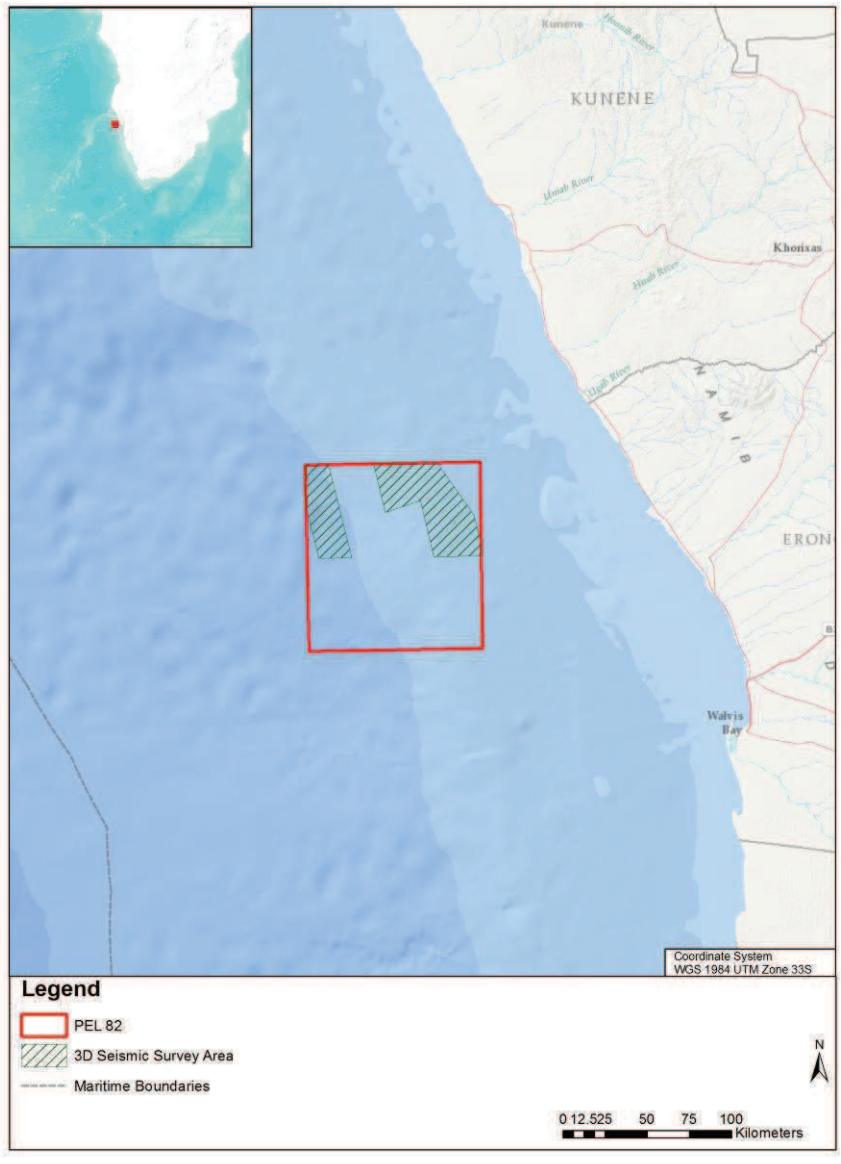
This document presents the results of the Environmental Impact Assessment (EIA) undertaken for the 3-dimensional (3D) marine seismic survey programme proposed by GALP through its Namibian subsidiary Windhoek PEL 23 B.V. in the PEL82, in Namibia. This document has been prepared by *Environmental Resources Management Iberia S.A* (ERM).

The proposed survey area lies 100 km west of the closest point in the Namibian coast and 190 km Northwest from Walvis Bay, in water depths varying between 200 and 1,800 meters. Windhoek PEL 23 B.V. intends to acquire approximately 3,000 full fold km² of seismic area (see *Figure 0.1*).

Figure 0.1 Location of PEL82



Source: ERM, 2017

Legislation, legal and institutional framework standards

In Namibia, the main environmental institution is the Ministry of Environment and Tourism (MET). 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.

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

Table 0.1 Key Namibian regulations and international conventions relevant to the Project

	Thematic	Reference
National Framework	Environment	Environmental Management Act (Act 7 of 2007
		Nature Conservation Ordinance (Ordinance 4 of 1975),
		Nature Conservation Amendment Act (Act 5 of 1996)
		Marine Resources Act (Act 27 of 2000)
	Hydrocarbons	Petroleum (Exploration and Production) Act. Act 2 of 1991. Amended by the Petroleum Laws Amendment Act, 1998
		Petroleum Act Regulations, 1991.
		Petroleum Taxation Act, 1991
	Air, Effluents and Waste	Hazardous Substances Ordinance (Ordinance 14 of 1974)
		Atmospheric Pollution Prevention Ordinance (Ordinance 11 of 1976)
		Prevention and combating of pollution of sea by oil Act (Act 6 of 1981) and associated Regulations Act
		Marine Notice on transfer of oil outside harbours (02 of 2012)
		International Convention for the Prevention of Pollution from Ships Act (Act 2 of 1986)
	Health and Safety	Labour Act (Act 11 of 2007) and associated regulations.
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).
		International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention).

		International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973).
	Flora, Fauna and Protected Areas	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).
		Convention on Wetlands of International Importance (Ramsar Convention, 1971).
		Convention on International Trade of Wild Fauna and Flora Endangered Species (1973)
		The Convention on Biological Diversity (Rio, 1992)
		United Nations Framework Convention on Climate Change – UNFCCC (1992).
		United Nations Convention to Combat Desertification in those Countries Experiencing serious Drought and/or Desertification, Particularly in Africa (1994).
		Cartagena Protocol on Biosafety to the Convention on Biological Diversity (2000).
	Maritime safety	International Convention for the Safety of Life at Sea (SOLAS, 1960).
		Convention on the International Regulations for Preventing Collisions at Sea (COLREGs, 1972).
		International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978
		The International Convention on Load Lines, 1966 and its protocol of 1988
	Archaeology and Cultural Heritage	Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972).
	Fishing	Agreement to Promote Compliance with Intl. Conservation and Management Measures by Fishing Vessels on the High Seas (1993).
		Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean (2001)
International Standards	Environment, health and safety	OGP n°432 Guideline (Oil and Gas Producers) - Managing Health, Safety and Environment in a geophysical contract.
		OGP n°389 (2007) Environmental/Social/Health risk impact management process.
		OGP n°254 (1997) Environmental management in oil and gas exploration and production
		IOGP n°475 (2012) Managing Oil and Gas activities in coastal areas.
		IPIECA (2003) - The Oil and Gas Industry: Operating In Sensitive Environments.
	Marine fauna	JNCC Guidelines (2017).
GALP's Standards and Policies	Environment, health and safety	GALP's HSE Management System.

Source: ERM, 2017.

Project description

Principles of 3D seismic survey

An offshore seismic survey uses a vessel towing underwater acoustic energy sources to generate a low-frequency acoustic signal into the water column, by releasing compressed air bubbles into the water. This acoustic signal, also known as "seismic wave", spreads through the water down to the seabed. The acoustic signal emitted in the column of water penetrates the seabed and is then reflected by the rocky layers in the sub-surface. On its return, it can be recorded using submarine microphones, known as hydrophones, distributed along a set of lines towed from the vessel, known as streamers.

The 3D acquisition technique requires at least two seismic sources and several streamers, placed in parallel and separated one from another by several dozen metres. Given the length of the towed equipment and the needs for acquiring seismic data along pre-defined lines, the vessel towing this equipment must travel at regular speed, along predefined navigation lines.

To make them visible to third parties, each streamer is equipped with a tail buoy. The main vessel is supported by two chase vessels, in charge of liaising with third party vessels to reduce the potential for interference between the seismic survey and third party activities.

Schedule

The proposed 3D seismic exploration survey is scheduled to begin in early 2018. Depending on the equipment configuration and the weather conditions, the expected duration of the survey is approximately 65 days, running an uninterrupted schedule of 24 hours a day and 7 days per week. Duration can be increased due to standby by weather constraints.

Operational details on the 3D seismic survey proposed by GALP

The Project will be conducted following the conventional steps:

- Mobilisation of one seismic vessel, at least two chase vessels and one supply vessel to the Project area;
- Seismic acquisition campaign including the deployment of the seismic equipment (source and streamers) and data acquisition operations; and
- Demobilisation: once the seismic survey is performed, the seismic, chase and supply vessels will leave the study area to navigate to their next assignment or back to the port of embarkation. No trace of the survey activity will be left in the study area after demobilisation.

The seismic vessel will navigate at a speed ranging from 4 to 5 knots, towing seismic sources at a depth of approximately 7-8 m. The hydrophones will be

placed along 10 to 14 loose cables (known as streamers), 8 to 10 kilometres in length, also towed by the seismic vessel.

Before the start of the survey, the seismic vessel will berth in Walvis Bay port where crew members and supplies will be taken onboard, and where they will be supplied with fuel, before sailing to the area where the seismic survey will take place. The supply vessel will most probably also berth in Walvis Bay port.

Alternatives to the Project

3D seismic acquisition is an essential step in the collection of the necessary geological data for evaluating the prospectively of hydrocarbon presence offshore. The technique and the equipment used for this survey can be considered to be necessary for the acquisition of quality data that will allow proper assessment of the hydrocarbon potential of PEL82.

Description of the baseline environment

Climate

The climate of the northern Namibian coastline is characterized by its hyper-aridity where rainfall is unpredictable and always reduced in quantity. Average annual rainfall ranges from 11 to 23 mm at Walvis Bay. Maximum temperatures occur between December and March (e.g summer season), being highest on average in February, at around 19.2 °C. In September (e.g. mid-winter), the average temperature is 13.7 °C being the lowest of the whole year.

The prevailing winds are driven by the South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of Southern Africa and the seasonal atmospheric pressure field over the subcontinent. Many physical processes are therefore governed by the average seasonal wind patterns and episodic changes in these wind patterns have strong effects on the entire Benguela region.

Oceanographic conditions

The survey area lies in water depths generally beyond the continental shelf, in a region characterized by the dominance of the Benguela Current that constitutes the eastern boundary current of the South Atlantic subtropical gyre, extending from Cape of Good Hope until around 16°S, within Angolan waters.

The Benguela can be considered as divided into two parts; the southern Benguela system which extends as far northwards as Lüderitz, while the rest of the Namibian coast as far as the Kunene River mouth falls within the northern Benguela system. The driving physical process in the Benguela system is coastal, wind-induced upwelling. Prevailing south to south-westerly

winds, which occur all year round off Namibia, tend to move nearshore surface water northwards and offshore, while cool, central water from a depth of about 300 m wells up to take its place. The unusually intense cell of upwelling off Lüderitz effectively divides it.

The continental shelf off the coast of northern Namibia is generally uniform in width of approximately 140-170 km, though in the border area with Angola it can reach as low as 60 km. The proposed seismic survey area lies some 100 km west of the Namibian coastline, in waters where depths vary between 200 and 1,800 m.

Marine ecological sensitivity

The proposed seismic survey area in PEL82 is located within the Benguela Current Large Marine Ecosystem (BCLME) which extends along the area occupied by the Benguela current from the Good Hope Cape until the province of Cabinda in Northern Angola.

This BCLME is characterized by hosting one of the major coastal upwelling systems in the world which feeds seasonally the ecosystem with nutrient rich water and in some areas throughout the year. This phenomenon supports high phytoplankton productivity that in turn supports a diverse marine ecosystem and associated fisheries.

Within the BCLME, the presence of large pelagic species is common as part of their migration, and this group constitute the most likely to be encountered within the survey area given its distance to the coast and the depth of its waters as they generally prefer areas where depths are over 300 m. Species targeted commercially include albacore (*Thunnus alalunga*), yellowfin tuna (*T. albacares*), bigeye tuna (*T. obesus*), skipjack tuna (*Katsuwonus pelamis*), Atlantic blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*) and the broadbill swordfish (*Xiphias gladius*).

The upwelling conditions that occur within the Benguela ecosystem combined with the geographical location of Namibia between tropical breeding grounds and artic feeding grounds of several migrating cetaceans result in a suitable and important habitat for marine mammals all along the Namibian coastline. Thirty three species of whales and dolphins are known (based on sightings or stranding records) or likely (based on habitat projections of known species parameters) to occur in the central Benguela region and in the offshore waters of the proposed survey area. The most abundant baleen whales in the Benguela are southern right whales (*Eubalaena australis*) and humpback whales (*Megaptera novaeangliae)*.

The Leatherback turtle (*Dermochelys coriacea*)is considered to be the sea turtle species most likely to be encountered within the offshore waters of Namibia. They are known to arrive mainly from Gabonese and Brazilian Nesting grounds migrating into Atlantic waters reaching the northern and southern coasts of Namibia.

Seabirds are abundant over the continental shelf but several species can also be present further offshore, along the seismic survey, where they may be observed feeding.

Fisheries in the Project area

Namibian waters are typified by their abundant fish stocks due to the high productivity of the Benguela upwelling ecosystem. The large commercial fish stocks typically support intensive commercial fisheries. Namibian fisheries have focused on demersal species, small pelagic species, large migratory pelagic fish, line-fish (caught both commercially and recreationally) and crustacean resources (e.g. lobster and crabs).

Than main fishery resources exploited throughout the Namibian Economic Exclusive Zone (EEZ) are: sardine (*Sardinops ocellatus*), horse mackerel (*Trachurus capensis*), Albacore tuna, yellowfin tuna, bigeye tuna, and swordfish; hake (*Merluccuis capensis and Merluccius paradoxus*), monkfish (*Lophius vomerinus)*, deep sea red crab (*Chaceon maritae*), orange roughy (*Hoplostethus atlanticus*) and rock lobster (*Jasus lalandii*). Seven commercial fisheries have been identified as being active within PEL82 being the demersal long-line, small pelagic purse-seine, mid-water trawl, demersal trawl, pelagic long-line, tuna pole-and-line and deep-sea crab fisheries.

Assessment of impacts

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 Significance matrix

		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, 2012.

The components of the Project taken into account in the assessment are:

- The seismic acquisition vessel and its operations;
- The chase/supply vessels and associated operations; and
- Any non-routine or accidental events.

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

Table 0.3 Summary of potential sources of impact and potential receptors

		Potentially impacted environmental aspect								
		Physical impacts		**Biological Impacts**			**Socio-economic Impacts**			
		Air Quality and Climate Change	Water Quality	Marine Flora	Marine Fauna	Protected Areas	Commercial Fishing	Maritime Navigation	Local Population and Health	Coastal Infrastructure, Tourism and Cultural Heritage
Sources of impact	**Routine activities**									
	Atmospheric emissions from vessels	x								
	Liquid discharges from vessels		x	x	x		x		x	x
	Discharge of solid waste from vessels (macerated food and kitchen waste)		x	x	x		x		x	x
	Underwater Noise emissions (seismic acquisition)				x		x			
	Physical presence of the vessels (mobilization, survey, demobilization)			x	x		x	x		x
	Artificial light illumination				x					
	Accidental events									
	Accidental spillage / discharge		x	x	x	x	x	x	x	x

Source: ERM, 2017.

Table 0.4 presents a summary of the significance of residual impacts (i.e. after implementation of mitigation measures) resulting from the 3D seismic acquisition survey planned by Windhoek PEL23 B.V. in the Namibia PEL82 area.

Table 0.4 Summary of Residual Impacts

Receptor	Potential Impact	Impact Significance
Impacts from Routine Activities		
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**
Marine Flora	Potential localized increase in organic matter.	**Negligible**
Marine Fauna	Potential disturbance to Marine wildlife due to noise emissions (behaviour effects, physical impacts from temporary TTS and potentially PTS)	***Marine mammals and Turtles*** **Minor**
		Fish **Negligible**
		Seabirds, invertebrates and plankton **Negligible**
	Potential disturbance to marine wildlife due to secondary effects from liquid and solid waste discharges on the water column.	**Negligible**
	Potential disturbance to marine wildlife due to collisions with Project vessels.	**Minor**
	Potential disturbance to marine wildlife due to entanglement with towed array equipment	**Minor**
	Potential impacts derived from the use of artificial lightning.	**Negligible**
Protected Areas	Potential impacts to biodiversity features of coastal protected areas.	**Negligible**
Commercial Fishing	Temporary disruption or cessation of access to fishing grounds, interference of fishing boats or temporary fishery stock displacement.	**Negligible**
Marine Traffic and Navigation	Project vessel's movements may disrupt maritime traffic in the area.	**Negligible**
Local Population	Potential nuisance impacts	**Negligible**

Receptor	Potential Impact	Impact Significance
	and local socioeconomic conditions.	
Coastal Infrastructure, Cultural Heritage and Tourism	Potential impacts and or interference with coastal resources.	**Negligible**
Event-related impacts		
Impact on Water Quality **Coastal Area Impact**	Refuelling operations at sea, collisions or vessel maintenance activities leading to accidental oil spills.	**Minor**

Source: ERM, 2017.

All the impacts from the Project, considering the implementation of mitigation measures were assessed as being *Negligible* or *Minor*. Conclusions on key identified impacts are summarized as follows:

- **Potential disturbance from i) noise emissions and ii) presence of survey equipment on marine mammals and sea turtles (Minor significance)**

The presence of a Marine Mammal Observer on-board together with the installation of Passive Acoustic Monitoring (PAM) on the seismic vessel will ensure the proper application of the JNCC guidelines (*Guidelines for minimising the risk of injury to marine mammals from geophysical surveys, 2017*) and the implementation of the soft start procedure, both designed to minimize impacts on wildlife due to noise emissions, that will reduce the significance of the potential noise impact on sea turtles and on marine mammals to minor. The reduction in the vessel's speed during transits from or to Port together with the presence of fauna observers will reduce the risk of collision between vessels and marine mammals. Similarly, the use of turtle exclusion devices will also reduce potential disturbance from entanglement.

- **Potential disturbance from the presence and movements of Project vessels on i) fisheries and ii) maritime traffic and navigation (Negligible significance)**

The Project will notify Naval, Transport and Port authorities about the development plans, timing and location of activities, that together with the direct information to other ships through Notice to Mariners and by periodic broadcasts on appropriate communication channels will ensure other marine users are aware of the activities and location of Project vessels. Prior to the start of the survey a Fishery information campaign will be undertaken. In addition, the presence of chase vessels and a Fisheries Liaison Officer will ensure the exclusion area around the seismic vessel is properly maintained and any incident is avoided. Given the presence of two chase vessels, together with the presence of sensitive marine mammal observers, and the mobile nature of the exclusion zone as the seismic vessel advances, the reduction in the risk of residual impacts derived from the physical presence of the seismic vessel and the presence of the exclusion zone on sea users is considered to be Negligible.

- **Accidental Hydrocarbon Spill (Minor Significance)**

The seismic acquisition vessel will have a plan and procedures to implement in case of any accidental spillage of hydrocarbons (or other pollutants) at sea (also known as the SOPEP - Shipboard Oil Pollution and Emergency Plan), that meets the demands of the International Marine Organisation. This plan will be supported by the patrolling of chase vessels which will reduce the possibility of a collision. The likelihood that a spillage could lead to any large volume is considered unlikely and in view of mitigation measures described, the distance to the coast and the sensitivity of the environmental receptors, the resulting residual impact is assessed as Minor.

Environmental and Social Management Plan

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 EIA are implemented while the Project is carried out, in accordance with the commitments made by Windhoek PEL23 B.V. 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 Namibian 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 Windhoek PEL23 B.V. and identified in the EIA report are taken into account during the survey planning and operation phases;
- To provide a framework for mitigating impacts that may be unforeseen or unidentified; and,
- To establish an environmental surveillance and monitoring programme so that the ESMP can be updated and improved as the survey 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) *Guidelines for minimising the risk of injury to marine mammals from geophysical surveys, 2017*. These guidelines will further protect other marine fauna such as turtles through the use of: marine mammal observers (MMO), visual monitoring and seismic source operation protocols (i.e. soft start, restart procedures) and Passive Acoustic Monitoring (PAM) technologies.

- Oil pollution emergency procedures: in order to ensure effective management of refuel operations a Shipboard Oil Pollution Emergency Plan (SOPEP) and Bunkering Procedures 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.
- Liaison with ships and fisheries: through an effective communications plan, Seismic Contractor and Windhoek PEL23 B.V. will implement proposed protocols at the pre-survey stage (information to Fishing and Port authorities and associations) and Fisheries Liaison Officers (FLO) will implement mitigation during operational stages (chase vessel investigation and warning actions).
- 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.

Conclusion

The development and implementation of a detailed programme of environmental protection as an outcome of the impact assessment process would serve to minimise the impacts and risks associated with the proposed activities to industry standard levels.