A1						T1	M1			NT1	FS1			
		2	Presença física do navio-sonda/sonda e das embarcações de apoio							T1	M1	SB1		NT1	FS1			
		3	Operação das embarcações de apoio e dos helicópteros	A1								SB1		NT1		E1		
		4	Operação da unidade de perfuração	A1					F1	T2	M2			NT1	FS1	E1		
		5	Operação das instalações em terra (base de suprimentos e base de helicópteros)										SA1			E1	I1	C1
		6	Operacões de Perfil Sísmico Vertical (VSP)					B2	F1	T2	M2			NT1	FS2			
		7	Testes aos poços (*flare*)	A1														
		8	Uso de produtos e serviços a nível local													E1		
		9	Geração e gestão de resíduos incluindo a produção de descargas de águas residuais		W1		P1		F2	T3	M3	SB2			FS3	E1	I1	C1
		10	Descarga de cascalho e de lamas de perfuração		W2	B1	P1	B1	F2	T3	M3							
		11	Tratamento, armazenamento e consumo de água doce													E1	I1	
	Eventos Acidentais	12	Derrames de lamas, hidrocarbonetos derivados do poço (por ex., blow-out ou derrames de combustível (gasóleo) das embarcações ou do navio-sonda/sonda)	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1	AE1

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Potential impacts on the physical environment

Air Quality

Potential Impacts

- Combustion product releases such as carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), sulfur oxides (SOx), volatile organic compounds (VOCs) and particulate matter (PM).
- Localized temporary increase in pollutant concentrations and reduced air quality at local level; and
- Contribution to greenhouse gases.

Residual Impact significance: Negligible

Mitigation measures

- Advanced planning to aid efficient operations.
- Proper maintenance of equipment and generators;
- Regular monitoring of fuel consumption; and
- Well test duration and volume of produced hydrocarbons will be reduced as much as practical to meet the objectives of the test.
- The flare (only applicable to appraisal wells) will be visually monitored to ensure efficient combustion
- Compliance with MARPOL Annex VI which sets limits on sulfur dioxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances.

Potential impacts on the physical environment

Water Quality

Potential Impacts

- Potential localized reduction in water quality, including increased turbidity and BOD, from discharges of sewage/grey water and solid waste.
- Potential introduction of alien invasive species from ballast water discharges.

Residual Impact significance: Negligible

Mitigation measures

- Vessels will be equipped with a sewage treatment unit compliant with MARPOL Annex IV.
- Discharges will comply with MARPOL Annex IV.
- Bilge and drainage water will be directed to an oil-water separator and treated before discharge (max 15 ppm of oil).
- Each vessel will carry an oil record book and ballast water log.
- All Ballasting activities will comply with the International Convention for the Control and Management of Ship's Ballast Waste and Sediments (BWM Convention).
- NADF on cuttings will be reduced using good international industry technology.
- The usage and discharge of drilling muds and fluids during drilling activity will be regularly monitored.

Potential impacts on marine biodiversity

Seabed and Benthic communities

Potential Impacts

- Generation of noise emissions, from operation of drillship/SS and support vessels.
- Loss of seabed, habitats and benthic fauna in the direct footprint of the well and where cuttings and cement are deposited
- Potential increase in total suspended solids and contaminants directly discharged to seabed

Residual Impact significance: Negligible

Mitigation measures

Seabed and Benthic communities

- The volume of discharged cuttings and drilling muds will be monitored.
- Low toxicity either for WBF and/or NADF will be selected and used during drilling activities for all drilling sections.
- Drill cuttings from the sections where NADF is used will be treated onboard to ensure a average content of 6.9% overall in weight of muds within the cuttings to be discharged.
- There shall be no discharge to sea of free oil coming from drilling fluids and cuttings.
- Visual inspections by ROV of the general pattern of the seabed sediments distribution around the drilling center will be conducted before and after the drilling operations.

Potential impacts on marine biodiversity
Marine mammals, sea turtles and fish/other fauna

Potential Impacts

- Potential marine wildlife effects due to noise emissions from VSP activities
- Physical presence and operation of drillship/SS and support vessels

Residual Impact significance:

***Minor** (marine mammals and turtles) **to negligible** (fish and other fauna)*

Mitigation measures

Marine mammals and turtles.

- Conduct VSP operations following full implementation of JNCC Guidelines
- Visual monitoring by marine fauna observers.
- Vessels will use designated and relevant navigation channels where possible;
- The transit of supply vessels in coastal waters at night hours will be limited to the extent possible.
- Supply vessel operators should maintain awareness for marine mammals and sea turtles, and take avoidance action if a collision seems likely, if safe to do so.
- Good maintenance procedures on vessel engines.
- Documentation sharing with STP authorities of relevant and applicable marine environmental data and opportunistic sightings of marine fauna.

Potential impacts on marine biodiversity

Discharges, vessel/equipment presence, lighting

Potential Impacts

- Potential disturbance to marine wildlife due to secondary effects from liquid and solid waste discharges on the water column.
- Potential disturbance to marine wildlife due to collisions with Project vessels.
- Potential impacts derived from the use of artificial lighting.

Mitigation measures

- Food waste will be the only solid waste discharged overboard, and always according to MARPOL Annex V requirements.
- Liquid discharges will comply with MARPOL Annex IV.
- Supply vessel operators will maintain awareness for marine wildlife and take avoidance action if a collision seems likely.
- Lighting will be restricted to that which is required for safe operations.

Residual Impact significance:

Minor *(physical presence and risk of collision)*

Negligible *(noise and 2ary impacts due to water quality changes)*

Potential impacts on fisheries

Potential Impacts

- Temporary disruption or cessation of access to fishing grounds in the high seas.
- Secondary impacts due to changes in water quality

Residual Impact significance: Negligible

Mitigation measures

- Engagement with fishing associations and STP fishery authorities will be undertaken.
- Communicate with any fishing vessels or other navigators that are present in the vicinity of the exclusion zone around the drillship/SS.
- Ensure procedures are in place for dealing with claims in the event of damaged fishing gear due to the movement of support vessels.
- Applicable embedded measures related to noise generation will apply (see summary of impacts on marine mammals).
- Applicable embedded measures related to water quality will apply.
- Compliance with MARPOL requirements and good industry practice.
- Operational controls contained in Waste Management Plan or other suitable plan or procedure.

Potential impacts on maritime traffic

Potential Impacts

- Project vessel's movements may have the potential to disrupt maritime traffic in the area.
- Increase of collision risk

Residual Impact significance: Negligible

Mitigation measures

- Notification to relevant marine authorities and advanced notice to mariners prior to commencement of the drilling program including notification of the establishment of the 500 m exclusion zone around well location.
- Vessels will use designated and relevant navigation channels where applicable and comply with designated exclusion zones.
- Navigational marks and lights on the drill ship.
- Safety exclusion zone will be monitored for the safety of the facility and other users of the area.
- Ensure that vessels are equipped with collision risk reducing devices i.e. navigational lights and beacons, etc.

Event related Impacts (e.g. accidental *Hydrocarbon spills*)

Potential Impacts

- Scenarios evaluated for this exploration program include the accidental release of contaminants/hidrocarbons.

Boeing 727 – Dispersante aéreo para resposta rapida

Capping stack

Residual Impact significance: 'ALARP'*

*ALARP is the acronym of '*As Low as Reasonably Practicable*' which is a technical term used in the industry to define the Risk Levels associated to accidental events.

Main Mitigation Measures

- Ensure following Intl best practice applicable to well drilling operations.
- Ensure the existence of an Shipboard Oil Pollution Emergency Plan (SOPEP) to respond to a possible spill.
- Ensure the existence of an Oil Spill Response Plan (OSRP).
- Availability of oil spill cleaning materials.
- Compliance with MARPOL 73/78 (Oil spill record log).
- Separate storage of lubricants and other hazardous substances, in accordance with pre-defined waste management plan.
- Ensure integrity of the exclusion zone.
- Use of suitable Dry-break fittings for all vessels when refueling.
- Notification of vessel positions and issuance of Notice to Mariners.

Summary of Impacts

All identified impacts are negligible or minor

Receptor	Potential Impact	Impact Significance
Air Quality and Climate Change	• Potential reduction in localized air quality and contribution to greenhouse gases.	**Negligible**
Seawater Quality	• Potential localized reduction in water quality, including increased turbidity and BOD. • Potential introduction of alien invasive species from ballast water discharges.	**Negligible** (routine effluents and ballast waters) **Negligible** (discharge of cuttings and muds)
Seabed and Benthic communities	• Generation of noise emissions. • Loss of seabed, habitats and benthic fauna in the direct footprint of the well and where cuttings and cement are deposited. • Potential localized and short term increase in total suspended solids (TSS) in the water column and near the seabed. • Impacts on sediment quality and benthic organisms from contaminants contained in WBM directly discharged to seabed and NADF coated in cuttings discharged from the drillship/SS.	**Negligible** (noise) **Negligible** (change in water quality)
Plankton	• Potential localized increase in organic matter and reduction in water quality.	**Negligible**
Fish	• Impacts due to the generation of noise emissions. • Secondary impacts due to changes in water quality.	**Negligible**
Sea Turtles	• Disturbance from the presence of Project vessels. • Potential collision risk with Project vessels. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Minor** (physical presence and risk of collision) **Negligible** (noise and secondary impacts due to changes in seawater quality)

Risk of Spill: ALARP for all spill scenarios (refuelling operations, collision or blow-out, including Emergency Plans for vessel and well ready in case of need)

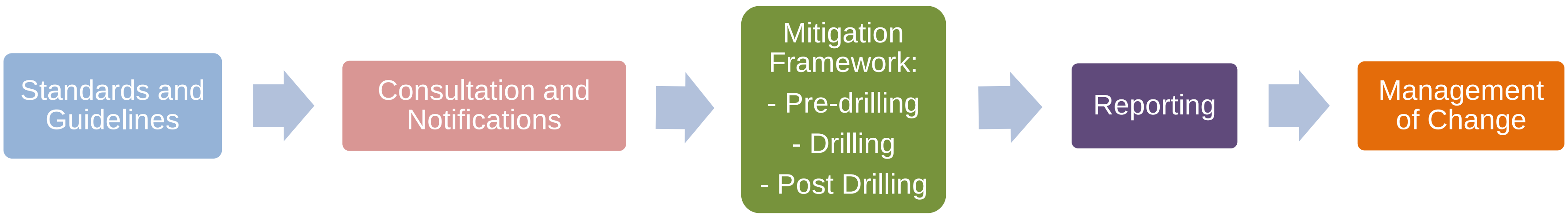
Receptor	Potential Impact	Impact Significance
Marine Mammals	• Disturbance from the presence of Project vessels. • Potential collision risk with Project vessels. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Minor** (physical presence, risk of collision and noise generated by VSP) **Negligible** (secondary impacts due to changes in seawater quality)
Seabirds	• Disturbance from the presence and movements of Project vessels and helicopter flights. • Secondary impacts due to changes in water quality.	**Minor** (physical presence and helicopter flights) **Negligible** (secondary impacts due to changes in seawater quality)
Sensitive coastal areas	• Disturbance to sensitive coastal areas from onshore activities.	**Negligible**
Oher Marine Users	• Impacts to maritime traffic. • Increase of collision risk.	**Negligible**
Fisheries	• Impacts due to the presence of drillship/SS and associated exclusion area for fisheries. • Impacts due to the generation of underwater noise emissions. • Secondary impacts due to changes in water quality.	**Negligible** (presence of Project vessels) **Negligible** (impacts from underwater noise and from water quality changes)
Local Economy	• Impacts on local economy, livelihood and employment.	**Minor (positive)**
Local Infrastructure and Services	• Impacts on submarine infrastructures (i.e. marine cables). • Impacts on local water network.	**Negligible**
Community and Workers Health & Safety	• worker-community interactions resulting in lack of appreciation of local customs. • use and handling of hazardous materials.	**Minor**

ERM

ANP-STP galp KOSMOS ENERGY

Environmental and Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) will help to implement all the mitigation measures proposed in the ESHIA during the course of the project, in compliance with GALP's and KOSMOS's HSE Policy, management system and procedures, São Tomé e Príncipe legislation, laws and international standards and good international practices in the oil and gas industry.



The ESMP will contain a series of specific management procedures related to:

- Waste management
- Oil pollution prevention and emergency
- Marine fauna Monitoring
- Communications and Reporting

This plan will be valid for all phases of the project and considers the procedures reflecting best practices and environmental standards currently in force in the oil industry. The plan will be periodically monitored during the project.

Conclusions

- GALP and KOSMOS propose to undertake an exploratory and appraisal drilling programme within the Blocks 5, 6, 11 and 12, in Offshore Sao Tome and Principe.
- All drilling activities will be located at least 50 km from the coast.
- The combined programme is currently scheduled to begin late 2019 and its expected duration could be approximately 3 calendar years.
- GALP and KOSMOS will respect the applicable Sao Tome and Principe laws and regulations and will follow the worldwide good international industry best practices and standards (MARPOL, JNCC, etc.) in order to guarantee safety and an environmentally friendly operation.
- A systematic impact assessment process was applied to assess the impact of project activities on Blocks 5, 6, 11 and 12. For all aspects of operations, the effects were deemed negligible or minor.
- When appropriate, mitigation measures have been developed and described to minimize any potential adverse effects and enhance potential benefits.
- The Project's activities will operate following GALPs and KOSMOS HSE policies, management system, procedures and the ESMP; therefore, there is a high level of confidence that potential effects will be reduced to as low as reasonably practicable, thus safeguarding against significant environmental and social impacts.

ESHIA for a Drilling Campaign
São Tomé e Príncipe
Blocks 5, 6, 11 and 12

galp
KOSMOS ENERGY

Questions and Answers
Q&A

ESHIA for a Drilling Campaign
São Tomé e Príncipe
Blocks 5, 6, 11 and 12

Thank you for your attention

2.1 *SÃO TOMÉ PUBLIC SESSION 28TH NOVEMBER 2018*

The Public Consultation session on the "Environmental, Social and Health Impact Assessment Study of the Drilling Campaign in Blocks 5, 6, 11 and 12" was held on November 28, 2018 in São Tomé.

The session had approximately 50 participants according to the attendance list in Section 2.1.2 - note that some participants may not have been registered.

After the opening speeches by the ANP / KOSMOS ENERGY / GALP, a presentation of the project, the reference situation, the methodology of the study, the main potential impacts and conclusions was made, followed by a question and answer session.

2.1.1 *Q&A – Questions & Anwsers*

The main questions are set forth in the following table, presenting for each of them the main clarifications provided as well as the chapter of the ESHIA in which the topic is approached and detailed.

Questions and Answers directly related to the GALP / KOSMOS ENERGY and ERM Operators.

#01 – What plans are in place to respond to an accident situation and ensure that, after such a situation, the situation of reference is restored? In the ESHIA, all the measures planned to respond to a possible accident situation are defined, which will be detailed according to applicable international standards and specific characteristics of the project. The implementation of these measures will be monitored through the Environmental and Social Management Plan (ESMP). The Operators (GALP and KOSMOS ENERGY) will inform the competent authorities about the implementation of this plan on a periodic basis. *Section 5.9. Acidental Events: Oil Spills* *Section 6. Environmental and Social Management Plan*
#02 – Will there be a team to monitor the environmental measures proposed in the ESHIA? GALP and KOSMOS ENERGY have a Management System that includes inspections, verifications, audits and monitoring of project activities. In addition, the Operator Management System will provide the Authorities with the

necessary periodic reports and will be in contact with them by providing the requested information and other information collected during the execution of the project activities. *Section 6.6. Reporting*
#03 – After demobilization, what will be the treatment of sludge and hazardous waste and where will it be carried out, since São Tomé and Príncipe does not have these resources (treatment / disposal sites)? All waste will be transported and treated in a certified final treatment facilities located outside the territory of São Tomé and Príncipe. The details related to the types of waste, segregation, identification, recovery, treatment and the places where these treatment and final disposal operations will be carried out will be defined in the Waste Management Plan. *Section 5.5.3. Mud and Drill Cuttings Discharge* *Section 6.4.2. Issue Specific management Plans and procedures*
#04 – What is the expected response to an accidental spill at sea? A Shipborad Marine Pollution Emergency Plan (SOPEP) will be implemented to respond to a possible spill, as well as a Oil Spill Response Strategy (OSPR), compliance with MARPOL 73/78 (oil spill log) and the possibility of use international resources that can be mobilized in case of need. *Section* 5.9. *Acidental Events: Oil Spills* *Section* 6. *Environmental and Social Management Plan*
#05 - How will Operators deal with sea pirates? Are there specific plans for this? Operators do not anticipate that the subject of piracy could have any implication in the project. This will be monitored periodically in order to assess the need to implement specific measures. Operators received warnings regarding the existence of piracy in the project area, which will allow a dynamic management of the theme.

#06 – With regard to waste, will the project comply with international standards and conventions? All applicable standards in the field of waste management will be complied with. Complementarily see answer to Question # 03. *Section 6.3. Operational Controls and Mitigation Procedures*
#07 – Given the lack of existing resources, how will coastal areas be cleaned in an accidental oil spill situation? The Oil Spill Response Strategy (OSRP) defines, in accordance with international good practice, which situations and emergency levels should be taken into account as well as the resources and measures that should be available for each level. The response to a potential spill will depend on its magnitude. In the case of small spills, they will be treated locally since the vessels will have the means available to manage these situations. In the case of larger spills, its management will be carried out according to the specific characteristics of the accidental situation and based on a decision tree that will establish the actions to be carried out and the means to be mobilized. *Section 6.3. Operational Controls and Mitigation Procedures* *Section 6.4.2. Issue Specific Management Plans and procedures*
#08 – How will the fishing communities be sensitized to the project? In this context work will be continued with the local communities, which was initiated during the seismic evaluation project. *Section 5.7. Impacts to the Social Environment / Section 5.7.2. Fisheries*
#09 – What measures will be implemented to ensure that drilling will not occur during the periods when the presence of marine mammals / turtles is most likely to occur? The ESHIA report considered the seasonality for these species (marine mammals and turtles), however, given the nature of the operations (drilling one well at a time and in open water), it was not considered necessary to define exclusion periods. All of the above species will be able to easily avoid drilling sites if they are perceived to pose a threat. In any case, measures will be implemented that

will help GALP and KOSMOS ENERGY to monitor this situation, namely: presence of observers of the marine fauna on board the Drillship, establishment of a speed limit for support vessels, definition of designated corridors for the project vessels as well as anti-collision devices and application of the procedures defined by JNCC-2017 (Joint Nature Conservation Commitee).

Section 5.6. Impacts to the Biological Environment

#10 – What treatment will be given to the muds and what is its final destination?

See answer to question #03.

#11 – In the event that a oil spill reaches the shore, what are the response conditions to be implemented and how will coordination be managed between the various entities involved (Operators, Civil Protection, etc.)?

The management of any accidental situation is defined in the Oil Spill Response Strategy. This plan will include roles and responsibilities as well as levels of action.

#12 – What measures are planned to minimize the impacts of noise on cetaceans?

The project will follow at least applicable international good practice, including the requirement procedures of the Joint Nature Conservation Commitee (2017), which will be specifically applicable to the vertical seismic profile. It should be noted that the project activities generate noise levels similar to those associated with the circulation of ships in the area.

Section 5.6. Impacts to the Biological Environment

#13 – Are the indirect impacts foreseen in this study? Particularly those related to noise arising from project activities?

The ESHIA takes into account not only the direct impact of marine mammals (eg vertical seismic noise) but also potential indirect impacts (eg changes in water quality).

Section 5. Environmental, Social and Health Impact Assessment

#14 – How the ESHIA is made available in order to ensure the transparency of the dissemination process?

The ESHIA will be available at ANP offices for 30 days. All comments from stakeholders should be addressed to the ANP.

#15 – How will the connection between the Contingency Plan currently under development for São Tomé and the Operator Contingency Plans be achieved for the project activities?

The GALP / KOSMOS ENERGY Consortium will have an autonomous Contingency Plan. The interconnection of this Plan with the São Tomé Contingency Plan will be of interest to both parties once the latter is completed and implemented.

#16 – What is the country in which the logistics activity will be located?

At this moment the location of the logistics base is not yet defined. Due to the inexistence of adequate infrastructure in São Tomé and Príncipe this logistics base will be located in a neighboring country. However, operators will have offices installed in São Tomé before and during operations, for coordination and general management of operations, which will also be monitored in a coordinated way from the headquarters located in Lisbon.

Section 3.2. Description of the offshore drilling campaign

#17 – Are the consulting firms that participated in the study registered with the environmental entity? What are the valences of the technicians involved in the preparation of the study?

ERM (https://www.erm.com/) is an independent multinational company with extensive experience in the development of environmental impact studies for similar projects in other countries of the Gulf of Guinea, namely Ghana, Gabon and Equatorial Guinea (we incorporate experience and ERM services in this Annex of the ESHIA). ERM has already developed several environmental impact studies in São Tomé and Príncipe, namely for the expansion works of Príncipe Airport and the development of the 3D seismic evaluation study for Blocks 5, 6, 11 and 12. These environmental impact studies were approved and issued their respective environmental licenses. ERM and its local partner, Grupo L & R

Nazare), have prepared this ESHIA in accordance with the regulations of the local legislation for ESHIA of São Tomé and Príncipe. It should be noted that the project team is a multidisciplinary team with the following areas of expertise: biodiversity, socioeconomic aspects, noise modeling, spill modeling and cutting deposition modeling.

Other Questions and Answers not directly related to Operators or ERM.

Does the ANP have resources to be trained to fill existing gaps in the number of human resources available and their technical capacity? The ANP currently has the necessary resources for the activities that are under development. It is planned to develop a long-term training plan in order to meet the future needs of the projects.
Is ANP's intention to hire an independent, certified external company to ensure the performance of Audits by the Regulator? The ANP has limited resources, which will be allocated to the activities considered most relevant.
Does the ANP have any planned training plan that ensures the existence of local resources that could be involved in the development of this type of study, in order to potentially work with foreign companies? See answer to question #11.

2.1.2 List of Participants

Sessão de consulta pública relativa ao Estudo de Avaliação de Impacto Ambiental, Social e de Saúde da Campanha de Perfuração nos Blocos 5, 6, 11 e 12 em São Tomé

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São Tomé, 28 de Novembro de 2018

Sessão de consulta pública relativa ao Estudo de Avaliação de Impacto Ambiental, Social e de Saúde da Campanha de Perfuração nos Blocos 5, 6, 11 e 12 em São Tomé

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São Tomé, 28 de Novembro de 2018

2.2 *PRÍNCIPE PUBLIC SESSION 30TH NOVEMBER 2018*

The Public Consultation session on the "Environmental, Social and Health Impact Assessment Study of the Drilling Campaign in Blocks 5, 6, 11 and 12" was held onNovember 30, 2018 in Principe.

The session had approximately 50 participants according to the attendance list in Section 2.2.2 - note that some participants may not have been registered.

After the opening speeches by the ANP / KOSMOS ENERGY / GALP, a presentation of the project, the reference situation, the methodology of the study, the main potential impacts and conclusions was made, followed by a question and answer session.

2.2.1 *Q&A– Questions & Anwsers*

The main questions are set forth in the following table, presenting for each of them the main clarifications provided as well as the chapter of the ESHIA in which the topic is approached and detailed.

Questions and Answers directly related to the GALP / KOSMOS ENERGY and ERM Operators.

#01 – How are questions related to human factors (error / disqualification) envisaged in the study? All the operations to be carried out will be planned and prepared in such a way as to ensure their safe execution. Safety measures will be implemented in order to comply with the Health, Safety and Environment requirements enshrined in the respective Management and Policy Systems. Some examples will be the selection and acquisition of design equipment that integrates the best technologies available in the market, which include redundant security and alarm systems, which will also be subject to inspections / verifications / audits. All personnel involved in the project will have training / skills for the functions they will perform. Specific operational procedures will be implemented for the activities to be developed and a supervision of their implementation / compliance. There will also be several Emergency Management Plans to deal with unplanned situations. As the project is being implemented, all relevant documentation will be updated and adjusted if this need is identified. *Section 6. Environmental and Social Management Plan*

#02 – During drilling the well, what happens to the small particles (of cuttings) that are deposited in the bottom of the sea? Can impacts occur?

The drilling techniques that will be applied in these four blocks will follow the best international practices, equivalent to what has been carried out in other parts of the world, namely in the Gulf of Guinea.

The cuttings, equivalent in terms of composition to crushed rock, are mostly inert material that will deposit on the ocean floor and may form a small accumulation. It should be noted that a remote operated vehicle (ROV) will be used prior to any drilling operation, during and at the end of the drilling operation, to observe the characteristics of the drilling location. It should also be noted that non-aqueous drilling fluid (NADF), which functions as an element of safety of the activity, will exhibit good environmental performance and will be reused. At the end of the operation, these muds will be recycled for reuse in a next drilling / well or treated in an authorized place and not discarded for the environment.

The drilling of each block will be carried out in deep waters, far from the coast, constituting a punctual activity, whose footprint will be reduced and recolonized by the local fauna.

Section 5.5.3. Mud and Drill Cuttings Discharge

Section 6.4.2. Issue Specific Management Plans and procedures

#03 – Will a new study and a new license be necessary if the Operators decide to move to the development and production stage?

According to São Tomé and Príncipe legislation, if the Operators decide to proceed to the development and production phase (based on the results of the drilling activities), an Environmental Impact Assessment Study will be required for this specific activity, the which must be submitted to the approval of the Ministry of the Environment and be the subject of a Public Consultation. It is only after these activities and their approval by the Authorities that progress can be made to the development and production stage.

#04 – Assuming that preventive measures are implemented, a failure may still occur during the drilling operation?

Implementing prevention measures is a priority for Operators in order to avoid the possibility of failure during operation.

The Operators have already carried out previous operations in these same blocks (5, 6, 11 and 12) which were carried out safely, and no incidents were recorded. During this project the interaction between the Operators and the Competent Entities was observed, with the sharing and reporting of information relevant to the project, as well as the physical presence of the authorities on board the vessels.

It is the intention of the Operators to remain in São Tomé and Príncipe during the coming years, developing their activities in a safe and sustainable manner ensuring the minimization of any potential impact.

Operators have internal and external verification and auditing mechanisms. GALP is included in the Dow Jones Sustainability Index, which recognizes it as an industry leader for its sustainability practices.

Section 6. Environmental and Social Management Plan

#05 – How are Operators prepared to respond to personal accident situations with workers?

The platform will be permanently garnished with a Doctor and a Nurse on board, and there is a clinic for the treatment of casualties. There will also be helicopters and medical evacuation, and may also opt for the expatriation. There will also be a 24-hour videoconferencing system for medical support. All workers will be subject to medical evaluation and issuance of their medical fitness certificate before the start of activities.

#06 – How will the security issues in the perimeter of the 4 blocks be ensured in view of the current conflicts on the African coast (acts of piracy)?

Operators do not anticipate that the issue of piracy could have any implication in the project. This topic will be monitored periodically in order to assess the need to implement specific measures. Operators receive alerts regarding the existence of piracy in the project area, which will allow a dynamic management of the theme.

The drillship shall be equipped with a radar which shall enable identification of the approach of vessels.

#07 – What guarantees can be given by Operators for the protection of animals and other resources? The Operators will implement all possible measures to ensure that impacts are kept to a minimum. Periodic monitoring and ongoing contact will be carried out with the Competent Entities. At the end of the project a Report will be developed describing all the measures implemented and their comparison with the measures that were initially proposed in the Environmental and Social Management Plan (ESMP) included in ESHIA. *Section 6. Environmental and Social Management Plan* *Section 6.3. Operational Controls and Mitigation Procedures*
#08 – How will project information be available? The Operators will have permanent contact with the Authorities with the presentation of information relevant to the project and its updating. During the project operations, technicians from the São Tomé and Príncipe Authorities will be present on board. In this context, work will be continued with the local communities, which were initiated during the seismic evaluation project. *Section 5.7. Impacts to the Social Environment / Section 5.7.2. Fisheries* *Section 6.6. Reporting*
#09 – What measures will be implemented by the Operators after the drilling phase of the wells? This ESHIA is intended for the drilling of wells to evaluate the existence or not of resources that deserve to be investigated in more detail. Operators still can not commit to a response because the development and production phase depends on the success or failure of the exploratory drilling phase. The exploration phase is a distinct activity, with impacts and mitigation measures different from those presented in this Environmental Impact Assessment. See also Question #03.
#10 – What is the geological risk of the project? The petroleum system is dependent on several factors: mother rock, migratory system, rock reservoir and seal or trap. All these elements must occur in a specific sequential manner, which means that the presence of all elements may not imply

the accumulation of commercial hydrocarbons. This implies that for all the exploratory fields it is only known if there are commercial hydrocarbons after drilling the well.
#11 – Who will be responsible for the circulation / disclosure of activities related to the project? The Operators will make available all the information related to the project phases in advance, which will be transmitted to the relevant Authorities as well as to the fishing communities. The means of disclosure this information may be the following: in writing, in brochures and in person with the relevant communities. The ANP will be the main contact for the disclosure of this information. *Section 5.7. Impacts to the Social Environment / Section 5.7.2. Fisheries* *Section 6. Environmental and Social Management Plan*
#12 – Is there any relationship between oil exploration and tectonic plates that could give rise to earthquakes? There is no relationship between tectonic seismic activity and exploratory well drilling. There is, so far, no record of seismic activity caused by exploration wells.
#13 – There is a geographical discontinuity between the two islands (São Tomé and Príncipe) which can lead to the occurrence of "losses" of information. What measures will be implemented to prevent these situations from occurring? View Questions #08 e #11.
#14 – Is the impact matrix valid for the 4 blocks or are there differences between them? All 4 blocks are located offshore, in deep waters, and for this reason have many similarities. The differences are actually very few; however, where they exist, they are included in the respective Environmental Impact Assessment Reports. Impact assessment is very similar, as is the mitigation measures to be implemented.

Other Questions and Answers not directly related to Operators or ERM.

Where is Block 10 located?

Block 10 is not part of this ESHIA. The same is located between the Island of São Tomé and Ilha do Príncipe.

2.2.2 *List of Participants*

Sessão de consulta pública relativa ao Estudo de Avaliação de Impacto Ambiental, Social e de Saúde da Campanha de Perfuração nos Blocos 5, 6, 11 e 12 em Príncipe

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Sessão de consulta pública relativa ao Estudo de Avaliação de Impacto Ambiental, Social e de Saúde da Campanha de Perfuração nos Blocos 5, 6, 11 e 12 em Príncipe

ANP-STP galp KOSMOS ENERGY

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On December 30th 2018, The federation of NGOs in Sao Tomé e Príncipe (FONG-STP) submitted to the ANP-STP a **Joint Position Document** in response to the invitation of ANP-STP to receive comments from interested parties and general public on the Environmental, Social and Health Impact Studies (ESHIA) for an Exploratory Drilling and Evaluation Program in Blocks 5, 6, 11 and 12 of STP's Exclusive Economic Zone.

This Questions and Answers (Q&A) document collects the relevant observation made by FONG.-STP in regards to the **contents of the Block 11 ESHIA document**. It is assumed that most of these comments are equally applicable to the ESHIAs developed for the other Blocks (5, 6 and 12).

ID	Comment from NGO Position Paper	Answer from Project promoters
General Comments		
A	**Incomplete and superficial state of social and environmental reference.** It can be observed that the social and environmental state of the ESHIA is very superficial and incomplete, most of the data is out of date and this suggests that ERM does not carried out an in-depth data collection mission on the ground and this does not provide a relevant and objective assessment of the potential impacts of the project under international standards in the field of ESHIAs of such design.	**Specific comments on the ESHIA report raised by FONG-STP in regards to the scope of the baseline definition of the ESHIA reports have been answered further below.** **Overall, the information provided in regards to baseline features of STP is relevant and fit for purpose for the expected interference of these with the project. The current ESHIAs have been made to comply with local legislation and international good practice.** **See answers to ID1, ID17.**
B	**Lack of consultation of parties and national actors.** The analysis of the ESHIA documents allows to conclude that ERM did not consult the (e.g. artisanal fisheries and coastal tourism) in the present ESHIA. This lack of participation on assessing potential impacts is not in line with the international standards of such a project.	**Kosmos and Galp have undertaken interactions with fishing communities in the case of the previous seismic exploration activities. Local Tourist operators had not been engaged considering there is no impact foreseen from Project routine activities.** **See answers to ID26, ID28**
C	**Lack of stakeholder engagement plan for the ESHIA.** The stakeholder engagement plan is addressed in a superficial way without details on the implementation modalities and is only planned for the future. This limits the scope of the ESHIA and raises the issue in regards to international (IFC standards for example): it seems that during this phase, no local community participated in the process or was consulted to elaborate this ESHIA. This lack of participation of the parties and the local populations in the process of elaborating the ESHIA	**Kosmos and GALP have indicated as a mitigation measure the existence of a Stakeholder Engagement Plan that shall be developed and implemented, including the implementation of a grievance mechanism with interested and affected communities and other stakeholders on a range of issues and to ensure concerns are addressed in a timely manner.** **Such grievance mechanism is similar to the one that already exists from the past seismic campaign**

	questions the relevance and credibility of the present study.	
D	**Concern about the risks of accidental spillage of hydrocarbons**. The effects of any accidents, such as hydrocarbons /oil and oil spills caused may have very serious consequences for the small-scale fishing sector and for the coastal tourism sector, especially in a country such as São Tomé and Príncipe, which does not have the technical, logistical, organizational and financial means to activate a contingency plan and pollution control in the event of an accident leading to a spill of hydrocarbons. Some coastal natural habitats such as coral reefs and mangroves (essential for the sustainability and regeneration of fisheries resources) are particularly sensitive to hydrocarbon pollution.	**An Oil Spill modelling study is available in the ESHIA addendum. The results which shall be incorporated to an emergency response system in the event of a crude spill incident due to a blow-out event.** A project specific comprehensive Oil Spill Contingency Plan (OSCP) for our operations is required before drilling operations commences to respond to any significant spill. This is currently being developed and would be submitted as required before drilling begins
E	**Impacts on artisanal fisheries not satisfactorily assessed.** There will probably be much more interaction between artisanal fishermen and the offshore project facilities whereas artisanal fishermen (who use the trawl, flying net and flying whip) regularly move up to 50 or 60 miles from the coast (this means within block 11). The ESHIA report contains wrong statements on this issue and this compromises the correct assessment of project impacts on the artisanal fisheries sector. It is likely that the project will have a much greater impact on the artisanal fisheries sector than is provided for in the ESHIA report produced by ERM. There is a need to better assess these impacts and to identify compensation and mitigation measures (especially with regard to the risks of damage to artisanal fishing vessels and equipment due to collisions and direct interaction with the equipment and infrastructures of the offshore project).	**Though Block 11 is significantly close to the Sao Tome island eastern shore, drilling activities (comprised of a single rig in a static location and 2-3 supply vessels supporting it) are expected to occur towards the Blocks eastern area. Kosmos would continue to interactions with fishermen associations as was done during the past seismic campaign.** The physical presence of a single drillship and its supply vessels sitting far offshore is negligible given the volume of routine shipping traffic all along West Africa. See Section 4.5.6 of the baseline (marine traffic density map) and Section 5.7.1 of the impact assessment; Impacts on maritime traffic. **See answers to ID3, ID4 and ID18.**
F	**Impacts on coastal tourism not assessed** It is inadmissible that there is no reference to the potential impacts of the project on the coastal tourism sector in full development on the eastern coast of the island of São Tomé (capital area, Santana, Porto Alegre and Ilheu das Rolas). Potentials oil spill accidents could have a significant impact on the sector tourist based partly on the wild and paradisiacal tropical beaches. ESHIAs should	**The only potential interaction with tourism sector would be in the case of an oil spill, which is highly improbable.** **See answer to ID28.**

	have taken these aspects into account in order to assess the impacts and mitigation measures.	
G	**Absence of modeling of oil spills** A model for hydrocarbon spills should have been made and integrated into the ESHIA report. Without such modeling, it is impossible to analyze objectively risks to coastal habitats (mangrove, coral, bays, estuaries, beaches), biodiversity (birds, marine mammals and sea turtles), resources fisheries and the economic sectors of small-scale fishing and tourism.	**The hydrocarbon spill modelling conducted for the Project is available in the ESHIA addendum (Oil Spill and Drill Cuttings Deposition Modelling report summary).** **See answer to ID29.**
H	**Impact considerations for sea turtles** The information in the documents concerning sea turtles clearly show that the present study did not take into account data relating to sea turtles occurring on the islands of São Tomé and Príncipe. The islands have benefited from protection, conservation and research measures since the 1990s, by a number of organizations, in particular MARAPA, a national NGO and more recently, by the Tatô Program Association. In both islands there is an increasing knowledge about the state of conservation of turtles and awareness raising, education, social inclusion, generation of economic alternatives for coastal communities and with the national authorities. It is unacceptable that information and bibliography on the island of Bioko should be used as a basis besides being relatively distant it presents a reality and a totally different ecosystem. As already mentioned, there are available literature sources from the country able to provide such information, such as updated bibliography (see below for a list of publications). The ESHIA report clearly shows that ERM has not done sufficient research and appropriate collection of data and information in STP. As such, the environmental reference status is incomplete and does not allow satisfactory assessment of the project's environmental impacts on turtles marine species. The mitigation measures presented are not sufficient to mitigate the real impacts on sea turtles.	**For sea turtles in STP, information has been extended to include other sources to provide a more detailed outlook of their presence.** **We welcome the list of references but not all of them address distribution and abundance of sea turtles in STP waters.** **The Impact Assessment takes the relative lack of data into consideration and proposes good practices for mitigation used Internationally in other projects where information is equally lacking.** **See answers to ID2, ID9, ID10, ID11, ID13, ID14, ID15, ID21 and ID22.**
ID	**Specific Comments on Executive Summary**	
1	**Description of environmental and social reference status**	**The information provided in regards to socioeconomic features of STP is relevant and fit for purpose for the**

	In the non-technical summary, there is no information about the population directly impacted by the project (coastal communities on the east coast of island of São Tomé). It is unacceptable that the ESHIA is not based on accurate data on demographics and local socio-economic context.	**expected interference with the project, which is located far from the coast. It is not practical to provide concise information on specific eastern coastal communities when there is no specific direct impact being expected.**
2	**Page 8 of Non-technical Summary of Block 11: "Tartarugas marinhas... dados obtidos na vizinha Ilha de Bioko"** It is incomprehensible that the study is not based on data on the island of São Tomé where 5 species of sea turtles are present and benefit from and protection measures since the 1990s. One species is missing from the list of turtles that frequent the waters of STP, the green turtle (*Chelonia mydas*). There is a contradiction between ESHIAs (which speaks of 5 species).	**The ESHIA has indeed used other sources of local information in regards to turtles, not just from Bioko island data.** **Listed species in the Executive Summary are those believed to NEST in STP (4 species), not those that are present in STP waters (5 species). We thank the comment and we will provide clearer wording in ESHIA final report.**
3	**Page 9 of Non-technical Summary of Block 11: "As águas offshore, onde estão planeadas as atividades de perfuração, são exploradas pelas frotas de pesca semi-industrial e industrial, especialmente de origem estrangeira."** The maritime zone of Block 11 is also exploited by artisanal fishermen (estimated at approximately 6000 fishermen who support 30,000 people including the Palaiés and who provide animal protein for the majority of the country's population).	**The offshore area where the drilling is planned is located to the far east sections of each of the Blocks (in the case of Block 11, though the Block itself is significantly close to shore, the area where the prospective wells will be drilled is at the eastern section). It is unlikely that there may be significant artisanal fishing (understood as vessels catalogued as artisanal by Carneiro (2011) and Belhabib (2015); but with the use of an outboard engine), nonetheless it cannot be completely ruled out.** The engagement plan shall capture such communities to create awareness on the proposed operations. **<u>Text will be edited indicating that area is "MAINLY" used by semi and industrial fisheries.</u>**
4	**Page 18 of Non-technical Summary of Block 11: "As embarcações de pesca artesanal não serão afetadas pela zona de exclusão dado os pescadores não pescarem em águas tão distantes da costa e tão profundas."** This is not true because there is evidence that artisanal fishermen (using the techniques with the "corrico", the flying net, or the flying whip) depart from times up to 50 or 60 miles from the coast (ie up to 92 km or 111km). Recent studies conducted by Mungu's Kike project in collaboration with the Tatô Program demonstrated this. The ESHIA can not	**Impacts of an "immobile" drilling ship, and a small exclusion radius (500 m) during operations in the open sea is expected to have minimal impact on any fishery occurring in the area.** **, The Project is expected to implement a series of mitigation measures such as:** **• Engagement with fishing associations/fishery authorities;** **• Communication on exclusion zone;** **• Procedures for dealing with claims in the event of damaged fishing gear.**

	neglect this impact and risk for the artisanal fisheries sector.	**This mitigation would allow impacts to be negligible on fishermen using boats with outboard engines (e.g. artisanal + semi-industrial).**
5	**Page 18 of Non-technical Summary of Block 11: "Será estabelecida comunicação com outras embarcações que se movimentem na área aconselhando-os sobre a presença da unidade de perfuração."** This measure is almost impossible to achieve with artisanal fishing vessels that go up to 50 or 60 miles from the coast and do not have the means to communication such as VHF radio example.	**There are a number of mitigation measures in order to reduce potential interactions with sea users. It must be clarified that most part of the drilling operation the drillship is immobile, and is of significant size to be appropriately avoided by any type of vessel. Furthermore, there will be an active monitoring of the exclusion zone by part of the drilling rig support vessels. The drilling rig will always have a 24/7 bridge watch while on location.** **Additional mitigation shall include Use of radar and detection equipment to assist in the early detection of any other vessel that may threaten safety of <u>seismic drilling</u> vessel and equipment.**
ID	**Specific comments on ESHIA**	
6	**Page 99 of the ESHIA Report from Block 11:** ***"****Os corais têm uma gama de ocorrência limitada devido à sua necessidade de regimes específicos térmicos, salinidades, profundidade da água, sedimentação e outras características físicas e químicas. Os recifes verdadeiros não ocorrem ao longo da costa oeste africana ou nas proximidades dos arquipélagos do Golfo da Guiné, embora sejam encontradas comunidades maduras de corais em alguns locais específicos, como as ilhas oceânicas e as costas rochosas do continente, ilhas de Cabo Verde, ilhas do Golfo da Guiné, Gana, Gabão e Camarões (Wells & Bleakley, 2003)."* Comment: The islands of São Tomé and Principe house several coral reefs very rich in biodiversity and important for the coastal fishing resources	**This is a contextual piece of information in regards to coral reefs in the Gulf of Guinea and is applicable to STP.** **The ESHIA already indicates after this paragraph that:** *"In open water, hermatypic (reef-building) corals are generally temperature limited to depths shallower than 20 meters where light can penetrate, with some exceptions in the off-shore archipelagos. In São Tomé é Príncipe, these reefs are known to be present mainly in the Island of São Tomé, more specifically within the conchas and Lagoa azul beaches. These are dominated by the species Montastrea cavernosa, Siderastrea siderea and Porites spp (ENPAB II, 2015). Given the depth of area where the appraisal and exploratory drilling wells are planned (between 2,000 and 3,000 meters) it is not possible that such corals would be present (Spalding et al., 2001)."*
7	**Page 104 of the ESHIA Report from Block 11:** *"Em geral, a distribuição e abundância de cetáceos encontra-se pouco documentado na literatura científica para o Golfo da Guiné"* Comment: This is not true because MARAPA has many data on the presence of different species of cetaceans collected over the years in the framework	**The text refers to the Gulf of Guinea in general (not STP), it is a known issue that along West Africa there are locations which have high abundance of data (e.g. STP; Namibia); but data is very local and cannot explain wide patterns of distribution and abundance, especially in the case of marine mammals with large distributions and in some cases widespread migration routes.**

	of the project "Operation Tunhã" of cetacean monitoring and tourism development of "whale and dolphin watching" around the island of São Tomé. This phrase from the ESHIA report shows that ERM has not done adequate and appropriate work of data and information collection in STP.	**Project is expected to occur in areas where MARAPA has limited data, as no whale watching tours are likely to visit the eastern areas of the Block, the previous seismic campaign undertaken in the very same area provides the most appropriate evidence of what cetacean species are most likely to be encountered.**
8	**Page 105 of the ESHIA Report from Block 11:** *"As 8 espécies mais prováveis de serem avistadas nas águas de São Tomé e Príncipe incluem: a baleia-comum (Balaenoptera physalus), baleia-de-bryde (Balaenoptera brydei), baleias-jubarte (Megaptera novaeangliae), cachalote (Physeter macrocephalus), baleia orca (Orcinus orca), Baleia-piloto-de-aleta-curta (Globicephala macrorhynchus), golfinho-roaz (Tursiops truncatus) e o Golfinhopintado- pantropical (Stenella attenuata)."* Comment: This list should be confirmed and possibly modified on the basis of the data collected by MARAPA in the framework of Operation Tunhã.	**The Project would be happy to incorporate such data into the ESHIA, but as commented in the previous answer, these 8 species were selected based on the previous seismic campaign observations by trained and Joint Nature Conservation Committee (JNCC) certified Marine Mammal Observers (MMO) observed where the Project is expected to take place, and not relatively close to shore as the case of MARAPA data. In any case they are consistent with the Operation Tunhã data**
9	**Page 106 of the ESHIA Report from Block 11:** *"Figura 4.11 Avistamentos de mamíferos marinhos e tartarugas ao longo dos Blocos orientais de São Tomé e Príncipe".* Comment: To better match reality, this very interesting map should be complemented with data from Tunha / MARAPA (for cetaceans) and data from the Tatô Program (for sea turtles). In the absence of these data, the environmental reference status is incomplete and does not allow the environmental impacts of the project to be satisfactorily evaluated.	**This figure is extracted from the MMO report, it has been provided to give an indication of cetacean distribution and abundance (which may obviously change with season of the year). It is deemed that such figure may provide a more fit for purpose indication compared to data derived from observations closer to the shore.**
10	**Page 120 of the ESHIA Report from Block 11:** *"Apesar da importância da área como um habitat para tartarugas marinhas, há pouca literatura científica sobre a utilização do habitat a sua abundância e distribuição (Tomas et al., 2010)."* Comment: This is not true because many scientific publications on sea turtles in STP. This statement demonstrates that the environmental reference status is incomplete and does not allow the environmental impacts of the project to be satisfactorily evaluated.	**The citing by Tomas et al. (2010) is indicated for the Atlantic Coastline of Africa. As commented before, main shortcomings in understanding marine fauna abundance and distribution is that data is frequently "concentrated" on specific locations, and thus only part of the life-history of a specific species is known.** **<u>For sea turtles in STP, information has been extended to include other sources to provide a more detailed outlook of their presence.</u>**

11	**Page 120 of the ESHIA Report from Block 11:** *"As tartarugas são encontradas principalmente nas águas claras rasas dos recifes costeiros, baías, estuários e lagoas."* Comment: This is not true because sea turtles migrate and are also found on the high seas in almost all components of marine habitats including in the areas included in the hydrocarbon exploration blocks (as was recently proven with the GPS trackers project of the Tatô Program; still under analysis).	**It says that turtles are "MAINLY" found in these areas (not exclusively). Table 4.4 already details that some species have more "oceanic" habits when either juvenile or adult. Migrations are also discussed in the same section.**
12	**Page 121 of the ESHIA Report from Block 11::** *"Adicionalmente ha necessidade de melhorar o conhecimento e conscientização sobre a importância do ecossistema marinho, e leis e prover recursos que regulem a proteção e a proibição da captura e venda de produtos com origem em tartarugas marinhas, bem como recursos para sua implementação."* Comment: This statement demonstrates the total ignorance of the work done by the national actors in the country. The Tatô Program, in partnership with MARAPA, has been developing protection actions, conservation and research of sea turtles on the island of São Tomé in recent years, and the same happens for the island of Principe, where there is a conservation program for sea turtles developed by the Principe Trust. In both islands there is an increasing knowledge in regards to the status of sea turtles awareness, education, social inclusion, coastal communities and enforcement actions in partnership with authorities.	**This wording is cited from Carvalho (2008), it is evident that conservation programs for turtle protection exist in STP, and understood that this type of work must be carried out continuously in order to constantly improve stakeholder engagement towards their protection.** **Turtle protection is paramount, and it is still common that in spite of significant efforts towards conservation and providing legislation for their protection, sea turtles are still under threat.**
13	**Page 123 of the ESHIA Report from Block 11:** "*Um estudo realizado por Tomas et al. (2010) mostrou que as tartarugas-oliva, tartarugas-de-pente e tartarugas-de-couro foram todas registadas como Nidificantes ao longo dos 15 quilómetros de praias de areia preta de costa sul da Ilha de Bioko."* Comment: It is unacceptable that information and bibliography of the island of Bioko should be used as a base, which, in addition to being relatively distant, presents a totally different reality, as well as a different ecosystem. As already mentioned	**Bioko island has been identified as of paramount importance to the nesting of various turtle species. It is a known fact that many turtle species after nesting disperse towards other areas (though specific routes are still unknown). Bioko has been identified as an "index site" for turtle species and as such its inclusion in the ESHIA as a reference is acceptable.** **Where STP has been identified as a known rookery site, this has been detailed (e.g. for Green Turtle).**

	previously there are not only conservation programs in the country capable of providing such information, such as updated bibliography referring to the country.	
14	**Page 123 of the ESHIA Report from Block 11:** *"Embora nenhum estudo semelhante tenha sido realizado para as tartarugas das águas de São Tomé e Príncipe, este estudo mostra o tipo de movimento que poder. Ser expectável."* Comment: Again, this type of statement is inadmissible in the submitted document, demonstrating that the environmental reference status is incomplete and does not allow the environmental impacts of the project to be satisfactorily evaluated. Since 2003 there has been a program for the conservation of sea turtles, the Tatô Program, as such the information presented is wrong.	**We are unaware of any available data obtained from satellite-tracking observations of tagged turtle individuals in STP. The text refers to this type of data, not to the inexistence of conservation programs.** **Available data of tagged turtles (especially leatherbacks) show that those travelling to/from Corisco Bay and Gabon may pass through STP EEZ waters (Kot et al. 2015). Any local data originated from research in STP would be welcome.**
15	**Page 126 of the ESHIA Report from Block 11:** *"Tabela 4.5 Presença sazonal de baleias e tartarugas no Golfo da Guiné"* Comment: The nesting periods of sea turtles cover a longer period and spawning peaks are not correct.	**The length of the nesting period is given for the overall Gulf of Guinea, not STP exclusively. We acknowledge there is an inconsistency with the text for peak periods and the referred table and will be corrected.**
16	**Page 129 of the ESHIA Report from Block 11:** *"Os parques nacionais Obô de São Tomé e Obô de Príncipe não foram considerados uma vez que são apenas terrestres e, portanto, as atividades de perfuração exploratória e avaliação propostas não representam qualquer potencial ameaça."* Comment: The coastal zone of São Tomé NP Obô includes everything along the coast between the São Miguel islet and the Malanza River that are part of the protected area and can suffer negative impacts in case of an accidental oil spill.	**Risk assessment of accidental spill events already take into consideration coastal habitats, whether protected or not.**

17	**Page 135 of the ESHIA Report from Block 11:** *Capitulo sobre "ATIVIDADES SOCIOECONÓMICAS"* Comment: This chapter on demography and economics presents many gaps that do not make the state of social reference superficial and does not allow the impacts of the project are evaluated in a satisfactory way: • The scale of socio-economic analysis does not seem to be adapted because it is only national, rather than also local and concentrated in the coastal zones potentially affected by the project. This scale of socio-economic analysis is too macro even for a small island country like Sao Tome and Principe. In many countries, to be confirmed in the legislation in force in Sao Tome and Principe, necessary to carry out an in-depth socio-economic study on all coastal communities located close to the offshore drilling zone in at least a range of about 15 km (this varies according to country legislation). • The data are all second-hand data from the bibliography. This shows that there were no field studies performed by ERM for the elaboration of these ESHIA. It is not in line with international standards to produce a state of reference for an ESHIA based solely on the literature. This makes the information outdated, incomplete and superficial and are not specific to the coastal communities that will be potentially affected by the project in the case of an accidental oil spill (fishing communities and tourism infrastructures located on the eastern coast of São Tomé Island). • The data are very old, for example 1994 data on small-scale fishing practices. The most recent quantitative data are from 2006 and are therefore completely obsolete to make a relevant and credible analysis of the social state of reference and thus of the potential impacts of the project. • There is a large gap of information on the income and economic strategies of communities living in the coastal zone located in front of Block 11. These serious gaps do not allow an objective assessment of the socioeconomic impacts of the project.	**As already indicated in the first comment; the information provided in regards to socioeconomic features of STP is relevant and fit for purpose for the expected interference with the project, which is located far from the coast.** **It is not practical to provide concise information of specific eastern coastal communities when there is no specific direct impact being expected.** **The current ESHIA has been made to comply with local legislation and international good practices.**

18	**Page 144 of the ESHIA Report from Block 11:** *"Dados recentes recolhidos pelas ONG's ATM e MARAPA, através do acompanhamento de pescadores semi-industriais com um GPS, mostraram como os pescadores de Santana, na Ilha de São Tomé, conseguem atingir distâncias de mais de 60 km da costa (Kikedamungu, 2017), que lhes permite pescar nas águas dentro dos limites do Bloco 11."* Comment: These data were collected by the Tatô Program in collaboration with the project of sustainable fisheries management in the south of the island of São Tomé of OIKOS entitled "Kike da Mungu". These data have not yet been analyzed or published neither by the Tatô Program nor by OIKOS; which is why we are asking why ERM used this information without requesting authorization from the Tatô Program or OIKOS. These spatial tracking data for fishing effort correspond to fisheries rather than semi-industrial fisheries as written in the ERM report. In that the information collected to date with the GPS trackers project has confirmed that artisanal fishermen (using trawl, flying net, or the flying whip) regularly take off up to 50 or 60 miles away from the coast (i.e. between about 90 and 110km from the coast) and are in fact present almost every day in of Block 11 where there is likely to be disruption of cause of the project.	**Such data is available from the public domain as part of a Project report : https://kikedamungu.weebly.com/uploads/1/0/7/0/107098529/relatorio_pescarias_ativas_final.pdf** **The figure is described as presenting an example of a GPS track, it does not indicate that it is the product of the data analysis which may surely include significantly more data from other artisanal fishermen. The intention is to show that fishers with outboard engines can effectively reach Block 11 area of interest. Figure 5.2 of the ESHIA already indicates the fishing activity for Artisanal, Semi-Industrial and Industrial fisheries can take place here (though artisanal fishers without outboard engines are usually very close to the coast).**
19	**Page 145 of the ESHIA Report from Block 11:** *"Dado o afastamento da área de estudo da costa de ambas as ilhas de São Tomé e Príncipe, é improvável a interferência das operações propostas com a pesca artesanal, embora possível para os pescadores semi-industriais."* Comment: This is not true because recent Tatô Program and project of the Kike da Mungu fisheries have shown that artisanal fishers move up to 50 or 60 miles (ie 92 or 111km) off the eastern coast of São Tomé Island. This means that artisanal fishers attend the Block 11 marine zone every day and that there will necessarily be interactions with the project and potential disruption of artisanal fishers' activities because of the project.	**As discussed in Comment ID3. It is unlikely that there may be significant artisanal fishing in the deep offshore (understood as vessels catalogued as artisanal by Carneiro (2011) and Belhabib (2015); but with the use of an outboard engine), nonetheless, it cannot be completely ruled out.** **<u>Text will be edited to indicate that "artisanal" fishing with outboard engines may be considered semi-industrial.</u>**

20	**Page 146 of the ESHIA Report from Block 11:** *"existe apenas uma unidade de produção de gelo em São Tomé"* Comment: This is not true because there are now several ice machines on the island of São Tomé. This erroneous statement confirms that the state of social and environmental reference of the ESHIA is very superficial and incomplete, suggests that ERM did not an on-site data collection mission and does not allow for a relevant and objective assessment of the project's potential impacts.	**Text in the ESHIA will be edited to indicate there are "Limited" ice machines.**
21	**Page 168 of the ESHIA Report from Block 11:** *"As medidas de mitigação a serem implementadas pelo Projeto para reduzir os potenciais impactos nas tartarugas marinhas incluirão a utilização de um procedimento de arranque suave e a presença a bordo de um Observador de Fauna Marinha (MMO) durante as atividades VSP, conforme recomendado pelas diretrizes estipuladas pelo Comité Conjunto para a Conservação da Natureza (JNCC, 2017) com vista a minimização do risco de danos e de perturbação de mamíferos marinhos."* Comment: The mitigation measures presented are not sufficient to assess or mitigate the real impacts on sea turtles. Given the importance of the area for sea turtles, it is necessary to conduct studies on their spatial ecology, especially regarding the possibility that the areas of use of turtles seismic polygon, or evidence of changes in habitat use during seismic survey and prospecting. The geographical positioning system by satellite should be the system used to better of this activity in sea turtles, being considered one of the most to examine the movement and behavior of sea turtles.	**The past seismic campaign MMO report reported but one unidentified turtle. It is not known with a high degree of certainty what turtle distribution/abundance around the drilling area can be expected.** **Turtle tagging and satellite tracking data, though important would require a significant number of turtles be tagged in order to understand their movements along the Gulf of Guinea as well as associated to the STP archipelago.** **The Impact Assessment takes the relative lack of data into consideration and proposed good practices for mitigation used Internationally in other projects where information is equally lacking.**
22	**Page 186 of the ESHIA Report from Block 11:** *"Todavia, a iluminação das estruturas das embarcações que operam em offshore é considerada como tendo um impacto baixo nas crias das tartarugas devido a natureza de curto prazo das atividades, a dispersão antecipada das crias em mais de 60 km da praia e que as crias podem ser transportadas passivamente pelas correntes oceânicas."*	**Lighting effects are known on turtles, but it is correct that no direct evidence of offshore structures lighting effects exists.**

	Comment: There is no scientific evidence to support this information.	
23	**Page 186 of the ESHIA Report from Block 11:** *"Figura 4.15 Principais locais de nidificação conhecidos das tartarugas em São Tomé e Príncipe."* Comment: This map is incomplete and difficult to understand. The source of information (Graff, 1996) is very old and outdated	**The comment is correct; ERM will implement an update to this map using SWOT data.**
24	**Page 195 of the ESHIA Report from Block 11** *"Os recursos marinhos obtidos da pesca representam uma fonte importante de meios de subsistência e de nutrição para a população de STP. Sabe-se que a pesca artesanal ocorre principalmente nas primeiras 6 milhas da faixa costeira, estendendo-se a pesca semiindustrial até 20 a 60 milhas; enquanto a pesca industrial ocorre entre 6 a 200 milhas, onde está localizado o Bloco 11."* Comment: This is not true because recent Tatô Program and project of the Kike da Mungu fisheries have shown that artisanal fishers move up to 50 or 60 miles (ie 92 or 111km) off the eastern coast São Tomé Island. This means that artisanal fishers attend the Block 11 marine zone every day and that there will necessarily be interactions with the project and potential disruption of artisanal fishers' activities because of the project.	**See answer to Comments ID 3; ID 4 and ID 18**
25	**Page 196 of the ESHIA Report from Block 11:** *"A potencial interferência mais provável nas atividades de pesca artesanal pode ocorrer quando as embarcações de apoio fizerem o percurso entre o porto em terra (no continente africano e em Neves na ilha de São Tomé) e a área do Projeto; onde estas se podem deparar com dispositivos de agregação de peixes (FADs)... ... prevê-se que as atividades do projeto venham a ter pouco impacto nas atividades de pesca artesanal."* Comment: There will likely be much more interaction between artisanal fishermen and	**See answer to Comments ID3; ID4 and ID18**

	offshore vessels and offshore design facilities whereas artisanal fishermen (who use trawl, flying net, or the flying whip) regularly move up to 50 or 60 miles from the coast (that means in of block 11). This wrong statement compromises the correct evaluation of the impacts of the project on the small-scale fishing sector. It is likely that the project will have a much greater impact on the artisanal fisheries sector than is anticipated in the ESHIA report produced by ERM. There is need to better evaluate these impacts and to identify specific compensation and mitigation measures (especially regarding the risks of damage to artisanal fishing vessels and equipment due to collisions and direct interaction with offshore project equipment and infrastructures.	
26	**Page 197 of the ESHIA Report from Block 11:** *"Os efeitos do ruído nos peixes foram avaliados nos impactos F1 e F2. Estes impactos, incluindo potenciais efeitos comportamentais de curto prazo, que podem causar aredistribuição de peixes tornando-os temporariamente não disponíveis para os pescadores, são considerados negligenciáveis."* Comment: The fact of considering negligible the fact that some species of fish may become temporarily unavailable to artisanal fishermen is not acceptable and demonstrates a lack of knowledge and understanding of the reality of the artisanal fisheries sector. The fact that some species of fish can become temporarily unavailable to artisanal fishermen is on the contrary of great concern considering the economic vulnerability of artisanal fishermen, their exclusive dependence on subsistence fishing, fuel costs for travel of up to 50 or 60 miles that need to be covered by the capture and sale of fish... We can not accept that the ESHIA report concludes that this impact is negligible. It would be important to have the views of the fishermen themselves, the Federation of Fishermen's Associations and the Palaiés and the Fisheries Directorate on this issue before arriving at this kind of conclusion. Again this phrase makes you think that the ERM did not consult the national players in the small-scale fishing sector to draw up the present ESHIA. This lack of participation of	**Underwater sound effects derived from Vertical Seismic Profiling (VSP) activities are expected to be minimal (1-2 days per well from a total of 270 days drilling time of the overall campaign).** **Kosmos and Galp have also undertaken interactions with fishing communities in the case of the previous seismic exploration activities, which have a significantly higher sound generation footprint with no negative effects having been identified.**

	impacted project potential is not in line with international standards for ESHIA for this type of projects.	
27	**Page 198 of the ESHIA Report from Block 11:** *"a única interferência potencial nas atividades de pesca artesanal seria esperada quando as embarcações do Projeto navegassem entre os portos em terra e a área do Projeto; mas tal é considerado muito limitado."* Comment: There will probably be much more interaction between fishermen crafts and vessels and offshore design facilities since artisanal fishermen (who use trawl, flying net, or the flying whip) regularly move up to 50 or 60 miles from the coast (that means within block 11). This erroneous assertion compromises the correct assessment of the impacts of the project on the artisanal fisheries sector. It is likely that the project will have a much greater impact on the artisanal fisheries sector than is anticipated in the ESHIA report produced by ERM. There is need to better evaluate these impacts and to identify specific compensation and mitigation measures (especially regarding the risks of damage to artisanal fishing vessels and equipment due to collisions and direct interaction with offshore project equipment and infrastructures.	**See answer to Comments ID 3; ID 4 and ID 18**
28	**Page 199 of the ESHIA Report from Block 11:** *"Considerando as medidas de mitigação especificadas acima, o impacto sobre a economia, emprego e meios de subsistência a nível local é considerado positivo e Menor."* Comment: It is unacceptable that there should be no reference to the potential impacts of the project on the coastal tourism sector in full development on the eastern coast of the island of São Tomé (Capital area, Santana, Porto Alegre and Islet of Rolas). Potential Oil Spill Accidents May Have Significant Impact on the tourism sector based in part on the wild and paradisiacal tropical beaches. ESHIA should have taken these aspects into account in order to assess impacts and propose mitigation measures.	**The only potential interaction with tourism sector would be in the case of an oil spill (considering that for routine activities, these would be considerably far from the coast).** **The risk assessment has indicated that an extreme event such as a well blowout, though of major consequence, it is highly unlikely to occur, with small spill events having higher likelihood of occurring, at a significant distance from the coast, and with a series of mitigation measures in place should the event occur.**

29	**Page 220 of the ESHIA Report from Block 11:** "*Note-se que os resultados que serão obtidos da modelação do derrame de óleo / hidrocarbonetos consideram a ausência de medidas de mitigação após o evento, as quais seriam parte do Plano de Contingência para Derrames de Óleo (OSCP).*" Comment: A modelling of hydrocarbon spills should have been done and integrated in the ESHIA report. Without such modeling, it is impossible to objectively analyze the risks to coastal habitats (mangrove, coral, bays, estuaries, beaches ...), biodiversity (birds, marine mammals and sea turtles), fishery resources and the economic sectors of artisanal fisheries and tourism.	**The hydrocarbon spill modelling conducted for the Project is available in the ESHIA addendum (Oil Spill and Drill Cuttings Deposition Modelling report summary).**

4 ESHIA TEAM

4.1 ESHIA TEAM – COMPANIES AND TEAM

4.1.1 ERM IBERIA S.A

ERM, an international sustainability consulting firm, employs approximately 5,000 people in 160 offices worldwide. ERM operates exclusively in the environmental, social, health and safety areas, with the vast majority of its industrial customers being private or industrial in the public sector. ERM has been operating on the African continent for several decades from its offices in Africa and Europe, including South Africa, Kenya, Mozambique, Spain, Italy, France, Belgium and the United Kingdom. ERM's experience covers several sectors, particularly oil and gas, mining and energy. ERM has extensive experience in offshore projects worldwide, including in the Gulf of Guinea and specifically the block that relates to this project. ERM has developed studies of offshore impacts for seismic, drilling or oil and gas development surveys in São Tomé and Príncipe and in several African countries such as Gabon, Ghana, Equatorial Guinea, Angola, Morocco and the Republic of Congo.

4.1.2 *Grupo L & R Nazare*

The Grupo L & R Nazare is an STP environmental consulting firm based on excellence and able to deal with the various facets of legislation and environmental studies in STP, conditioning monitoring and licensable activities. The action is directed to the reduction of negative environmental impacts in an up-to-date way with the current legislation, as well as the application of the most current techniques of environmental studies, and existing biodiversity.

4.1.3 *Project Team*

The project team formed between ERM and Grupo L&R Nazare involved in the development of the ESHIA reports offered a combination of technical and social expertise, in-depth knowledge of the specificities of O&G activities and experience in the country in different areas. Such combination allowed that that will be addressed in the ESHIA and other reports requested under this project.

The ERM Project team was led by Mrs. Paola Quijano/Paula Gonzalez (as ERM Charge Partners) and Ferran Climent (as Project Manager - PM). Local support to the Projects leads was in charge of Mr. Lodney Nazare, manager of the Grupo L&R Nazare, whom played the role of local environmental specialist and participated in the review of the full description of the baseline chapter. Further support from local consultants included Mrs.Ana Semedo whom was the local legal counsel as well as reviewer of socioeconomic baseline.

The core ERM consultant team is presented in the next page, with a a brief description of the main team experience involved in the development of the ESHIAs.

ESHIA TEAM: EXPERIENCE SUMMARY

Ms. Quijano is Partner in ERM Iberia with over 16 years of experience working for O&G projects worldwide. She has managed a wide array of environmental and social studies focused on offshore exploration and production projects. Ms Quijano has lead all previous projects performed for Galp and Kosmos in STP. She has also lead other projects delivered to Kosmos and Galp in other geographies providing her a good understanding of Galp and Kosmos' procedures, needs and expectations.

Partner in charge

Ms. Gonzalez is Partner in ERM Iberia with over 18 years of experience working for O&G projects worldwide. Ms. Gonzalez is also an environmental and a health and safety (EHS) auditor having performed due diligences in several countries. In the past Ms, Gonzalez was part of the corporate team of the Portuguese Oil and Natural Gas Company. She has worked in several projects offshore given her a good understanding of the mains procedures, requirements and expectations.

Partner in charge

Ferran Climent is an Ecologist, with an extensive experience (more than 15 years) in International EIA project management and delivery. He has lead a project for Kosmos recently and has extensive experience in the development of ESIAs for exploratory O&G projects (onshore and offshore projects, seismic, drilling and field development) and has completed drilling offshore project near the current Project area.

Project Manager

Mr. Odriozola is a Technical Director and has 30 years experience in environmental consulting, and he is specialized in marine environments. Mr. Odriozola has a deep knowledge and technical expertise in offshore seismic, drilling and field development ESHIAs, having worked in more than 20 different countries. He has experience working with Kosmos and Galp, has participated in the Kosmos 2016 STP ESIA public sessions and provided technical expertise as well as experience in ESIA well drilling offshore development near the current Project area.

Technical Director

Lodney Nazare is an Environmental Consultant specialized in environmental impact, with more than 10 years of experience in many different projects in Sao Tome. Mr Nazare is native from Sao Tome and has performed many roles in different Sao Tome companies given him knowledge about the Project area. He has also experience in establishing impact measures and conservative policies for the local biodiversity.

Local Environmental Specialist

Dr. Lalith K. Dasanayaka has over 14 years professional and research experience in 3- and 2-dimensional mathematical modeling in deep ocean water. His modelling experience includes the use of COSIM and ERM's GEMSS model including expertise in its oil spill module COSIM and dredge / drill cutting module, GIFT. He has performed oil spill and drill cuttings modeling for Environmental Impact Assessments (EIA) for over many projects including near the current Project area.

Modelling Specialist

Mr. Marin is a marine biologist with over 12 years experience in environmental consultancy. He has mainly worked for O&G projects in Europe and Africa. He has experience working with Kosmos and Galp, having a good understanding of Kosmos and Galp's procedures and needs. He has also experience in the development of Coastal Sensitivity mapping, including for projects near the current Project area.

Environmental Specialist

Jorge Sanchez is a biologist with over 8 years of experience as an Environmental Consultant. His expertise is centered on EIAs, Biodiversity Assessments, and Marine Studies. He has extensive experience in exploratory activities (seismic and drilling projects) for the Oil & Gas industry in the offshore environments in Southern Europe and Africa. He has experience working with Kosmos and Galp and has participated in the of well drilling offshore ESHIA development near the current Project area.

Marine specialist

Esmeralda Francisco is a Sociologist specialized in international development, with more than 15 years of experience in the field project management and social assessment. She is specialized in social assessment and design of stakeholder engagement processes according to international standards (eg. WBG, IFC, EBRD). She has leaded the development of Environmental and Social Impact Assessments, SEPs and HRIA for multiple Oil & Gas and Energy companies.

Social and HR Specialist

Maria João Costa is a Senior Consultant in ERM's, specialized in Safety Engineering with 18 years of experience. Her experience is related to Major Accidents Prevention (MAP), having worked for about 10 of the 60 Portuguese SEVESO Plants (upper limit), of Oil & Gas, Chemicals Storage and Process areas. She performed Fire safety, Environmental and Safety Legal Compliance Verification Audits, H&S Management System Implementation and Preparation and Implementation of Internal and External Emergency Plans.

Safety Engineering Specialist

Mr. Fichera is a senior project engineer with experience since 1993 in water quality and oil spill modeling, natural resource damage assessments (NRDA), risk assessment, and project management. His modeling experience includes CORMIX, CE-QUAL-W2, EFDC, VPLUMES, QUAL-2k, and ERM's GEMSS model including expertise in its oil spill module COSIM and dredge / drill cutting module, GIFT. Mr. Fishera participated in the development of the oil spill and drill cutting and muds modellings near the current Project area.

Modelling Specialist

Fátima is an Environmental Consultant with more than 1 year of experience in environmental projects such as due diligences audits, Corporate Social Responsibility and supporting in Oil and Gas Projects. She is a native Portuguese and speaks English. She assisted on the project due to the Portuguese language, by helping the seniors in some project managing.

Environmental Consultant

Ms Martins Semedo is a lawyer with over 10 years of professional experience. She has been a Legal Advisor of the General Attorney of the STP Republic for almost 2 years. Ms Martins has a deep knowledge of STP in-country conditions and administrative and regulatory framework and she is highly experienced in working with the STP authorities. She has participated in the Kosmos STP 2016 ESIA studies as Local Advisor. Fluent in Portuguese and English.

Local Legal Support

David Japp is the director of CapFish PTY Ltd. Since 15 years. He has been a practicing natural scientist (fisheries specialization) for over 20 years and has extensive experience with regards to oil industry impacts on fisheries. Dave has worked with key industry clients and has acted as facilitator between the Oil Industry and the fishing industry; evaluated impacts on fisheries in the immediate area of prospect drilling and seismic surveys; and conducted numerous expert reviews on fisheries for EIA / EMPRs.

CapMarine

Sarah Wilkinson is a consultant of CapFish PTY Ltd. She has more than 15 years of experience in Marine Biology and has worked as specialist in fisheries Impact Assessments. Off-shore hydrocarbons explorations. She has worked in different fisheries studies in the surrounding areas near the current Project area.

CapMarine