NAMISUN
ENVIRONMENTAL PROJECTS & DEVELOPMENT

GALP

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR FURTHER EXPLORATION ACTIVITIES IN PEL 83 (ORANGE BASIN) OFF THE COAST OF NAMIBIA:

PROPOSED FURTHER 3D TOWED STREAMER SEISMIC ACQUISITION, OBN SEISMIC ACQUISITION AND ASSOCIATED ACTIVITIES

EIA SCOPING (INCLUDING IMPACT ASSESSMENT) REPORT

July 2024

Prepared for: Windhoek PEL28 B.V. (Galp)

galp

DOCUMENT CONTROL

Report Title	EIA SCOPING (INCLUDING IMPACT ASSESSMENT) REPORT FOR FURTHER EXPLORATION ACTIVITIES IN PEL 83 (ORANGE BASIN) OFF THE COAST OF NAMIBIA: 3D SEISMIC ACQUISITION	
EIA Project Manager	Werner Petrick	
Report Author	Werner Petrick	
Report Review	Pierre Smit	
Specialists (extracts from specialist input used in this report)	Andrea Pulfrich	Pisces Environmental Services (Pty) Ltd
	Sarah Wilkinson and David Japp	CapMarine (Pty) Ltd (CapMarine)
Extracts from original EIA Reports (Relevant Specialist Reports that were Appended to the EIA Reports are also referenced in this report)	Environmental Resources Management	Report Title: Environmental Impact Assessment for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia (ERM, 2017)
	SLR Environmental Consulting (Namibia) (Pty) Ltd	Report title: Final EIA Report and ESMP for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia (SLR, 2019).
	Namisun Environmental Projects & Development	Report Title: EIA Amendment Report for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia: Well Testing (Namisun, 2023).
Applicant	Windhoek PEL28 B.V.	
Client	GALP	
Project Number	NSP2024G1	
Report Number	4	
Status	FINAL REPORT TO MME AND MEFT	
Issue Date	July 2024	

DISCLAIMER

Neither the author(s) nor Namisun Environmental Projects and Development (Namisun) have any business, personal, financial, or other interest in the proposed project apart from fair remuneration for environmental consulting work performed. The content of this report is based on the author's best scientific and professional knowledge, input from the specialist, as well as available information and previously conducted EIAs. Namisun accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions based on this document.

Project information contained herein is based on the interpretation of data collected and data (and reports) provided by the client, accepted in good faith as being accurate and valid. Namisun reserves the right to modify the report in any way deemed necessary should new, relevant, or previously unavailable or undisclosed information become available that could alter the assessment findings. This report must not be altered or added to without the prior written consent of the author.

EXECUTIVE SUMMARY

This Environmental Impact Assessment (EIA) Scoping (including Impact Assessment) Report has been compiled as part of the EIA process, relating to two applications for environmental clearance, for Galp Energia E&P B.V's (i.e. Galp's) proposed further offshore exploration activities in Petroleum Exploration Licence (PEL) 83. Registered Interested and / or Affected Parties (I&APs) were provided with the opportunity to comment on this EIA Report. After the comment period closed, the report was updated to a final report[1] with due consideration of the comments received, and will be submitted to the Ministry of Mines and Energy (MME): Directorate of Petroleum Affairs (i.e. Competent Authority) and the Ministry of Environment, Forestry and Tourism (MEFT) for decision-making.

1. GENERAL INTRODUCTION

"PEL 83" is a Joint Venture between the block partners, namely Windhoek PEL28 B.V. (a wholly owned subsidiary of Galp, the National Petroleum Corporation of Namibia (NAMCOR) and Custos Investments, holding PEL 83. Galp is currently the operator of PEL 83. PEL 83 is in the Orange Basin off the coast of Namibia. The licence area covers an area of approximately 9 954 km^2 between 130 km and 250 km from the coastline between Lüderitz and Oranjemund in water depths ranging from approximately 500 m to 2 500 m. The Licence Block is therefore situated offshore of the Orange River mouth at the edge of the Namibian Exclusive Economic Zone (EEZ). See Figure 1 for the regional location of PEL 83.

Galp has been performing exploration activities in PEL 83 since 2016, with a 3-Dimensional (3D) seismic acquired in 2019 and recently completed the drilling of two exploration wells (i.e. the Mopane-1X well and Mopane-2X well) and one well test in PEL 83.

The above-mentioned activities were undertaken based on the successful completion of EIA processes, approved EIA Reports and related Environmental Clearance Certificates (ECCs), issued by the MEFT: Department of Environmental Affairs (DEA).

[1] Please note: The Report distributed to I&APs for their review and comments was one consolidated (i.e. combined) report, including all proposed further exploration activities (i.e. 3D Seismic Acquisition as well as Well Drilling) and the associated impact assessment, etc. The different activities, aspects and impacts identified and the (re)assessment of impacts were documented independently in different sections of the consolidated report. As part of the finalisation and the final submission of the report to MME and MEFT, the report had to be separated into two reports, not changing any of the project details or the impact assessment findings, as required by MEFT (DEA) - linked to the two Applications. Further details of the two Applications are provided in the report.

Galp plans to continue their exploration / appraisal activities in PEL 83 and requires new environmental clearances from MEFT for the following activities (like what was previously undertaken):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign) as well as Ocean Bottom Node (OBN) seismic acquisition.
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years).

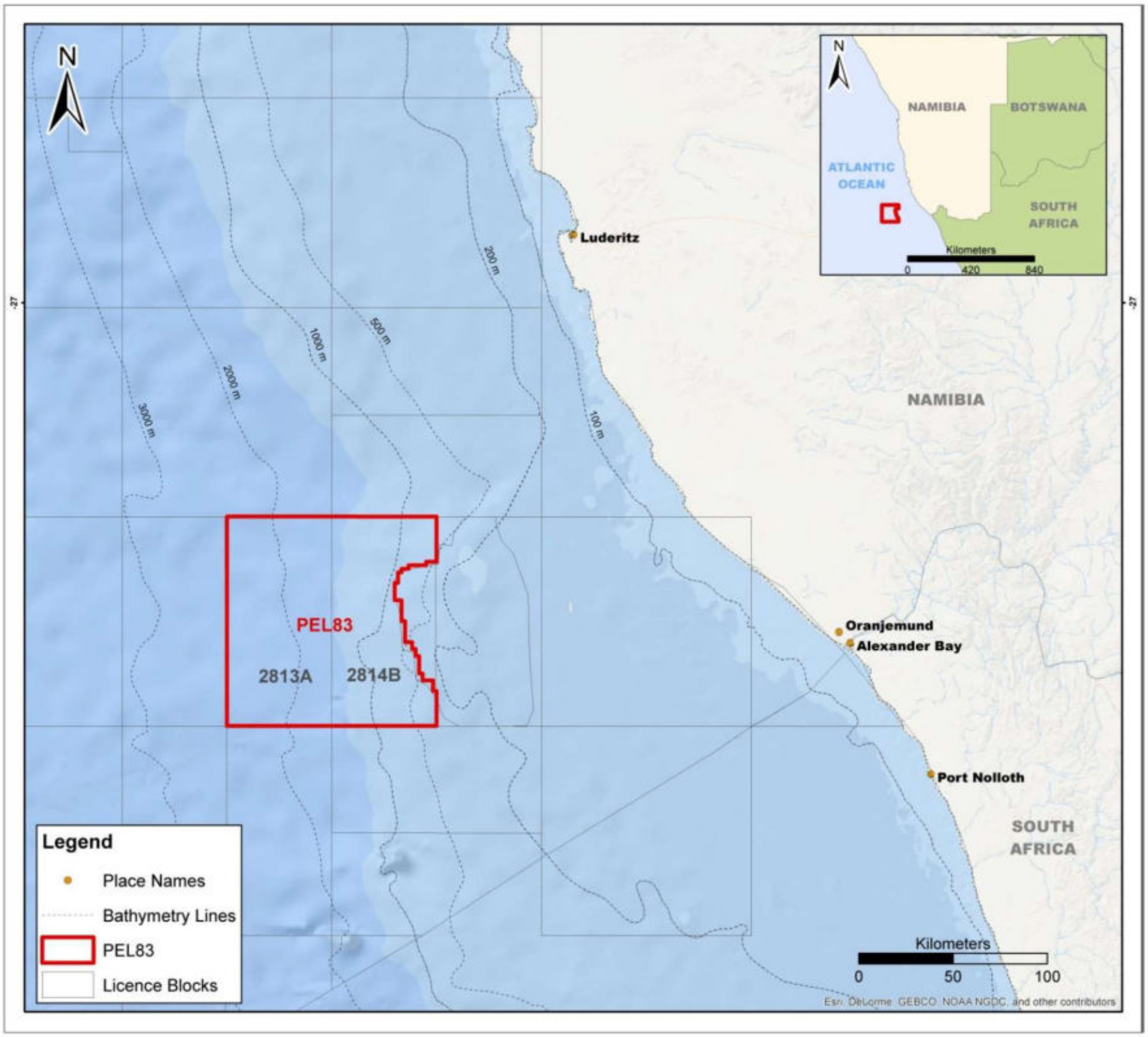


FIGURE 1: LOCATION OF PEL 83 (SLR, 2019)

Prior to the commencement of further activities proposed, including the amendments / additions to the previously approved activities, further authorisations (i.e. environmental clearances) are required from MEFT: DEA in terms of the Environmental Management Act, No. 7 of 2007 and associated EIA Regulations (January 2012).

Galp appointed Namisun Environmental Projects and Development (Namisun), as an independent environmental consulting company to undertake the required EIA process for the proposed further exploration activities, to compile the relevant EIA Report and amend the accompanying Environmental and Social Management Plans (ESMPs) as part of the process for the new applications for environmental clearances.

2. ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

EIAs and associated (new and amendment) applications are regulated by the DEA of the MEFT in terms of the Environmental Management Act, No. 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966) and its associated Regulations were promulgated in January 2012 (Government Gazette No. 4878) in terms of the Act. Galp received an ECC from MEFT in November 2017 for their initial 3D towed streamer seismic survey activities in PEL 83, based on an approved EIA process and associated EIA Report and ESMP (Environmental Resources Management (ERM), 2017). This ECC expired in November 2020. Galp did not renew this ECC, as the seismic survey was completed in 2019 and, at that stage, Galp did not see the need for further seismic survey activities.

In 2019, Windhoek PEL28 B.V. (i.e. Galp) applied for an ECC to drill one or possibly two exploration wells in PEL 83 with the successful completion of an EIA process and the submission of an EIA Report and Environmental and Social Management Plan (ESMP) (SLR, 2019). The application and associated reports (including the ESMP) was approved by MEFT (DEA) and an ECC was issued on the 27th of April 2020. This ECC, which expired in April 2023, was renewed and a new ECC was issued in March 2023 (based on a renewal Application and amended ESMP (Namisun, 2023)). In October 2023, Windhoek PEL 28 B.V. (i.e. Galp) received an ECC for their offshore exploration well drilling, including well flow testing in PEL 83, on the basis of an approved Amendment Application. The ESMP was updated and approved as part of this process. This ECC is valid until 7 March 2026. The above-mentioned assessments, previously undertaken, with the related approvals (i.e. ECCs) are schematically summarised in Figure 2.

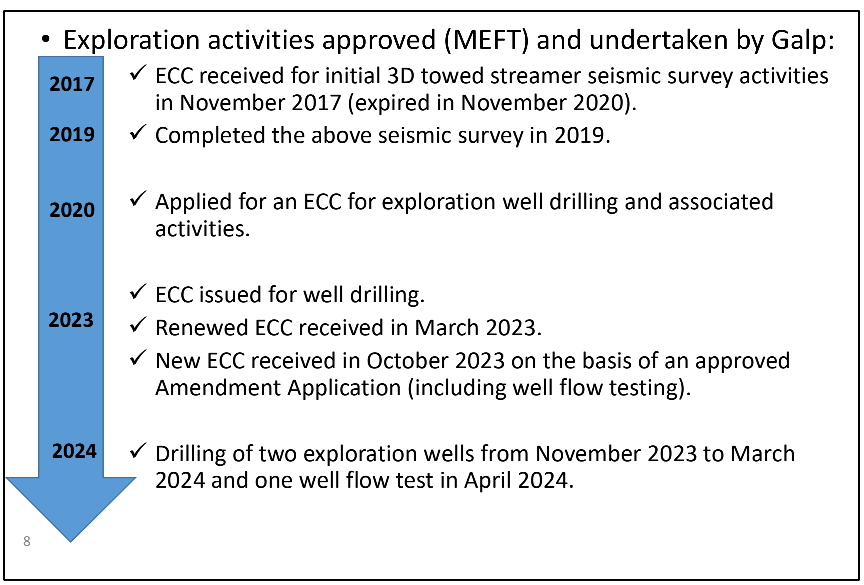


FIGURE 2: HISTORY OF APPROVALS AND ACTIVITIES

Prior to the commencement of further exploration activities proposed (including the amendments / additions to the previously approved activities) two separate applications will be submitted to MME: Petroleum Directorate (i.e. Competent Authority) as well as the Regulating Authority, i.e. MEFT in terms of the Environmental Management Act, No. 7 of 2007 and associated EIA Regulations (January 2012), as follows:

- Amendment application for the exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC).
- New application for the seismic (i.e. 3D towed streamer and OBN) surveys and related activities.

This EIA Scoping (including Impact Assessment) Report and the related amended ESMP (see Appendix H) will be submitted as part of the two applications. The EIA process includes an internal screening phase; a scoping phase, which includes an impact assessment; and an amendment to the approved ESMPs. A final decision relating to the above-mentioned applications will be made by MEFT: DEA.

The main purpose of this EIA Scoping (including Impact Assessment) Report is to provide information relating to the further, ongoing exploration activities – specifically relating to the 3D seismic survey and associated activities – and to indicate which environmental aspects and potential impacts have been identified during the internal screening and scoping phases. During the internal screening exercise, Namisun identified the need for the input of a Marine Ecologist and a Fisheries Specialist. Existing information from the previously approved EIAs (ERM, 2017; SLR, 2019; and Namisun 2023) and related Specialist Reports (including amongst others the Noise Studies and Oil Spill Modelling Study) were used in this report and has been further augmented by input from the Marine Ecologist and Fisheries Specialist, the Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024) undertaken in November 2023 and from comments gathered during consultations with key stakeholders during public and Focus Group Meetings. Therefore, no other specialists have been appointed.

It is thought that this EIA Scoping (including Impact Assessment) Report and the accompanying amended ESMP associated with the proposed ongoing exploration activities (i.e. 3D Seismic Acquisition) provide sufficient information for the DEA of the MEFT to make an informed decision regarding the application for environmental clearance.

The EIA process and corresponding activities which have been undertaken for this project was in accordance with the requirements outlined in the EIA Regulations of 2012 and various consultations with the MEFT: DEA, summarised as follows:

- PHASE I - Project initiation & Internal Screening (February - April 2024):
  - Project initiation meetings with Galp to discuss the proposed project and EIA / applications for environmental clearance process.
  - Meeting with MEFT: DEA.
  - Early identification of environmental aspects and potential impacts that might change because of the ongoing exploration activities.
  - Identify key stakeholders and review / update the Galp EIA I&AP database.
  - Liaison with specialist(s) and discuss the terms of reference for additional assessment input.
- PHASE II – Combined Scoping & Assessment Phase and updated ESMP (April – July 2024):
  - Prepare Application Forms and submit to MME: Petroleum Directorate and MEFT: DEA and online registration of the application (i.e. on MEFT's portal).
  - Notify authorities and I&APs of the proposed EIA process (distribute Background Information Document (BID), telephone calls, WhatsApp messages, e-mails, newspaper advertisements and "site notice").
  - I&AP registration and initial comments.
  - Public meetings and key stakeholder (Focus Group) Meetings.
  - Include I&AP issues and concerns in the studies and assessments.
  - Conduct specialist studies.
  - Compilation of EIA Scoping (including Impact Assessment) Report and ESMP (amendments).
  - Distribute EIA Scoping (including Impact Assessment) Report and ESMP to relevant authorities and registered I&APs for review.
  - Update and finalise reports, considering comments from I&APs.
  - Online submission of the final reports onto the MEFTs portal.
  - Submit application and finalised EIA Scoping (including Impact Assessment) Report with ESMP and I&APs comments to MME and MEFT for decision-making.

This EIA Scoping (including Impact Assessment) Report[2] (with amended ESMP) was distributed for public / authority review. I&APs were invited to comment on these documents, which were available for a review and comment period from **25 June 2024**. Comments had to be sent to Namisun at the telephone number, or e-mail address shown below by no later than **17 July 2024**.

Namisun

Attention: Werner Petrick and Pierre Smit

E-mail address: wpetrick@namisun.com; oudoring@gmail.com

Cell number: +264 (0)81 739 4591 / +264 (0)81 752 7207

[2] Refer to Footnote 1 regarding the Combined Report that was originally prepared and distributed to I&APs for comment.

3. PROJECT DESCRIPTION

3.1 3D Seismic Survey activities previously assessed / approved and undertaken by Galp in 2019

Galp has successfully completed a 3D-seismic survey between January and March 2019, over an area covering ~3,015 km^2 of the PEL 83. The area that was surveyed in 2019 is shown in Figure 3 (orange dotted polygon). The (bigger) area that was, however, assessed and approved for the related activities are shown in Figure 3 (green polygon).

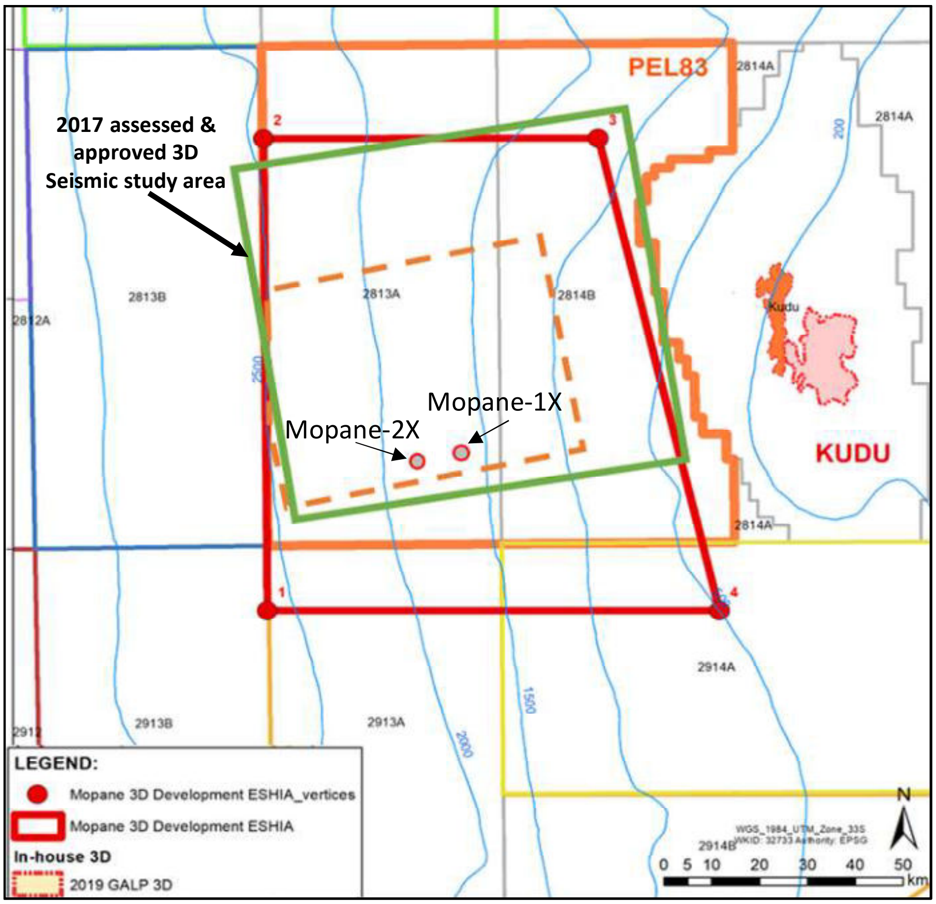


FIGURE 3: 3D-SEISMIC SURVEY AREAS IN PEL 83

3.2 Well drilling, well logging and testing, flow testing and associated activities previously assessed / approved and recently undertaken by Galp (end of 2023 – Q1 2024)

The two wells were drilled using a semi-submersible drilling rig. The location of the two wells are shown in Figure 3. The diameter of the well decreased with increasing depth. The final depth of the two wells drilled are as follows:

- Mopane-1X drilled to a depth of 3 157 m below the seafloor.
- Mopane-2X drilled to a depth of 2 694 m below the seafloor.

Drilling was essentially undertaken in two stages, namely the riserless and risered drilling stages. Well / flow testing was undertaken for Mopane-1X well. After the two exploration wells have both been sealed, tested for integrity and temporary abandoned (for later re-entry for Drill stem test (DST) operation), the wellheads (with a height of approximately 4 m and a diameter of less than 1 m) were left on the seafloor with an abandonment cap.

3.4 Proposed ongoing / further exploration activities and related amendments.

Due to the positive results from the recent exploration activities, Galp plans to continue with further exploration / appraisal activities in PEL 83 and requires new environmental clearances from MEFT for the following activities (similar to what was previously undertaken):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign) as well as ocean bottom node (OBN) seismic acquisition.
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years).

A summary of the key activities relating to the further 3D Seismic Survey is provided in Table 1. The activities associated with further exploration well drilling project components are described and (re)assessed in a separate report.

During the *3D towed streamer seismic surveys*, high-level, low frequency sounds will be directed towards the seabed from near-surface sound sources (i.e. source air-gun arrays) towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor will be recorded by multiple receivers towed in a multiple streamer configuration. Analyses of the returned signals will allow Galp to further interpret the subsea geological formations. The components that will (again) make up the 3D towed streamer seismic survey configuration to be towed behind the vessel will comprise of the following main components:

- Airgun arrays.
- Streamers.
- Paravanes, Buoys and Deflectors.
- Positioning equipment.

Refer to Figure 4 for an illustration of the principles of 3D Towed Streamers Seismic Surveys and Figure 5 for an illustration of the survey vessel and streamer layout and tail buoys.
The following devices will be used to monitor and control the depth / positioning of the streamers:

- Depth control units or birds.
- Magnetic compasses.
- Acoustic positioning units.

An *OBN seismic acquisition* is very similar to a 3D towed streamer seismic acquisition regarding the sound source levels created by the air-gun arrays, with only slight differences in the shot spacing. The most relevant difference is the receiver's component, which is placed on the seafloor for a specific period. OBN is a multi-component seismometer (3 geophones positioned orthogonally to each other and a hydrophone) placed on the seafloor which could independently collect and record seismic signals. Refer to Figure 6 for principles and a diagrams of an OBN survey.

The commencement date of the next well drilling (two appraisal wells) campaign has not yet been fixed; however, the earliest date for commencement of drilling is planned for Q4 (i.e. October) 2024. It is expected to take approximately two to three months per well to complete, whereafter the further 3D seismic surveys activities are likely to commence.

TABLE 1: SUMMARY OF KEY ACTIVITIES RELATING TO THE FURTHER 3D SEISMIC SURVEY CAMPAIGN

Survey method	Activity
1. Towed Streamers Seismic Survey	Seismic acquisition: 3D acquisition technique will require one seismic vessel with source arrays at 7-8 m below see surface, 8-12 streamers approximately 8 km in length, towed more than 15 m below sea surface, placed in parallel and spaced ~ +75 m to 100 m apart.
2. OBN Seismic Survey	Seismic acquisition: Similar to a 3D towed streamer seismic acquisition regarding the sound source levels created by the air-gun arrays. OBN is a multi-component seismometer (3 geophones positioned orthogonally to each other and a hydrophone) placed on the seafloor which could independently collect and record seismic signals.
3. Relevant to both Seismic Survey campaigns	Operation of vessels (survey and support) and helicopters (i.e. for emergencies only).
	Onshore logistics base: The onshore logistics base will be located in either the Port of Lüderitz or the Port of Walvis Bay.

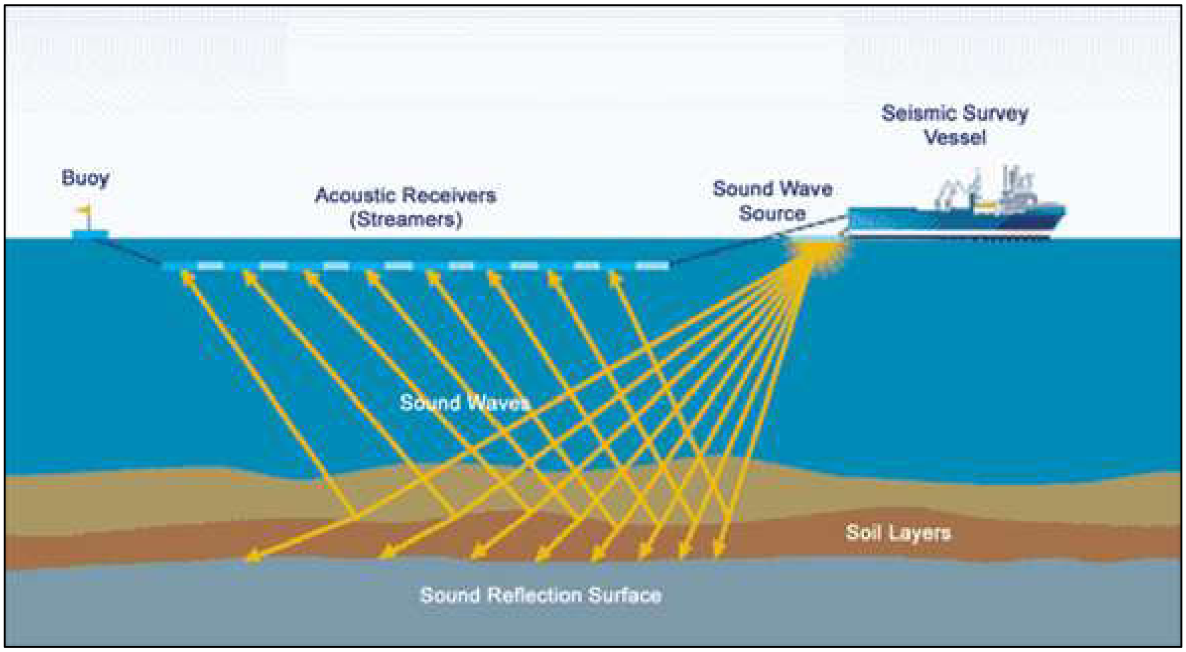


FIGURE 4: ILLUSTRATION OF THE PRINCIPLES OF 3D TOWED STREAMERS SEISMIC SURVEYS (SOURCE: HTTPS://OCEANSNOTOIL.ORG/OFFSHORE-OIL-AND-GAS-PHASES/)

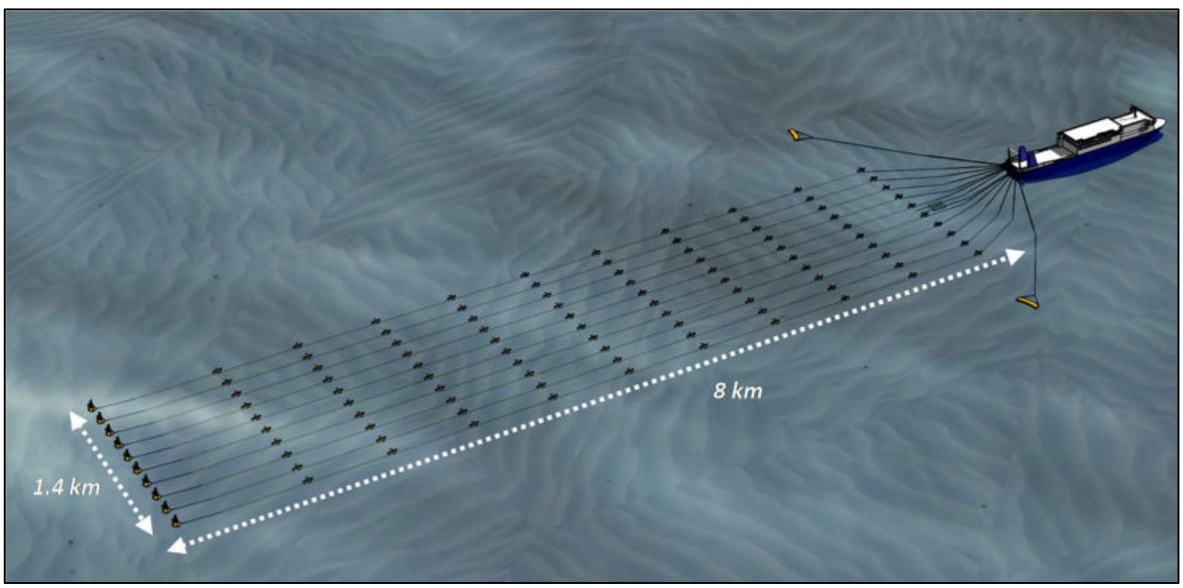
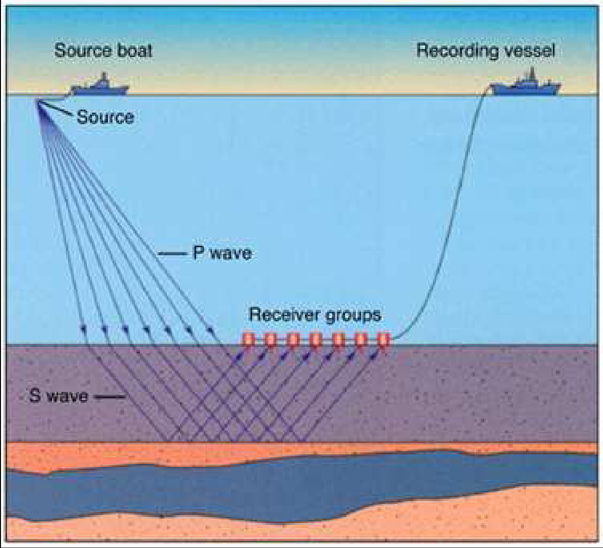


FIGURE 5: ILLUSTRATION OF THE SURVEY VESSEL AND STREAMER LAYOUT AND TAIL BUOYS



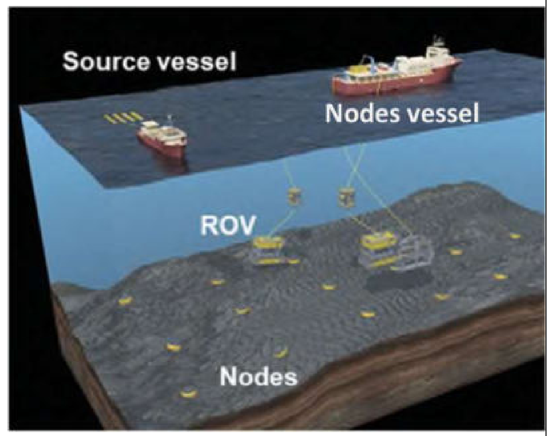


FIGURE 6: PRINCIPLES OF AN OCEAN BOTTOM NODE SURVEY (SOURCE: SEIS-TECH.COM) (LEFT) AND GENERIC DIAGRAM OF A OBN SURVEY (RIGHT)

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

An understanding of the environment and the sensitivity of the site and surroundings is important to understand the potential impacts of the project. A general overview of the current baseline conditions associated with the proposed ongoing / further exploration in PEL 83 (and associated activities), drawing on the baseline information provided in the previous EIAs, additional Specialist input and the Environmental Baseline Survey and Bathymetry Survey is provided in Chapter 6 of the main EIA Scoping (including Impact Assessment) Report. This chapter provides information on the Geophysical Characteristics; Biophysical Characteristics; Biological Environment; conservation areas; and the socio-economic environment.

5. IDENTIFICATION AND DESCRIPTION OF POTENTIAL ENVIRONMENTAL IMPACTS THAT ARE LIKELY TO CHANGE AS A RESULT OF THE PROPOSED ONGOING EXPLORATION ACTIVITIES

Environmental aspects and potential impacts were identified as part of the original EIAs, as follows:

- EIA for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia (ERM, 2017)
- EIA for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia (SLR, 2019).
- EIA Amendment for the proposed offshore exploration well drilling in PEL 83: Well Testing (Namisun, 2023).

The above mentioned EIA processes each included public participation / stakeholder engagement, and aspects and impacts were therefore further identified in consultation with stakeholders. Information and study findings from the above mentioned EIAs were therefore referred to in the identification of key aspects / potential impacts to be further assessed (i.e. re-assessed as part of this EIA process and report), relating to the ongoing exploration activities (specifically the proposed further 3D Seismic acquisition and associated activities), taking cognisance of the fact that the proposed activities would largely be similar to those previously identified, assessed, approved and undertaken. Another public participation process is also being undertaken as part of the current EIA process, allowing I&APs further opportunities to identify aspects / potential impacts and to review the related EIA reports. The aspects are linked to the project description in Chapter 4 of the main EIA Scoping (including Impact Assessment) Report and should be read in the context of the updated baseline conditions.

A summary of the environmental and social aspects and potential impacts, linked to the further 3D seismic survey activities, are provided in Table 2.

The potential impacts relating to the proposed further exploration activities need to be re-assessed, as part of: 1) a new application for the 3D seismic (i.e. towed streamer and OBN) surveys and related activities (this report); and 2) an amendment application for the further exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC) (refer to the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling (submitted at the same time as this report to MEFT and MME)).

Therefore, the (re)assessment of impacts relating to the new application provides detailed quantification of the various criteria (in Chapter 8 of the main EIA Scoping (including Impact Assessment) Report).

The potential cumulative impacts were also considered where relevant, taking the interaction between the existing environment, existing or planned third-party activities (i.e. other companies' exploration activities in the surrounding area) with the Galp's proposed ongoing activities. It must be noted, however, that a Strategic Environmental Assessment (SEA) has not been undertaken for all the current and planned offshore exploration (and associated) activities in this part of the Orange Basin. It is therefore, recommended that the relevant Namibian Ministries (i.e. MME, MFMR and MEFT) consider that an SEA be undertaken to further assist in future development plans and related impact assessments for this area.

TABLE 2: SUMMARY OF THE ENVIRONMENTAL AND SOCIAL ASPECTS AND POTENTIAL IMPACTS, LINKED TO THE FURTHER 3D SEISMIC SURVEY ACTIVITIES

Activities	Aspects	Receptor	Potential Impacts
Mobilisation phase			
Transit of survey vessels between the survey area and the onshore logistics	Underwater noise levels	Marine ecology	Disturbance to marine fauna
	Routine discharge to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
	Vessel Lighting	Marine ecology	Disorientation and mortality of marine birds
			Increased predator - prey interactions
	Discharge of ballast water and equipment fouling	Marine ecology	Loss of biodiversity due to the introduction of invasive alien species
Operation Phase			
Operation of survey vessels	Increase in underwater noise levels	Marine ecology	Disturbance to marine fauna
	Routine discharge of waste to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Fish aggregation and increased predator - prey interactions
	Increase in ambient lighting	Marine ecology	Disorientation and mortality of marine birds
			Increased predator - prey interactions
Deployment of streamers	Safety exclusion zone	Fishing Industry	Temporary cessation or displacement of marine traffic and transport within the survey area.
		Marine traffic and transport	

Activities	Aspects	Receptor	Potential Impacts
Deployment of OBNs	Movement of ROV close to the seafloor and placement of the OBNs	Marine ecology	Disturbance of seabed sediments and crushing of benthic macrofauna due to OBN placement
Seismic acquisition	Acoustic emissions from sound sources, i.e. increase in underwater noise levels	Marine ecology	Disturbance / behavioural changes to marine fauna
			Physiological effect on marine fauna
			Fish avoidance of key feeding areas
			Reduced fish catch and increased fishing effort
		Fishing Industry	Change in catch rate due to behavioural avoidance of fish in and around survey areas
Operation of helicopters (Only used for Medical evacuations or any hypothetical rescue exercises)	Increase in noise levels	Marine ecology	Avoidance of key breeding areas (e.g. coastal birds and cetaceans)
			Abandonment of nests (birds) and young (birds and seals)
Demobilisation Phase			
Survey vessels leave survey area and transit to port or next destination	Increase in underwater noise levels during transit	Marine ecology	Disturbance to marine fauna
	Routine discharge to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality during transit	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
	Increase in noise levels	Marine ecology	Avoidance of key breeding areas (e.g. coastal birds and cetaceans)
			Abandonment of nests (birds) and young (birds and seals)
Unplanned Events			
	Collison and entanglement with marine fauna	Marine ecology	Physiological effect on marine fauna

Activities	Aspects	Receptor	Potential Impacts
Collision with survey vessels and equipment / deployment of streamers	Safety exclusion zone	Fishing Industry	Disturbance to fishing activities from accidental interactions with fishing gear.
Dropped objects / Lost equipment	Increased hard substrate on seafloor	Marine ecology	Physical damage to and mortality of benthic species / habitats
			Obstruction to or damage of fishing gear
Hydrocarbon spills	Release of fuel into sea during bunkering and localised reduction in water quality	Marine ecology	Effect on faunal health (e.g. respiratory damage) or mortality (e.g. suffocation and poisoning)

6. IMPACT ASSESSMENT: FURTHER 3D SEISMIC SURVEY ACTIVITIES

Chapter 8 of the main EIA Scoping (including Impact Assessment) Report assesses the key potential impacts, relating to the proposed further 3D Seismic survey (and associated) activities in PEL 83. Information in this section was sourced from, amongst others, the following Specialist Studies:

- The Marine Specialist Study (refer to Appendix F).
- Underwater Heritage Impact Assessment report (Appendix G).

Furthermore, the assessment findings from the following reports were considered, where relevant:

- The original EIA Report for 3D seismic survey in PEL 83 (ERM, 2017).
- The EIA Amendment Report (Namisun, 2023).

Relevant sections were therefore extracted from the above mentioned specialist studies and reports. A summary of the detailed assessment of impacts (i.e. a detailed quantification of the various criteria) is provided in Table 3, which relate to the new application for Galp's proposed further 3D seismic survey activities.

TABLE 3: SUMMARY OF (RE) ASSESSMENT FINDINGS FOR THE 3D SEISMIC SURVEY AND ASSOCIATED ACTIVITIES

Activity	***Potential Impact***	***Impact Rating***	
		Unmitigated	***Mitigated***
Vessel movements as well as helicopter flights (i.e. emergencies only)	Disturbance and behavioural changes in seabirds, seals, turtles and cetaceans due to due to vessel movement and support aircraft	**L**	**L**
Seismic acquisition	Impacts of seismic noise on mysticetes and odontocetes	**M**	**L**
	Impacts of seismic noise on seals	**L**	**L**
	Impacts of seismic noise on turtles	**L**	**L**
	Impacts of seismic noise on fish	**L**	**L**
	Impacts of seismic noise on seabirds	**M**	**L**
	Impacts of seismic noise on marine invertebrates	**L**	**L**
	Impacts of seismic noise on plankton and ichthyoplankton	**L**	**L**
	Impact of Survey Vessel Lighting on Pelagic Fauna	**L**	**L**
	Disturbance of seabed sediments and crushing of benthic macrofauna due to OBN placement	**L**	**L**
	Impacts of marine biodiversity through the introduction of non-native species in ballast water and on ship hulls	**L**	**L**
	Impacts of normal vessel discharges on marine fauna	**L**	**L**
	Impacts on marine traffic and transport	**L**	**L**

Activity	Potential Impact	Impact Rating	
		Unmitigated	Mitigated
	Impact of Exclusion of Fisheries from Fishing Ground	**M** **(large pelagic longline)** **L** **(demersal trawl, demersal longline, tuna pole-line)**	**L** **(demersal trawl, demersal longline, tuna pole-line)**
	Impact of underwater noise on catch rates	**L** **(large pelagic longline, demersal trawl, demersal longline, tuna pole-line)**	**L** **(large pelagic longline, demersal trawl, demersal longline, tuna pole-line)**
Unplanned events	Impacts on turtles and cetaceans due to ship strikes, collision and entanglement with towed equipment	**L**	**L**
	Impacts on benthic and pelagic fauna due to accidental loss of equipment to the seabed or the water column	**L**	**L**
	Impacts of an operational spill or vessel collision on marine fauna	**L / M** **(moderate for nearshore)**	**L**
	Impact of Accidental Release of Oil at Sea on Fisheries Sectors	**L**	**L**
	Impact on Fisheries Sectors of Loss of Equipment at Sea	**L**	**L**

7. PROJECT CONTROLS AND MANAGEMENT AND MITIGATION MEASURES

Based on the (re)assessment of impacts, the project controls, management and mitigation measures and monitoring requirements were reviewed and updated (where required) and are included in the updated ESMP, attached as Appendix H of the main EIA Scoping (including Impact Assessment) Report.

8. WAY FORWARD

The way forward is as follows:

- MME and MEFT review the documentation and provide record of decision.

9. ENVIRONMENTAL IMPACT STATEMENT AND CONCLUSIONS

It is Namisun's opinion that the environmental aspects and potential impacts relating to the proposed ongoing / further exploration activities in PEL 83 have been successfully identified, described and re-assessed.

These activities include the following (i.e. similar activities to what was previously assessed, approved and undertaken by Galp in PEL):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign) as well as Ocean Bottom Node (OBN) seismic acquisition.
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years).

The potential impacts relating to the proposed further exploration activities were re-assessed, as part of: 1) a new application for the 3D seismic (i.e. towed streamer and OBN) surveys and related activities (addressed in this report; and 2) an amendment application for the further exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC) (refer to the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling (submitted at the same time as this report to MEFT and MME)). Key consideration in this EIA process and the (re)assessment of impacts are the following:

- The original (approved) "Environmental Impact Assessment for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia" (ERM, 2017) and associated specialist studies (appendices) that formed part of the EIA (including, amongst others, an Underwater Noise Modelling Study).

- The original (approved) “EIA Report for the offshore exploration well drilling project in PEL 83” (SLR, 2019) and associated specialist studies (appendices) that formed part of the EIA (including, amongst others, an including amongst others the Noise Studies and Oil Spill Modelling Study)[3].
- The approved “EIA Amendment Report for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia: Well Testing” (Namisun, 2023)[3].
- Further specialist studies undertaken as part of the EIA process to update the baseline description and (re)assess impacts:
  - Marine Ecologist Specialist Study.
  - Commercial Fisheries Specialist Study
- Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024) undertaken in November 2023.
- Further consultations and meetings with I&APs.

The potential impacts relating to the proposed further 3D Seismic survey (and associated) activities in PEL 83 are summarised in Table 3.

It is recommended that, if MEFT provides a positive decision on the application for the proposed project changes, they should include a condition to the clearance that Galp must implement all commitments in the Amended ESMP. The management and mitigation measures and monitoring requirements were reviewed and updated by the Environmental Team, in the respective ESMP for 3D Seismic Surveys, as a results of the EIA process and (re)assessment of impacts.

[3] These reports with associated specialist studies were specifically referred to in the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling

EIA SCOPING (INCLUDING IMPACT ASSESSMENT) REPORT FOR ONGOING OFFSHORE EXPLORATION ACTIVITIES IN PEL83 (ORANGE BASIN)

CONTENTS

List of Figures

List of Tables

APPENDICES:

ACRONYMS AND ABBREVIATIONS

The list of acronyms and abbreviations used in this report (and the two Specialist Reports) are summarized in the table below:

Acronyms / Abbreviations	Definition / Description
A	Amperes
AAIW	Antarctic Intermediate Water
ALARP	As Low as Reasonably Practicable
BAR	Basic Assessment Report
BAT	Best Available Techniques
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
BEP	Best Environmental Practice
CBD	Convention of Biological Diversity
cm	Centimetres
cm/s	centimetres per second
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
CSIR	Council for Scientific and Industrial Research
dB	Decibels
DNA	deoxyribonucleic acid
EBSA	Ecologically or Biologically Significant Area
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ESMP	Environmental and Social Management Plan
EPLs	Exclusive Prospecting Licences
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
g/m^2	grams per square metre
$g\ C/m^2$	grams Carbon per square metre
g/ℓ	Grams per litre
h	Hour
ha	Hectares
HAB	Harmful Algal Bloom
HF	High Frequency
H_2S	hydrogen sulphide
Hz	Herz
IBAs	Important Bird Areas
IMMA	Important Marine Mammal Area
IMO	International Maritime Organisation
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
KBA	Key Biodiversity Area
kHz	kilohertz
km	Kilometre
km^2	square kilometre
km/h	kilometres per hour
kts	Knots
LCDW	Lower Circumpolar Deep Water
LF	Low Frequency

LUCORC	Lüderitz upwelling cell - Orange River Cone
Ma	million years
MEFT	Ministry of Environment, Forestry and Tourism
MFMR	Ministry of Fisheries and Marine Resources
ML	Mining Licence
MME	Ministry of Mines and Energy
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MSP	Marine Spatial Planning
MWT	Ministry of Works and Transport
m	Metres
m^2	square metres
mm	Millimetres
m^3/s	cubic metre per second
m/sec	metres per second
MFO	Mixed-function oxygenase
mg $C/m^2/hr$	milligrams Carbon per square metre per hour
mg/ℓ	milligrams per litre
mg/m^3	milligrams per cubic metre
ml/l	millilitres per litre
NADW	North Atlantic Deep Water
NAMCOR	National Petroleum Corporation of Namibia
NBHF	narrow band, high frequency
NEMBA	National Environmental Management: Biodiversity Act
NDP	Namibian Dolphin Project
NIMPA	Namibian Islands Marine Protected Area
NMFS	National Marine Fisheries Service
NSF	National Science Foundation
NW	north-west
OBNs	Ocean Bottom Nodes
OMZs	Oxygen Minimum Zones
OSCP	Oil Spill Contingency Plan
OSPAR	Oslo/Paris convention *(for the Protection of the Marine Environment of the North-East Atlantic)*
OSPL	Oil Spill Response Limited
PAH	Polycyclic aromatic hydrocarbons
PAM	Passive Acoustic Monitoring
PEL	Petroleum Exploration Licence
PIM	Particulate Inorganic Matter
PNEC	Predicted no-effect concentration
POM	Particulate Organic Matter
ppm	parts per million
psi	pound-force per square inch
PTS	permanent threshold shifts
rms	root mean squared
RMU	Regional Management Unit
ROVs	Remote Operated Vehicles
SACW	South Atlantic Central Water
SADCO	Southern African Data Centre for Oceanography
SANBI	South African National Biodiversity Institute
SAR	Synthetic Aperture Radar
SAT	Saturation
SD	standard deviation
S&EIR	Scoping and Environmental Impact Reporting
SEL	sound exposure level

SLR	SLR Consulting (Pty) Ltd
Sm^3/day	Standard cubic metre per day
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	sound pressure level
SPRFMO	South Pacific Regional Fisheries Management Organisation
SSDI	Subsea Dispersion Injection
SST	Sea Surface Temperature
SW	south-west
SWIO	South Western Indian Ocean
TAC	Total Allowable Catch
TOC	Total Organic Carbon
TOPS	Threatened or Protected Species
TSPM	Total Suspended Particulate Matter
TSS	Total Suspended Solids
TTS	temporary threshold shifts
UCDW	Upper Circumpolar Deep Water
UK	United Kingdom
US	United States of America
VHF	Very High Frequency
VMEs	Vulnerable Marine Ecosystems
VOCs	volatile organic compounds
VOS	Voluntary Observing Ships
WBM	Water-based mud
WHO	World Health Organisation
WWF	World Wildlife Fund
W-SW	west south-west
µg	micrograms
µm	Micrometre
µg/ℓ	micrograms per litre
µM/ℓ	micro Mols per litre
µPa	micro Pascal

1 INTRODUCTION

This chapter describes the purpose of the report, briefly describes the background and proposed further exploration activities (specifically relating to the 3D Seismic Acquisition and associated activities), summarizes the legislative requirements relating to two applications for environmental clearance, explains the report structure, summarize assumptions and limitations of the study, and explains how the input from Interested and Affected Parties (I&APs) are included.

1.1 PURPOSE OF THIS REPORT

This Environmental Impact Assessment (EIA) Scoping (including Impact Assessment) Report has been compiled as part of the EIA process, relating to a new application for environmental clearance, for Galp Energia E&P B.V's (i.e. Galp's) proposed further offshore exploration activities (i.e. 3D Seismic Acquisition and associated activities) in Petroleum Exploration Licence (PEL) 83.

This report describes and assesses proposed changes associated with the previously assessed and approved activities and based on this assessment, the environmental management and mitigation measures are reviewed and where relevant, changes / additional measures documented as part of the amended Environmental and Social Management Plan (ESMP).

Registered Interested and / or Affected Parties (I&APs) were provided with the opportunity to comment on this EIA Report (see Section 1.6). After the comment period ended, the report was updated to a final report[4] with due consideration of the comments received, for submission to the Ministry of Mines and Energy (MME): Directorate of Petroleum Affairs (i.e. Competent Authority) and the Ministry of Environment, Forestry and Tourism (MEFT) for decision-making.

1.2 BACKGROUND AND CONTEXT FOR THE PROPOSED FURTHER OFFSHORE EXPLORATION ACTIVITIES

"PEL 83" is a Joint Venture between the license partners, namely Windhoek PEL28 B.V. (a wholly owned subsidiary of Galp, the National Petroleum Corporation of Namibia (NAMCOR) and Custos Investments, holding PEL 83. Galp is currently the operator of PEL 83.

PEL 83 is located in the Orange Basin off the coast of Namibia. The licence area covers an area of approximately 9 954 km^2 between 130 km and 250 km from the coastline between Lüderitz

[4] Please note: The Report distributed to I&APs for their review and comments was one consolidated (i.e. combined) report, including all proposed further exploration activities (i.e. 3D Seismic Acquisition as well as Well Drilling) and the associated impact assessment, etc. The different activities, aspects and impacts identified and the (re)assessment of impacts were documented independently in different sections of the consolidated report. As part of the finalisation and the final submission of the report to MME and MEFT, the report had to be separated into two reports, not changing any of the project details or the impact assessment findings, as required by MEFT (DEA) - linked to the two Applications. Further details of the two Applications are provided in the report.

and Oranjemund in water depths ranging from approximately 500 m to 2 500 m. The Licence Block is therefore situated offshore of the Orange River mouth at the edge of the Namibian Exclusive Economic Zone (EEZ). See Figure 1 for the regional location of PEL 83.

Galp has been performing exploration activities in PEL 83 since 2016, with a 3-Dimensional (3D) seismic acquired in 2019 and recently completed the drilling of two exploration wells and one well test in PEL 83.

The above-mentioned activities were undertaken based on the successful completion of EIA processes, approved EIA Reports and related Environmental Clearance Certificates (ECCs), issued by the MEFT: Department of Environmental Affairs (DEA). Galp plans to continue their exploration / appraisal activities in PEL 83 and requires new environmental clearances from MEFT for the following activities (similar to what was previously undertaken):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign – see Figure 2) as well as Ocean Bottom Node (OBN) seismic acquisition.
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years).

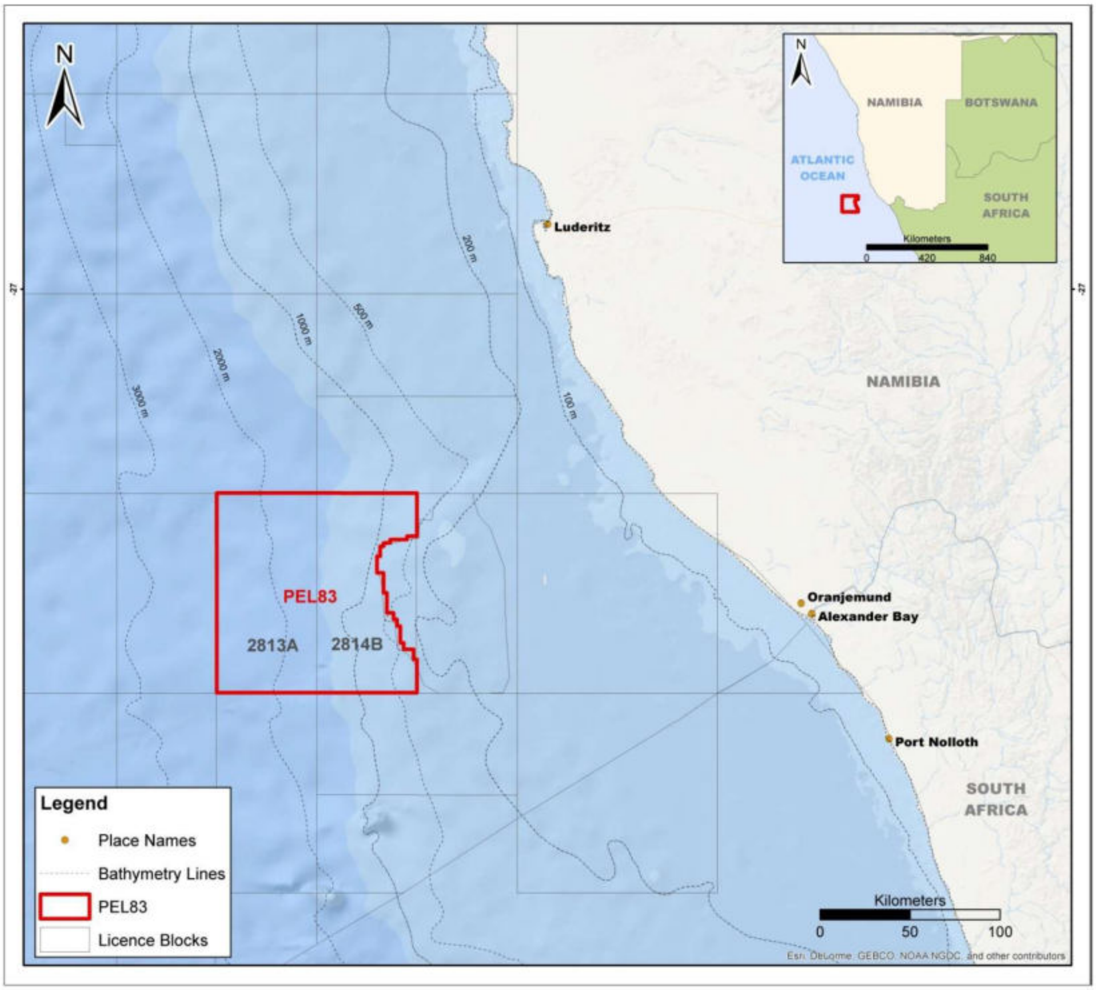


FIGURE 1: LOCATION OF PEL 83 (SLR, 2019)

Prior to the commencement of further activities proposed, including the amendments / additions to the previously approved activities, further authorisations (i.e. environmental clearances) are required from MEFT: DEA in terms of the Environmental Management Act, No. 7 of 2007 and associated EIA Regulations (January 2012).

Galp appointed Namisun Environmental Projects and Development (Namisun), as an independent environmental consulting company to undertake the required EIA process for the proposed further exploration activities, to compile the relevant EIA Report and amend the accompanying ESMPs as part of the process for the new applications for environmental clearances.

It is thought that this EIA Scoping (including Impact Assessment) Report and amended ESMP (Appendix H) will provide sufficient information for MME and MEFT to make an informed decision regarding the ongoing exploration activities (i.e. 3D Seismic Acquisition and associated activities), and whether an ECC can be issued or not.

1.3 Motivation (Need and Desirability) for the Project and Amendment Application

Galp completed the drilling of two exploration wells (i.e. the Mopane-1X well and Mopane-2X well – refer to Figure 2 for the locations as well as other well drilled in in the Orange Basin) from November 2023 to March 2024 and one well flow test in April 2024. All activities, including the safe abandoning of the wells were completed in May 2024.

The first phase of exploration in the Mopane complex was concluded and the results were very encouraging to proceed with further work in the area.

In both wells, which are 8 kilometres apart (see Figure 2), significant light oil columns were discovered in high-quality reservoir sands.

Due to these positive results from the recent exploration activities, Galp plans to continue with further activities as described in this report to further quantify the discovery.

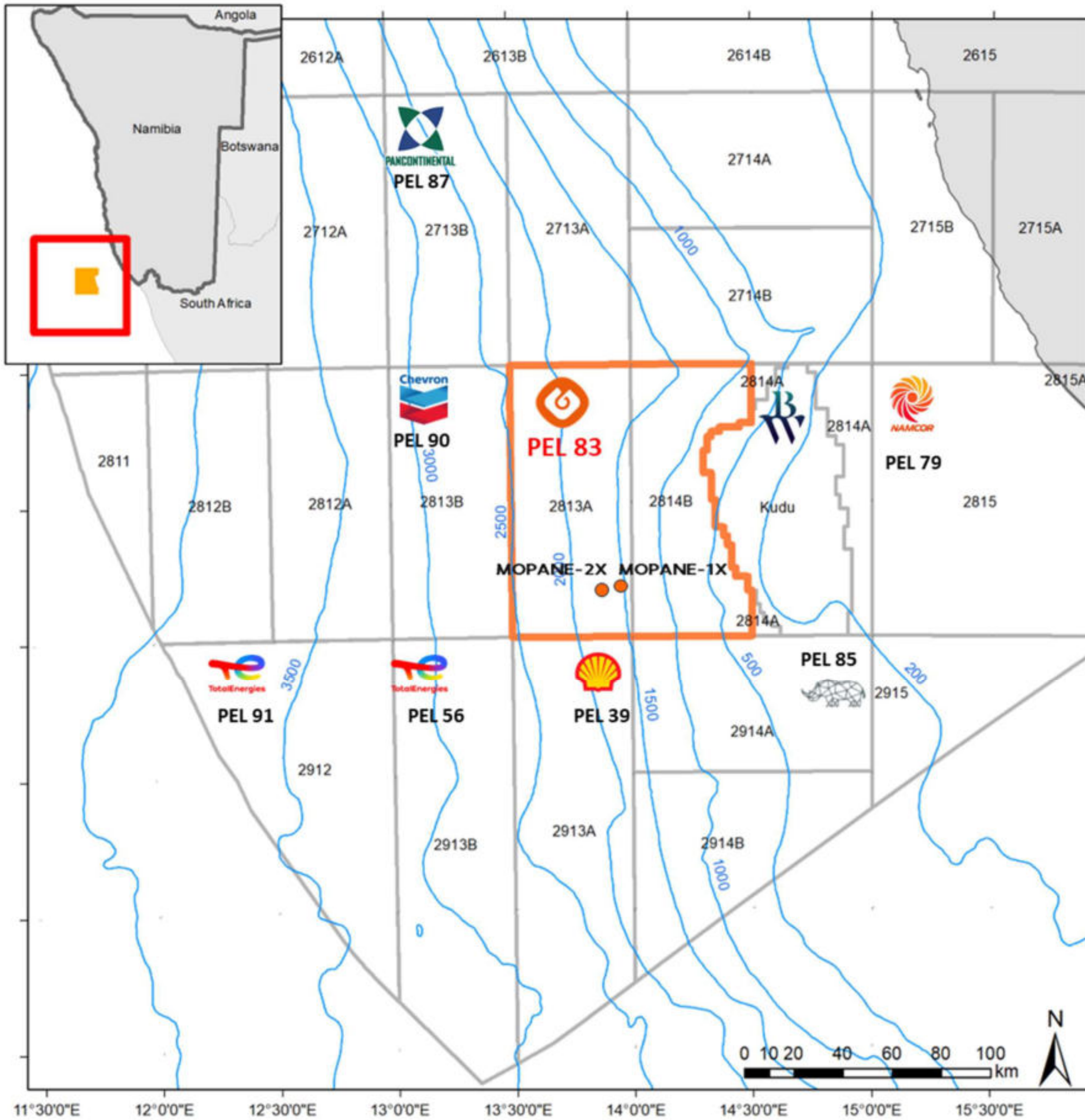


FIGURE 2: LOCATION OF THE MOPANE-1X AND MOPANE-2X WELLS WITHIN PEL 83

The overall “need and desirability” of the proposed project from the perspective of wider society and policy ‘fit’ is addressed in terms of the following:

- White Paper on the Energy Policy (1998);
- Vision 2030;
- The Fifth National Development Plan (2017/18 – 2021/22);
- Namibia’s Industrial Policy;
- Regional and local planning guidance; and

- Oil and gas sector history, policy and promotion initiatives.

The above-mentioned sources were reviewed and discussed in the original EIA (SLR, 2019) and a brief summary is provided below.

The policy compatibility review has showed that Namibian policy is broadly aimed towards improving socio-economic welfare through the sustainable utilisation of the country's natural resources. NDP5 plans to accomplish economic progression by developing value-added industrialisation, substituting imports for locally produced goods, creating value chains of production, and to accelerate SME development. Although Namibian policy is increasingly focussed on beneficiation and the creation of downstream opportunities, it is still recognised that upstream industries involving resource extraction play an important role in the overall goal of achieving the full potential which the country's resources can offer. The overall conclusion is that the proposed project will be largely compatible with key socio-economic policies and plans provided environmental and other risks can be adequately mitigated.

The need and desirability for the further exploration activities now being proposed, is economic and strategic in nature. The project has the potential to benefit the country, society and the local economies of Lüderitz and Walvis Bay, both directly and indirectly; although only in the short-term. Direct economic benefits will be derived from employment and wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the increased spending power of employees.

The proposed next round of 3D seismic acquisition will be specifically designed for reservoir oriented purposes, with the focus on stratigraphic / structural hydrocarbon trapping configurations defined by amplitude variation with offset (AVO) anomalies. The expectation is to acquire high quality seismic data suitable for the forthcoming project needs.

1.4 Introduction to the EIA Process

EIAs and associated (new and amendment) applications are regulated by the DEA of the MEFT in terms of the Environmental Management Act, No. 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966) and its associated Regulations were promulgated in January 2012 (Government Gazette No. 4878) in terms of the Act.

1.4.1 Previous assessments and approvals

Galp received an ECC from MEFT in November 2017 for their initial 3D towed streamer seismic survey activities in PEL 83, based on an approved EIA process and associated EIA Report and ESMP (Environmental Resources Management (ERM), 2017). This ECC expired in November

2020. Galp did not renew this ECC, as the seismic survey was completed in 2019 and, at that stage, Galp did not see the need for further seismic survey activities.

In 2019, Windhoek PEL28 B.V. (i.e. Galp) applied for an ECC to drill one or possibly two exploration wells in PEL 83 with the successful completion of an EIA process and the submission of an EIA Report and Environmental and Social Management Plan (ESMP) (SLR, 2019). The application and associated reports (including the ESMP) was approved by MEFT (DEA) and an ECC was issued on the 27th of April 2020. This ECC, which expired in April 2023, was renewed and a new ECC was issued in March 2023 (based on a renewal Application and amended ESMP (Namisun, 2023)).

In October 2023, Windhoek PEL 28 B.V. (i.e. Galp) received an ECC for their offshore exploration well drilling, including well flow testing in PEL 83, on the basis of an approved Amendment Application. The ESMP was updated and approved as part of this process. This ECC is valid until 7 March 2026.

The above-mentioned assessments, previously undertaken, with the related approvals (i.e. ECCs) are schematically summarised in Figure 3.

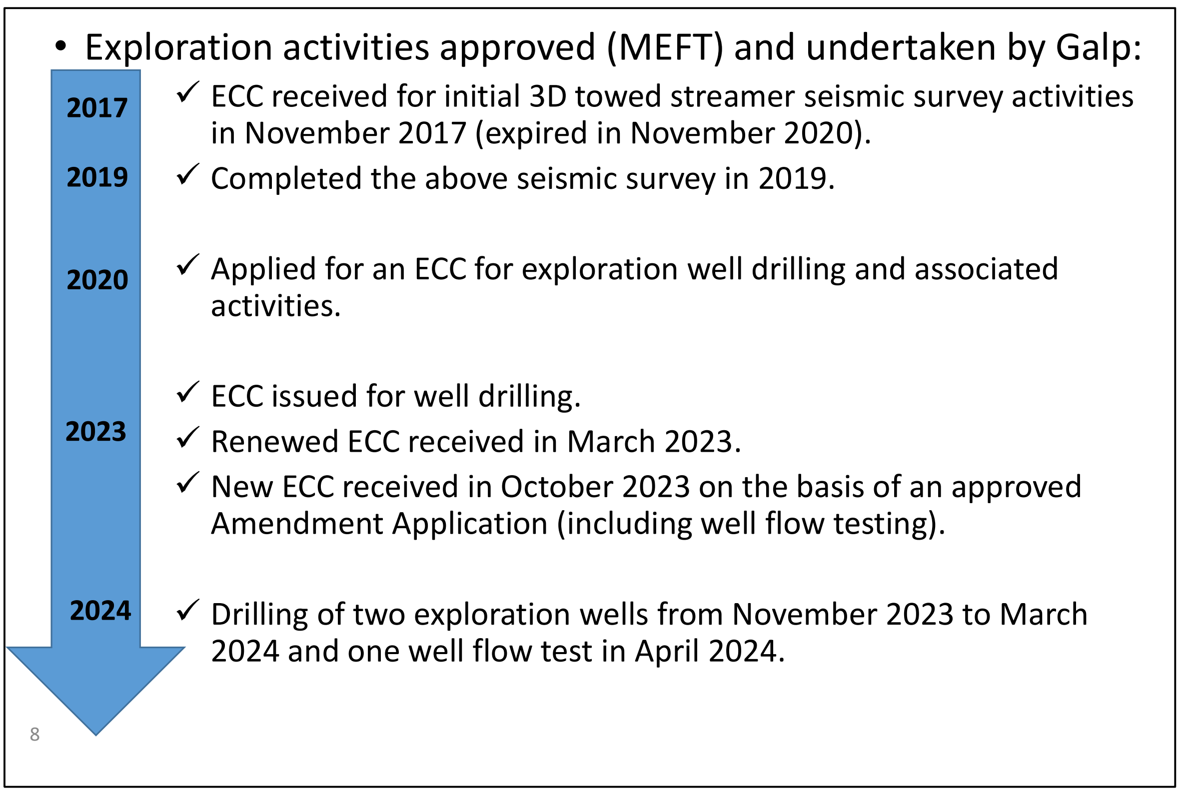


FIGURE 3: HISTORY OF APPROVALS AND ACTIVITIES

1.4.2 Environmental clearances required for Galp's proposed ongoing exploration activities

Even though Galp is proposing to undertake relatively similar (ongoing) exploration activities in PEL 83, to those previously assessed and approved, further authorisations (i.e. ECCs) are first required from MEFT. The key reasons being the following:

- The ECC for 3D seismic survey activities expired in November 2020 (see Section 1.4.1).
- A bigger area needs to be surveyed, in comparison with the area previously assessed / approved. The previously assessed / approved area does fall within the new area though (see Section 4.2 and Figure 4 for further details).
- The current (i.e. valid) ECC for well drilling and associated activities only allows for two wells to be drilled in the PEL.

Taking the above-mentioned into consideration, Galp and Namisun met with MEFT (DEA) (i.e. the Environmental Commissioner) in their Windhoek Office on the 13th of February 2024 to confirm the requirements for the ECCs but more so the process to be followed (i.e. one amendment of the current ECC Application process for all further activities or two applications). Mr Mufeti, the Environmental Commissioner, indicated that the ministry prefers for these activities (i.e. seismic and well drilling – with the associated activities) to be kept "separate" as different applications and separate ESMPs be prepared and ultimately separate ECCs issued, if approved.

However, it was agreed that "one consolidated (parallel) EIA process" can be undertaken, even though two applications will be submitted and two ESMPs would ultimately to be prepared. During a second meeting with MEFT (DEA) in May 2024, it was further agreed that one consolidated EIA report (with two ESMPs) can be prepared covering all Galp's proposed ongoing / further exploration activities (and amendments) and the re-assessment of impacts for the review period by I&APs (refer to the minutes of the meeting in Appendix C). However, MEFT requested that two separate reports (i.e. one per application) be submitted as part of their review and decision - making (after the review period by I&AP and consideration of comments received), as follows (even though large sections in the two reports would be a duplication):

- An EIA Amended Report with all the related Appendices (including the Amended ESMP) for the application related to the further well drilling activities.
- An EIA Report (including both scoping and assessment (i.e. 're-assessment of impacts) in one consolidated report) (this report) with all the related Appendices (including the ESMP) for the application related to the further 3D Seismic survey activities. MEFT requested that the related expired ECC also be submitted (see Appendix I).

Therefore, taking the above-mentioned into account, prior to the commencement of further exploration activities proposed (including the amendments / additions to the previously approved activities) two separate applications will be submitted to the MEFT: DEA in terms of the Environmental Management Act, No. 7 of 2007 and associated EIA Regulations (January 2012), as follows:

- Amendment application for the exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC).
- New application for the seismic (i.e. 3D towed streamer and OBN) surveys and related activities.

The overall objectives of this EIA process are to:

- Provide information on the further (ongoing) exploration activities.
- Describe the current environment in which the project will be situated by updating relevant information from the previous (approved) EIAs (ERM, 2017; SLR, 2019; and Namisun 2023) (where required).
- Identify / update, in consultation with I&APs the potential environmental (and social) aspects associated with the proposed further activities.
- (Re-)assess the potential impacts associated with all the proposed further activities, taking the previous (approved) EIAs and related specialist studies into consideration.
- Review management and mitigation measures required to avoid impacts or to mitigate such impacts to acceptable levels by updating the approved ESMPs, where required.

1.4.3 EIA PROCESS FOR THE PROPOSED PROJECT (I.E. TWO APPLICATIONS FOR ECCS FOR THE FURTHER EXPLORATION ACTIVITIES)

As described in Section 1.4.2, two applications for ECCs (i.e. a new application for the 3D seismic survey activities and an amendment application for the appraisal wells drilling campaign) will be submitted to the MME: Petroleum Directorate (i.e. Competent Authority) as well as the Regulating Authority, i.e. MEFT. This EIA Scoping (including Impact Assessment) Report and the related ESMP (see Appendices H) will be submitted as part of the new application for further 3D Seismic survey activities. The EIA process includes an internal screening phase; a scoping phase, which includes an impact assessment; and an amendment to the previously approved ESMP. A final decision relating to the above-mentioned application will be made by MEFT: DEA.

The main purpose of this EIA Scoping (including Impact Assessment) Report is to provide information relating to the further, ongoing exploration activities – specifically relating to the 3D seismic survey – and to indicate which environmental aspects and potential impacts have been identified during the internal screening and scoping phases.

During the internal screening exercise, Namisun identified the need for the input of a Marine Ecologist and a Fisheries Specialist.

Existing information from the previously approved EIAs (ERM, 2017; SLR, 2019; and Namisun 2023) and related Specialist Reports (including amongst others the Noise Studies and Oil Spill Modelling Study) were used in this report and has been further augmented by input from the Marine Ecologist and Fisheries Specialist, the Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024) undertaken in November 2023 and from comments gathered during consultations with key stakeholders during public and Focus Group Meetings. Therefore, no other specialists have been appointed.

It is thought that this EIA Scoping (including Impact Assessment) Report and the accompanying amended ESMP associated with the proposed ongoing exploration activities (i.e. 3D Seismic Acquisition and associated activities) provide sufficient information for the DEA of the MEFT to make an informed decision regarding the application for an new environmental clearance.

The EIA process and corresponding activities which have been undertaken for this project are outlined in Table 1. The process that was followed was in accordance with the requirements outlined in the EIA Regulations of 2012.

TABLE 1: THE EIA PROCESS

Objectives	Corresponding activities
PHASE I: Project initiation & Internal Screening (February - April 2024)	
• Consultation with MEFT: DEA • Information requirements • Initiate the EIA Scoping process • Identify specialist(s)	• Project initiation meetings with Galp to discuss the proposed project and EIA / applications for environmental clearance process. • Meeting with MEFT: DEA. • Early identification of environmental aspects and potential impacts that might change because of the ongoing exploration activities. • Identify key stakeholders and review / update the Galp EIA I&AP database. • Liaison with specialist(s) and discuss the terms of reference for additional assessment input.
PHASE II – Combined Scoping & Assessment Phase and updated ESMP (April – July 2024)	
• Involve I&APs in the scoping process through information sharing. • Identify further potential environmental issues associated with the	• Meeting with MME and a second meeting with MEFT (DEA). • Prepare Application Forms and submit to MME: Petroleum Directorate and MEFT: DEA and online registration of the application (i.e. on MEFT's portal).

proposed ongoing exploration activities. • Confirm the terms of reference for additional assessment input. • Consider alternatives. • Provide further details associated with the potentially affected environment. • Assessment (i.e. "re-assessment") of potential environmental impacts associated with the proposed activities. • Review and update management and mitigation measures. • Applications for ECCs. • Receive feedback on the application.	• Notify authorities and I&APs of the proposed EIA process (distribute Background Information Document (BID), telephone calls, WhatsApp messages, e-mails, newspaper advertisements and "site notice"). • I&AP registration and initial comments. • Public meetings and key stakeholder (Focus Group) Meetings. • Include I&AP issues and concerns in the studies and assessments. • Conduct specialist studies. • Compilation of EIA Scoping (including Impact Assessment) Report and ESMPs (amendments). • Distribute EIA Scoping (including Impact Assessment) Report and ESMPs to relevant authorities and registered I&APs for review. • Update and finalise reports, considering comments from I&APs. • Online submission of the final reports onto the MEFTs portal. • Submit applications and finalised EIA Scoping (including Impact Assessment) Reports with ESMPs and I&APs comments to MME and MEFT for decision-making.

1.4.4 EIA Scoping (including Impact Assessment) Report

The main purpose of this EIA Scoping (including Impact Assessment) Report is to indicate which environmental aspects relate to the ongoing exploration activities – specifically the 3D seismic survey – and to provide additional assessment and or mitigation measures, where required. Table 2 outlines the report content.

TABLE 2: REPORT TEMPLATE

Chapter	Objective
Chapter 1: Introduction	Describes the report purpose, briefly describes the project background / proposed ongoing (further) exploration activities, summaries legislative requirements, explains the report structure, summarises assumptions and limitations of the study and explains how I&APs can comment.
Chapter 2: EIA process and methodology	Outlines the EIA process, including the I&AP consultation process.

Chapter	Objective
Chapter 3: Legal framework	Provides an overview of relevant Namibian policies and applicable Namibian legislation.
Chapter 4: Overall project description & proposed ongoing exploration activities – focussing on the 3D Seismic Acquisition	Brief summary of the activities assessed during the original / approved EIA processes. Furthermore, describes Galp's proposed ongoing offshore exploration activities in PEL 83, taking the proposed changes and further areas to be explored into consideration.
Chapter 5: Alternatives	This chapter summarise the project alternatives.
Chapter 6: Description of the current environment	Provides an updated general overview of the current baseline conditions associated with the proposed project, also drawing on the baseline information provided in the original / approved EIA processes and associated specialist studies.
Chapter 7: Identification and description of potential impacts	This chapter outlines the environmental aspects and potential impacts that could change because of the proposed project (i.e. ongoing exploration activities). It reasons potential cumulative impacts and provides the relevance (screening) / qualitative assessment of potential impacts.
Chapter 8: Impact assessment	This chapter "re-assesses" the potential environmental (and social) impacts associated with Galp's proposed ongoing exploration activities (i.e. 3D Seismic Acquisition and associated activities). It draws on the specialist studies and assessments in the original / approved EIA processes and associated specialist studies.
Chapter 9: Way forward	Explains the way forward in term of completing the EIA process and final submission of the two applications.
Chapter 10: Conclusion and recommendations	EIA conclusion and impact statement.
Chapter 11: References	Reference list.

1.4.5 EIA TEAM

Namisun Environmental Projects and Development (Namisun) is an independent environmental consultancy firm appointed by Galp to undertake the EIA process.

Werner Petrick, the EIA project manager, has more than twenty-five years of relevant experience in conducting / managing EIAs, compiling EMPs and implementing EMPs and Environmental Management Systems (EMSs). Werner has a B. Eng (Civil) degree and a master's degree in environmental management and is certified as lead environmental assessment practitioner (EAP) and reviewer under the Environmental Assessment Professionals Association of Namibia (EAPAN).

Pierre Smit, the EIA project assistant, holds a PhD in Landscape Ecology and has more than twenty-nine years of experience in environmental management, managing environmental assessment, the implementation of EMPs and EMSs in Namibia.

Dr Andrea Pulfrich of Pisces Environmental Services (Pty) Ltd (Pisces) is the Marine Ecologist. Andrea has a PhD in Fisheries Biology from the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany. As Director of Pisces since 1998, Andrea has considerable experience in undertaking specialist environmental impact assessments, baseline and monitoring studies, and environmental management programmes relating to hydrocarbon exploration, marine diamond mining and dredging and thermal / hypersaline effluents. She is a member of the South African Council for Natural Scientific Professions, South African Institute of Ecologists and Environmental Scientists, and International Association of Impact Assessment (South Africa).

The Commercial Fisheries assessment (and report) was prepared by Sarah Wilkinson and David Japp of CapMarine (Pty) Ltd. David Japp has a BSc in Zoology, University of Cape Town (UCT) and an MSc degree in Fisheries Science from Rhodes University. Sarah Wilkinson has a BSc (Hons) degree in Botany from UCT. Both are professional natural scientists registered with the SA Council for Natural Scientific Professions (SACNASP). Mr Japp has worked in the field of Fisheries Science and resource assessment since 1987 and has considerable experience in undertaking specialist environmental impact assessments relating to fishing and fish stocks. His work has included environmental economic assessments and the evaluation of the environmental impacts on fishing. Sarah Wilkinson has worked on marine resource assessments, specializing in spatial and temporal analysis (GIS) as well as the economic impacts of fisheries exploitation in the southern African region.

The relevant Curriculum Vitae (CV) documentation is attached as Appendix A.

1.5 Assumptions and Limitations

The assumptions and limitations during the preparation of the EIA process relating to the applications for the two ECCs are:

- Namisun assumed that all technical information provided by Galp and their technical team is correct and valid at the time it was provided.
- It is assumed that the baseline descriptions and assessments (including the related Specialists Reports) conducted as part of the original / approved EIAs (ERM, 2017 and SLR, 2019) are accurate. However, where relevant these were updated by further work presented in the Specialist reports and this report.

- There will be no significant changes to the project description or surrounding environment between the completion of the EIA process and implementation of the proposed project that could substantially influence findings and recommendations of this ECC amendment.

Refer to the Marine Ecology and Commercial Fisheries Specialist reports in Appendices F and G for further assumptions and limitations. Assumptions and limitations were also listed in the original EIA Reports and will not be repeated here.

1.6 Opportunity to Comment

This EIA Scoping (including Impact Assessment) Report (with amended ESMP) was distributed for public / authority review. I&APs were invited to comment on these documents, which were available for a review and comment period from **25 June 2024**. Comments had to be sent to Namisun at the telephone number, or e-mail address shown below by no later than **17 July 2024**.

Namisun

Attention: Werner Petrick and Pierre Smit

E-mail address: wpetrick@namisun.com; oudoring@gmail.com

Cell number: +264 (0)81 739 4591 / +264 (0)81 752 7207

2 EIA PROCESS (SCOPING AND ASSESSMENT) METHODOLOGY

This chapter outlines the EIA (Scoping and Impact Assessment) methodology and I&AP consultation process followed in the EIA process.

2.1 Information Collection

Namisun, with input from the specialists (and original / approved EIAs) obtained baseline information; and a description of the proposed ongoing exploration activities from Galp to identify the environmental aspects associated with the proposed project; and to (re)assess the potential impacts.

Information for the preparation of this EIA report was sourced from:

- The original (approved) "Environmental Impact Assessment for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia" (ERM, 2017) and associated specialist studies (appendices) that formed part of the EIA.
- The original (approved) "EIA Report for the offshore exploration well drilling project in PEL 83" (SLR, 2019) and associated specialist studies (appendices) that formed part of the EIA.
- The approved "EIA Amendment Report for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia: Well Testing" (Namisun, 2023).
- Specialist studies undertaken as part of the EIA process:
  - Marine Ecology Impact Assessment Reports (i.e. a report for the further well drilling and another for the further 3D seismic survey activities) (Pisces, 2024) – see Appendix F.
  - Commercial Fisheries Specialist Report (Capmarine, 2024) – see Appendix G.
- Technical information provided by Galp.
- Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024).
- Consultations and meetings with I&APs.
- Other relevant EIAs, i.e. "Application for amendment of ECC exploration and appraisal well drilling in PEL 39" (SLR, 2023) and ESIA for Proposed Exploration and Appraisal Well Drilling in Block 2912 off the South Coast of Namibia, prepared for TEEPNA (SLR, 2023a).

2.2 Report Structure

The structure of this EIA Scoping (including Impact Assessment) Report is outlined in Table 3, following largely the Scoping Report requirements as set out in Section 8 of the EIA Regulations (2012).

TABLE 3: REPORT STRUCTURE

Component	Report reference
(a) Details of the Environmental Assessment Practitioner (EAP) who prepared the report	Section 1.4.5 and Appendix A
(b) A description of the proposed activity (i.e., proposed amendments)	Chapter 4
(c) A description of the environment that may be affected by the activity and the way the physical, biological, social, economic, and cultural aspects of the environment may be affected by the proposed activity	Chapters 6, 7 and 8
(d) A description of the need and desirability of the proposed listed activity and identified potential alternatives to the proposed listed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity	Section 1.3, Chapter 5, 7 and 8
(e) An identification of laws and guidelines that have been considered in the preparation of the Scoping Report.	Chapter 3
(f) Details of the public consultation process conducted in terms of Regulation 7(1) in connection with the application, including:	Section 2.3
(i) steps that were taken to notify potentially interested and affected parties of the proposed application;	Section 2.3.2 and Appendix B
(ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given;	
(iii) a list of all persons, organisations and organs of state that were registered in terms of Regulation 22 as interested and affected parties in relation to the application; and	Section 2.3.1 and Appendix D
(iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues	Section 2.3.3 and Appendices C and E
(g) An indication of the methodology used in determining the significance of potential effects / A description and assessment of the significance of effects, including cumulative effects, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the proposed listed activity	Chapter 8
(h) A description and comparative assessment of all alternatives identified during the assessment process	Chapter 5
(i) A description of all environmental issues that were identified during the assessment process, an assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of mitigation measures	Chapters 7 and 8
(j) An assessment of each identified potentially significant effect	

Component	Report reference
(k) A description of any assumptions, uncertainties and gaps in knowledge	Section 1.5
(l) A management plan	Appendices H
(m) An opinion as to whether the proposed listed activity must or may not be authorised, and if the opinion is that it must be authorised, any conditions that must be made in respect of that authorisation	Chapter 10
(n) A non-technical summary of the information	Executive Summary

2.3 Public Participation Process

Public participation processes were conducted as part of the original (approved) EIAs (ERM, 2017; SLR, 2019; and Namisun 2023) for the previously undertaken exploration activities (i.e. both 3D seismic survey and well drilling and associated activities – see Sections 1.4.1 and 4.2 for further details) to ensure that all persons and or organisations that may be affected by, or interested in, the exploration activities were informed of the activities and could register their views and concerns. Those previous (approved) studies and assessments took the I&AP comments into account.

Similarly, as part of the current EIA process for the applications of two ECCs for Galp's ongoing (further) exploration activities, the I&APs were informed of the proposed activities, to raise further (associated) views and concerns.

Section 2.3.1 provides a summary of I&APs informed of the proposed ongoing activities and the EIA process associated with the two new applications for environmental clearances. Section 2.3.2 describes the process that was followed and the issues that were identified are summarized in Section 2.3.3.

2.3.1 Interested and Affected Parties

The broad list of persons, group of persons or organisations that were informed about Galp's plans for ongoing exploration in PEL 83, and were requested to register as I&APs, should they be interested and or affected are:

- Government and parastatals – National, Regional and Local, including (amongst others) the following:
    - The Directorate of Directorate of Petroleum Affairs at the MME.
    - The DEA at the MEFT.

- The Directorate of Maritime Affairs (DMA) at the Ministry of Works and Transport (MWT)
- Ministry of Fisheries and Marine Resources (MFMR).
- Lüderitz Town Council.
- Karas Regional Council.
- Namport.

- Fishing associations and companies.
- Oil and gas Industry and other businesses.
- Non-government organisation (i.e. Namibia Chamber of Environment and Earthlife Namibia).
- Other I&APs that registered on the project.

The full stakeholder database for this project is included in Appendix D of this report. Note: Appendix D1 is the full / complete list of I&APs that were informed via emails. This list is an updated list from the original (complete) I&AP database developed during the original (approved) EIA (SLR, 2019) and revised during the amendment application process (Namisun, 2023).

2.3.2 Steps in the Consultation Process

Table 4 sets out the steps that were followed as part of the consultation process.

TABLE 4: CONSULTATION PROCESS WITH I&APS

TASK	DESCRIPTION	DATE
Notification - regulatory authorities and I&APs		
I&AP identification	The Galp stakeholder database of 2019 (revised in 2023) was updated. This database is updated as and when required. A copy of the I&AP database is attached in Appendix D.	March 2024 – ongoing
Distribution of Background Information Document (BID) and relevant information sharing	Copies of the BID were distributed via email to authorities and I&APs on the stakeholder database and copies were made available on request to any other I&AP. The purpose of the BID was to inform I&APs and authorities about Galp's proposed ongoing exploration activities, the assessment process being followed, possible environmental impacts and ways in which I&APs could provide input / comments to Namisun. A copy of the notifications and BID are attached in Appendix B. Furthermore, Namisun reached out to numerous key stakeholders, identified from the I&AP database, during the initial registration (and review of the BID) period. This was done through telephone calls, WhatsApp messages, etc. to further inform them about the proposed activities,	April 2024

TASK	DESCRIPTION	DATE
	availability of the BID and the planned meeting (see below).	
Site notices	A poster (i.e. "site notice") was placed at the "Lüderitz Information Centre" (i.e. Lüderitz Safaris & Tours) to notify I&APs of the proposed project and the EIA process being followed. Photos of the site notice that were displayed are attached in Appendix B.	April 2024
Newspaper Advertisements	Block advertisements were placed in the Market Watch (on 16 April and again 23 April 2024) as part of the following newspapers: • The Namibian Sun • Die Republikein • Allgemeine Zeitung Copies of the advertisements are attached in Appendix B.	April 2024
Public meetings and key stakeholder / Focus Group Meetings and submission of comments		
Public meetings and Focus Group Meetings	Two public meetings were arranged as follows: • 26 April 2024 @ 10:00 at the Alte Turnhalle, Lüderitz. • 29 April 2024 @ 9:00 at the Protea by Marriott Hotel Walvis Bay Indongo. Various Focus Group Meetings were also conducted as follows: • Fishing Industry on 26 April 2024 at Alte Turnhalle, Lüderitz. • Kelp Blue on 26 April 2024 in Desert Deli, Lüderitz. • Mr Jean-Pierre Roux and Ms Jessica Kemper on 26 April 2024 at Alte Turnhalle, Lüderitz. • Mr Jason Burgess (i.e. Namibia Tuna Association Chairman) on 26 April 2024 in Desert Deli, Lüderitz • Fishing Industry on 29 April 2024 at Indongo Protea Hotel. • NamPort on 29 April 2024 in the Boardroom, Directorate of Marine Affairs in Walvis Bay. • The DMA at MWT on 29 April 2024 in the Boardroom of DMA, Walvis Bay. • MFMR) on 30 April 2024 in the Boardroom, MFMR, Swakopmund. • Shell on 7 May 2024 (virtual meeting). The objectives of all the above-mentioned meetings meeting were as follows: • To share information about the proposed project and its location. • Provide a description of the EIA process.	May / June 2023

TASK	DESCRIPTION	DATE
	• Provide information about the key potential environmental issues. • Provide stakeholders with an opportunity to be involved in the EIA. • Describe the way forward, highlighting further opportunities to be involved in the EIA process. Refer to Appendix C for the minutes of the meeting. Furthermore, an informal (virtual) meeting was arranged with SLR Environmental Consulting, and the relevant specialists involved in the related EIA processes. The objective of this meeting was to discuss the various EIAs being undertaken by both Namisun and SLR for various companies in the same general area in the Orange Basin and to consider cumulative impacts where relevant.	
Comments and responses	All comments received via e-mail are included in Appendix C. A summary of key questions / comments / issues raised (with responses) during the meetings and received per email are included in Section 2.3.3 and were incorporated in this report, where relevant. An Issues and Reponses Report (IRR) with all comments received, with related responses, are attached as Appendix E. The IRR will be updated with further comments received by I&APs as part of the review process of the report. The final IRR will be submitted as part of the final EIA Scoping (including Impacts Assessment) Report to MME and MEFT for their review and decision.	April to June 2024
Review of EIA Scoping (including Impact Assessment) Report by I&APs and authorities and submission final report and applications to MME and MEFT		
I&APs and authorities review of EIA Scoping (including Impact Assessment) Report with amended ESMPs	The EIA Scoping (including Impact Assessment) Report (i.e. main report) Executive Summary was distributed to all relevant authorities and registered I&APs on the I&AP database via e-mail. A copy of the email notifications are attached in Appendix B. Electronic copies of the full report (with appendices) were available on request from Namisun. A hard copy (as well as electronic copies) of the full report was also available for review at the Walvis Bay Public Library and the Lüderitz Public Library. Authorities and I&APs had the opportunity to review the draft report and submit comments in writing to Namisun. The comments period commenced on the 25 June 2024 and the closing date for comments was 17 July 2024. During the review period Namisun also liaised with a few of the Key Stakeholders (i.e. MFMR and the Namibia Tuna Association Chairman – as agreed during the initial public	June / July 2024

TASK	DESCRIPTION	DATE
	participating process) to confirm their further engagement, etc.	
MME and MEFT review of Final Report and decision on applications	Namisun considered all the comments received during the review period and where relevant incorporated further input into the respective report(s). A copy of the final report including comments from authorities and I&AP, will be submitted to MME and MEFT who will do the final review for decision-making.	July 2024

2.3.3 SUMMARY OF THE ISSUES RAISED

The key questions / comments / issues raised by I&APs during the meetings and received per email are summarised below. The full list of questions / comments / issues raised, as well as responses provided, are included in the IRR as Appendix E.

Refer to Appendix C for a summary of emails received and minutes of meetings.

2.3.3.1 KEY QUESTIONS / COMMENTS / ISSUES RAISED BY I&APS RELATING TO THE FURTHER 3D SEISMIC SURVEY AND ASSOCIATED ACTIVITIES

- When do you plan to begin with the seismic activities?
- If you say that the duration is estimated to be two to three months – when exactly do you want to start? Will it be during winter? Take note that the weather needs to be considered.
- Can the seismic also be done in winter? Or is it only restricted because of the movement of animals?
- Impact of seismic on fishing activities.
- Impact of seismic on Tripp Seamount.
- Noise related impacts of seismic, taking the frequency ranges and the decibel ranges of the seismic sounds into consideration.
- What are the exclusive zones and associated impacts.
- Proper / ongoing (open) communication between the company(s) undertaking the activities and the Fishing industry is required.
- Distance from Tripp Seamount and associated impacts.
- Overlap of activities with other PELs and associated cumulative impacts.
- Impacts of Remotely Operated Vehicle (ROVs) on the seabed.
- Working at great sea depths with the ROVs will create important marine biology information for scientific applications. This is a great opportunity to allow marine scientists to collaborate and get more information from the deep seafloor (deeper than 300 m).

2.3.3.2 KEY QUESTIONS / COMMENTS / ISSUES RAISED BY I&APS RELATING TO ALL FURTHER PROPOSED EXPLORATION ACTIVITIES

- Impacts from exploration activities on migratory fish migrate over large areas along the Namibian coast.
- Will it be possible to engage personnel on the vessels and rigs to observe the movements of species? It would also be good for the MFMR to have access to the information from the MMO surveys for comparison purposes – e.g. the locational information, movement patterns, numbers, behaviour, etc. This information is very valuable for several scientific reasons.
- To which of the international conventions (related to the sea) is Namibia a signatory?
- Is it possible to have an emergency team trained and available for managing potential incidents and will such a team work collaboratively with all the exploration parties involved?
- Can the exploration companies work collaboratively to establish such an emergency team?
- Will this joint emergency team be based in Lüderitz or Walvis Bay?
- Good communication and interaction between fishing vessels and the exploration service vessels is important to avoid disruptions to fishing operations and causing reduced catch. Communication in the past was a problem because the crew of some vessels could not speak English.
- More face-to-face involvement and liaison between the exploration team and the fishing companies is necessary to communicate the planned activities in the same area of interest.
- Communication about planned activities in the far south of Namibian water is important because some fishing vessels come from South Africa to fish, especially in the area around Tripp Seamount and are not necessarily informed.
- Dialogue between the regulators and developers is improving, and also among the different bodies of regulation (for example between the MEFT, DMA, MME and MFMR).
- Galp must ensure to communicate each of its activities through its Notice to Mariners. DMA will share this information with other parties then. In addition, the 500 m buffer zone around operating activities is an international practice but is very short in terms of safety. Therefore, a change in this regard can be communicated through the Notice to Mariners.
- Will it be possible to do transfer of skills to establish a team of Namibian workers to work on the exploration activities?
- Increase the number of Namibians on the drill rigs and in the exploration activities – this will also alleviate the communication problem.
- What is the plan to have Namibian registered and operated vessels to support the activities?
- Rent becomes a challenging issue in a small town like Lüderitz with its limited opportunities. Due to the shortage of housing, it is hard to recruit personnel to stay in the town. The town

also experiences many knock-on socio-economic impacts like inward migration and shortages in housing, increase in social ills, etc. because of its growing local economy.

- Lüderitz already experiences heavy pressure because of the socio-economic impacts associated with its growing local economy – in essence the town infrastructure is fallen apart. Will Galp consider to establish its operations from Lüderitz?
- Helicopter flights over the islands and some species must be prevented (for example birds when they are hatching). It would be advisable to have clear communications with personnel of MFMR in this regard.
- Lighting on board (especially during hazy and foggy conditions) can attract some seabirds and cause accidents and deaths. Consideration of migratory species is especially important. The ESMP must address the design and use of lighting on-board.

3 LEGAL FRAMEWORK

This chapter provides a summary of the relevant Namibian legislation and international conventions / treaties that are applicable to the offshore exploration activities in PEL 83.

The Republic of Namibia has five tiers of law and a few guiding policies relevant to environmental assessment and protection, which include the Constitution of the Republic of Namibia, statutory law, common law, customary law and international law.

As the main source of legislation, the Constitution of the Republic of Namibia (1990) makes provision for the creation and enforcement of applicable legislation. Article 95 (1) of the Constitution says: *"The State is obliged to ensure maintenance of ecosystems, essential ecological processes and biological diversity and utilisation of living natural resources on a sustainable basis for the benefit of Namibians both present and future"*.

In this context and in accordance with the constitution, Namibia has passed numerous laws intended to protect the natural environment and mitigate against adverse environmental impacts.

3.1 Policies and Legal Frameworks Applicable to Oil and Gas Exploration

The relevant policies and acts, applicable to oil and gas exploration include the following:

- Environmental Assessment Policy for Sustainable Development and Environmental. Conservation, 1995.
- Environmental Management Act, No. 7 of 2007.
- EIA Regulations (2012).
- Minerals Policy of Namibia (2004).
- Petroleum (Exploration and Production) Act, No. 2 of 1991.
- Petroleum (Exploration and Production) Act Regulations (1999).

3.2 Other Laws and Policies Applicable to Gas and Oil Exploration

Other relevant legislation relevant to the proposed exploration activities are summarised below:

Petroleum:

- Petroleum Products and Energy Act, No. 13 of 1990 and relevant regulations.
- Petroleum Laws Amendment Act, No. 24 of 1998.
- Petroleum (Taxation) Act, No. 3 of 1991.

Transport and Maritime:

- Marine Traffic Act, No. 2 of 1981 (as amended by the Marine Traffic Amendment Act, No. 15 of 1991.
- The Merchant Shipping Act, No. 57 of 1951.

- Namibian Ports Authority Act, No. 2 of 1994 and Port Regulations.
- Civil Aviation Act, No. 6 of 2016 and associated regulations.
- Road Traffic and Transport Act, No. 22 of 1999.
- Wreck and Salvage Act, No. 4 of 2004.
- Territorial Sea and Exclusive Economic Zone of Namibia Act, No. 3 of 1990.
- The Territorial Sea and Exclusive Economic Zone of Namibia Amendment Act, No. 30 of 1991.

Pollution:

- Atmospheric Pollution Prevention Ordinance, Ordinance 11 of 1976.
- Dumping at Sea Control Act, No. 73 of 1980.
- International Convention for the Prevention of Pollution from Ships Act, No. 2 of 1986.
- International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties Act, No. 64 of 1987.
- Prevention and Combating of Pollution of Sea by Oil Act, No. 6 of 1981 and associated regulations.
- Marine Notice, No. 2 of 2012: Transfer of Oil Outside Harbours.

Environment / Conservation:

- Marine Resources Act, No. 27 of 2000 and accompanying regulations.
- Nature Conservation Ordinance, No. 4 of 1975.
- Nature Conservation Amendment Act, No. 5 of 1996.
- National Heritage Act, No. 27 of 2004.
- Water Resources Management Act, No. 24 of 2004 and its associated regulations (promulgated in 2023).

Hazardous Substances:

- Hazardous Substances Ordinance, Ordinance 14 of 1974.
- Hazardous Substances Ordinance, Ordinance 14 of 1974: Group I Hazardous Substances.

Labour:

- Labour Act, No. 11 of 2007.
- Regulations relating to the health and safety of employees at work (GN 156 of 1997).
- Employee's Compensation Act, No. 30 of 1941, as amended.

Health:

- Health Act, No. 21 of 1988.

Other policies, plans and guidelines applicable proposed exploration activities (including well testing.

- White Paper on the Energy Policy, 1998.
- Namibia Vision 2030.
- Fifth National Development Plan 2017/18 – 2021/22 (NDP5).
- Harambee Prosperity Plan.
- Strategic Plan, 2017/2018 – 2021/2022.
- Policy for the Conservation of Biotic Diversity and Habitat Protection, 1994.
- National Waste Management Policy (2010).
- National Biodiversity Strategy and Action Plan (NBSAP) 1 and 2 (draft).
- New Equitable Economic Empowerment Framework Policy, 2011.
- National Environmental Health Policy (2002).

3.3 INTERNATIONAL LAWS AND CONVENTIONS RATIFIED BY THE NAMIBIAN GOVERNMENT

Relevant international conventions and treaties which the Namibian Government has been ratified and which have become law through promulgation of national legislation are listed below.

Air and Atmosphere:

- Kyoto Protocol on the Framework Convention on Climate Change, 1997.
- Montreal Protocol on Substances that Delete the Ozone Layer, 1987.
- Paris Agreement (United Nations Framework Convention on Climate Change) 2016.
- United Nations Framework Convention on Climate Change – UNFCCC (1992).
- Vienna Convention for the Protection of the Ozone Layer, 1985.

Chemicals and Waste:

- Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989).
- Stockholm Convention on Persistent Organic Pollutants (2001).

Flora, Fauna and Protected Areas:

- African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968) and the revised version (Maputo, 2003).
- Cartagena Protocol on Biosafety to the Convention on Biological Diversity (2000).
- Convention on Biological Diversity, 1992.
- Convention on International Trade of Wild Fauna and Flora Endangered Species (1973) (CITES).
- Convention on Wetlands of International Importance (Ramsar Convention, 1971).
- International Convention for the Conservation of Atlantic Tunas (ICCAT).

- Memorandum of Understanding (MoU) concerning Conservation Measures of Marine Turtles of the Atlantic Coast of Africa (1999).
- United Nations Convention to Combat Desertification in those Countries Experiencing serious Drought and/or Desertification, particularly in Africa (1994).

Marine Pollution:

- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78).
- International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969 and its protocol (Amends the 1969 Convention about the method of calculation for the limitation of liability).
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention).
- International Convention on the establishment of an International Fund for Compensation for Oil Pollution Damage (The Fund Convention), 1971.
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and 1996 Protocol.
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969).
- Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973).

Marine Safety:

- Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS).
- International Convention for the Safety of Life at Sea, 1974 (SOLAS) with its protocol of 1978.
- The International Convention on Load Lines, 1966 and its protocol of 1988.
- International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978.

Marine Resources:

- 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).
- Convention of the International Maritime Organisation (IMO), 1948.
- United Nations Law of the Sea Convention, 1982, (UNCLOS).

Archaeology and Cultural Heritage:

- Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972).

Fishing:

- Agreement to Promote Compliance with International 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).

4 PROJECT DESCRIPTION

This chapter first provides a brief summary of the activities associated with the 3D Seismic survey assessed during the original / approved EIA processes, already undertaken by Galp. Furthermore, it provides a summarised description of Galp's proposed ongoing Offshore Exploration activities in PEL 83 (focusing on the proposed further 3D Seismic Acquisition and associated activities), taking the proposed changes and further areas to be explored into consideration.

Due to the proposed further activities being relatively similar to that previously described, assessed, approved and undertaken, references (and extracts) are made from the following reports (where relevant), with further updates provided by Galp: ERM, 2017.

4.1 DETAILS OF THE APPLICANT

Company name:	Windhoek PEL28 B.V. Physical: Dr. Frans Indongo Street, Frans Indongo Gardens - 15th Floor - Erf 1657, Windhoek Headquarters: Avenida da India, n.8 (ALLO B Bluiding) 1349-065 Lisboa, Portugal
Contact (responsible) person:	Mr Flavio Lucena (Galp HSE Manager for Namibia)
Telephone / Fax:	+351 967 22 687
E-mail:	flavio.lucena@galp.com

As stated in section 1.2, PEL 83" is a Joint Venture between the license partners, namely Windhoek PEL28 B.V. (a wholly owned subsidiary of Galp Energia E&P B.V), the National Petroleum Corporation of Namibia (NAMCOR) and Custos Investments. Galp is currently the operator of PEL. Galp holds an 80% controlling interest in PEL 83, while NAMCOR and Custos each hold 10%. Galp is currently the operator of PEL 83.

4.2 BACKGROUND OF PREVIOUS EXPLORATION ACTIVITIES UNDERTAKEN BY GALP IN PEL 83

With reference to sections 1.2 and 1.4.1 (also Figure 3), Galp has been performing exploration activities in PEL 83 since 2016, on the basis of approved Applications for Environmental clearance and related EIA processes. Galp completed a 3D seismic survey campaign in 2019 and recently completed the drilling of two exploration wells, of which one well was tested.

4.2.1 3D SEISMIC SURVEY ACTIVITIES PREVIOUSLY ASSESSED / APPROVED AND UNDERTAKEN BY GALP IN 2019

Galp has successfully completed a 3D seismic survey between January and March 2019, over an area covering ~3,015 km^2 of the PEL 83. The area that was surveyed in 2019 is shown in

Figure 4 (orange dotted polygon). The (bigger) area that was, however, assessed and approved for the related activities are shown in Figure 4 (green polygon).

The following key activities were foreseen to be undertaken[5] during the original 3D seismic survey campaign (as explained / assessed by ERM (2017) in the EIA Report:

- The offshore seismic survey was undertaken using a vessel, towing underwater acoustic energy sources (at a depth of approximately 7-8 m) 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 a “seismic wave”, spread through the water down to the seabed.
- The acoustic signals emitted in the column of water penetrated the seabed and were then reflected by the rocky layers in the sub-surface.
- On its return, it was recorded using submarine microphones, known as hydrophones, distributed along a set of lines towed from the vessel, known as streamers.
- The 3D towed streamer acquisition (i.e. actual acquisition undertaken in 2019) technique required one seismic source with 10 streamers, 8.1 km long and 150 m apart. (ERM (2017) considered two seismic sources and with streamers 10 km in length, 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 travelled at regular speed (i.e. ranging from 4 to 5 knots), along predefined navigation lines.
- To make them visible to third parties, each streamer was equipped with a tail buoy. The main vessel was supported by 1 supply and 1 guard / chase vessel. In charge of liaising with third party vessels to reduce the potential for interference between the seismic survey and third-party activities. (ERM (2017) considered 1 supply vessel with two chase vessels as part of their study).
- Once the seismic survey was performed, the seismic, chase and supply vessels left the study area to navigate to their next assignment. No trace of the survey activity was left in the study area after demobilisation.

Before the start of the survey, the seismic vessel berthed at the Walvis Bay port, where crew members and supplies were taken onboard, and where they were supplied with fuel, before sailing to the area where the seismic survey took place. The supply vessel was also berthed at the Walvis Bay port. Crew changes were made to / from Walvis Basin using the support vessel.

[5] These activities were described by ERM (2017), however, slightly modified (where relevant) to indicate the actual / performed activities.

Bunkering operations were made during operations using also the support vessel.

Generally, seismic acquisition vessels generate only a limited amount of waste. Insofar as possible, paper waste, food waste, wood and plastic materials was incinerated on board. A waste management plan was developed for the Seismic activities.

No waste generated during the seismic operations were disposed in Namibia. All waste generated from the project was exported to a final waste disposal facility. Food wastes were generated from galley and food service operations. Food waste was ground prior to discharge in accordance with MARPOL requirements.

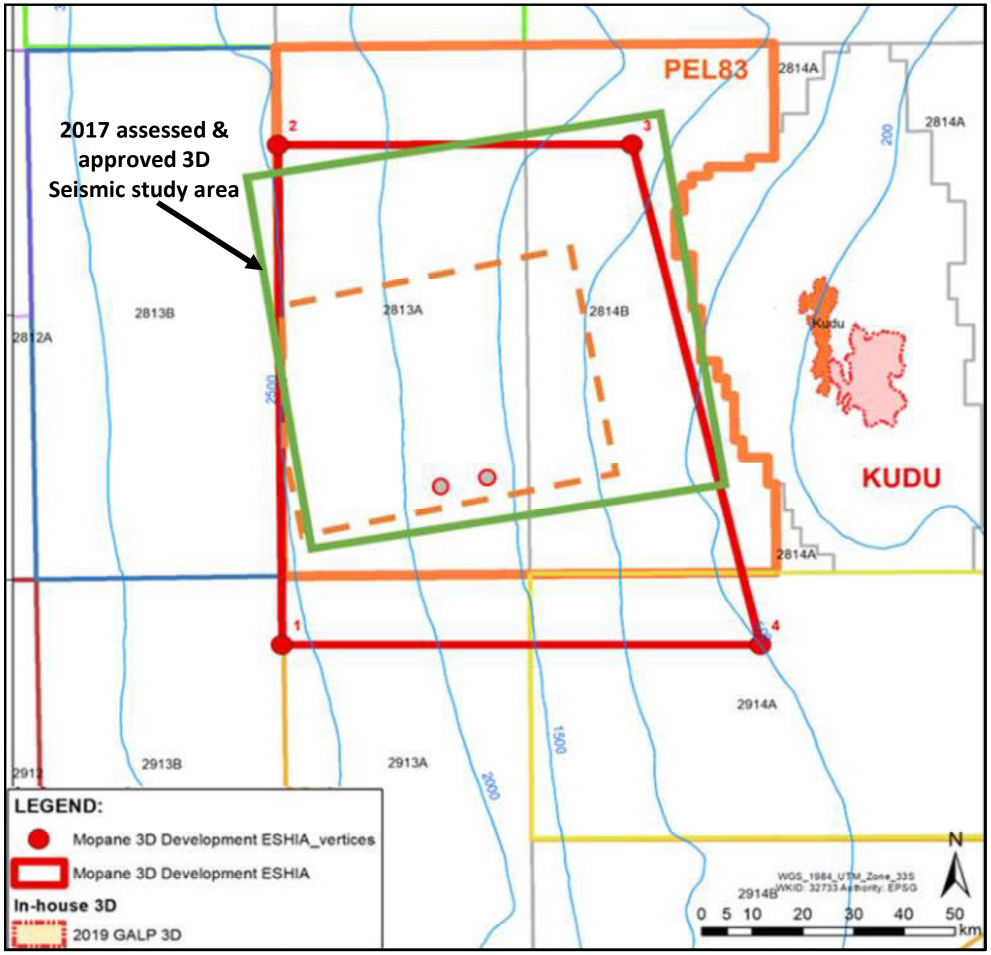


FIGURE 4: 3D-SEISMIC SURVEY AREAS IN PEL 83

4.3 PROPOSED ONGOING / FURTHER EXPLORATION ACTIVITIES AND RELATED AMENDMENTS

With reference to section 1.3, due to the positive results from the recent exploration activities, Galp plans to continue with further exploration / appraisal activities in PEL 83 and requires new environmental clearances from MEFT for the following activities (similar to what was previously undertaken):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign) as well as ocean bottom node (OBN) seismic acquisition (refer to sections 4.3.1 and 4.3.2 for further details regarding each of the survey methods).
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years) (refer to the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling (submitted at the same time as this report to MEFT and MME)).

4.3.1 FURTHER 3D SEISMIC SURVEY: *TOWED STREAMERS SEISMIC SURVEY*

The proposed (further) activities will be similar in nature to that previously undertaken, as described below. Where relevant (modified / updated) extracts from the original "EIA for 3D Seismic Survey in PEL 83 (prepared for: Windhoek PEL 28 B.V". (i.e. Galp) (ERM, 2017) are, amongst others, provided below.

4.3.1.1 SURVEY LOCATION

The area to be surveyed by Galp, likely towards the first quarter 2025, will be ~ 4000 km^2 within the red polygon as shown in Figure 4. With reference to Figure 4, the survey would extend partially into the neighbouring blocks (to the south). Galp will engage with the neighbouring licence holders to obtain permission to survey in their blocks.

Refer to section 1.2 for details on the size of the PEL, water depths, etc.

4.3.1.2 SURVEY SCHEDULE / TIMING

Precise dates for Galp's next proposed 3D towed streamer seismic exploration survey are not yet known, though it is scheduled to commence in Q1 of 2025. Depending on the equipment configuration and the weather conditions, completion of the well drilling of two of the additional (i.e. appraisal) wells (see section 4.3.3) the expected duration of the survey is approximately 90 days (conservatively), running an uninterrupted schedule of 24 hours a day and 7 days per week. The duration of the survey can be increased due to weather constraints.

4.3.1.3 DESCRIPTION OF THE TOWED STREAMER SEISMIC SURVEY

General Principles of 3D Towed Streamers Seismic Surveys and equipment to be used[6]

A marine seismic survey is a geophysical technique that uses acoustic energy and seismology to map the location and structure of geological features below the seabed to ultimately identify the possible discovery of hydrocarbons.

The proposed survey will (again) be conducted by a vessel that tows a seismic energy source. The seismic energy source, which will be submerged to depths ranging between ~ 7-8 m and towed some 250 m behind the vessel, will generate a low frequency acoustic signal by instantaneously releasing compressed air into the water. Acoustic sound waves will thereby be directed down toward the seabed into the various buried rock layers beneath the seafloor.

The sound waves will reflect back to the surface from geological interfaces below the seafloor, which will be recorded by multiple receivers towed in a multiple streamer configuration.

Analyses of the returned signals will therefore allow Galp to further interpret the subsea geological formations by means of a three-dimensional image.

Similar to the previous (i.e. 2019) survey, the proposed (further) 3D acquisition technique will again require one seismic vessel with source arrays at 7-8 m below see surface, 8-12 streamers approximately 8 km in length, towed more than 15 m below sea surface, placed in parallel and spaced ~ +75 m to 100 m apart. The seismic vessel towing this equipment will operate 24 hours a day and will travel at a speed of ~ 4.5 knots, along predefined navigation lines, within the proposed survey area. Each streamer will again be equipped with a tail buoy, to ensure they are visible to third parties. The position of the tail-buoys will assist in determining the location and shape of the entire streamer.

Deflectors will be attached to the configuration to keep the survey array (i.e. the streamers and airguns) in position. Deflectors will be pointed forward and away from the direction that the vessel will travel, therefore pushing the configuration to its widest possible point.

Therefore, the components that will (again) make up the seismic survey configuration to be towed behind the vessel will comprise of the following main components:

- Airgun arrays.
- Streamers.
- Paravanes, Buoys and Deflectors.

[6] General description provided. Exact details will only be known during planning phase with the seismic contractor

- Positioning equipment.

Refer to Figure 5 for an illustration of the principles of 3D Towed Streamers Seismic Surveys and Figure 6 for an illustration of the survey vessel and streamer layout and tail buoys.

The following devices will be used to monitor and control the depth / positioning of the streamers:

- Depth control units or birds.
- Magnetic compasses.
- Acoustic positioning units.

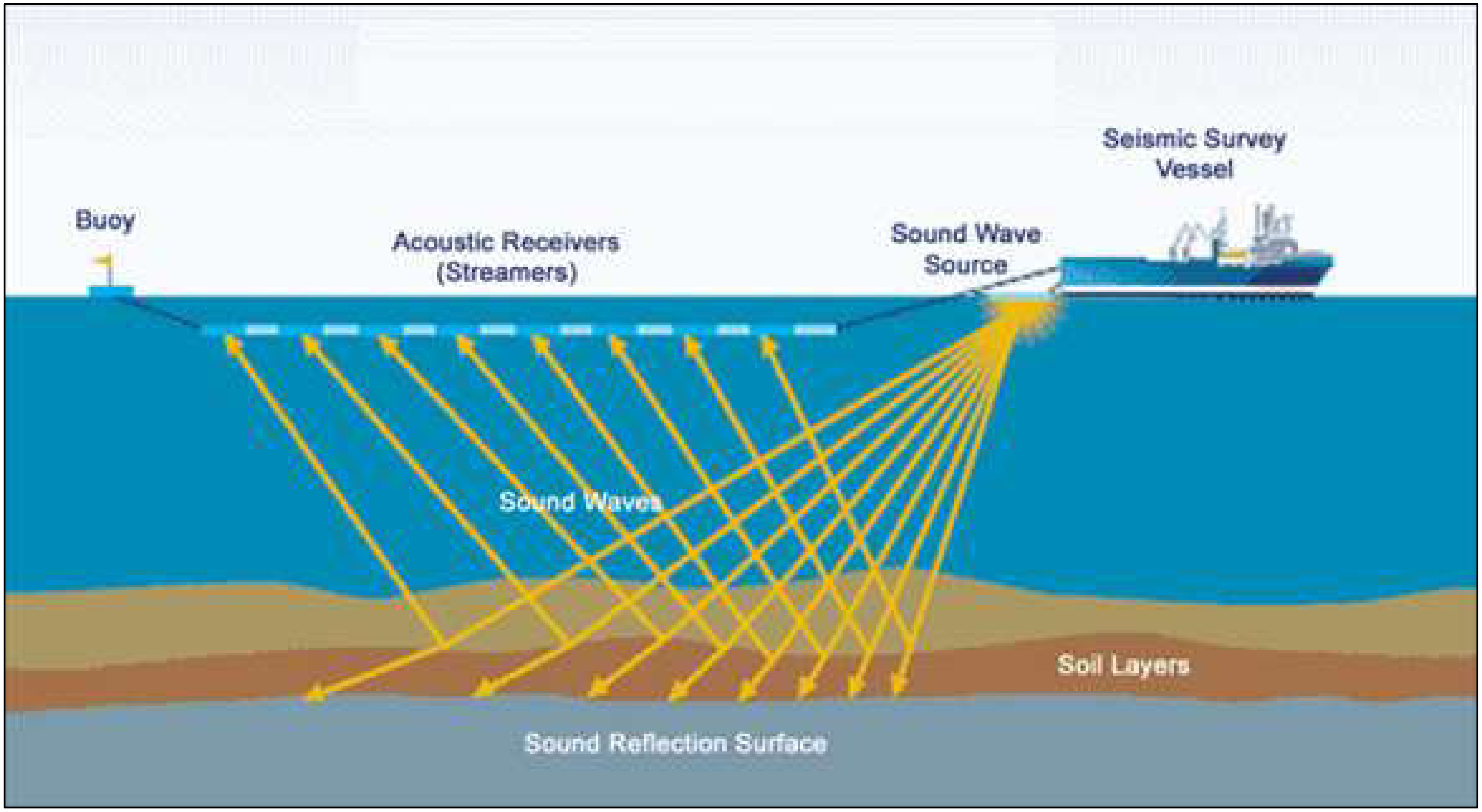


FIGURE 5: ILLUSTRATION OF THE PRINCIPLES OF 3D TOWED STREAMERS SEISMIC SURVEYS
(SOURCE: HTTPS://OCEANSNOTOIL.ORG/OFFSHORE-OIL-AND-GAS-PHASES/)

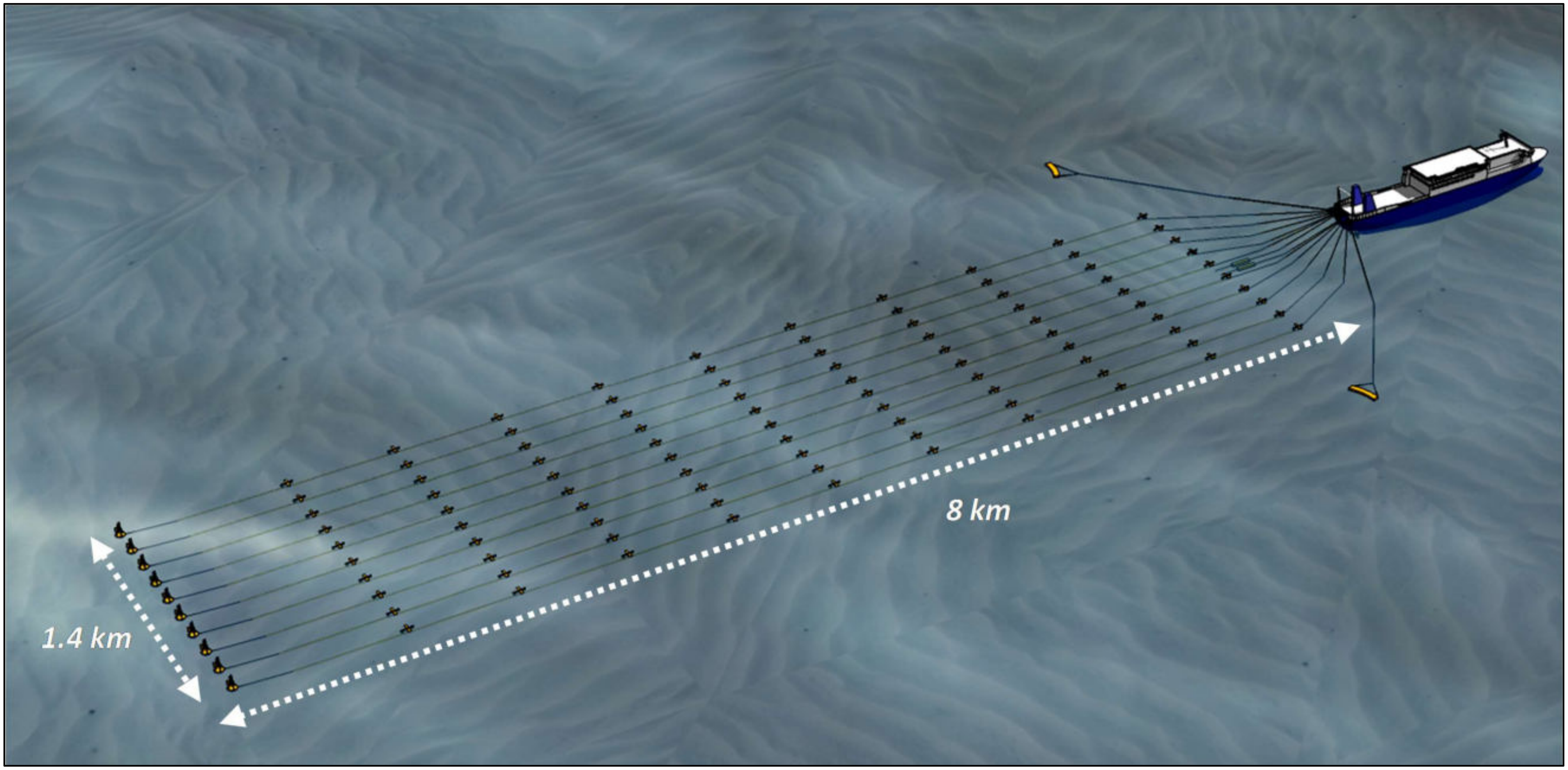


FIGURE 6: ILLUSTRATION OF THE SURVEY VESSEL AND STREAMER LAYOUT AND TAIL BUOYS

Noise from the Airgun array

The anticipated acoustic source (airgun) and hydrophone array would consist of 24 active guns configured in three dual gun arrays, with operating pressures of 2 000 pound-force per square inch (psi).

Each triggering of a sound pulse is termed a seismic shot, and these are fired at intervals of 6 - 20 seconds (depending on water depth and other environmental characteristics) (Barger & Hamblen 1980). Each seismic shot is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each shot being high, the total energy delivered into the water is low.

Airguns have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-100 Hz.

Sound levels from individual airguns used today in the seismic industry range from 200 to 232 dB re 1 µPa at 1 m, for small to large individual guns, respectively. For airgun arrays, sound levels range from 235 dB re 1 µPa at 1 m for a small array (500 cubic inches) to 260 dB re 1 µPa at 1 m for large arrays (7 900 cubic inches) (Bröcker 2019). The majority of the produced energy is below 250 Hz, with 90% of the energy between 70 to 140 Hz, although pulses do contain some higher frequencies up to 16 kHz (Bröcker 2019; Harding & Cousins 2022). It must be noted, however, that the sound level specifications for airgun arrays refer to sound levels in the vertical direction directly beneath the airgun array, generally near its centre, with nominal sound levels (but higher frequency components) in the horizontal direction being ~10-20 dB lower (Caldwell & Dragoset 2000; Dragoset 2000). If spread in a sound channel, sound signals from seismic airgun surveys can be received thousands of kilometres away from the source. The low-frequency energy can also travel long distances through seabed sediments, re-entering the water far from the source (Harding & Cousins 2022). (Pisces, 2024).

Configuration of the survey

The seismic vessel would steam a series of predefined transects describing the survey pre-plot, the headings of which would be fixed and reciprocal. The gridlines would likely be spaced between 400 m and 1200 m apart.

As the seismic vessel would be restricted in manoeuvrability (a turn radius of approximately 5 km is expected), other vessels should remain clear of it. The vessel would track down one line, skips several lines and tracks up another line. This sailing pattern would result in adjacent lines being recorded in the same direction. Refer to Figure 7 for a schematic illustration of the survey plan.

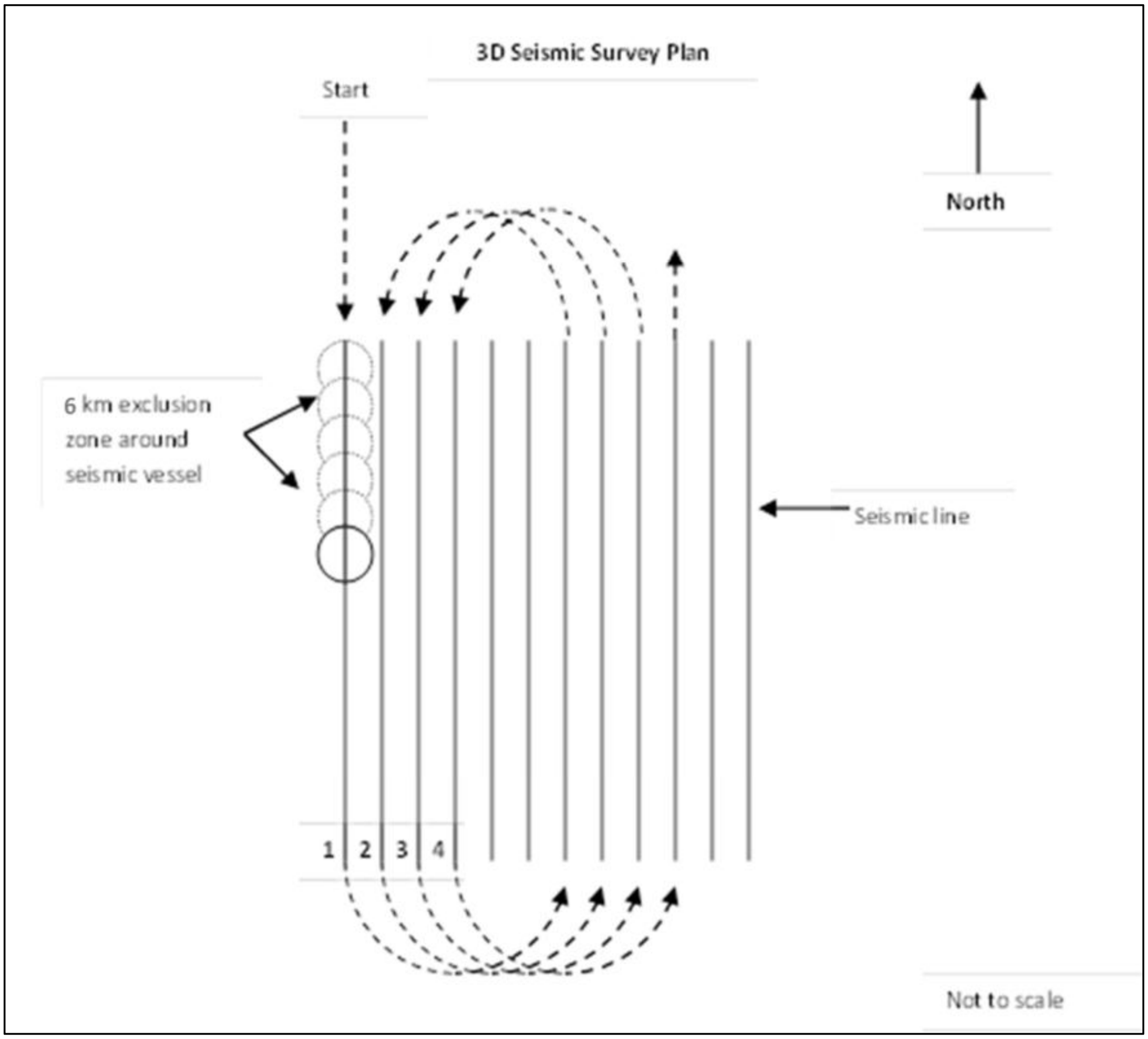


FIGURE 7: ILLUSTRATION OF THE PROPOSED 3D TOWED STREAMER SEISMIC SURVEY VESSEL MOVEMENT (ERM, 2006)

4.3.1.4 SUPPLY VESSELS AND GUARD VESSELS

The survey vessel will be supported by a supply vessel and potentially two guard vessels. The supply vessel will transport fresh supplies, fuel and crew from the mainland to the seismic vessel, while the guard vessels will be used to patrol the spread in water, perform equipment maintenance and liaise with third party vessels to reduce the potential for interference between the seismic survey and third party activities. All vessels will be equipped with radar and communications systems, which will assist in patrolling the area.

4.3.2 Further 3D seismic survey: OBN seismic survey

4.3.2.1 Survey location and schedule / timing

Galp will undertake an Ocean Bottom Node (OBN) seismic acquisition within the area where the 3D towed streamer seismic activities will be conducted (refer to the red polygon as shown in Figure 4), either during the same time or at a later stage - to be determined.

With reference to section 4.3.1.1, the precise date for Galp's next proposed 3D seismic exploration survey is not yet known. It is planned to be undertaken within valid Clearance Certificate period (i.e. within three years from the time MEFT issued the ECC), with the earliest date Q1 2025.

4.3.2.2 Description of the OBN seismic survey

An OBN seismic acquisition is very similar to a 3D towed streamer seismic acquisition regarding the sound source levels created by the air-gun arrays, with only slight differences in the shot spacing. The most relevant difference is the receiver's component, which is placed on the seafloor for a specific period.

OBN is a multi-component seismometer (3 geophones positioned orthogonally to each other and a hydrophone) placed on the seafloor which could independently collect and record seismic signals. Refer to Figure 8 for principles and a diagram of an OBN survey.

One of the main advantages of OBN technology over traditional 3D seismic acquisition is that the data recorded is of higher quality than surface acquisition, which is usually affected by noise from water, seismic interference and potentially other vessels in the area. Ocean bottom acquisition can also provide a wider azimuth range than streamer acquisition, which is limited by the number of towed streamers. It can record P-waves and mode-converted shear waves (S-waves) by the geophones on the seabed, while in a streamer only hydrophone exists to record P-waves.

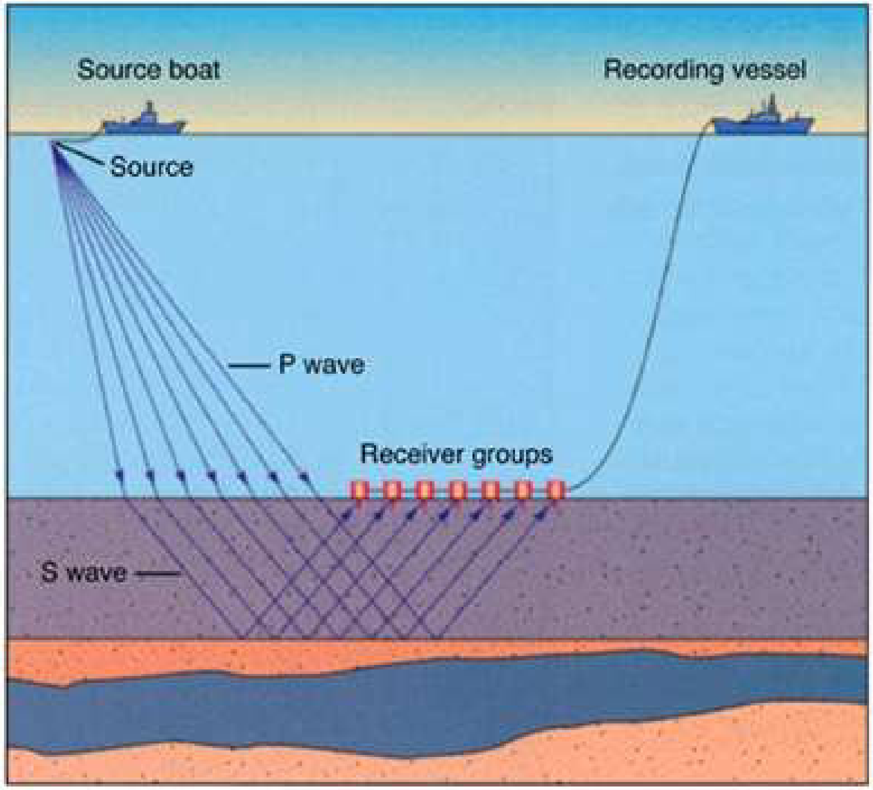
Seismic data is stored in the OBN until it's recovered to the node's vessel, where data is downloaded.

OBN's are receivers, positioned in a grid formation on the seafloor with the use of remote operated vehicles (ROV) and a node deployment vessel. The nodes, which are powered by batteries that could last up to 150 days, do not need to be anchored as they are heavy enough to remain on the seafloor. Node recovery is undertaken either by ROV or by remotely triggering a buoyancy mechanism that lifts the node to the sea surface where it is subsequently retrieved by the node vessel.

Depending on the size of the survey and number of nodes available, nodes can be all deployed before the source vessels starts shooting. This is only possible for small areas of acquisition where production and downtime or standby periods do not exceed the predicted nodes dive time battery live. At larger survey areas and due to the limited number of nodes available, a rolling spread type is used. This means that nodes can start to be recovered from one edge and deployed at the other while acquisition is ongoing.

For traditional (using streamers) and OBN 3D seismic acquisition in PEL83, Galp is proposing to use the same sound source levels, with only slight differences in the shot spacing.

Marine Mammals Observers (MMO), Passive Acoustic Monitoring (PAM) and Fishery Liaison Officer (FLO) support would be used during both towed streamer and OBN acquisition.



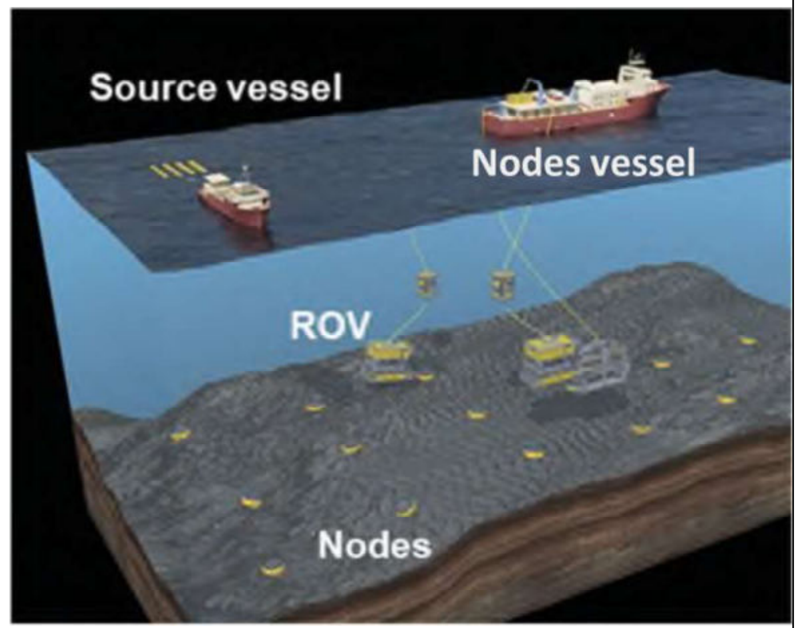


FIGURE 8: PRINCIPLES OF AN OCEAN BOTTOM NODE SURVEY (SOURCE: SEIS-TECH.COM) (LEFT) AND GENERIC DIAGRAM OF A OBN SURVEY (RIGHT)

4.3.2.3 VESSELS / FLEET AND OTHER EQUIPMENT

At an OBN acquisition, the nodes are handled by a node vessel or ROV node handling vessel (see Figure 8). The fleet would comprise of a separate source vessel for deployment and operation of the seismic sources, which clearly increases the cost of this type of survey compared to towed streamer acquisitions. One support vessel and one or two guard vessels can also be used to support the operations.

4.3.3 ACTIVITIES RELEVANT TO ALL PROPOSED 3D SEISMIC SURVEY ACTIVITIES

4.3.3.1 WORKFORCE AND JOB CREATION[7] (I.E. LOCALS)

It is estimated that the survey vessel will carry about 60 people, working 12 hour shifts. In addition to the crew of the survey vessel, every guard vessel will have each a crew of approximately 5 to 8 people and the support vessel a maximum of 12 people.

Source and nodes vessels can host up to 60 pax each, support vessel 9 to 12 pax and guard vessels 5 to 8 pax.

4.3.3.2 REFUELLING OF VESSELS

Fuel will be loaded prior to mobilisation in the port base of Walvis Bay. Considering the expected duration of the survey(s) (expected approximately 90 days) and the operational endurance of a typical seismic vessel refuelling is anticipated to occur approximately every three weeks. Refuelling will take place most likely at sea from the supply vessel refuelling. The process will be done using dry break couplings (TODO) between the supply and survey vessels. Fuel transfer will occur either via inline or alongside transfer protocols during daylight hours. Detailed procedures of refuelling operations during the course of the survey, when the vessel is at sea, will be prepared to ensure they comply with the requirements of the International Association of Geophysical Contractors (IAGC)/International Oil and Gas Producers (IOGP) Guideline 432-01 (October 2012). (ERM, 2017).

4.3.3.3 LOGISTICS

The vessel will likely mobilise from Walvis Bay and use the same port for crew change. Crew change, food, water, fuel supply and logistic operations will be handled at Walvis Bay. A further crew change may be required during the survey which will also take place in Walvis Bay. Existing infrastructure and services at the port will be utilised.

[7] Galp will make the best efforts in its control to use local personnel. Provided numbers are not local specific.

Food, provisions, fuel and lubricants will likely be purchased at Walvis Bay. Bunkering of the seismic survey vessel is anticipated to be undertaken during mobilization, hypothetically in port. Bunkering at sea may be required.

4.4 SUMMARY OF PROJECT DESCRIPTION / ACTIVITIES

A summary of the key activities relating to the further 3D Seismic Survey is provided in Table 5

The commencement date of the next well drilling (two appraisal wells) campaign has not yet been fixed; however, the earliest date for commencement of drilling is planned for Q4 (i.e. October) 2024. It is expected to take approximately two to three months per well to complete, whereafter the further 3D seismic survey activities are likely to commence.

TABLE 5: SUMMARY OF KEY ACTIVITIES RELATING TO THE FURTHER 3D SEISMIC SURVEY CAMPAIGN

Survey method	Activity
1. Towed Streamers Seismic Survey	Seismic acquisition: 3D acquisition technique will require one seismic vessel with source arrays at 7-8 m below see surface, 8-12 streamers approximately 8 km in length, towed more than 15 m below sea surface, placed in parallel and spaced ~ +75 m to 100 m apart.
2. OBN Seismic Survey	Seismic acquisition: Similar to a 3D towed streamer seismic acquisition regarding the sound source levels created by the air-gun arrays. OBN is a multi-component seismometer (3 geophones positioned orthogonally to each other and a hydrophone) placed on the seafloor which could independently collect and record seismic signals.
3. Relevant to both Seismic Survey campaigns	Operation of vessels (survey and support) and helicopters (i.e. for emergencies only).
	Onshore logistics base: The onshore logistics base will be located in either the Port of Lüderitz or the Port of Walvis Bay.

5 ALTERNATIVES

This chapter describes the various alternatives that were previously (during the original EIAs) considered and again taken into consideration for Galp's further / ongoing exploration activities in PEL 83.

5.1 ALTERNATIVES RELATING TO 3D SEISMIC SURVEY ACTIVITIES

For 3D seismic surveys, alternatives are limited because offshore seismic surveys use specialised equipment. However, with reference to sections 4.3.1 and 4.3.2, Galp is considering to undertake an OBN seismic acquisition, in addition to the traditional towed streamer seismic campaign.

Over the last few years, the efficiency of OBN acquisition has significantly improved in such a way that the acquisition method can be considered for a wider range of applications. It is principally on the receiver side that efficiency gain has occurred, but that fact has initiated a renewed interest in improving the source efficiency. Compared to conventional streamer acquisition, OBN acquisition has the ability to record a higher quality of seismic data due to multi-component receivers in a relatively quiet environment and without effects from water waves and noise produced by adjacent vessels.

OBN also allow to achieve long offsets of 20 km (against 8, 10 or 12 km streamer length), enabling enough diving waves at target depth that can be used as input for model building based on diving wave Full-Waveform Inversion (FWI) (Information provided by Galp).

Another positive aspect of OBN surveys is related to the required manoeuvring area being smaller than in a streamer acquisition, because there is no spread in the water that requires no space for long turns.

The downsides with OBN surveys include the following:

- Acquisition duration is highly dependent on the node's density and nodes carpet extension, tending to take longer than a conventional streamer acquisition.
- Although OBN acquisition costs have being decreasing and getting closer to streamer acquisitions, they are still more expensive.
- At the seismic processing side, due to all the intrinsic complexity of the OBN data, the workflows tend to be more complex and take much more time to process. (Information provided by Galp).

As described by ERM (2017), other alternatives are possible in terms of the survey design and timing within the constraints of the survey's scientific requirements. However, these alternatives are more correctly considered mitigations and are described in further detail in the impact assessment chapters of this report and the EMP.

5.2 No-Go alternative (i.e. no further / ongoing exploration activities)

The No-Go alternative represents the option not to proceed with further exploration, which leaves the project areas of influence (i.e. the offshore licence block, Lüderitz and Walvis Bay) in their current state – except for variation by natural causes and other human activities – taking the completed well drilling activities into account.

It thus represents the current status quo and the baseline against which all potential ongoing exploration impacts are assessed.

If the further / ongoing exploration activities do not proceed, further information about the subsurface geology and confirmation of the volume of oil and gas will not be collected. Without this information, any further plans for production activities would not be carried out and development would stop. The halt of oil and gas exploration and production would result in a decrease in commercial interest in Namibia's oil and gas sector and the loss of the economic benefits (by means of government revenues, taxes, and employment).

Global views regarding further exploration and possible production of oil and gas, and the subsequent use of hydrocarbons, the production activities and associated impacts are not part of the scope of this EIA.

Potential environmental impacts associated with the proposed ongoing / further exploration activities (i.e. 3D Seismic Acquisition and associated activities) are described in Chapter 7 and re-assessed in chapter 8.

6 DESCRIPTION OF THE RECEIVING ENVIRONMENT

An understanding of the environment and the sensitivity of the site and surroundings is important to understand the potential impacts of the project. This chapter provides a general overview of the current baseline conditions associated with the proposed project, drawing on the baseline information provided in the previous EIAs, additional Specialist input and the Environmental Baseline Survey and Bathymetry Survey.

This chapter was compiled by utilizing, amongst others, the following sources of information:

- The original EIA Report for 3D seismic survey in PEL 83 (ERM, 2017).
- The original "EIA Report for the Galp offshore exploration drilling Project" (SLR, 2019) and associated specialist studies (appendices) that formed part of the EIA
- The EIA Amendment Report (Namisun, 2023).
- The Marine Ecology Impact Assessment Report (Pisces, 2024) – see Appendix F.
- Commercial Fisheries Specialist Report (CapMarine, 2024) – see Appendix G.
- The knowledge baseline for Marine Spatial Planning in Namibia (MFMR, 2021).
- Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024).

The sections below provide a summary of the key baseline conditions / receiving environment. Further (detailed) information is available in the Marine Ecology Impact Assessment Report (Appendix F) and the Fisheries Specialist Report (Appendix G).

Note: All references made in the above-mentioned Specialist Reports are not all repeated in the sections below and can be viewed in these two respective reports.

6.1 GEOPHYSICAL CHARACTERISTICS

6.1.1 BATHYMETRY

The width of the continental shelf of southern Namibia is variable. Off the Orange River the shelf is wide (230 km) narrowing to the north and reaching its narrowest point (90 km) off Chameis Bay, before widening again to 130 km off Lüderitz. (See Figure 1). The Orange Bank (Shelf or Cone), offshore of the Orange River, comprise three low mounds rising to about 160 m on the outer shelf. North of Chameis Bay, the shelf becomes a stepped feature, with a low step having an elevation between roughly 400 - 450 m below mean sea level.

Banks on the continental shelf in the broader project area include the Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Childs Bank, situated ~150 km offshore in South African waters at about 31°S. Tripp Seamount is a geological feature situated ~300 km offshore at about 29°S, which rises from the seabed at ~1 000 m to a depth of 150 m. Tripp Seamount is located approximately 85 km to the south of PEL 83.

6.1.2 Coastal and Inner-shelf Geology and Seabed Geomorphology

As part of the recent Marine Spatial Planning (MSP) process in Namibia, the marine geology of the Namibian continental shelf and geomorphic seafloor features within the exclusive economic zone, (EEZ) were mapped (MFMR 2021) (Figure 9 and Figure 10). Figure 11 illustrates the distribution of seabed surface sediment types off the southern Namibian coast. As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the outer edge of the middle shelf between the Orange River and St Helena Bay in South Africa (Figure 11). These biogenic muds are the main determinants of the formation of low-oxygen waters and sulphur eruptions off central Namibia. Further offshore this give way to muddy sands, sands and gravels before changing again into mud-dominated seabed beyond the 500-m contour. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

The baseline survey undertaken in PEL 83 (Fugro 2024) identified that the seabed is characterised by homogeneous poorly to very poorly sorted sandy muds, which were comprised on average by 85% silts and clays and 15% sands. This reflects the results of sediment analyses undertaken in other blocks in the area. Video footage of the seabed throughout the area revealed evidence of bioturbation on the silt-dominated surface. The Total Organic Carbon (TOC) content of the sediments is comparatively low, suggesting that the carbon flux from near surface productivity is not strong. This would be expected from sediments in areas far offshore of the highly productive coastal upwelling.

Present day sedimentation is limited to inputs from the Orange River. This sediment is generally transported northward. In the southern portion of the study area, most of the sediment is therefore considered to be relict deposits by now ephemeral rivers active during wetter climates in the past. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the South African West Coast coastal plain.

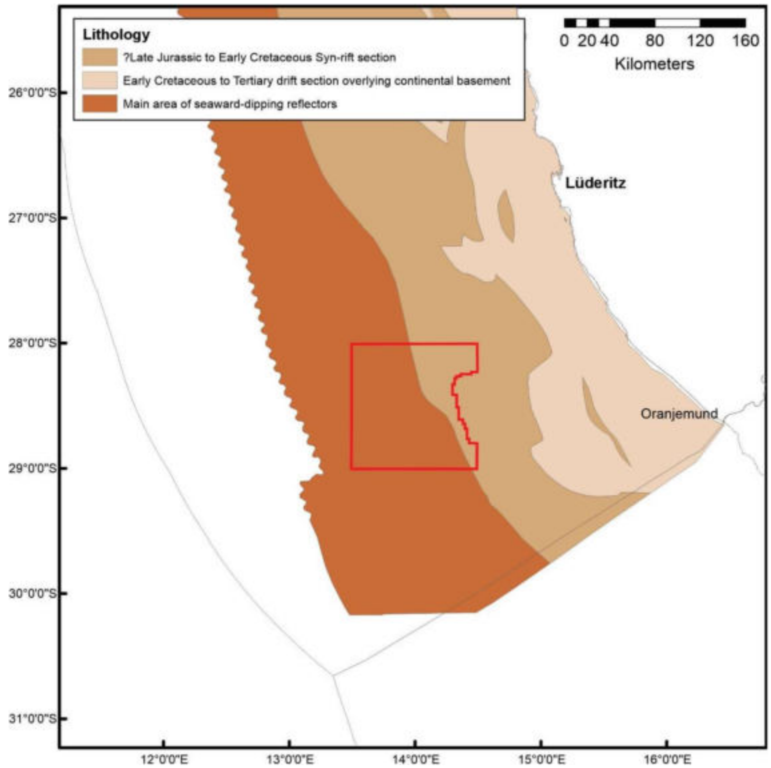


FIGURE 9: PEL 83 (RED POLYGON) IN RELATION TO THE MARINE GEOLOGY OF THE SOUTHERN NAMIBIAN CONTINENTAL SHELF (ADAPTED FROM MFMR 2021) (PISCES, 2024)

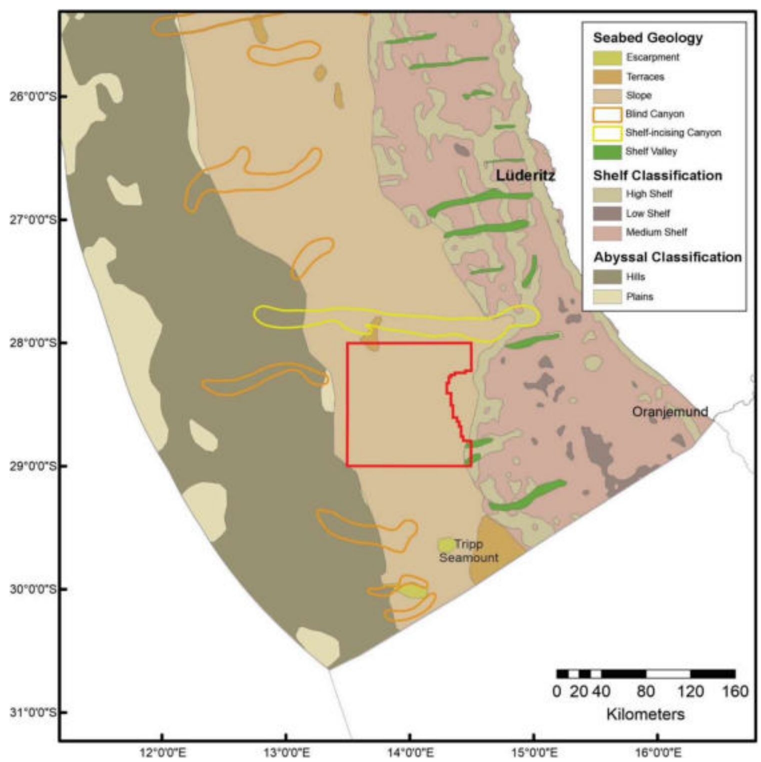


FIGURE 10: PEL 83 (RED POLYGON) IN RELATION TO SEABED GEOMORPHIC FEATURES OFF SOUTHERN NAMIBIA (ADAPTED FROM MFMR 2021) (PISCES, 2024)

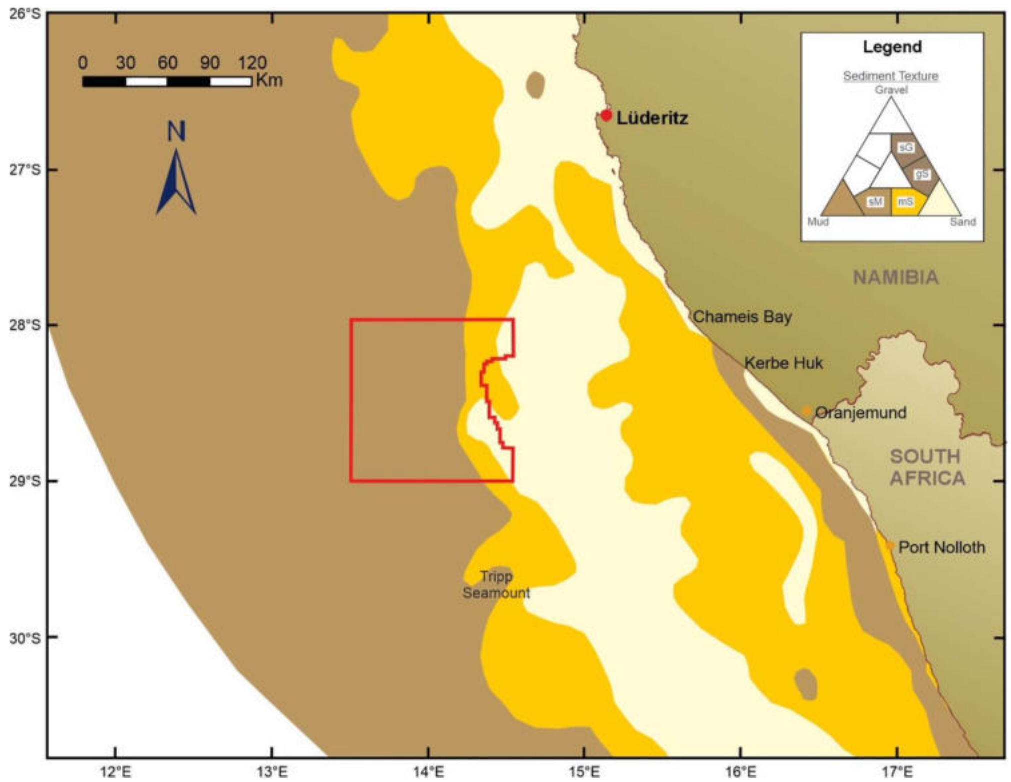


FIGURE 11: PEL 83 (RED POLYGON) IN RELATION TO THE SEDIMENT DISTRIBUTION ON THE CONTINENTAL SHELF OFF SOUTHERN NAMIBIA (ADAPTED FROM ROGERS 1977) (PISCES, 2024)

Note: Based on information in Holness et al. (2014), the mud/sandy mud sediments have been extended to the edge of the EEZ beyond that shown in Rogers (1977).

6.1.3 SEDIMENTARY PHOSPHATES

Phosphorite, or phosphate-rich rock, is defined as sedimentary rock typically containing between 5%-20% phosphate. In the marine environment, it occurs either as a nodular hard ground capping of a few metres thick or as layers of consolidated or unconsolidated sediments on continental shelves and in the upper part of continental slopes. Being one of the most productive upwelling systems in the world, the Benguela Upwelling System is associated with major phosphorite deposits (of various type and grade) exposed over an area of 24 700 km^2 on the Namibian shelf.

Various types of phosphorite are known to exist on the Namibian continental shelf these being concretionary phosphorite, as well as pelletal and glauconitized pelletal phosphorite on the middle shelf to the south and north of Walvis Bay, respectively. ‘Rock phosphate’ occurs on the middle and inner shelves, predominantly north of Walvis Bay (Bremner 1980). On the middle to outer shelf (190 m and 350 m water depth) offshore of Lüderitz and Walvis Bay the deposit consists of coarsening-upward muddy to gravelly pelletal phosphorite sand, up to several meters thick (Baturin 2002; Compton & Bergh 2016). These deposits are characterized by their spatial continuity (especially in a SSW - NNE direction) and general uniformity in grade. The variations in thickness are generally the product of thicker accumulation of sediment in very shallow palaeo-topographic depressions in the underlying clay surface, which is locally burrowed, with these borings being filled with phosphate-rich sediment.

PEL 83 overlaps primarily with low percentage occurrence of the known phosphate deposits (Figure 12).

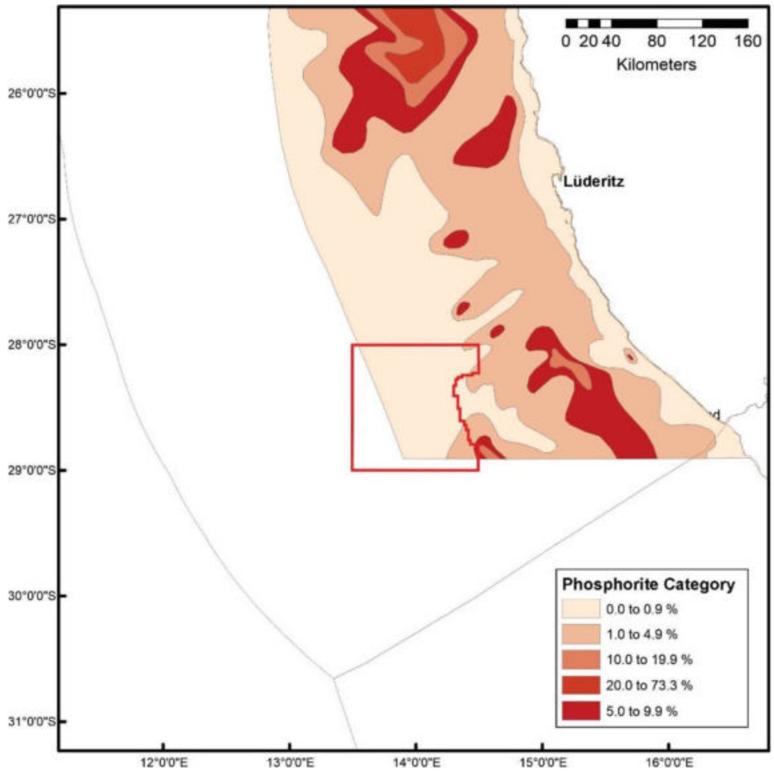


FIGURE 12: PEL 83 (RED POLYGON) IN RELATION TO THE KNOWN LOCATION OF PHOSPHATE DEPOSITS ON THE SOUTHERN NAMIBIAN CONTINENTAL SHELF (ADAPTED FROM MFMR 2021) (PISCES, 2024)

6.2 Biophysical Characteristics

6.2.1 Climate

The climate of the Namibian coastline is categorised as hyper-arid with typically low, unpredictable winter rains and strong predominantly southerly / south-easterly winds. Further out to sea, a south-easterly wind component is more prominent. Winds reach a peak in the late afternoon and subside between midnight and sunrise. Seasonal wind roses for the area offshore of Oranjemund, are illustrated in Figure 13. Further offshore and south in the project area, the winds have a stronger S-SE component.

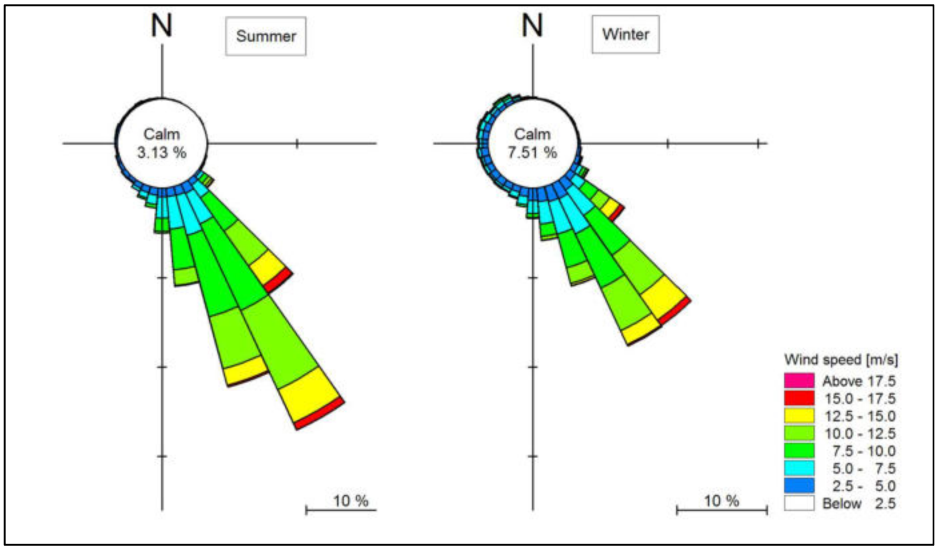


FIGURE 13: SEASONAL WIND ROSES AT 14°E, 28°S ON THE NORTHERN BOUNDARY OF PEL 83 (SOURCE PRDW 2019) (PISCES, 2024)

The main physical drivers of the nearshore Benguela Region are winds, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment.

6.2.2 LARGE-SCALE CIRCULATION, CURRENTS AND UPWELLING

The Namibian coastline is strongly influenced by the Benguela Current. Current velocities in continental shelf areas generally range between 10–30 cm/s. In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow. Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Near bottom shelf flow is mainly poleward with low velocities of typically 5 cm/s. The poleward flow becomes more consistent in the southern Benguela.

Near-surface currents in the project area are primarily from the south-southeast, with maximum speeds exceeding 60 cm/s occurring primarily during summer months (November to March). Current speeds decrease with depth to <20 cm/s near the seabed.

The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The Lüderitz upwelling cell is the most intense upwelling cell in the system, with the seaward extent reaching nearly 300 km, and the upwelling water is derived from 300-400 m depth. A detailed analysis of water mass characteristics revealed a discontinuity in the central and intermediate water layers along the shelf north and south of Lüderitz. The Lüderitz / Orange River region thus forms a major environmental barrier between the northern and southern Benguela sub-systems (see **FIGURE 14**).

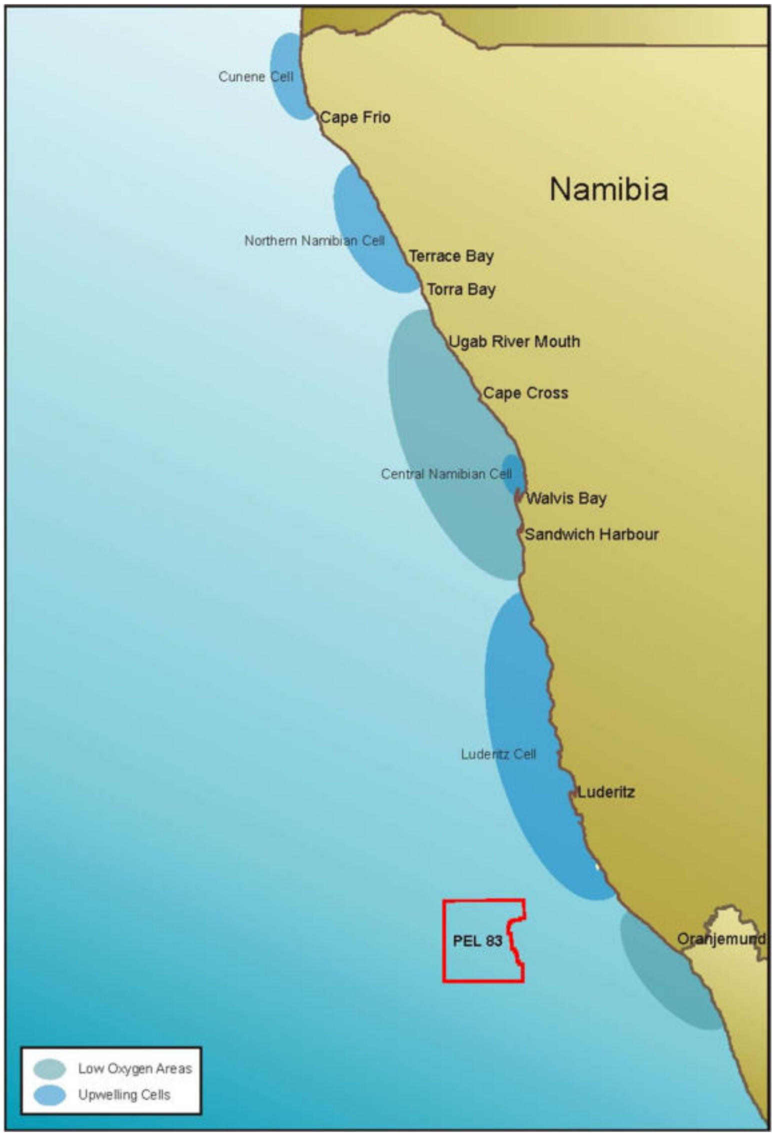


FIGURE 14: PEL 83 (RED POLYGON) IN RELATION TO UPWELLING CENTRES OFF THE WEST COAST OF NAMIBIA (PISCES, 2024)

During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

6.2.3 Waves and Tides

The wave regime along the southern African West Coast shows no strong seasonal variation with virtually all swells throughout the year coming from the south-west to south direction. In winter there is a slight increase in swell from SW-S direction. Generally, wave heights decrease with water depth and distance longshore.

In the project area the majority of waves come from the S to S-SW direction, with maximum swell height of over 0.6 m occurring in winter (June and July).

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

6.2.4 Natural Hydrocarbon Seeps

Petroleum discharges, both from natural seeps at the seabed and discharges occurring during the production and transport of petroleum are a common source of toxic substances in marine ecosystems. Satellite imagery analysis was used in an oil slicks detection study of the western offshore part of South Africa. The following was concluded from the oil slicks detection study:

- No oil seep anomaly was detected.
- Potential oil slicks detected were identified off the West Coast:
- Oil spills (pollution) from boats were identified orientated mainly NNW-SSE, and thus in agreement with the orientation of the shipping lanes.
- Potential oil seeps corresponding to light oil associated with gas, but they are not recurrent.

6.3 Biological Environment

Biogeographically, the study area falls into the cold temperate Namaqua Bioregion, which extends from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine. PEL 83 is located in the offshore Namib Biozone, which extends beyond the shelf break onto the continental slope and into abyssal depths. The coastal, wind-induced upwelling characterising the Namibian coastline, is the principle physical process that shapes the marine ecology of the Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). PEL 83 is located beyond the 500 m depth contour, the closest point to shore being ~130 km off the coast from Baker's Bay. The offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species.

6.3.1 Demersal Communities

6.3.1.1 Benthic Invertebrate Macrofauna

The seabed communities in PEL 83 lie within the Namib sub-photic and continental slope biozone, which extends from the shelf edge into the abyss. The benthic and coastal habitats of Namibia were mapped as part of the Benguela Current Commission's Spatial Biodiversity Assessment (BCC-SBA) to develop assessments of the ecosystem threat status and ecosystem protection level. Submarine canyons were also mapped as biodiversity features, although descriptions of their geographical situations were not sufficiently accurate to include them in the benthic habitat map (Figure 15). The benthic habitats were subsequently assigned an ecosystem threat status based on their level of protection and mapped (see Figure 16) (see Appendix F for further details).

The benthic biota of unconsolidated marine sediments constitutes invertebrates that live on (epifauna) or burrow within (infauna) the sediments and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm).

Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments, with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast. Generally, species richness increases from the inner shelf across the mid shelf and is influenced by sediment type. The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (± 50 g/m^2 wet weight) and decreases across the mid-shelf averaging around 30 g/m^2 wet weight. The midshelf mudbelt, however, is a particularly rich benthic habitat where biomass can attain 60 g/m^2 dry weight. The comparatively high benthic biomass in this mudbelt region represents an important food source to carnivores such as the mantis shrimp, cephalopods and demersal fish species. In deeper water beyond this rich zone biomass declines to 4.9 g/m^2 at 200 m depth and then is consistently low (<3 g/m^2) on the outer shelf.

Benthic habitats along the 500 m depth contour have been assigned a threat status of 'Endangered' by the Benguela Current Commission (BCC) Spatial Biodiversity Assessment but further offshore in PEL 83 the benthic habitat type is considered 'Least Threatened' (Figure 16).

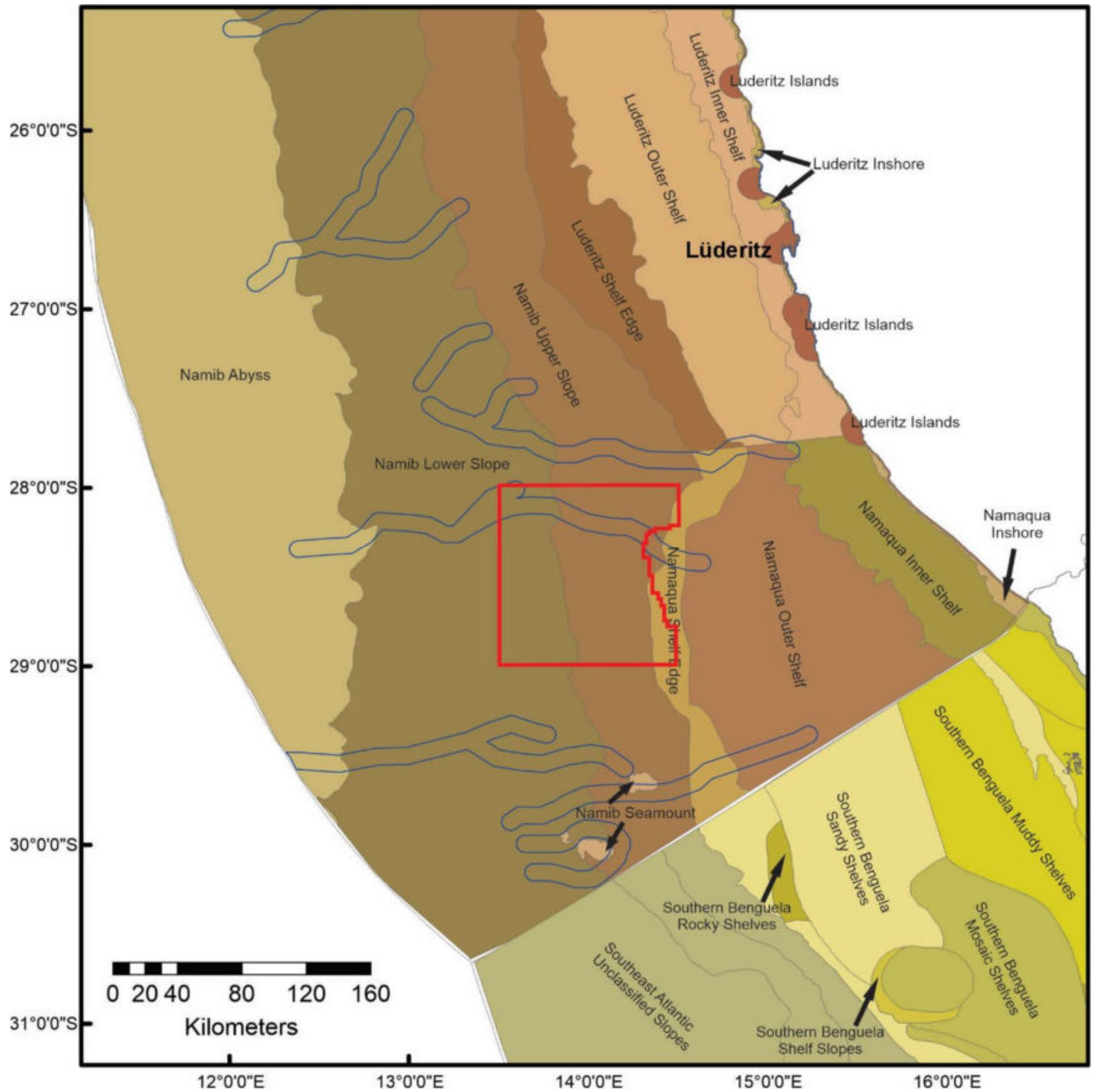


FIGURE 15: PEL 83 (RED POLYGON) IN RELATION TO THE NAMIBIAN BENTHIC AND COASTAL HABITATS (PISCES, 2024)

Note: The positions of potential submarine canyons are also shown (blue lines). The adjacent South African substratum types are also shown.

It is evident that an array of environmental factors and their complex interplay is ultimately responsible for the structure of benthic communities. Yet the relative importance of each of these factors is difficult to determine as these factors interact and combine to define a distinct habitat in which the animals occur. However, water depth and sediment composition are two of the major components of the physical environment determining the macrofauna community structure off the west coast of southern Africa, and elsewhere in the world. However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration, productivity, organic carbon and seafloor temperature may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deep-water shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses and hydrogen sulphide are a major cause of this variability.

Specialised benthic assemblages (protozoans and metazoans) can thrive in Oxygen Minimum Zones (OMZs), and many organisms have adapted to low oxygen conditions by developing highly efficient ways to extract oxygen from depleted water. Within OMZs, benthic foraminiferans, meiofauna and macrofauna typically exhibit high dominance and relatively low species richness. In the OMZ core, where oxygen concentration is lowest, macrofauna and megafauna (>10 cm) often have depressed densities and low diversity, despite being able to form dense aggregations at OMZ edges. Taxa most tolerant of severe oxygen depletion (~0.2 ml/l) include calcareous foraminiferans, nematodes, and polychaetes, with agglutinated protozoans, harpacticoid copepods, and calcified invertebrates typically being less tolerant. Small-bodied animals, with greater surface area for O_2 adsorption, are thought to be more prevalent than large-bodied taxa under conditions of permanent hypoxia as they are better able to cover their metabolic demands and often able to metabolise anaerobically. Meiofauna may thus increase in dominance in relation to macro- and megafauna. This was not the case, however, within the lower OMZs of the Oman (Levin *et al.* 2000) and Pakistan margins, where the abundant food supply in the lower or edge OMZs is thought to be responsible for promoting larger macrofaunal body size.

The deep assemblages of the OMZ off Namibia displayed high diversity, intermediate abundance and low biomass. Thyasirids, *Ceratocephale* sp. and *Spiophanes* sp were dominant in deeper areas. Slope communities are likely distributed along a much wider latitudinal range and deeper depths than were sampled by that study and are similar to other upwelling slope areas.

A deep-water benthic survey in a block adjacent to PEL 83 revealed consistent yet impoverished macrofauna dominated by polychaetes, molluscs, and crustaceans. As conditions in such deepwater habitats tend to be uniform (low temperatures and low oxygen concentrations characteristic of the SACW), similar communities to those reported from Block 2913B may be expected in PEL 83. A deposit-feeding polychaete, was the most abundant species in Block 2913B, highlighting the prevalence of deposit feeders in soft sediments. Information on the benthic fauna of the upper and lower continental slope is largely lacking due to limited opportunities for sampling.

As part of the Environmental Baseline Survey for PEL 83, however, deepwater benthic sampling was undertaken using a box corer (Fugro 2024) thereby providing valuable information on the benthic infaunal communities in the project area. A total of 303 taxa were identified, dominated by polychaetes (75 taxa) and crustaceans (78 taxa). Molluscs and echinoderms also contributed to the macrofaunal diversity. Polychaetes were dominated by *Galathowenia* sp., *Spiophanes* sp. and *Aricidae* sp., whereas *Pseudharpinia* spp. and *Macrostylis* sp. dominated the crustaceans, and Prochaetodermatidae were the dominat molluscs recorded.

Also associated with the seabed are mobile and sessile epifauna. From photographic data collected in PEL 83, epifauna was sparse.Mobile epifauna included urchins (including Phormosomatidae and Aspidodiadematidae), shrimp (including *Glyphocrangon* sp., and Dendrobranchiata, including possible Aristeidae), starfish (Brisingidae and Pterasteridae, including possible *Hymenaster* sp.), brittlestars, sea cucumbers (including *Paelopatides* sp., *Benthodytes* sp. and *Benthodytes* sp.), crab, sea spiders (including Colossendeidae) and gastropods. Sessile epifauna included anemones (Actiniaria including possible Relicanthidae), possible small cup corals (Hexacorallia, including possible Deltocyathidae), tube-dwelling anemone (Ceriantharia), glass sponge (Hexactinellida, possible *Hyalonema* sp.), possible tube worm (Sabellidae), sea whips (Antipatharia, including possible *Stichopathes* sp.) and possible sea pens (Pennatuloidea).

Fish observed comprised morid cod (*Antimora rostrata*), grenadier fish (Macrouridae), long nosed chimaera (possibly *Harriotta raleighana*), possible hagfish (Myxinidae), tripod fish (Ipnopidae, including possible *Bathypterois* sp.), cutthroat eel (Synaphobranchidae), halosaurs (Halosauridae), cusk eels (Ophidiidae) and unidentified fish (Osteichthyes). Cephalopods were also noted, specifically deep-sea octopus (Octopoda, including Grimpoteuthidae/ Opisthoteuthidae) and vampire squid (*Vampyroteuthis infernalis*) (Fugro, 2024). This compares well with the benthic biota reported during other environmental baseline surveys undertaken in the broader project area.

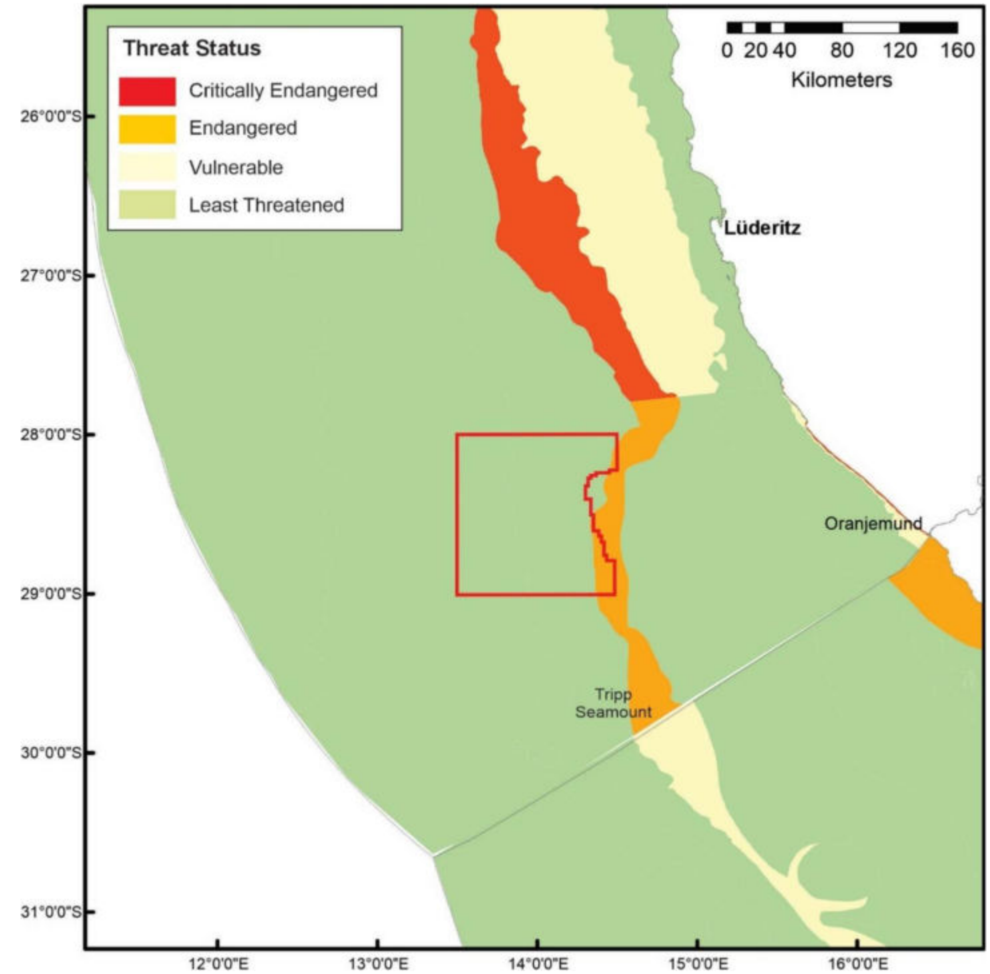


FIGURE 16: PEL 83 (RED POLYGON) IN RELATION TO ECOSYSTEM THREAT STATUS FOR OFFSHORE BENTHIC HABITAT TYPES OFF SOUTHERN NAMIBIA (PISCES, 2024)

Note: The threat status of adjacent South African substratum types are also shown.

6.3.1.2 DEEP-WATER CORAL COMMUNITIES

Deep-water corals (i.e. benthic filter-feeders) generally occur at depths exceeding 150 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity. Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement. Substantial shelf areas in the productive Benguela region should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities. Such communities would also be expected with topographic features such as Tripp Seamount, some 85 km to the south of PEL 83, i.e. outside the project area.

6.3.1.3 DEMERSAL FISH SPECIES

As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the southern African West Coast. Changes in fish communities occur with increasing depth, with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth. Common commercial demersal species found mostly on the continental shelf but also extending beyond 500 m water depth include both the shallow-water hake, *Merluccuis capensis* and the deep-water hake (*Merluccius paradoxus*), monkfish (*Lophius vomerinus*), and kingklip (*Genypterus capensis*). There are also many other demersal "bycatch" species that include jacopever (*Helicolenus dactylopterus*), angelfish/pomfret (*Brama brama*), kingklip (*Genypterus capensis*) and gurnard (*Chelidonichtyes* sp), as well as several cephalopod species (such as squid and cuttlefishes) and many elasmobranch (sharks and rays) species.

The species that may occur in the Area of Interest and on the continental shelf inshore thereof, and their approximate depth range, are listed in Appendix F. The distribution of some of these species on the South African coast is shown in Figure 17, and although not illustrated extending across the border, their continued distribution ranges into Namibian waters can be inferred. PEL 83 lies offshore of most of the distribution ranges of these species.

Information on demersal and cartilageonous fish species beyond the shelf break is lacking.

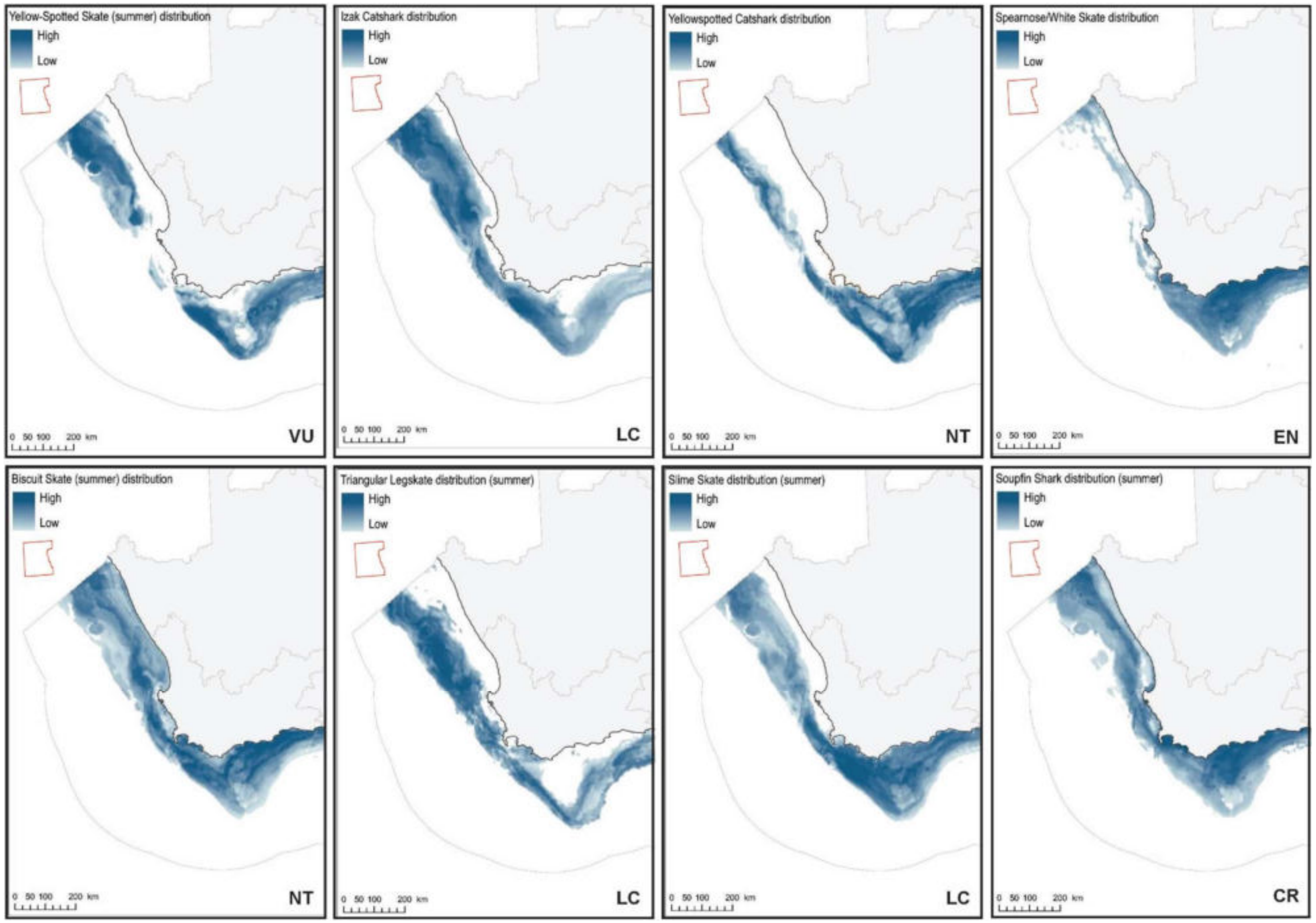


FIGURE 17: THE DISTRIBUTION SOUTH OF NAMIBIA'S BORDER WITH SOUTH AFRICA OF VARIOUS CARTILAGINOUS SPECIES MENTIONED IN TABLE 3 IN RELATION TO PEL 83 (RED POLYGON) (PISCES, 2024).
(The IUCN conservation status is provided in the bottom right of each figure)

6.3.2 Seamount Communities

Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity, which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding.

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times. Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species.

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts. Deep- and cold-water corals (including stony corals, black corals and soft corals) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids. There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters). Some of the smaller cnidarians species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity. Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location. Levels of endemism on seamounts are also relatively high compared to the deep sea. As a result of conservative life histories (*i.e*. very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover.

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. Evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off southern Namibia suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges occur on the continental shelf, and similar communities may thus be expected on Tripp Seamount, some 85 km to the south of PEL 83, i.e. outside the project area.

Of the taxa recorded by AUV and video transect from PEL 83, sea pens (Octocorallia/Pennatulacea), sea whips (Octocoral Lia/Antipatharia), and possible cup corals (Hexacorallia, including possible Deltocyathidae) were observed. Although listed as VME indicator species (SEAFO 2015), the abundances were too low to form a sensitive habitat (Fugro, 2024).

6.3.3 PELAGIC COMMUNITIES

The pelagic communities are typically divided into plankton and fish, and their main predators, marine mammals (seals, dolphins and whales), seabirds and turtles.

As with seabed habitats, pelagic habitat types have been defined as 'Vulnerable', 'Endangered' or 'Critically Endangered' depending on their level of protection. Pelagic ecosystems south of Walvis Bay have all been assigned a threat status of 'Least Threatened'.

6.3.3.1 PLANKTON

Plankton is particularly abundant in the shelf waters off Namibia, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2 m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton.

Off the Namibian coastline, phytoplankton are the principal primary producers with mean annual productivity being comparatively high at 2 g C/m^2/day. The phytoplankton is dominated by diatoms, which are adapted to the turbulent sea conditions. Diatom blooms occur after upwelling events, whereas dinoflagellates are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

The phytoplankton community observed within PEL 83 during the environmentall baseline survey was considered typical of the region, being dominated by diatoms, microflagellates and dinoflagellates. As could be expected, the aphotic mid-depth and near-seafloor communities differed from the surface community, with the aphotic zone dominated by non-photosynthetic microflagellates, while the photic near-surface community was dominated by photosynthetic diatoms and dinoflagellates. *Pseudo-Nitzschia* species was the most abundant taxon and was found in high densities across the survey area. This species is related to harmful algal blooms (HAB), suggesting that there may have been an ongoing HAB during the survey period. The second and third most abundant phytoplankton taxa were microflagellate (<20 μm) and the dinoflagellate *Gymnodinium* sp.

The zooplankton community observed within within PEL 83 was diverse and typical of the region, with 146 taxa recorded. Holoplanktonic copepods were the dominant zooplankton group recorded. The most abundant taxa were Oithonidae and Calanoida copepods. Other zooplankton included bryozoa, ctenophora, platyhelminthes, chaetognath and echinodermata. The most abundant and dominant taxa were present in all stations sampled suggesting a single, undifferentiated zooplankton community occurred throughout the survey area at the time of sampling.

Ichthyoplankton constitutes the eggs and larvae of fish. As the preferred spawning grounds of numerous commercially exploited fish species are located off central and northern Namibia (see Figure 18), their eggs and larvae form an important contribution to the ichthyoplankton in the region. The Lüderitz upwelling cell - Orange River Cone (LUCORC) area is considered to be an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems. Areas of powerful upwelling are considered unfavourable spawning habitats, with pelagic fish species, such as anchovy, redeye round herring, horse mackerel and shallow-water hake, reported as spawning on either side of the LUCORC area, but not within it (Figure 18). The area is characterised by diminished phytoplankton biomass due to high turbulence and deep mixing in the water column. A deficiency of phytoplankton results in poor feeding conditions for micro-, meso- and macrozooplankton and for ichthyoplankton, and successful survival and recruitment of these species in the area is considered unlikely. Due to its location far offshore and beyond the influence of upwelling, the abundance of phytoplankton, zooplankton and ichthyoplankton in PEL 83, is thus expected to be comparatively low.

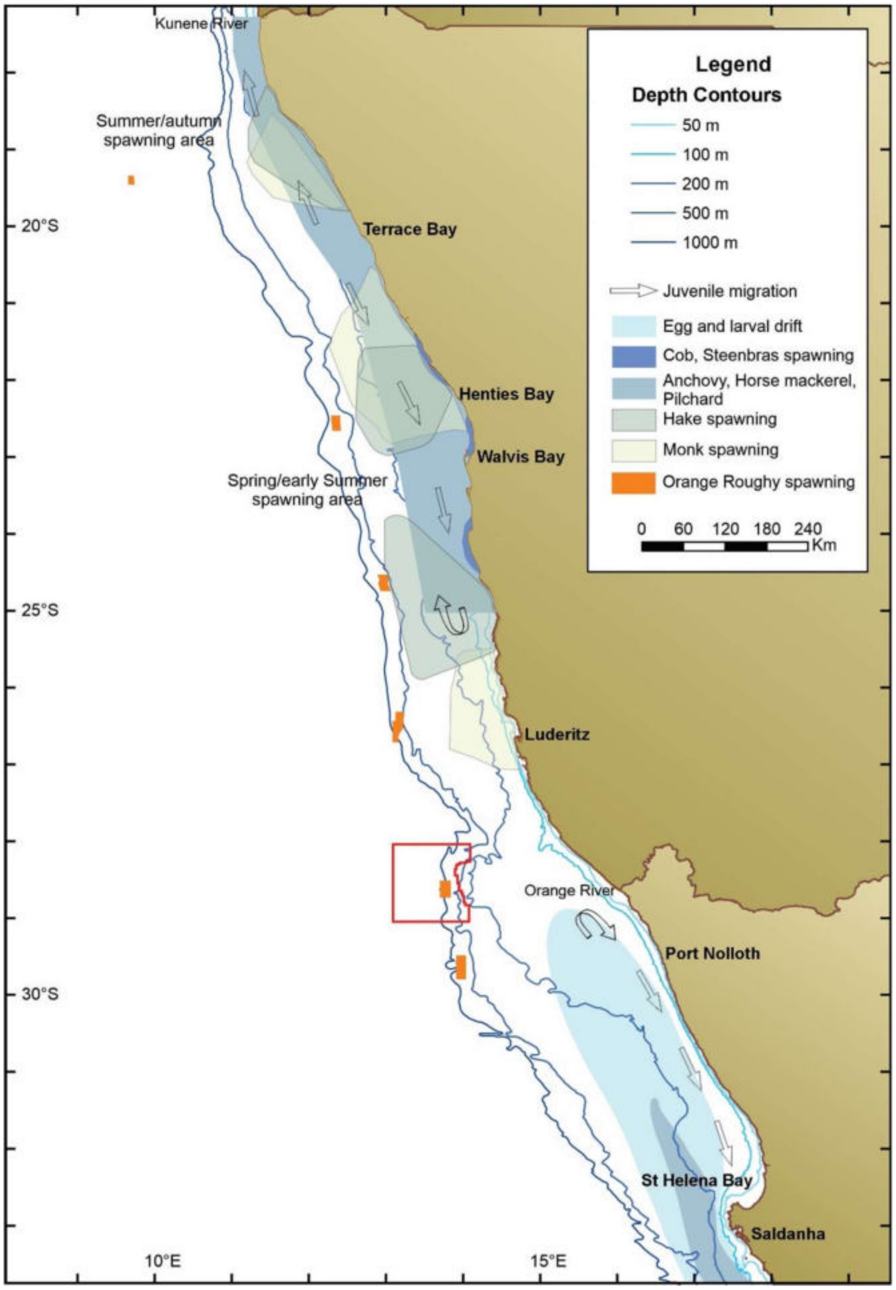


FIGURE 18: PEL 83 (RED POLYGON) IN RELATION TO MAJOR SPAWNING AREAS IN THE BENGUELA REGION (PISCES, 2024)

6.3.3.2 Pelagic Invertebrates

Pelagic invertebrates that may be encountered in the project area are the colossal squid *Mesonychoteuthis hamiltoni* and the giant squid *Architeuthis* sp. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-antarctic Southern Ocean while the giant squid is usually found near continental and island slopes all around the world's oceans.

Both species could thus potentially occur in the pelagic habitats of the project area, although the likelihood of encounter is extremely low.

6.3.3.3 FISH

Small pelagic species include the sardine/pilchard (*Sardinops sagax ocellatus*), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes, and generally occur within the 200 m contour, although they may often be found very close inshore, just beyond the surf zone. They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried up the coast in northward flowing waters. The Namibian pelagic stock is currently considered to be in a critical condition due to a combination of over-fishing and unfavourable environmental conditions as a result of *Benguela Niños*.

Two species that migrate along the southern African West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Both these species have been rated as 'Least concern' on the national assessment. Their appearance along the Namibian coast is highly seasonal.

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of PEL 83 are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing. Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Off the southern African west coast, fishers typically follow the movement of longfin tuna from the Southern Benguela waters northwards into southern Namibia and the southern part of the Northern Benguela. This movement occurs from mid to late summer (January to March) at which time aggregations may occur around or near oceanic features, in particular Vema and Tripp seamounts. Other species movements (e.g. yellowfin and bigeye tuna), which occur spatially and temporally throughout the south east Atlantic have not been clearly defined, although their availability to the fisheries is believed to increase from later summer into winter (March through to July). Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, where the fins are removed, and the remainder of the body discarded.

Species occurring off Namibia include the albacore/longfin tuna *Thunnus alalunga*, yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans*, the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias* *gladius*. Large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. The distributions of these species are dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts.

A number of species of pelagic sharks are also known to occur off the southern African West Coast, including blue *Prionace glauca*, short-fin mako *Isurus oxyrinchus* and oceanic whitetip sharks *Carcharhinus longimanus*. Using the Benguela drift in a north-westerly direction, it is likely that juveniles from the parturition off the south-western Cape would migrate through the project area en route to South America. Of the species that occur off the southern African West Coast the blue shark is listed as ‘Near threatened’, and the short-fin mako, whitetip, and great white as ‘Vulnerable’ on the IUCN.

6.3.3.4 TURTLES

Five of the eight species of turtle worldwide occur off Namibia. The Leatherback (*Dermochelys coriacea*) turtle is occasionally encountered in the offshore waters off Namibia. Observations of Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*) and Olive Ridley (*Lepidochelys olivacea*) turtles in the area are rare. Loggerhead turtles have been reported by MMOs during seismic operations in PEL 83. The leatherback turtle may also be encountered in the offshore waters of southern Namibia, although abundance in the study area is expected to be low.

The Benguela ecosystem is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic and south-east Indian Ocean (South Africa). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem.

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey. While hunting they may dive to over 600 m and remain submerged for up to 54 minutes. Their abundance in the study area is unknown but expected to be low. Refer to Figure 19 for the migration corridors of leatherback turtles in the south-western Indian Ocean.

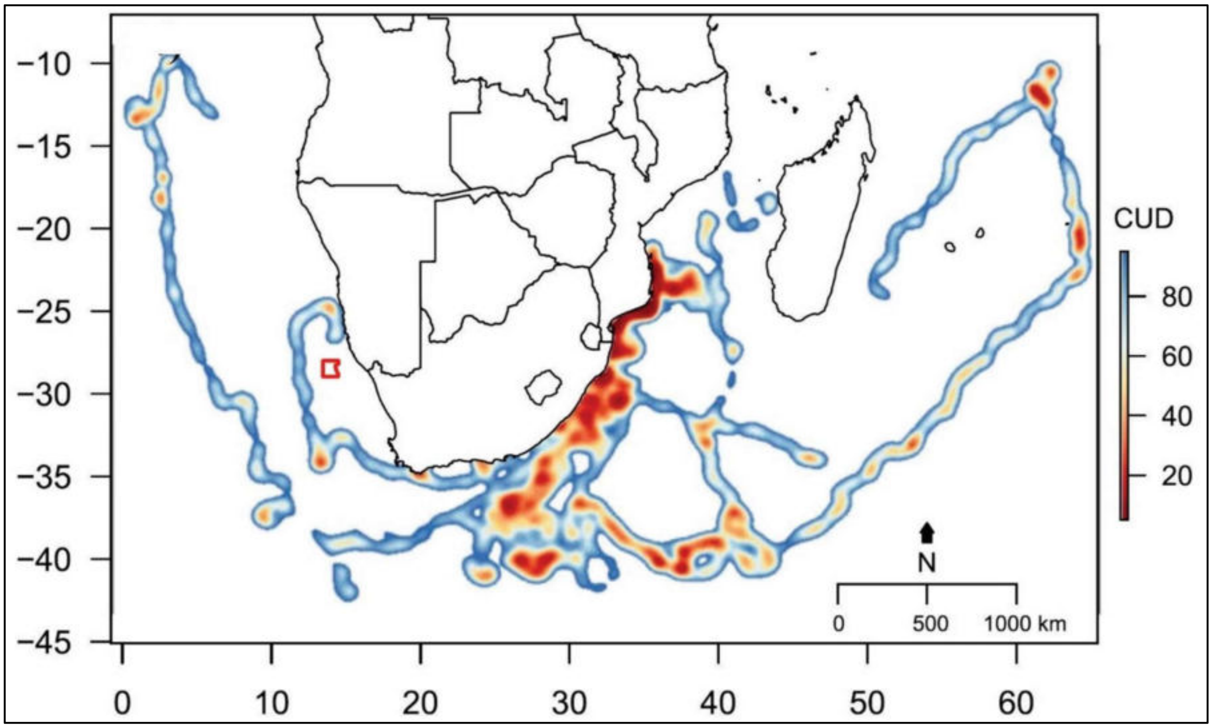


FIGURE 19: PEL83 (RED POLYGON) IN RELATION TO THE MIGRATION CORRIDORS OF LEATHERBACK TURTLES IN THE SOUTH-WESTERN INDIAN OCEAN (PISCES, 2024)
Note: Relative use (CUD, cumulative utilization distribution) of corridors is shown through intensity of shading: light, low use; dark, high use (adapted from Harris et al. 2018).

The Leatherback is the turtle most likely to be encountered in the offshore waters of west South Africa. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south-east Indian Ocean (South Africa).

Loggerheads use one of 3 migration corridors between their nesting and foraging grounds of which the coast-associated Mozambique Corridor is the most used (>80% of the population). Leatherbacks largely follow the same corridors as the loggerheads, with most riding the Agulhas Current southward to forage in high seas regions of the Agulhas Plateau, at which point they either swim east following the Agulhas Retroflection (Agulhas-Retroflection Corridor) as far north as the Mascarene Plateau or enter the Benguela Current to migrate into the southeastern Atlantic, as far north as central Angola (see **FIGURE 20**).

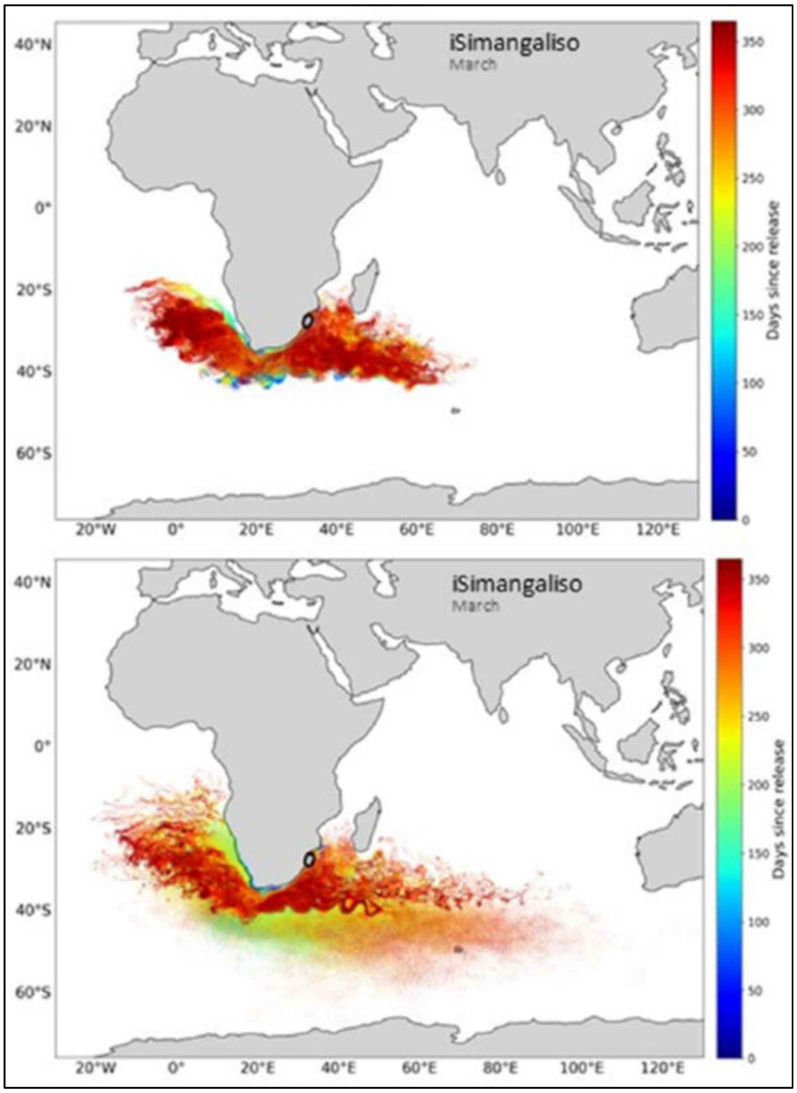


FIGURE 20: DISPERSAL MAPS SHOWING TRAJECTORIES OF 5000 PARTICLES RELEASED FROM THE RESPECTIVE NESTING SITES (WHITE CIRCLES) IN MARCH 2018 FOR LOGGERHEADS (TOP) AND LEATHERBACKS (BOTTOM) (PISCES, 2024)

Note: Colours (blue to red) indicate the number of days since release

Leatherback Turtles are listed as 'Vulnerable' worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). Loggerhead and Olive Ridley turtles are globally listed as 'Vulnerable' whereas Hawksbill are globally listed as 'Critically Endangered', and green turtles as 'Endangered'. According to the most recent conservation status, which assessed the species on a scale of Regional Management Units (RMU)[8], it is

[8] Regional Management Units (RMUs) organise marine turtles that might be on independent evolutionary trajectories within regional entities into units of protection above the level of nesting populations, but below the level of species.

evident that leatherback and loggerhead turtles, the two species most likely to be encountered in the licence area, are rated as 'Critically Endangered' and 'Near Threatened', respectively in the Southwest Indian RMU. Although not a signatory of CMS, Namibia has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. Namibia is thus committed to conserve these species at an international level.

3.3.3.5 Seabirds

The Namibian coastline sustains large populations of breeding and foraging seabird and shorebird species, which require suitable foraging and breeding habitats for their survival. In total, 12 species of seabirds are known to breed along the southern Namibian coast (see Appendix F for further details). Most seabirds breeding in Namibia are restricted to areas where they are safe from land predators, although some species are able to breed on the mainland coast, either cryptically on the open ground (e.g. Damara Tern) or in inaccessible places. In general most breed on the islands off the southern Namibian coast, inshore and in excess of 250 km to the east-northeast of PEL 83, or on the man-made guano platforms in Walvis Bay, Swakopmund and Cape Cross, well to the north of PEL 83. The southern Namibian islands and guano platforms therefore provide a vital breeding habitat to most species of seabirds that breed in Namibia. However, the number of successfully breeding birds at the particular breeding sites varies with local food abundance. With the exception of Kelp Gulls and White-breasted Cormorants all the breeding species are listed Red Data species in Namibia.

Most of the seabird species breeding in Namibia feed relatively close inshore (10-30 km), although exceptions occur, particularly when birds are forced to alter their dispersal patterns in response to environmental change. Cape Gannets, however, are known to forage up to 140 km offshore, and African Penguins have also been recorded as far as 60 km offshore (i.e. not in the PEL area). The closest Cape Gannet colony to PEL 83 is at Possession Island some 150 km to the northeast, with the closest African Penguin colony at Sinclair, Plumpudding and Possession Islands, which lie some 130 km, 125 km and 150 km to the northeast, respectively. As the project area is over 130 km offshore at its closest point and south of the southern-most islands (Sinclair and Plumpudding Islands in Baker's Bay), encounters with these species during exploration operations in PEL 83 is likely to be rare.

Among the other species present off Namibia's southern coast there are at least nine species of albatrosses, petrels or giant-petrels recorded. However, none of these species breed in Namibia, and the numbers foraging in Namibian waters are poorly known, although some tracking data are available. Forty-nine species of pelagic seabirds have been recorded in the broader project area, of which 14 are resident. Highest pelagic seabird densities occur offshore of the shelf-break in winter. Pelagic seabirds potentially encountered in PEL 83, and encountered *en route* and within adjacent Block 2913B are provided in Appendix F.

3.3.3.6 Marine Mammals

Marine mammals occurring off the central Benguela ecosystem include cetaceans (whales and dolphins) and seals. The cetacean fauna of southern Namibia comprises 33 species of whales and dolphins known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (Table 6), and their known seasonality (

Table **7**). Apart from the resident species such as the endemic Heaviside's dolphin, bottlenose and dusky dolphins, Namibia's waters also host species that migrate between Antarctic feeding grounds and warmer low latitude breeding grounds, as well as species with a circum-global distribution. The Namibian shelf and deeper waters have been poorly studied with most available information in deeper waters (>200 m) arising from historic whaling records, although data from marine mammal observers and passive acoustic monitoring is improving knowledge in recent years. Current information on the distribution, population sizes and trends of most cetacean species occurring in Namibian waters is lacking. Information on smaller cetaceans in deeper waters (>100 m) is particularly poor and the precautionary principal must be used when considering possible encounters with cetaceans in this area.

Although the location of PE 83 can be considered to be truly within the Benguela Ecosystem, the warmer waters that occur more than ~100 km offshore provide an entirely different habitat, that despite the relatively high latitude may host some species associated with the more tropical and temperate parts of the Atlantic such as rough toothed dolphins, striped dolphins, Pan-tropical spotted dolphins and short finned pilot whales.

The distribution of cetaceans in Namibian waters can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found in the shelf edge area (200-1 000 m) making this the most species-rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across 1 000s of kilometers. The most common species within the broader project area (in terms of likely encounter rate not total population sizes) are likely to be the humpback whale and pilot whale.

Cetaceans comprise two basic taxonomic groups, the mysticetes (filter feeding whales with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term 'whale' is used to describe cetaceans larger than approximately 4 m in length, in both these groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontocetes and the family Delphinidae and are thus dolphins, not whales). Due to large differences in their size, sociality, communication abilities, ranging behaviour and principally, acoustic behaviour, these two groups are considered separately.

Table 6 lists the cetaceans likely to be found within the licence area. The predicted distribution of some of these species on the South African coast is shown in Figure 21, and although not illustrated extending across the border, their continued distribution ranges into Namibian waters can be inferred. PEL 83 lies well offshore of most of the predicted distribution ranges of these species. From Marine Mammal Observer (MMO) sightings (Figure 22) it is evident that many species do occur as far offshore as PEL 83, particularly sei, fin, pilot and humpback whales.

The South African red list of cetacean fauna was updated in 2016 and global reviews are underway. As the Namibian list has not been updated recently the South African red list ratings are used as the most up to date. Of the 33 species listed, one is 'critically endangered', two are 'endangered' and one is considered 'vulnerable'. Altogether 11 species are listed as 'data deficient', underlining how little is known about cetaceans, their distributions and population trends in Namibian waters. A review of the distribution and seasonality of the key cetacean species likely to be found within the broader project area is provided below, based on information provided by the Sea Search - Namibian Dolphin Project (NDP), which has been conducting research in Namibian waters since 2008. The NDP holds the most up-to-date data of cetacean occurrence and distribution since whaling times, with the records including a total database of over 7 000 records with more than 1 000 sightings made by MMOs on seismic or mining vessels and fisheries observers operating in shelf or pelagic waters.

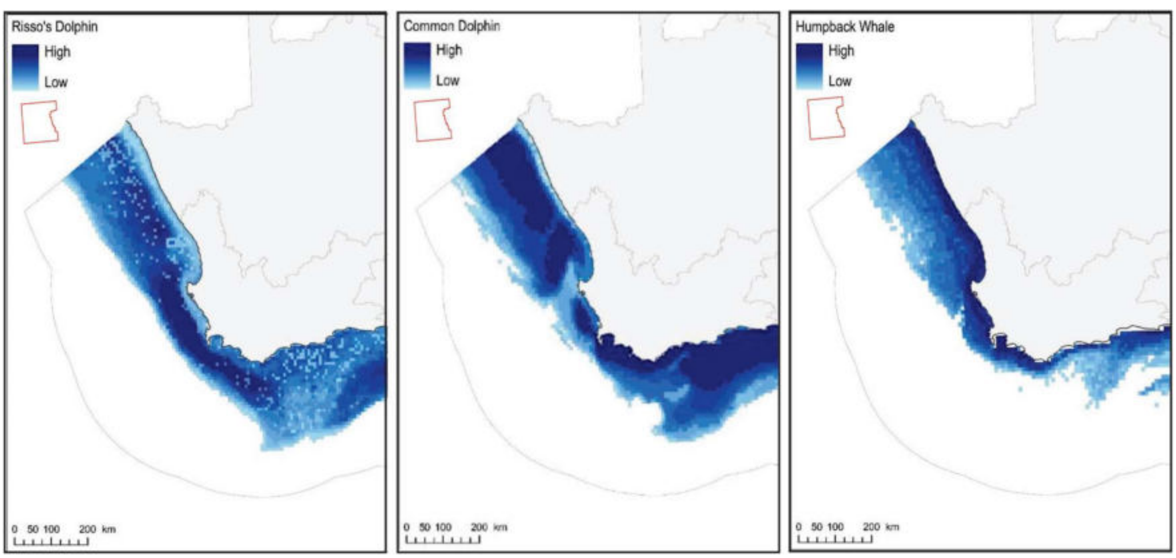


FIGURE 21: THE PREDICTED DISTRIBUTION OF RISSO'S DOLPHIN, COMMON DOLPHIN AND HUMPBACK WHALE SOUTH OF NAMIBIA'S BORDER IN RELATION TO PEL83 (RED POLYGONS) (PISCES, 2024)

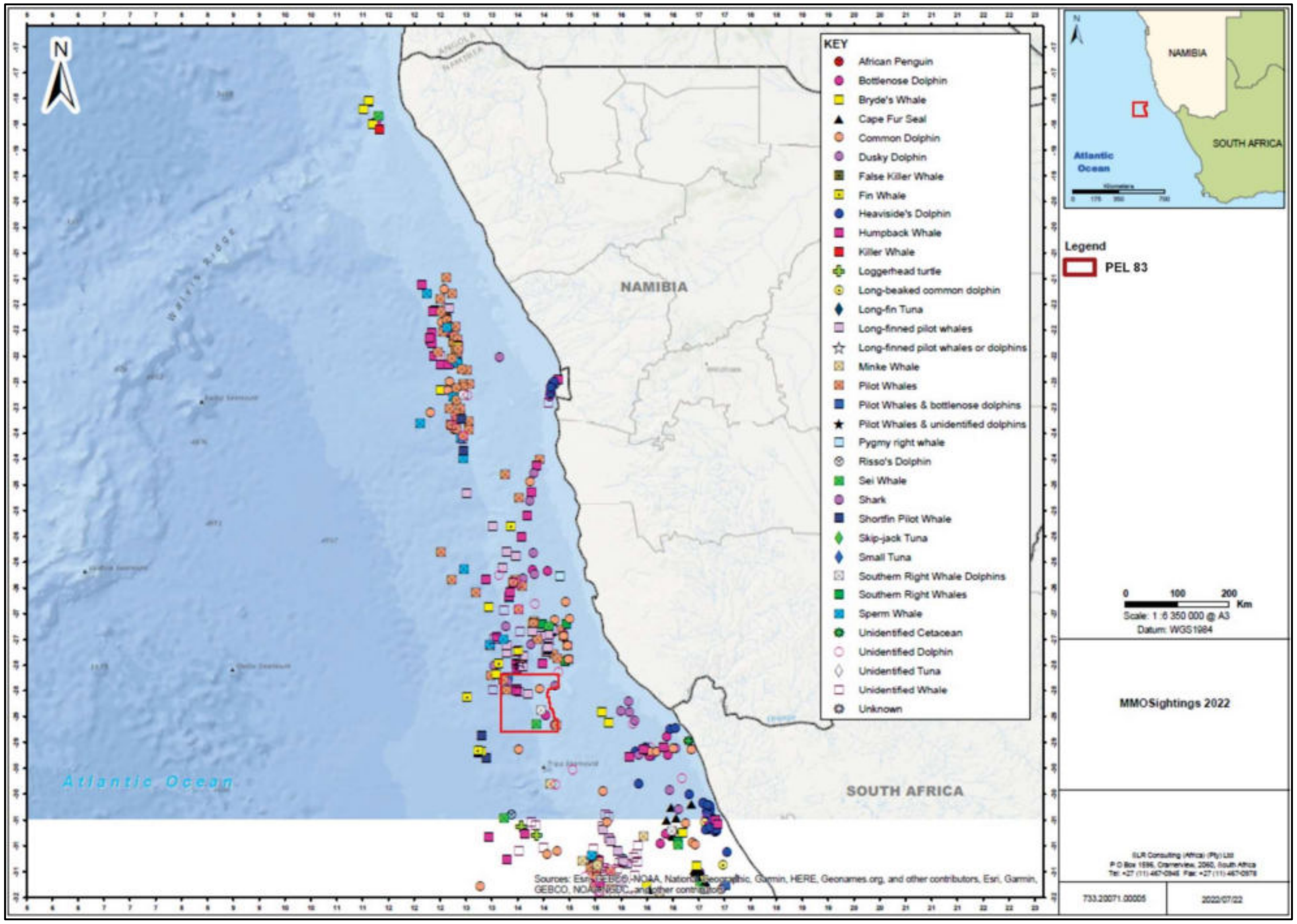


FIGURE 22: PEL 83 (RED POLYGON) IN RELATION TO THE DISTRIBUTION AND MOVEMENT OF CETACEANS SIGHTED BY MMOS WITHIN THE NAMIBIAN EEZ, COLLATED BETWEEN 2001 AND 2022 (SLR MMO DATABASE) (PISCES, 2024)

Mysticete (Baleen) whales

The majority of mysticetes whales fall into the family Balaenidae. Those occurring in the study area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whale. The majority of these species occur in pelagic waters with only the occasional visit to shelf waters. All of these species show some degree of migration either to, or through the latitudes of PEL83 when *en route* between higher latitude (Antarctic or Sub Antarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality in Namibian waters can be either unimodal, usually in winter months, or bimodal (e.g. May-July and October-November) reflecting a northward and southward migration through the area. Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail in Appendix F and their likelihood of occurrence in PEL 83 summarised below:

- Sei whales' encounters in the project area are likely to occur.
- Sightings of Bryde's whales were made in the vicinity of PEL 83. Encounters in the project area are thus likely to occur.
- Sightings of fin whales were made in the vicinity of PEL 83). Encounters in the project area are thus likely to occur.
- Several recent (2014-2015) sightings of blue whales have occurred during seismic surveys off the southern part of Namibia in water >1 000 m deep confirming their current existence in the area and occurrence in Autumn months. Encounters in the project area may occur.
- Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale and the dwarf minke whale; both species occur in the Benguela. Both species are generally solitary, and densities are likely to be low in the licence area, but encounters may occur.
- The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult. The species is typically associated with cool temperate waters and records in Namibia there are the northern most for the species with no confirmed records north of Walvis Bay.
- The most abundant baleen whales in the Benguela are southern right whales and humpback whales. Refer to Figure 23 for PEL 83 in relation to 'whale superhighways' showing tracks of Humpback whales and Southern Right whales between southern Africa and the Southern Ocean feeding grounds.

- Southern right whales are seen regularly in Namibian coastal waters (<3 km from shore), especially in the southern half of the Namibian coastline. Right whales have been recorded in Namibian waters in all months of the year but with numbers peaking in winter (June - August). A secondary peak in summer (November - January) also occurs, probably associated with animals feeding off the west coast of South Africa performing exploratory trips into southern Namibia. Notably, all available records have been very close to shore with only a few out to 100 m depth, so they are unlikely to be encountered in PEL 83.
- Regular sightings of humpback whales in spring and summer months in Namibia, especially in the Lüderitz area, suggest that summer feeding is occurring in Namibian waters as well (or at least those animals foraging off West South Africa range up into southern Namibia). The most recent abundance estimates available put the number of animals in the west African breeding population to be in excess of 9 000 individuals in 2005 and it is likely to have increased since this time at about 5% per annum. Humpback whales are thus likely to be the most frequently encountered baleen whale in PEL 83, ranging from the coast out beyond the shelf, with year-round presence but numbers peaking in June – July (northern migration) and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.

FIGURE 23: PEL83 (RED POLYGON) IN RELATION TO 'BLUE CORRIDORS' OR 'WHALE SUPERHIGHWAYS' SHOWING TRACKS OF HUMPBACK WHALES (ORANGE) AND SOUTHERN RIGHT WHALES (GREEN) BETWEEN SOUTHERN AFRICA AND THE SOUTHERN OCEAN FEEDING GROUNDS (PISCES, 2024)

TABLE 6: CETACEANS OCCURRENCE OFF THE SOUTHERN NAMIBIAN COAST, THEIR SEASONALITY, LIKELY ENCOUNTER FREQUENCY WITH PROPOSED EXPLORATION ACTIVITIES AND SOUTH AFRICAN AND GLOBAL IUCN RED LIST CONSERVATION STATUS (PISCES, 2024)

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids							
Dusky dolphin	*Lagenorhynchus obscurus*	HF	Yes (0- 800 m)	No	Year round	Least Concern	Least Concern
Heaviside's dolphin	*Cephalorhynchus heavisidii*	VHF	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	*Delphinus delphis*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*	HF	No	Yes	Year round	Least Concern	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	*Globicephala melas*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	HF	No	Yes	Year round	Not Assessed	Least Concern
Killer whale	*Orcinus orca*	HF	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	*Pseudorca crassidens*	HF	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	*Feresa attenuata*	HF	No	Yes	Year round	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Year round	Data Deficient	Least Concern
Sperm whales							
Pygmy sperm whale	*Kogia breviceps*	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Dwarf sperm whale	*Kogia sima*	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Berardius arnuxii*	HF	No	Yes	Year round	Data Deficient	Least Concern
Southern bottlenose	*Hyperoodon planifrons*	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF	No	Yes	Year round	Data Deficient	Least Concern
True's	*Mesoplodon mirus*	HF	No	Yes	Year round	Data Deficient	Least Concern
Gray's	*Mesoplodon grayi*	HF	No	Yes	Year round	Data Deficient	Least Concern
Blainville's	*Mesoplodon densirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Baleen whales							
Antarctic Minke	*Balaenoptera bonaerensis*	LF	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	*B. acutorostrata*	LF	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	*B. physalus*	LF	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	*B. musculus intermedia*	LF	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	*B. borealis*	LF	Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	*B. edeni (subspp)*	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. edeni*	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	?	Year round	Least Concern	Least Concern
Humpback sp.	*Megaptera novaeangliae*	LF	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	LF	Yes	Yes	Spring/Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	LF	Yes	No	Year round, ONDJFMA	Least Concern	Least Concern

TABLE 7: SEASONALITY OF BALEEN WHALES IN THE BROADER PROJECT AREA

Note: Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species. For abundance / likely encounter rate within the broader project area, see Table 6.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's Offshore	**H**	**H**	**H**	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	**H**	**H**	L	**H**	**H**	**H**	L	L
Fin	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Blue	L	L	L	L	L	**H**	**H**	**H**	L	M	L	L
Minke	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Humpback	M	M	L	L	L	**H**	**H**	M	M	L	M	**H**
Southern Right	**H**	M	L	**L**	L	**H**	**H**	**H**	**M**	**M**	**H**	**H**
Pygmy right	**H**	**H**	**H**	M	L	L	L	L	L	L	M	M

Odontocete (toothed) whales

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Each of the species is discussed in further detail in Appendix F and their likelihood of occurrence in PEL 83 summarised below:

- Sperm whales in the project area are likely to be encountered in deeper waters (>500 m), predominantly in the winter months (April - October). This is confirmed by the sighting / detection of two sperm whales en route to Block 2913B in April 2019.
- Beaked whales are all considered to be true deep-water species, usually recorded in waters in excess of 1 000 – 2 000 m and thus may be encountered in the project area. Presence in the project area may fluctuate seasonally, but insufficient data exist to define this clearly.
- *Kogia* species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the project area at low levels; seasonality is unknown.
- Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the license area at low levels.
- There is no information on population numbers or conservation status of False killer whales and no evidence of seasonality in the region.
- Short, finned pilot whales are regarded as a more tropical species and most sightings within the Benguela Ecosystem are thought to be long-finned pilot whales, however, due to the low latitude and offshore nature of the project, it is likely that either could be encountered.
- Due to the offshore location of PEL 83, encounters of Dusky dolphins within the project area are unlikely.
- Heaviside’s dolphins occupy waters from the coast to at least 200 m depth, suggesting they are unlikely to be encountered in the project area.
- Common dolphins have been reported by MMOs during seismic operations in PEL 83. Thus, encounters in the license area may occur.
- Common bottlenose dolphins’ nearshore habitat makes it unlikely to be impacted by the proposed project activities.
- Any encounters of Southern right whale dolphins in the project area are likely at low levels.

- Several other species of toothed whales that might occur in the deeper waters of the licence area at low levels include the pygmy killer whale, Risso's, and striped dolphins, and Cuvier's and Layard's beaked whales.

Summary of cetaceans

There is very little current data on the presence, density or conservation status of any cetaceans within the project area. All information provided above is based on at least some level of projection of information from studies elsewhere in the region, at some time in the past (often decades ago) or extrapolated from knowledge of habitat choice of the species. The large whale species for which there are current data available are the humpback and southern right whale, although with almost all data being limited to the continental shelf. Both these species are known to use feeding grounds around Cape Columbine in South Africa, with numbers there highest between September and February, and not during winter as is common on the South Coast breeding grounds. Whaling data indicates that several other large whale species are also most abundant on the West Coast during this period: fin whales peak in May-July and October-November; sei whale numbers peak in May-June and again in August-October and offshore Bryde's whale numbers are likely to be highest in January-March. Whale numbers on the shelf and in offshore waters are thus likely to be highest between October and February.

Of the migratory cetaceans, the blue whale is considered 'Critically Endangered', and Sei and Fin whales are listed as 'Endangered' in the IUCN Red Data book. All whales and dolphins are given protection under the Namibian Law. The regulations under the Namibian Marine Resources Act, 2000 (No. 27 of 2000) states that no whales or dolphins may be harassed, killed or fished. Although not legislated in Namibia, no vessel or aircraft should approach closer than 500 m to any whale and a vessel or aircraft should move to a minimum distance of 500 m from any whales if a whale surfaces closer than 500 m from a vessel or aircraft.

Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. The seal colonies closest to PEL 83 are at van Reenen Bay and Baker's Bay approximately 130 km inshore and to the east-northeast of the northeastern corner of the Block, in the Tsau//Khaeb (Sperrgebiet) National Park. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles (~220 km) offshore, with bulls ranging further out to sea than females. PEL 83 lies well offshore of the foraging ranges from these colonies. Seals were, however, regularly sighted by MMOs during previous seismic surveying in PEL 83.

6.4 CONSERVATION AREAS

Numerous conservation areas and a coastal marine protected area (MPA) exist along the southern Namibian coastline, although none overlap with PEL 83.

The coastline of Namibia is part of a continuum of protected areas that stretch along the entire Namibian coastline from Southern Angola into Namaqualand in South Africa and was recently proclaimed as the Namib-Skeleton Coast National Park (NSCNP). The NSCNP incorporates four terrestrial Management Areas, namely the Skeleton Coast National Park, the Dorob National Park, the Namib-Naukluft National Park and the Tsau//Khaeb-Sperrgebiet National Park (see Figure 24).

The Namibian Islands' Marine Protected Area lies inshore and northwards of PEL 83, with the closest point (southern boundary of the NIMPA) being just over 60 km to the east. See Figure 24 for PEL 83 in relation to the Namibian coast, illustrating sanctuaries, conservation areas and marine protected areas (MPAs).

PEL 83 overlaps with the Orange Seamount and Canyon Complex Ecologically or Biologically Significant Areas (EBSA) (i.e. Impact Management Zone) as well as the Ecological Support Area (see Figure 25). The EBSA have been identified as being of high priority for place-based conservation measures under the Convention of Biological Diversity.

Despite the development of the offshore EBSAs a few 'Vulnerable' ecosystem types in the broader project area are currently considered 'not well protected' or 'poorly protected' and further effort is needed to improve protection of these threatened ecosystem types. Most of PEL 83 falls within continental slope habitats that are 'not protected', with only the inshore portions considered 'moderately protected' (see Figure 26).

Three coastal Ramsar sites exist in Namibia (including Walvis Bay Wetland, Sandwich Harbour and Orange River Mouth) that fall within the broader project area. The licence area overlaps with one proposed Important Bird Area (IBA). Various marine IBAs have also been proposed in Namibian territorial waters, with a candidate trans-boundary marine IBA suggested off the Orange River mouth. The Atlantic Southeast 21 IBA specifically targets the protection of Atlantic, Yellow-nosed Albatross, Black-browed Albatross and White-chinned Petrels. (Refer to Figure 27).

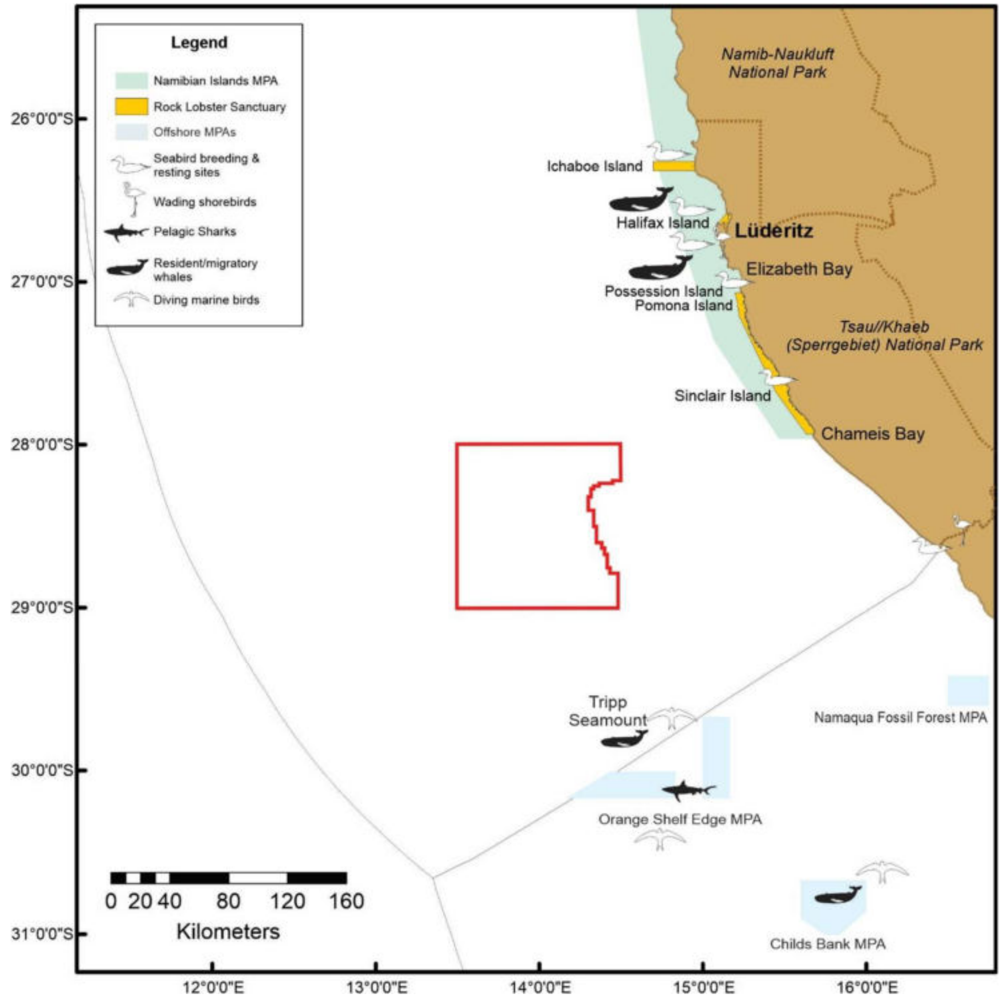


FIGURE 24: PEL 83 (RED POLYGON) IN RELATION THE NAMIBIAN COAST, ILLUSTRATING SANCTUARIES, CONSERVATION AREAS AND MARINE PROTECTED AREAS (MPAS) (PISCES, 2024)

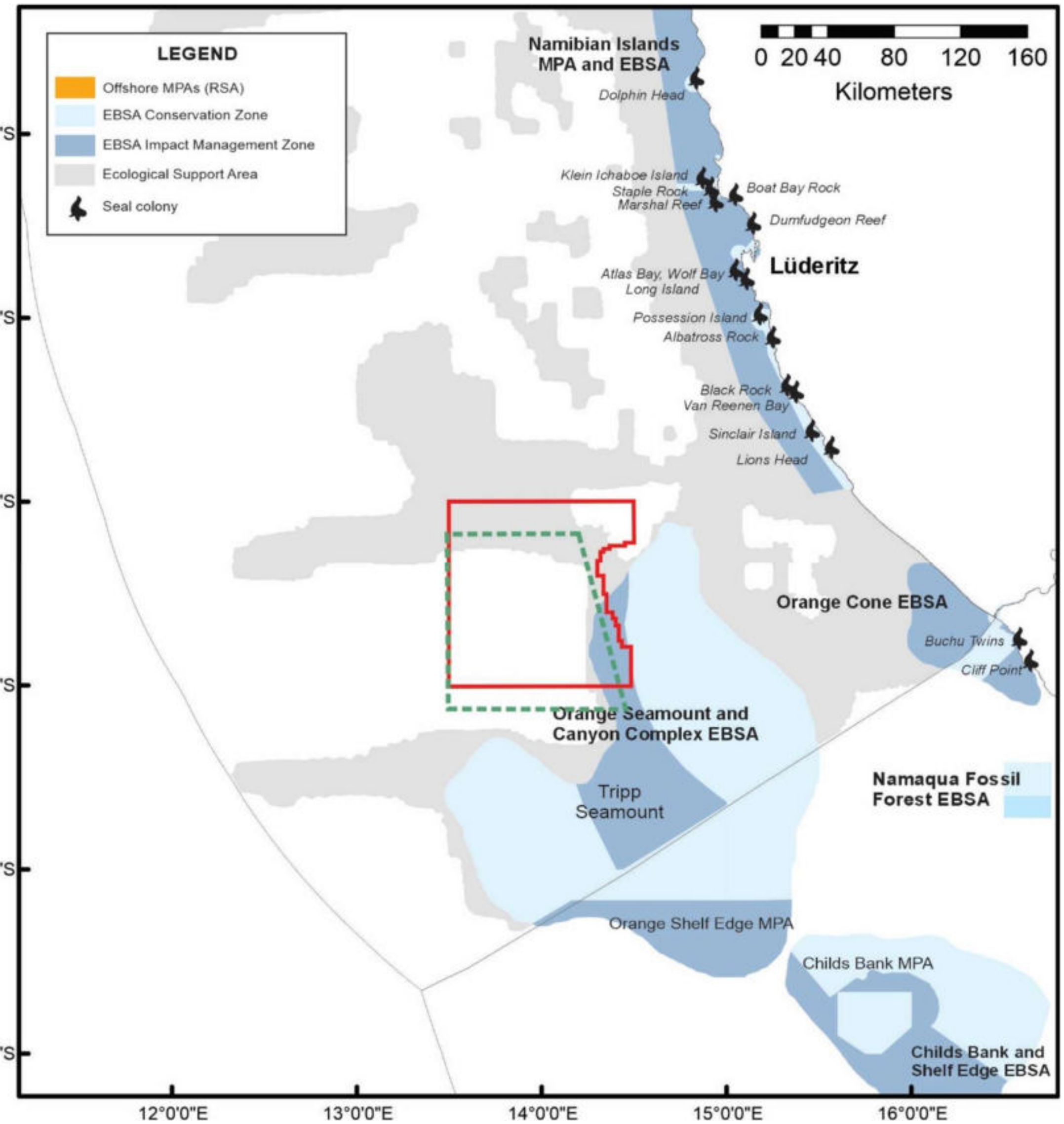


FIGURE 25: PEL 83 IN RELATION TO IN RELATION TO ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSAS) AND THE MARINE SPATIAL PLANNING ZONES WITHIN THESE (PISCES, 2024)

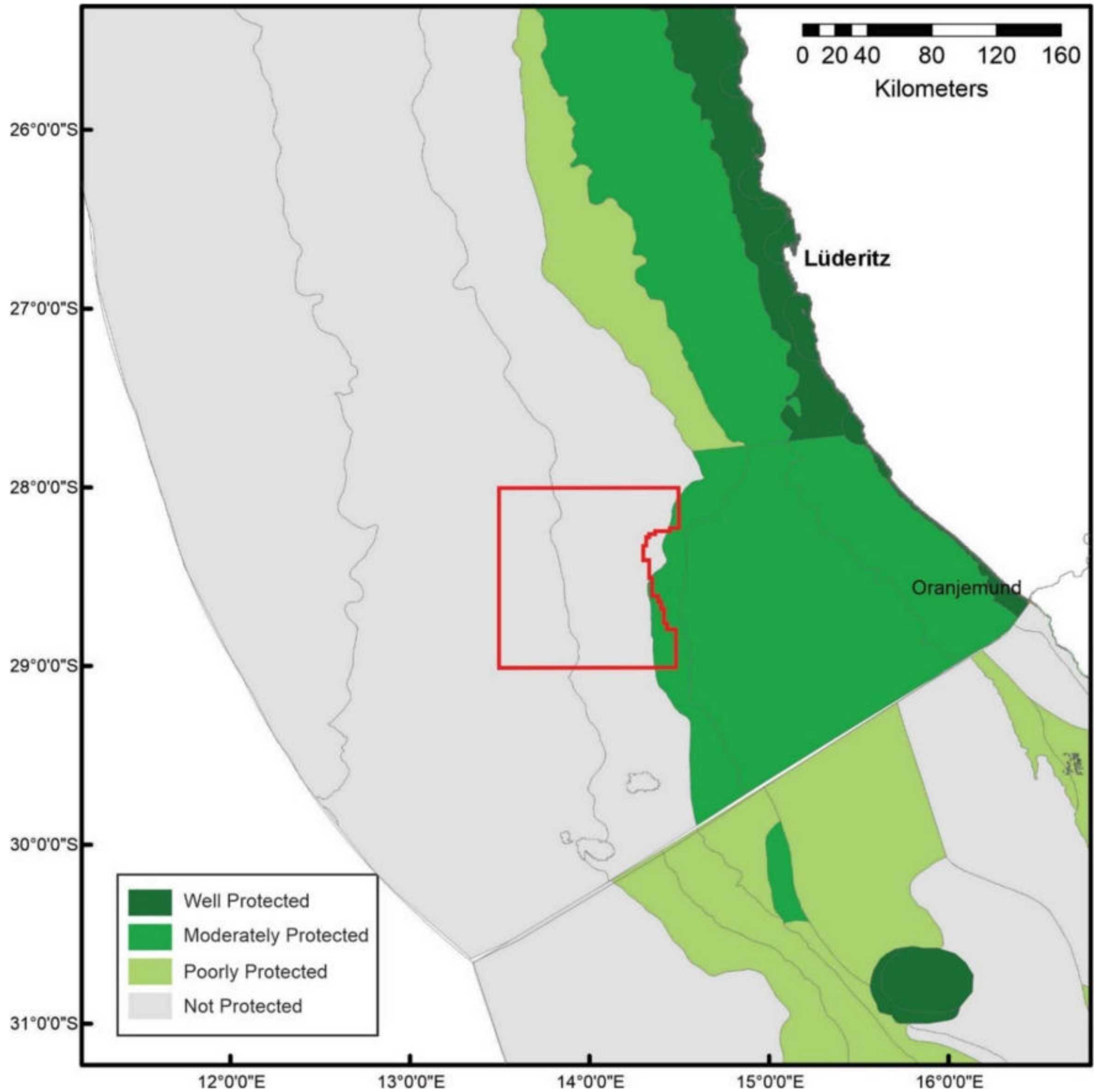


FIGURE 26: PEL 83 IN RELATION TO IN RELATION TO THE PROTECTION LEVELS OF BENTHIC HABITAT TYPES (PISCES, 2024)

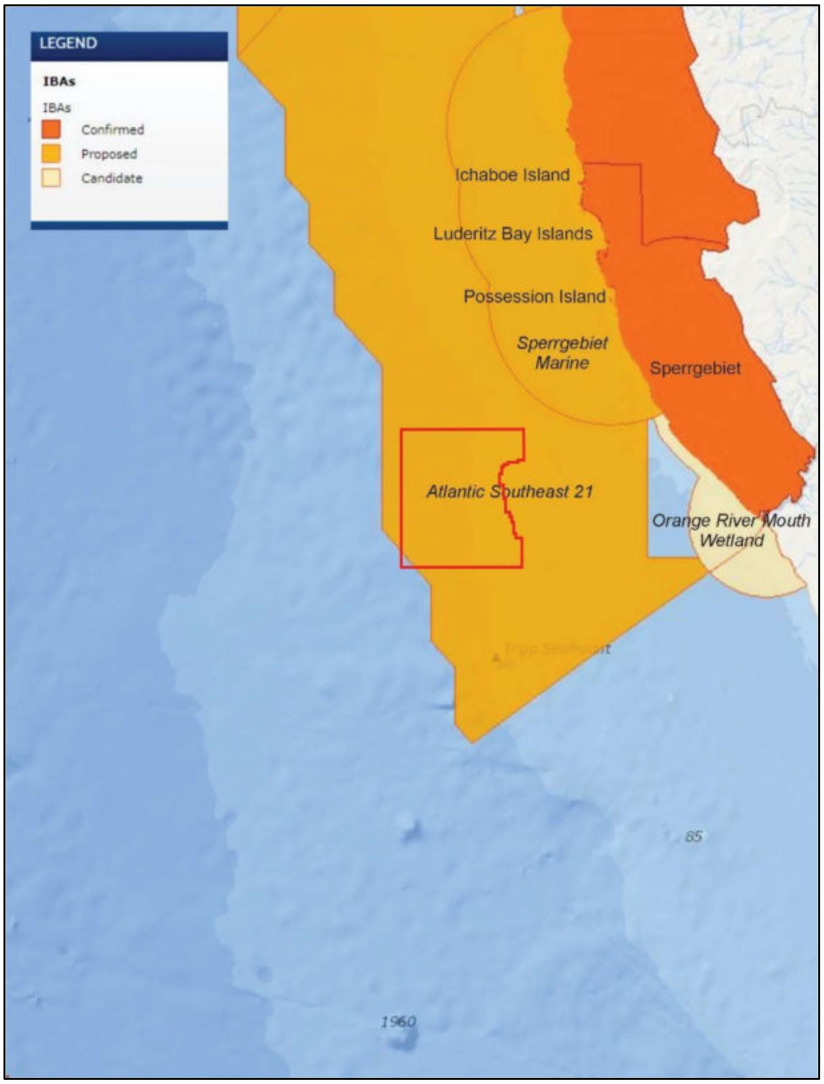


FIGURE 27: PEL 83 IN RELATION TO MARINE IBAS (PISCES, 2024)

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified based on four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Although much of the west coast of southern Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs namely the:

- Southern Coastal and Shelf Waters of South Africa IMMA (166 700 km^2),
- Cape Coastal Waters IMMA (6 359 km^2), and
- Southeast African Coastal Migration Corridor IMMA (47 060 km^2).

These all lie well to the south of PEL 83.

6.5 Socio-Economic Environment

6.5.1 Demographic Profile

6.5.1.1 Social baseline

The last national census in Namibia was conducted in 2023 and counted 3,022,401 million people, an increase of 30% since the last census in 2011 (www.nsa.org.na). Where not otherwise referenced, the text below is based on this online-based preliminary results of the 2023-census.

Being one of the least densely populated countries in the world (3.7 persons per km^2), vast areas of Namibia are without people, while some parts are densely populated, such as the central-north and along the Kavango River. Population densities in the country vary thus a lot – in the Erongo Region it was 3.8 persons per km^2 and in the ||Karas Region 0.68 persons per km^2 in 2023.

In the 2023-census the urban-rural spread of the population in Namibia was almost 50-50. However, this figure is skewed by the primacy of Windhoek which accommodates >15% of the total Namibian population. In the Erongo Region 89% of the total population live in urban areas, of which 83.2% live in Swakopmund and Walvis Bay alone and only 5.8% live in all the other towns together – Arandis, Henties Bay, Karibib, Usakos and Omaruru. This also means that only 11% of the region's total population live in its rural parts, indicating the low population density of the region outside urban areas.

Typifying the low population density of Namibia, the ||Karas Region is the largest and least densely populated of Namibia's 14 regions with only 109,893 people (3.64% of the total population) on an area of 161,235 km^2, i.e. only 0.68 persons per km^2. In the ||Karas Region 60% of the population is urbanized, but only three towns, Keetmanshoop, Lüderitz and Oranjemund alone, accommodate 46.8% of the total population of the region.

In 2023 the total population of the !Nami‡Nûs Constituency (in which Lüderitz is situated) was 17,243, with 5,496 households of an average size of 3.1. Population growth was relatively slow over the years, rarely exceeding 1.6% per annum. To the contrary, the population in Walvis Bay is much bigger – in its two constituencies there was 103,115 people in 2023, existing of 31,747 households of an average household size of 3.2. In comparison to Lüderitz, the population growth of Walvis Bay was also significantly faster over time. In general, the Erongo Region's population increased by 53% since the last census (2011), while in the ||Karas Region it increased by 41.9%.

Living in an urban environment implies better living conditions – access to safe water, sanitation and electricity, and access to educational, medical and financial services and facilities such as amenities and recreation. However, a higher figure of the number of people living in an urban area in Namibia does not indicate how many households still live in substandard housing (shacks and other informal shelters), how many people still live in poverty, and how many people still are deprived from a civilized living standard after three decades of independence. It is estimated that almost 80% of Walvis Bay's population live in the low-income neighbourhoods (Ashby, 2022, referenced in Namisun, 2023a), for example.

Namibia's population is young – 37% was younger than 14 years of age and >46 % of the total population was younger than 19 years of age in 2023. The percentage of working age population (15 – 59 years of age) was 56.1% and only 6.8% was older than 59. Although a young population presents a high employability, it presents also high dependency ratios, education demands, health care needs, employment challenges and urbanization pressures, which in turn demands effective policies on these fronts.

A large portion of Namibia's young population is indeed unemployed: Using the broad definition of unemployment, an estimated 33.4% of all Namibians from a working age was unemployed in 2022. There is also a strong correlation between unemployment and low or inadequate education. Of all employed people in Namibia, 63.5% are not higher qualified than junior secondary level (Grade 10 and lower) and the highest unemployment rates are found amongst persons with education levels lower than junior secondary (NSA, 2019). Moreover, the low education levels affect employability and prevents many Namibian households to earn a decent income.

6.5.1.2 ECONOMIC BASELINE

Although Namibia is classified as a high middle-income country, this status is somewhat deceptive owing primarily to Namibia's level of income inequality. Socio-economic inequalities inherited from pre-independence remain extremely high and structural constraints to growth have hampered job creation. Economic advantage remains in the hands of a relatively small segment of the population and the large disparities of income have led to a dual economy – a highly developed modern sector co-existing with an informal subsistence-oriented one. The duality of the labour market, combined with slow job creation and low primary-sector productivity, results in very high unemployment (Ashby, 2022, referenced in Namisun, 2023a).

Namibia's economy grew between 2010 and 2015 by an average of 5.3% per annum, but then slumped into a recession with primary and secondary industries contracted by 2.0 and 7.8% respectively. During 2017 the economy contracted by 1.7, 0.7 and 1.9% in the first, second and third quarters respectively (Ashby, 2022, referenced in Namisun, 2023a). In 2021 the domestic economy rebounded to a positive growth for the first time in two years, growing by 2.4% compared to a contraction of 7.9% recorded in 2020 during the height of COVID-19 pandemic. In 2022 an annual GDP growth rate of 4.6% was recorded (www.nsa.org.na).

The Erongo Region has a well-developed infrastructure, is the second most prosperous region in Namibia and includes Namibia's largest coastal towns of Walvis Bay and Swakopmund. Mining, fishing, tourism, transportation, and storage comprise the principal economic activities in the Erongo Region. Mining is a pronounced industry in the Erongo Region, and the main commodities are uranium, gold, salt and dimension stones. Fishing is another prominent economic sector in the Erongo Region, playing a significant role in terms of production, foreign exchange earnings and government revenue. The sector is a significant employer in Walvis Bay (Ashby, 2022, referenced in Namisun, 2023a).

Walvis Bay is the principal home of Namibia's fishing industry and enjoys linkages with the rest of Namibia and its neighbours via the Trans-Kalahari and Trans-Caprivi Highways as a well as a railway, mainly because of its world-class port facilities. Except for fishing and fish processing, key economic activities of Walvis Bay include manufacturing, logistics, marine engineering, and storage. The Port of Walvis Bay plays an important role in these activities (Namisun, 2023a).

Lüderitz is Namibia's oldest colonial town, established in 1883. After the discovery of diamonds nearby, Lüderitz enjoyed a sudden surge of prosperity, and recorded a total population of more than 1,100 people by 1912. Initially its economy was driven by the diamond industry, with harbour-based activities and fishing also emerging. After diamond mining activities moved further south, the town experienced many years of economic stagnation due to several reasons of which one is its remoteness. Today the town and the area around is known for its unique landscape, including the Tsau //Khaeb (formerly Sperrgebiet) National Park, and its colonial history, which is responsible for attracting tourists to this corner of the country.

Currently Lüderitz has 3 primary and 2 secondary state schools and one private school. The town has a district hospital. Although natural, the harbour at Lüderitz has a comparatively shallow rock bottom and is limited in capacity, making the Port of Lüderitz unusable for large vessels and it remained secondary to Walvis Bay, much larger and more centrally located on the Namibian coastline. The tarred B4 national road and a railway line connects the town with Keetmanshoop 341 km away. The town is also connected to the national power grid and has an airport suitable for smaller aircraft.

Duality of the economy and the high unemployment rate of Namibia are vividly apparent in the case of Lüderitz, accentuated by the small historical part of the town which is occupied by people with a higher income, and a large portion of the town's population living in the informal parts of the town, in makeshift shelters and or substandard houses. Residents rely almost exclusively on wage labour for income, being employed in formal or informal jobs in the private sector or in government and parastatal offices, or the fishing industry or rely on small businesses or subsistence activities to earn a living. Most of the population falls into the low-income category while a significant portion of the population live in poverty (Namisun, 2023b).

With the current interest in developing a huge green hydrogen project nearby and the findings of oil in the Orange Basin off the Namibian coast, economic prospects of Lüderitz look better for the future. This expectation is already amplified in a rise in the renting of accommodation and in the upgrading and conversion of old buildings for housing and offices.

6.5.2 FISHING

6.5.2.1 OVERVIEW OF NAMIBIAN FISHERIES

The Namibian fishing industry is the country's second largest export earner of foreign currency and the third largest economic sector in terms of contribution to the Gross Domestic Product (GDP). In terms of the value of production, Namibia ranks among the top ten fishing countries globally. Supported by the high productivity of the Benguela upwelling ecosystem, abundant fish stocks have historically typified Namibian waters.

Commercial fish stocks, as found in the Benguela system typically support intensive commercial fisheries. Although varying in importance at different times in history, 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). Mariculture production is a developing industry based predominantly in Walvis Bay and Lüderitz Bay and surrounds. The main commercial fisheries, targeted species and gear types are shown in Table 8 and recent Total Allowable Catches (TACs) are presented in Table 4.2 below. The allocation of TACs and management of each fishing sector is the responsibility of MFMR.

TABLE 8: LIST OF FISHERIES THAT OPERATE WITHIN NAMIBIAN WATERS, TARGETED SPECIES AND GEAR TYPES (CAPMARINE, 2024)

Sector	Gear Type	Target Species
Small pelagic	Purse-seine	Sardine (*Sardinops sagax*), horse mackerel (*Trachurus capensis*)
Mid-water trawl	Mid-water trawl	Horse mackerel (*Trachurus capensis)*
Demersal trawl	Demersal trawl	Cape hakes (*Merluccius paradoxus, M. capensis*), monkfish (*Lophius vomerinus)*
Demersal long-line	Demersal long-line	Cape hakes (*Merluccius paradoxus, M. capensis*)
Large pelagic long-line	Pelagic long-line	Albacore tuna (*Thunnus alalunga*), yellowfin tuna (*T. albacares*), bigeye tuna (*T. obesus*), swordfish (*Xiphias gladius*), shark spp.
Tuna pole	Pole and line	Albacore tuna
Deep-sea crab	Demersal long-line trap	Red crab (*Chaceon maritae*)
Deep-water trawl	Demersal trawl	Orange roughy (*Hoplostethus atlanticus),* alfonsino (*Beryx splendens*)

Sector	Gear Type	Target Species
Rock Lobster	Demersal trap	Rock lobster (*Jasus lalandii*)
Line-fish	Hand line	Snoek (*Thyrsites atun*) silver kob (*Argyrosomus inodorus*), dusky kob (*A. coronus*)
Mariculture	Long-lines, rafts	Pacific oysters, European oysters, black mussel, seaweed (Gracilaria sp.)

TABLE 9: TOTAL ALLOWABLE CATCHES (TONS) FROM 2009/10 TO 2022/23 (SUPPLIED BY MINISTRY OF FISHERIES AND MARINE RESOURCES, NAMIBIA) (CAPMARINE, 2024)

Year	Sardine (Pilchard)	Hake	Horse Mackerel	Crab	Rock Lobster	Monk
2009/10	17 000	149 000	230 000	2700	350	8 500
2010/11	25 000	140 000	247 000	2700	275	9 000
2011/12	25 000	180 000	310 000	2850	350	13 000
2012/13	31 000	170 000	310 000	3100	350	14 000
2013/14	25 000	140 000	350 000	3100	350	10 000
2014/15	25 000	210 000	350 000	3150	300	12 000
2015/16	15 000	140 000	335 000	3446	250	10 000
2016/17	14 000	154 000	340 000	3400	240	9800
2017/18	0	154 000	340 000	3400	230	9600
2018/19	0	154 000	349 000	3900	200	9600
2020/21	0	154 000	349 000	3900	180	9600
2021/22	0	154 000	330 000	4200	180	9600
2022/23	0	154 000	290 000	4200	180	9000

Note: Deepwater trawl TAC is currently not applied for Alfonsino and Orange roughy. There is no TAC (output control) for albacore tuna – this is an effort (input) controlled sector with no restriction on catch.

Namibia has only two major fishing ports from which all the main commercial fishing operations are based namely, Walvis Bay and Lüderitz. A significant amount of fishing activity takes place from Lüderitz, from where hake trawlers and longliners operate, as well as a small rock lobster fishery based in southern Namibian waters.

There are currently 116 Namibian-registered commercial fishing vessels. The dominant fleet comprises demersal trawlers that include both large freezer vessels (up to 70 m in length), as well as a smaller fleet of monk trawlers. These vessels fish year-round, with the exception of a one month closed season in October, and range the length of the Namibian EEZ. There is a 200 m fishing depth restriction (i.e. no bottom trawling permitted shallower than 200 m).

The large pelagic (tunas and shark) long-line vessels operate broadly in Namibian waters, but unlike the mid-water vessels, concentrate in the south near the South African border targeting the migrations of albacore and yellowfin tuna. The numbers of these vessels varies and is dependent on the seasonal availability of tuna and tuna-like species. The tuna pole (baitboat) vessels are a small fleet and also increase in numbers depending on the number of licenses issued to South African boats. The tuna long-liners are also variable with the number of licenses issued to both Namibian flags and others (mostly Asian) fluctuating annually. The extent and number of these vessels is difficult to ascertain (as they are unpublished), although the actual numbers are limited and are less than the numbers of licensed Namibian boats.

There are few known foreign fishing vessels licensed to fish in Namibian waters, although the majority of the current mid-water fleet have permits to fish under foreign flag registration, but as a rule all licensed fishers must reflag under Namibia. There is a possibility that licenses may have been issued to foreign tuna boats, although these would be few in number and they would be closely monitored by the Namibian compliance units and their Vessel Monitoring System (VMS).

6.5.2.2 Stock Distribution, Spawning and Recruitment

The principle commercial fish species in Namibia undergo a critical migration pattern which is central to the sustainability of the small pelagic and hake fisheries. In Namibian waters, hake spawning commences north of the powerful Lüderitz upwelling centre and continues up to the Angola–Benguela Front. Sardines and horse mackerel also spawn in the region between Lüderitz and the Angola–Benguela front. Circulation patterns at depth reveal complex eddying and considerable southward and onshore transport beneath the general surface drift to the north-west. As eggs drift, hatching takes place followed by larval development. Settlement of larvae occurs in the inshore areas. Sardine spawning peaks 30–80 km offshore during September–October off the central Namibian shelf, with larvae occurring slightly further offshore and recruits appearing close inshore, so there appears to be a simple inshore–offshore movement over the Namibian shelf. Spawning also occurs in mid-summer in the vicinity of the Angola–Benguela Front. During late summer (December – March) warm water from the Angolan Current pushes southwards into central Namibian waters, allowing pelagic spawning products to be brought into the nursery grounds off central Namibia. There is a high likelihood of substantial offshore transport associated with this convergent frontal region.

Refer to Figure 18 for the major spawning grounds in Namibian waters. The stock distribution, spawning and recruitment of key target species are discussed below.

Sardine

The Namibian sardine stock is distributed inshore of the 200 m isobath, from the Lüderitz upwelling cell into southern Angola. There was a rapid decline in the sardine stock in the late 1960s, following intense exploitation, ecosystem change and variability, and poor recruitment. The status remains overexploited with a low biomass estimate and a significantly contracted distribution pattern compared to historical levels. It is reported that the stock has reduced by

99.5%, from an estimated 11 million tonnes in the 1960s to 50 000 tonnes in 2015. The fishery is currently closed following a moratorium that was implemented in 2018. Following the collapse of the sardine stock, two main spawning areas have been described in the northern Benguela, one off central Namibia in the Walvis Bay region and another further north near Palgrave Point. The spawning season is thought to be between August and April, with peaks in September/October and March.

Cape Horse Mackerel

Cape horse mackerel occurs predominantly north of 25°S, with juveniles present in the inshore pelagic regions up to the 200 m isobath and adult horse mackerel extending into waters up to 500 m deep. Concentrations are dense between Cape Cross and the Kunene River. Biomass estimates in this region are mostly low in summer, increasing in winter and early spring. Horse mackerel shoal in large numbers with a distinct diurnal vertical migration pattern, staying near the seabed during the day and rising in the water column to feed on zooplankton at night. Horse mackerel spawn continuously from September to May, peaking from January and April. Spawning occurs between Cape Frio and Cape Cross, with the highest spawning intensity taking place 50-100 km from the shore.

Large Pelagic Species

Albacore tuna, yellowfin tuna, bigeye tuna, shark and swordfish are large pelagic species with an extensive offshore distribution ranging along the entire Namibian coastline. Seven species occur in Namibian waters; however, albacore tuna dominate the pole fishery and bigeye tuna dominate the longline fishery. The abundance of these species has a strong seasonal signal resulting in increased availability to the fisheries targeting them at different periods.

For the pole fishery, availability increases from summer and peaks late summer to early autumn.

- Albacore tuna spawn off Brazil just south of the equator and in the central Atlantic, where surface temperatures exceed 24°C. Bait boats using pole and line target albacore tuna primarily in southern Namibia from January to March. Aggregations of albacore tuna are known to occur in the vicinity of the Tripp Seamount and the highest catch levels are recorded in this area.

For the pelagic longline sector targeting bigeye tuna, yellowfin tuna, longfin tuna and swordfish, the availability of these target species is highest from April to September. The longline tuna fishing season peaks two to three months later than the fishery for albacore tuna.

- Bigeye tuna spawn across the east central Atlantic, North of 5°N in the warmest season when surface temperatures are above 24°C, and in the Gulf of Guinea.
- Yellowfin tuna are distributed between 10°S and 40°S in the south Atlantic, and spawn in the central Atlantic off Brazil in the austral summer). Juvenile and immature yellowfin tuna

occur throughout the year in the Benguela system. After reaching sexual maturity they migrate (in summer) from feeding grounds off the West Coast of southern Africa to the spawning grounds in the central Atlantic.

- The availability of longfin tuna increases during the summer upwelling season due to the increased biological activity and bait fish (sardine and anchovy) abundance.
- Swordfish spawn in warm tropical and subtropical waters and migrate to colder temperate waters during summer and autumn months.

It is important to note that weather conditions play an important role in operations within the tuna fisheries (pole and line and longline). The high market price for tuna makes up for their relatively low catches off Namibia.

Hake

Hake is the most commercially important Namibian fishery. Two species of hake are caught in Namibian waters: Cape/shallow-water hake and deepwater hake. These species display diurnal vertical migration, occurring in demersal waters in the daytime and moving to mid-water at night. Studies suggest that deepwater hake migrate to South Africa to spawn and do not spawn within Namibian waters. However, Cape hake has been shown to spawn within Namibian waters, from north of the powerful Lüderitz upwelling centre to the Angola-Benguela front. This species displays variation in spawning, however spawning peaks during July to September along the shelf break off central Namibia. The hake stocks extend along the entire Namibian shelf and slope approximately between the 100 m and 1000 m isobaths.

Monkfish

Monkfish are found along the entire extent of the Namibian coast, with the fishery concentrated between 17°15'S and 29°30'S on the deeper continental shelf and upper slope between depths of 200 m to 500 m. Cape monkfish spawn throughout the year with a peak between July and September. Cape monkfish appear to spawn throughout Namibian waters, with evidence of hotspot spawning aggregation between 21º S and 25º S.

Deep-Sea Red Crab

Deep-sea red crab stocks are distributed predominantly from 23°35'S northwards into Angolan waters, within a depth range of approximately 300 m to 1000 m). Highest densities occur along the northern range of its distribution, the Angolan border, to 18°S. Spawning takes place throughout the year in the shallower waters of the continental slope with adult females generally occurring at shallower depths to that of males.

Orange Roughy

Orange roughy has a discontinuous pattern of distribution along the continental slope. Aggregations of fish occur within four known spawning grounds (within designated Quota Management Areas) within Namibian waters. The species has a short, intense spawning period of about a month from July to August during which individuals aggregate. As a result of overexploitation of the stock(s), the fishery (which only existed for four years) has been closed since 2007; however, the stock is currently being assessed and the viability of re-opening the fishery is under consideration.

6.5.2.3 COMMERCIAL FISHING SECTORS

The sector that overlaps most with PEL 83 is the large pelagic longline fishery. The other sectors are, however, also summarised below.

Large Pelagic Long-Line

This sector makes use of surface long-lines to target migratory pelagic species including yellowfin tuna (*T. albacares*), bigeye tuna (*T. obesus*), swordfish (*Xiphias gladius*) and various pelagic shark species particularly blue shark and mako shark. Commercial landings of these species by the fishery are variable and Namibian-reported catch from 2000 to 2021 is shown in Figure 28. There is provision for up to 26 fishing rights and 40 vessels, however 19 vessels were active during 2022.

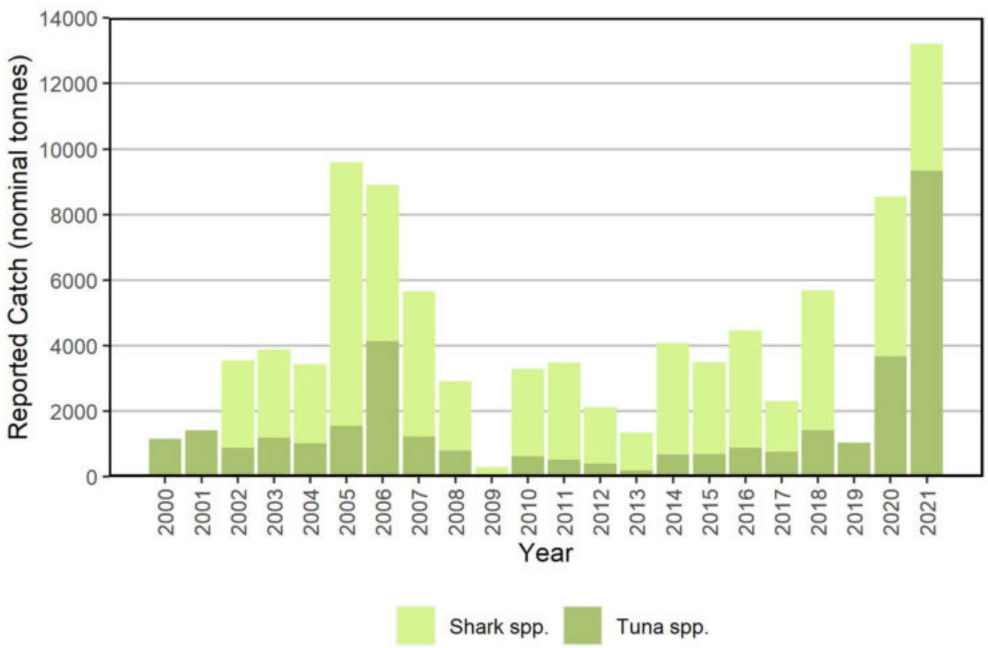


FIGURE 28: ANNUAL LONGLINE CATCH (NOMINAL TONNES) OF LARGE PELAGIC SPECIES REPORTED TO ICCAT BY THE NAMIBIAN LONGLINE FLEET BETWEEN 2000 AND 2021 (CAPMARINE, 2024)

Longline vessels targeting pelagic tuna species and swordfish operate extensively around the entire coast along the shelf-break and into deeper waters. The spatial distribution of fishing effort is widespread and may be expected predominantly along the shelf break (approximately along the 500 m isobath) and into deeper waters (2 000 m). Effort occurs year-round with a slight peak over the period March to May (see Figure 29). Figure 30 shows the spatial distribution of commercial catches along the Namibian coastline and in the vicinity of PEL83. Fishing takes place across the entire licence area. Over the period 2010 to 2022, an average catch of 69 tons per year was taken within the licence area. Average annual effort expended within the area amounted to 48,000 hooks. Note recent high catches within the area amounted to 124 tons during 2022.

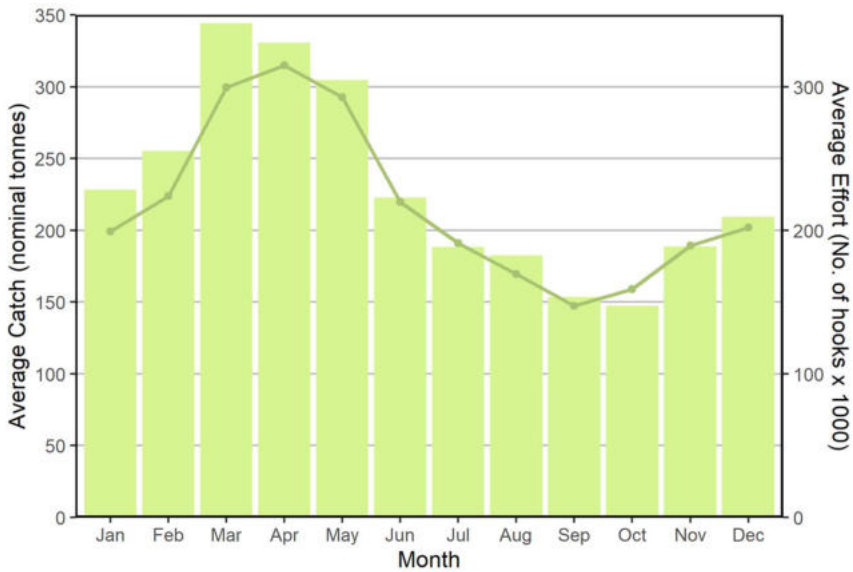


FIGURE 29: MONTHLY AVERAGE CATCH (BARS) AND EFFORT (LINE) RECORDED BY THE LARGE PELAGIC LONGLINE SECTOR WITHIN NAMIBIAN WATERS (2004 – 2019). SOURCE: MFMR (2019) (CAPMARINE, 2024)

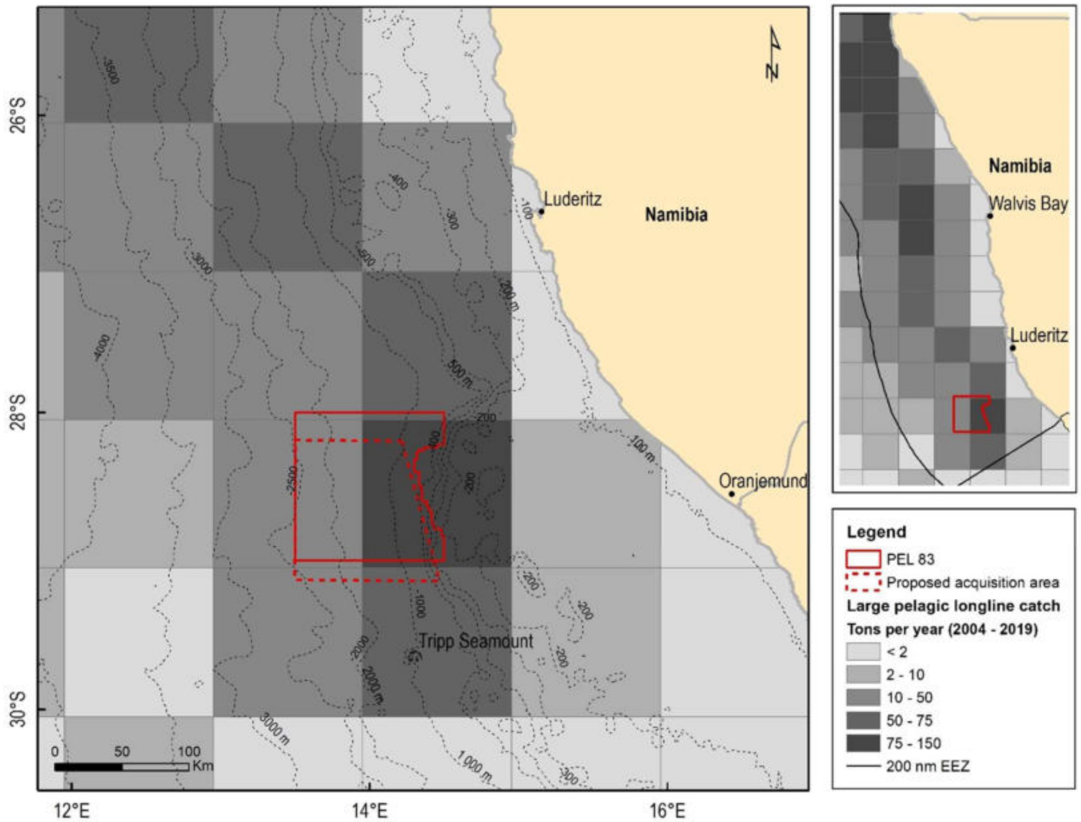


FIGURE 30: SPATIAL DISTRIBUTION OF CATCH RECORDED BY THE PELAGIC LONGLINE FISHERY (2004 – 2019) IN RELATION TO PEL 83. CATCH IS DISPLAYED ON A 60 X 60 MINUTE GRID (CAPMARINE, 2024)

Small Pelagic Purse-Seine

The pelagic purse-seine fishery is based on the Namibian stock of Benguela sardine (*Sardinops sagax*) (also regionally referred to as pilchard), and small quantities of juvenile horse mackerel. The main commercial fishing grounds are situated at least 360 km northward of the licence area and fishing grounds do not overlap with PEL 83.

Mid-Water Trawl

The fishery for Cape horse mackerel (*Trachurus capensis*) is the largest contributor by volume and second highest contributor by value to the Namibian fishing industry. The stock is caught by the mid-water trawl fishery (targeting adult horse mackerel) and pelagic purse-seine fishery (smaller quantities of juvenile horse mackerel). The midwater fishery operates using trawls within the water column to catch schools of adult horse mackerel. At closest point the main commercial fishing grounds are situated approximately 260 km northward of the licence area with incidental fishing recorded inshore of PEL 83. There is; however, no overlap of fishing activity with PEL 83.

Demersal Trawl

The most economically important species in Namibia are shallow-water hake (*Merluccius capensis*) and deepwater hake (*Merluccius paradoxus*). Fishing effort is relatively constant throughout the year except for a closure for the month of October and relatively lower levels of effort expended during November and December. Fishing grounds extend along the entire coastline following the distribution of hake and monkfish along the continental shelf at a depth range of 200 m to 850 m (refer to Figure 31). The nearshore extent of PEL 83 coincides with demersal trawling grounds. Over the period 2017 to 2022 an average catch and effort of 1551 tons and 1240 hours per year were reported within PEL 83. This is equivalent to 1.33% and 1.35%, respectively, of the total catch and effort reported by the sector.

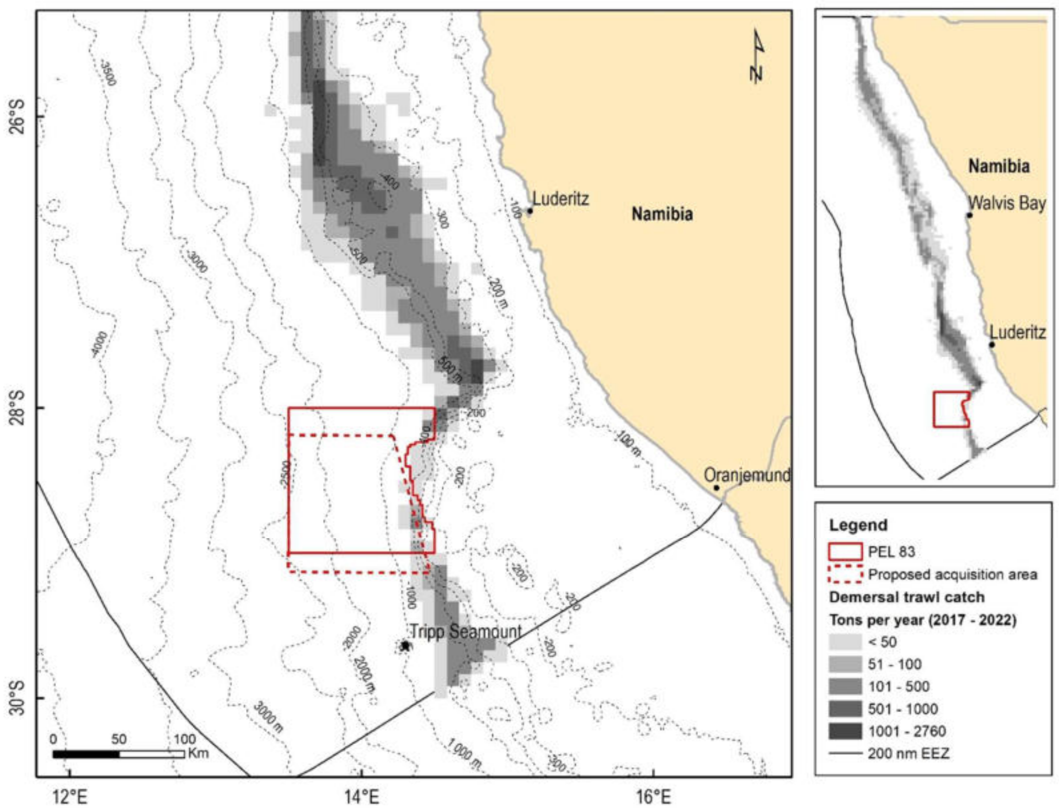


FIGURE 31: SPATIAL DISTRIBUTION OF HAKE CATCH BY DEMERSAL TRAWL VESSELS (2017 – 2022) IN RELATION TO PEL83 (CAPMARINE, 2024)

Demersal Long-Line

Similar to the demersal trawl fishery the target species of this fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. Long-line vessels fish in similar areas targeted by the hake-directed trawling fleet, in a broad area extending from the 200 m to 650 m contour along the full length of the Namibian coastline. Some 18 vessels operate within the sector. Those based in Lüderitz mostly work south of 26°S towards the South Africa border. Figure 32 shows the distribution of catch reported in relation to PEL 83. The nearshore extent of PEL 83 coincides with demersal longline fishing grounds. Over the period 2005 to 2018 an average catch and effort of 113 tons and 625,000 hooks per year were reported within PEL 83. This is equivalent to 1.1% and 1.53%, respectively, of the total catch and effort reported by the sector.

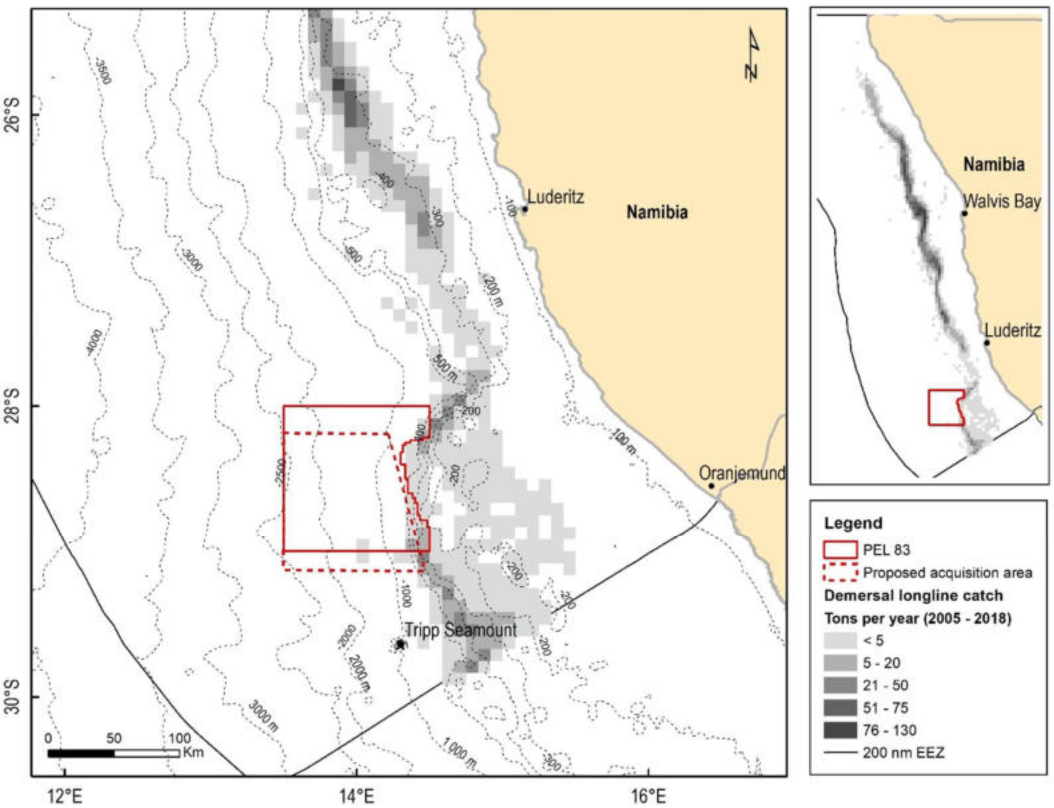


FIGURE 32: SPATIAL DISTRIBUTION OF CATCH REPORTED BY THE DEMERSAL LONG-LINE FISHERY TARGETING CAPE HAKES (*M. CAPENSIS*; *M. PARADOXUS*) IN RELATION TO PEL83 (2005 – 2018) (CAPMARINE, 2024)

Tuna Pole-Line

Poling for tuna is predominantly based on the southern Atlantic albacore (longfin tuna) stock (*T. alalunga*) and a small amount of skipjack tuna (*Katsumonus pelamis*), yellowfin tuna and bigeye tuna. Commercial landings of large pelagic species are variable and Namibian-reported catches reported by the pole sector (also referred to as "baitboat") are shown in Figure 33. The fishery is seasonal with vessel activity mostly between November and May and peak catches in March and April. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. As such the fishery is dependent on window periods of favourable conditions relating to catch availability.

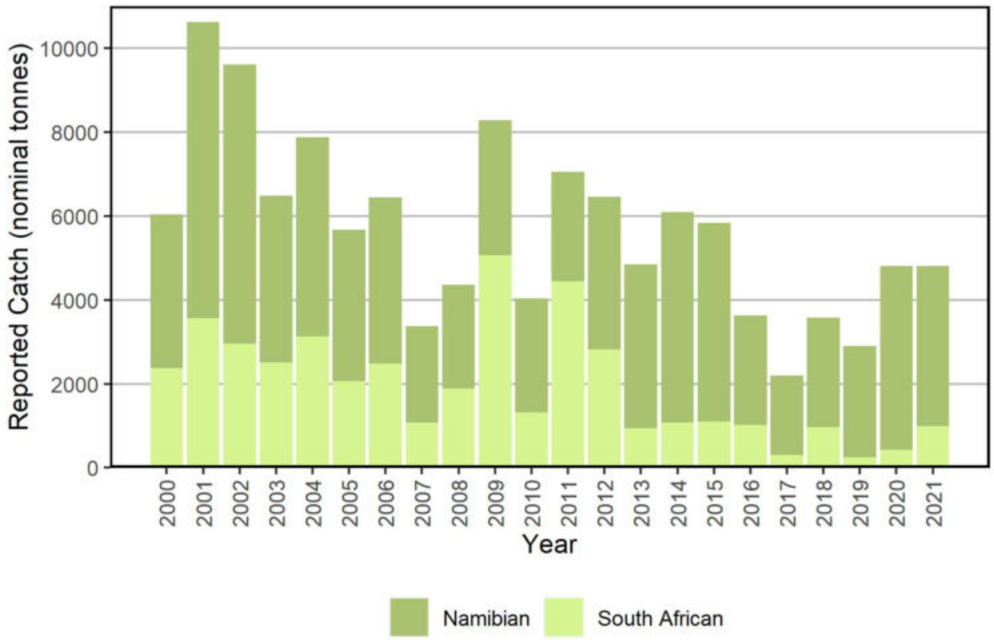


FIGURE 33: TOTAL NOMINAL POLE-LINE CATCH (TONNES) REPORTED BY SOUTH AFRICAN AND NAMIBIAN FLAGGED VESSELS FROM 2000 TO 2021 (CAPMARINE, 2024)

Aggregations of albacore tuna occur in specific areas, in particular Tripp Seamount which is situated just north of the South Africa/ Namibia maritime border. Catches in this area are variable from year to year, although boats will frequent the area knowing that albacore aggregate around the seamount after migrating through South African waters. The southern boundary of the licence area is situated 70 km to the North of Tripp Seamount. The movement of albacore between South Africa and Namibia is not clear although it is believed that the fish move northwards following bathymetric features and generally stay beyond the 200 m depth contour.

Figure 34 shows the spatial distribution of catch reported by the sector between 2012 and 2022. Over this period an annual average of 7.5 t of albacore per year was caught within PEL 83, with fishing activity only on the eastern extent of the licence area. This is equivalent to 1.38% of the national effort and 1.05% of the national albacore catch reported by the sector. Due to variability year-to-year in this sector, it is noted that yields in the area were relatively high in 2021, with a reported albacore catch of 50.7 t (6.36% of total). The latest available data shows albacore catch of 11.5 t in 2022 (1.56% of total). Activity in PEL 83 takes place predominantly during February, with some activity reported during January and March.

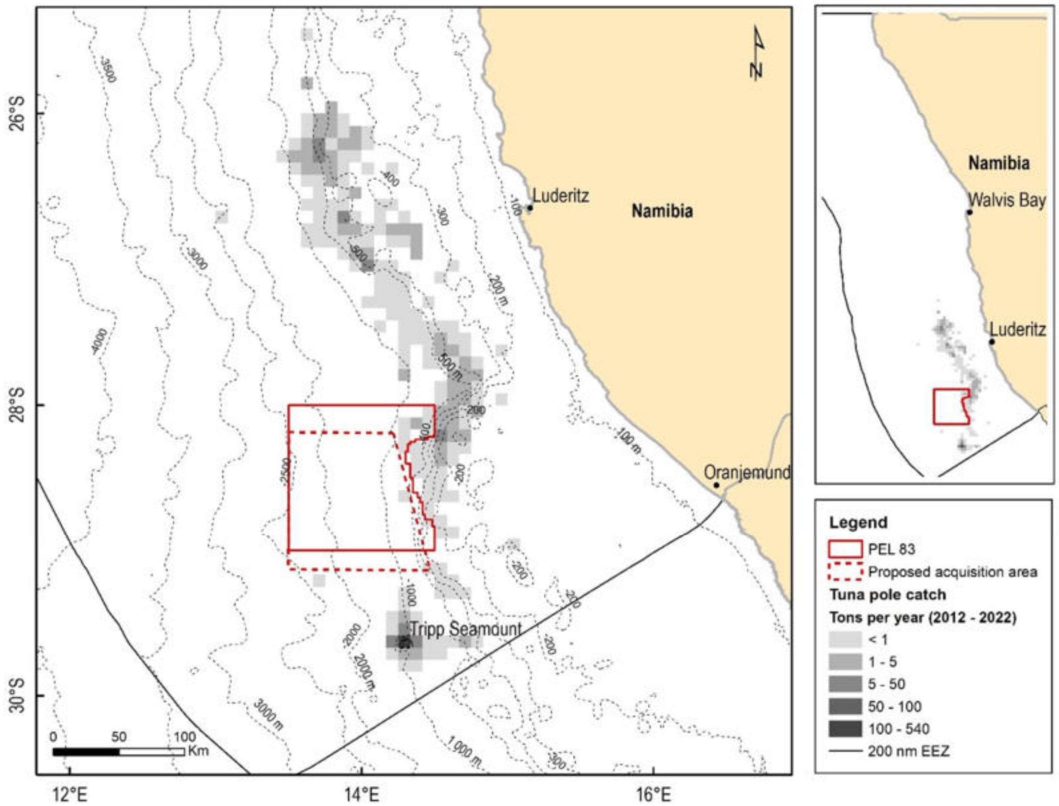


FIGURE 34: SPATIAL DISTRIBUTION OF CATCH REPORTED BY THE TUNA POLE AND LINE FLEET ALONG THE NAMIBIAN COASTLINE AND IN THE VICINITY OF PEL83 (2012 – 2022) (CAPMARINE, 2024)

Line fish

The traditional line fishery primarily targets snoek (*Thyrsites atun*) with bycatch of yellowtail, silver kob (*Argyrosomus inodorus*), dusky kob (*A. coronus*), and shark, which are sold on the local market. Snoek availability to the fishery is seasonal. Catches peak in late summer where after the fish migrate south into South African waters. The other species caught, such as kob and shark occurs year-round, but is in relatively small amounts. Operationally the fishery is limited in extent to Walvis Bay, Swakopmund and Henties Bay and also due to the small size of the boats does not operate much further than 12 nm offshore (i.e. 22 km). There is also a small component of the fishery operating out of Lüderitz in the South.

The sector operates inshore of the 200 m depth contour with incidental reports of fishing in deeper waters. Although there are incidental reports of fishing activity within PEL 83 it is likely that these are incorrectly reported fishing positions or errors in the transcription of records from logbooks to electronic database as it is unlikely that activity would be expected in waters deeper than 200 m. The closest fishing activity taking place from Lüderitz, is at least 120 km north-east of PEL 83.

Deep-Sea Crab

The Namibian deep-sea crab fishery is based on two species of crab namely spider crab (*Lithodes ferox*) and red crab (*Chaceon maritae*). Fishing grounds are located at least 620 km to the north of PEL 83 and there is therefore no spatial overlap of the licence blocks with the sector.

Deep-Water Trawl

The deep-water trawl fishery is a small but lucrative fishing sector directed at the outer Namibian shelf from 400 m to 1500 m water depth targeting orange roughy (*Hoplostethus atlanticus*) and alfonsino (*Beryx splendens*). Both species are extremely long-lived and aggregate densely, leading to high catch rates. General aggregations of the stock occur between June and August. Fishable aggregations are usually found on hard grounds on features such as seamounts, drop-off features or canyons. Off Namibia, orange roughy has a restricted spawning period of less than a month in late July, when spawning takes place in dense aggregations close to the bottom in small areas typically between 10 and 100 km^2 in extent. The fishery is split into four Quota Management Areas (QMA's) referred to as "Hotspot", "Rix", "Frankies" and "Johnies" (see Figure 35) and TACs are set for each specific QMA. The licence area coincides with the QMA "Johnies". The fishery has been closed since 2007; however, the stock is currently being assessed with a view to considering the viability of re-opening the fishery. Research surveys are undertaken in July each year by MFMR to assess the status of the resource.

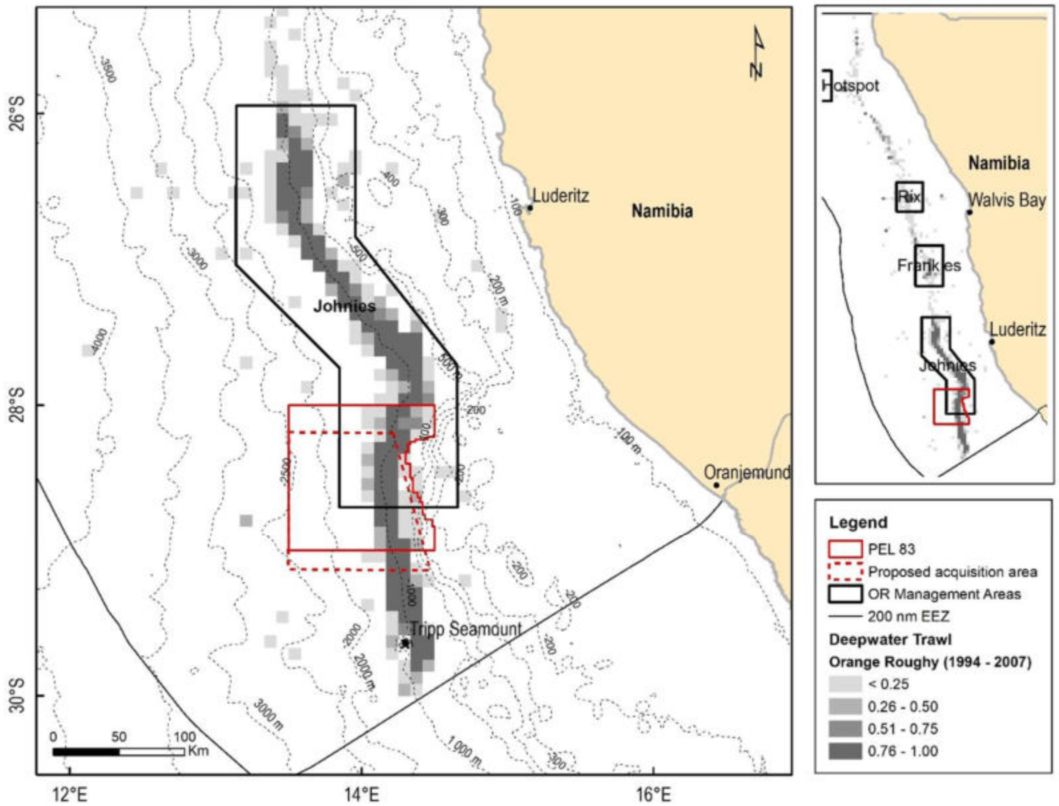


FIGURE 35: MANAGEMENT AREAS USED BY THE DEEP-WATER TRAWL FISHERY IN RELATION TO PEL 83 (CAPMARINE, 2024)

Rock Lobster

The small but valuable fishery of rock lobster (*Jasus lalandii*) is based exclusively in the port of Lüderitz. The sector operates in water depths of between 10 and 80 m. PEL 83 is situated at least 100 km from the outer depth (50 m) at which rock lobster is caught and therefore there is no spatial overlap between the licence area and fishing grounds.

6.5.3 SHIPPING

There are various international shipping routes along the Namibian coastline. The majority of the international shipping traffic is located on the outer edge of the continental shelf. Traffic inshore of the continental shelf largely comprises fishing and mining vessels, especially off the coast of Oranjemund, which is inshore of the licence area. PEL 83 is located on the eastern boundary of the main traffic routes that pass around southern Africa (see Figure 36). There are also dense traffic routes along the inshore edges and eastern section of the licence area.

The two main ports in Namibia, both operated by NamPort, are:

- Port of Walvis Bay: Walvis Bay is Namibia's largest commercial port and is a key port for regional and international shipping trade. It offers direct access to principal shipping routes and is a natural gateway for international trade. It has a sheltered deep-water harbour which benefits from a temperate climate.
- Port of Lüderitz: Lüderitz Port is historically Namibia's second largest port, functioning mainly as a fishing port. It has expanded in recent years to ship cargo from the mining industry and to support and service offshore petroleum exploration, diamond mining activities and other commodities. Lüderitz is the closest Namibian port to the licence area, approximately 165 km to the north-east.

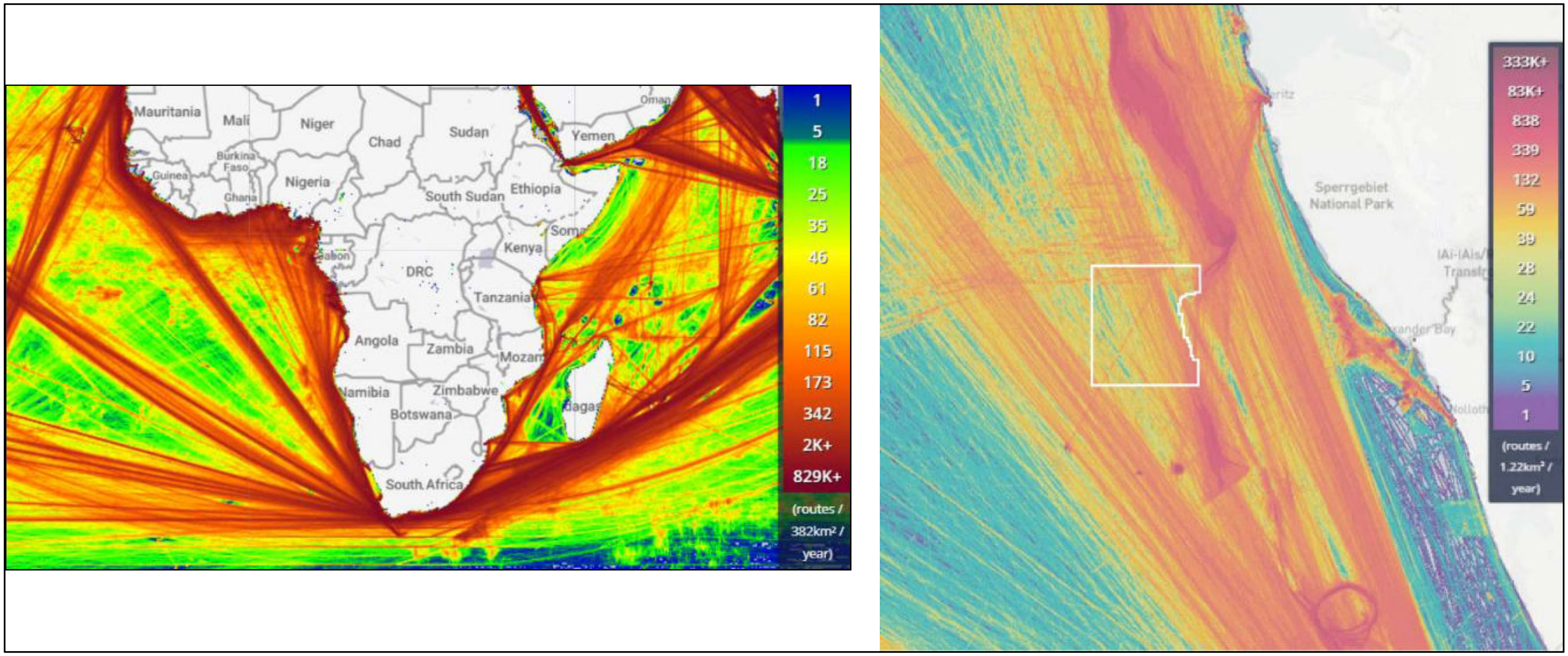


Figure 36: **PEL83 IN RELATION TO SHIPPING DENSITY AROUND SOUTHERN AFRICA (adapted from www.marinetraffic.com/en/ais/home)**

6.5.4 MINING

PEL 83 lies well offshore of the Exclusive Prospecting Licences (EPLs) and Mining Licences (MLs) for minerals (Figure 37). Current activities in the EPLs are minimal to non-existent, the only active operations being diamond mining in ML47 (Atlantic 1) held by De Beers Marine Namibia off Oranjemund. Deep-water diamond mining operations in the Atlantic 1 ML Area are typically conducted to depths of 150 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. These vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread. Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

Other current and proposed industrial uses of the marine environment include the intake of cooling water for power plants, intake of feedwater for desalination plants, and seawater intakes for fish processing, or mariculture operations. These, however, are all located around Lüderitz and Walvis Bay, well to the north and inshore of PEL 83 and should in no way be affected by the drilling of exploration wells beyond the 3 000 m depth contour.

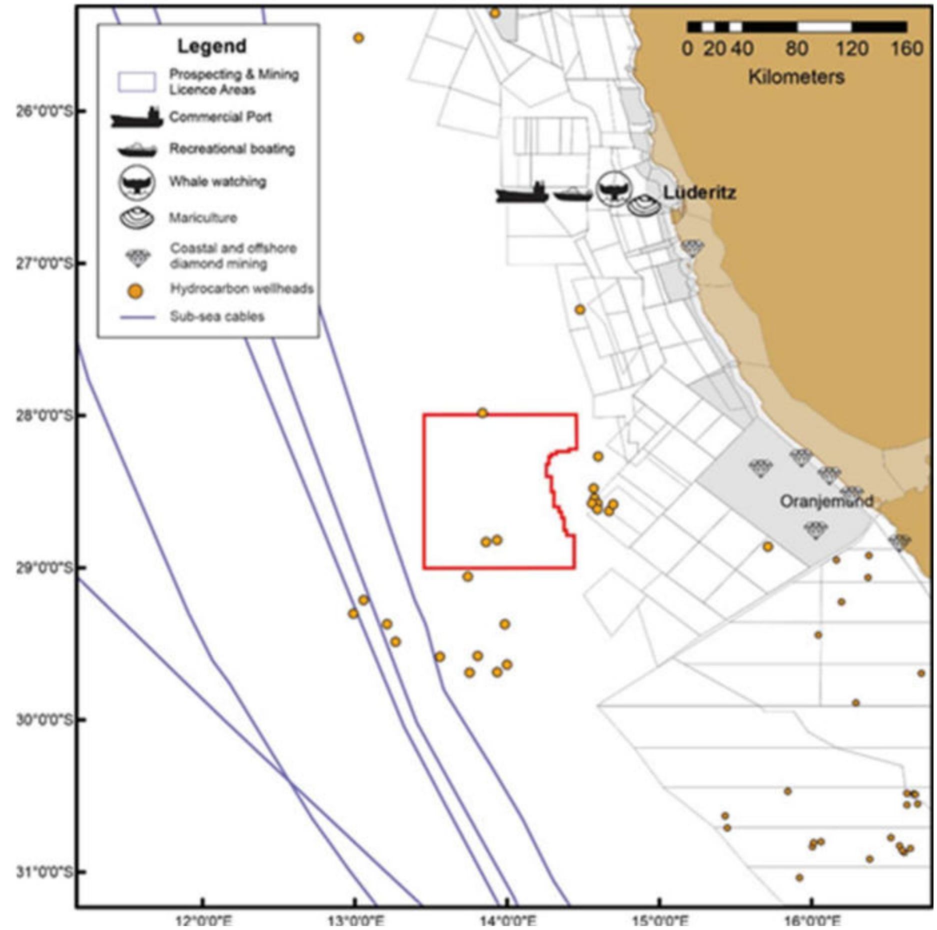


FIGURE 37: PEL 83 IN RELATION TO PROJECT - ENVIRONMENT INTERACTION POINTS ON THE NAMIBIAN COAST, ILLUSTRATING THE ACTIVE MARINE DIAMOND MINING CONCESSIONS (SHADED) AND EPLS, HYDROCARBON WELLHEADS, TELECOMMUNICATIONS CABLES AND OTHER USERS OF THE MARINE ENVIRONMENT (PISCES, 2024)

7 IDENTIFICATION AND DESCRIPTION OF POTENTIAL ENVIRONMENTAL IMPACTS THAT ARE LIKELY TO CHANGE AS A RESULT OF THE PROPOSED ONGOING EXPLORATION ACTIVITIES AND ASSESSMENT CRITERIA & METHODOLOGY

This chapter outlines the environmental aspects and potential impacts associated with the proposed ongoing / further exploration activities in PEL 83, focusing on the further 3D Seismic Acquisition and associated activities. Furthermore, the assessment criteria and methodology for (re)`assessing the impacts associated with the proposed 3D seismic survey activities are described.

7.1 Aspect and Impact Identification

Environmental aspects and potential impacts were identified as part of the original EIAs, as follows:

- EIA for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia (ERM, 2017)
- EIA for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia (SLR, 2019).
- EIA Amendment for the proposed offshore exploration well drilling in PEL 83: Well Testing (Namisun, 2023).

The above-mentioned EIA processes each included public participation / stakeholder engagement, and aspects and impacts were therefore further identified in consultation with stakeholders.

Information and study findings from the above mentioned EIAs were therefore referred to in the identification of key aspects / potential impacts to be further assessed (i.e. re-assessed as part of this EIA process and report[9]), relating to the ongoing exploration activities, taking cognisance of the fact that the proposed activities would largely be similar to those previously identified, assessed, approved and undertaken. Another public participation process is also being undertaken as part of the current EIA process, allowing I&APs further opportunities to identify aspects / potential impacts and to review the related EIA reports (refer to section 2.3).

The aspects are linked to the project description in Chapter 4 and should be read in the context of the updated baseline conditions described in Chapter 6. The key environmental and social impacts associated with Galp's proposed ongoing / further exploration activities (i.e. 3D Seismic Acquisition and associated activities) in PEL 83 are summarised below.

[9] The ERM (2017) report and related Specialist studies were specifically referred to in this report, relating to the (re) assessment of impacts for the proposed further 3D Seismic Acquisition and associated activities.

7.1.1 POTENTIAL IMPACTS RELATING TO THE FURTHER 3D SEISMIC SURVEY ACTIVITIES

A summary of the environmental and social aspects and potential impacts, linked to the further 3D seismic survey activities, are provided in Table 10. Refer to Chapter 8 for the assessment of the potential impacts.

TABLE 10: SUMMARY OF THE ENVIRONMENTAL AND SOCIAL ASPECTS AND POTENTIAL IMPACTS, LINKED TO THE FURTHER 3D SEISMIC SURVEY ACTIVITIES

Activities	Aspects	Receptor	Potential Impacts
		Mobilisation phase	
Transit of survey vessels between the survey area and the onshore logistics	Underwater noise levels	Marine ecology	Disturbance to marine fauna
	Routine discharge to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
	Vessel Lighting	Marine ecology	Disorientation and mortality of marine birds
			Increased predator - prey interactions
	Discharge of ballast water and equipment fouling	Marine ecology	Loss of biodiversity due to the introduction of invasive alien species
		Operation Phase	
Operation of survey vessels	Increase in underwater noise levels	Marine ecology	Disturbance to marine fauna
	Routine discharge of waste to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Fish aggregation and increased predator - prey interactions
	Increase in ambient lighting	Marine ecology	Disorientation and mortality of marine birds
			Increased predator - prey interactions
Deployment of streamers	Safety exclusion zone	Fishing Industry	Temporary cessation or displacement of marine traffic and transport within the survey area.
		Marine traffic and transport	

Activities	Aspects	Receptor	Potential Impacts
Deployment of OBNs	Movement of ROV on the seafloor and placement of the OBNs	Marine ecology	Disturbance of seabed sediments and crushing of benthic macrofauna due to OBN placement
Seismic acquisition	Acoustic emissions from sound sources, i.e. increase in underwater noise levels	Marine ecology	Disturbance / behavioural changes to marine fauna
			Physiological effect on marine fauna
			Fish avoidance of key feeding areas
			Reduced fish catch and increased fishing effort
		Fishing Industry	Change in catch rate due to behavioural avoidance of fish in and around survey areas
Operation of helicopters (Only used for Medical evacuations or any hypothetical rescue exercises)	Increase in noise levels	Marine ecology	Avoidance of key breeding areas (e.g. coastal birds and cetaceans)
			Abandonment of nests (birds) and young (birds and seals)
Demobilisation Phase			
Survey vessels leave survey area and transit to port or next destination	Increase in underwater noise levels during transit	Marine ecology	Disturbance to marine fauna
	Routine discharge to sea (e.g. deck and machinery space drainage, sewage and galley wastes) and local reduction in water quality during transit	Marine ecology	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
	Increase in noise levels	Marine ecology	Avoidance of key breeding areas (e.g. coastal birds and cetaceans)
			Abandonment of nests (birds) and young (birds and seals)
Unplanned Events			
	Collison and entanglement with marine fauna	Marine ecology	Physiological effect on marine fauna

Activities	Aspects	Receptor	Potential Impacts
Collision with survey vessels and equipment / deployment of streamers	Safety exclusion zone	Fishing Industry	Disturbance to fishing activities from accidental interactions with fishing gear.
Dropped objects / Lost equipment	Increased hard substrate on seafloor	Marine ecology	Physical damage to and mortality of benthic species / habitats
			Obstruction to or damage of fishing gear
Hydrocarbon spills	Release of fuel into sea during bunkering and localised reduction in water quality	Marine ecology	Effect on faunal health (e.g. respiratory damage) or mortality (e.g. suffocation and poisoning)

7.2 IMPACT ASSESSMENT CRITERIA AND METHODOLOGY

The criteria used to assess the environmental aspects identified above and the method used to determine the significance of the impacts are outlined in Table 11, Table 12 and Table 13.

This method complies with the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) EIA regulations. Table 11 provides the impact assessment criteria and the approach for determining impact consequence (combining nature and intensity, extent and duration) and impact significance (the overall rating of the impact). The significance is calculated by multiplying the consequence of an impact by its probability.

Consequence is a function of (a) nature and intensity of the potential impact, (b) geographical extent should the impact occur, and (c) duration of the impact. These factors are combined as shown in Table 12. The impact significance is determined as per Table 13.

TABLE 11: IMPACT ASSESSMENT CRITERIA

RANKING THE NATURE AND INTENSITY OF THE POTENTIAL IMPACT	
Negative Impacts	
Low (L)	The impact has no or minor effect/deterioration on natural, cultural and social functions and processes. No measurable change. Recommended standard / level will not be violated. Limited nuisance-related complaints.
Moderate (M)	Natural, cultural and social functions and processes can continue, but in a modified way. Moderate discomfort that can be measured. Recommended standard / level will occasionally be violated. Various third-party complaints can be expected.
High (H)	Natural, cultural or social functions and processes are altered in such a way that they temporarily or permanently cease. Substantial deterioration of the impacted environment. Widespread third-party complaints are expected.
Very high (VH)	Substantial deterioration (death, illness or injury). Recommended standard / level will often be violated. Vigorous action by third parties is expected.
RANKING THE NATURE AND INTENSITY OF THE POTENTIAL IMPACT	
Positive Impacts	
Low (L) +	Slight positive effect on natural, cultural and social functions and processes Minor improvement. No measurable change.
Moderate (M) +	Natural, cultural and social functions and processes continue but in a noticeably enhanced way. Moderate improvement. Little positive reaction from third parties.
High (H) +	Natural, cultural or social functions and processes are altered in such a way that the impacted environment is considerably enhanced /improved. Widespread, noticeable positive reaction from third parties.
Very high (VH) +	Substantial improvement. Will be within or better than the recommended level. Favourable publicity from third parties.

RANKING THE EXTENT		
Low (L)	Local (confined to within the project area and its close surroundings).	
Moderate (M)	Regional (confined to the coast, basin, catchment, municipal region, district, etc.).	
High (H)	National (beyond district or regional boundaries with national implications).	
Very high (VH)	International (impact extends beyond the national scale or may be transboundary).	
RANKING THE DURATION		
Low (L)	Temporary/short-term. Quickly reversible (less than the project life-time).	
Moderate (M)	Medium-term. Impact can be reversed over the life of the project.	
High (H)	Long-term. Impact will only cease after the life of the project.	
Very high (VH)	Permanent	
RANKING THE PROBABILITY		
Low (L)	Unlikely	
Moderate (M)	Possibly	
High (H)	Most likely	
Very high (VH)	Definitely	
SIGNIFICANCE DESCRIPTION		
	POSITIVE	**NEGATIVE**
Low (L)	Supports the implementation of the project.	No influence on the decision.
Moderate (M)	Supports the implementation of the project.	It should have an influence on the decision, the impact will not be avoided unless it is mitigated.
High (H)	Supports the implementation of the project.	It should influence the decision to not proceed with the project or require significant modification(s) of the project design, location (where relevant).
Very high (VH)	Strongly supports the implementation of the project.	It should influence the decision not to proceed with the project.

TABLE 12: DETERMINING THE CONSEQUENCE

DETERMINING THE CONSEQUENCE					
INTENSITY OF IMPACT = LOW					
DURATION	**VH**	**Moderate**	**Moderate**	**High**	**High**
	H	**Moderate**	**Moderate**	**Moderate**	**Moderate**
	M	**Low**	**Low**	**Low**	**Moderate**
	L	**Low**	**Low**	**Low**	**Moderate**
INTENSITY OF IMPACT = MODERATE					
DURATION	**VH**	**Moderate**	**High**	**High**	**High**
	H	**Moderate**	**Moderate**	**High**	**High**

	M	Moderate	Moderate	Moderate	Moderate
	L	Low	Moderate	Moderate	Moderate
INTENSITY OF IMPACT = HIGH					
DURATION	VH	High	High	Very High	Very high
	H	High	High	High	Very High
	M	Moderate	Moderate	High	High
	L	Moderate	Moderate	High	High
INTENSITY OF IMPACT = VERY HIGH					
DURATION	VH	Very high	Very High	Very High	Very high
	H	High	High	Very High	Very high
	M	High	High	High	Very High
	L	Moderate	High	High	Very High
		L	M	H	VH
		EXTENT			

TABLE 13: DETERMINING THE SIGNIFICANCE

DETERMINING THE SIGNIFICANCE					
PROBA-BILITY	VH	Moderate	High	High	Very high
	H	Moderate	Moderate	High	Very high
	M	Low	Moderate	High	High
	L	Low	Low	Moderate	High
		L	M	H	VH
		CONSEQUENCE			

Both mitigated and unmitigated scenarios are considered for each impact.

The methodology has been systematically applied in the assessment of the identified potential impacts, as described in Chapter 8. Management and mitigation measures to address the identified negative impacts and to enhance the positive benefits are included in the ESMP in Appendix H.

With reference to Section 1.4, the potential impacts relating to the proposed further exploration activities need to be re-assessed, as part of: 1) a new application for the 3D seismic (i.e. towed streamer and OBN) surveys and related activities (this report); and 2) an amendment application for the further exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC) (refer to the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling (submitted at the same time as this report to MEFT and MME)).

Therefore, the (re)assessment of impacts relating to the new application for the further 3D Seismic Acquisition and associated activities provides detailed quantification of the various criteria (in Chapter 8[10]), whereas the (re)assessment of impacts relating to the amendment application for the well drilling is carried out qualitatively in another report.

The potential cumulative impacts were also considered where relevant, taking the interaction between the existing environment, existing or planned third-party activities (i.e. other companies' exploration activities in the surrounding area) with the Galp's proposed ongoing activities. It must be noted, however, that a Strategic Environmental Assessment (SEA) has not been undertaken for all the current and planned offshore exploration (and associated) activities in this part of the Orange Basin. It is therefore, recommended that the relevant Namibian Ministries (i.e. MME, MFMR and MEFT) consider that a SEA be undertaken to further assist in future development plans and related impact assessments for this area.

[10] Even though these detailed (re)assessments were undertaken for the new application, it is noted that the proposed further seismic survey activities will be relatively similar to what was previously described, assessed, approved and undertaken by Galp.

8 IMPACT ASSESSMENT: FURTHER 3D SEISMIC SURVEY ACTIVITIES

This chapter assesses the key potential impacts (as identified in Chapter 7), relating to the proposed further 3D Seismic survey (and associated) activities in PEL 83.

The information in this section was sourced from, amongst others, the following Specialist Studies[11]:

- The Marine Specialist Study (refer to Appendix F).
- Underwater Heritage Impact Assessment report (Appendix G).

Furthermore, the assessment findings from the following reports were considered, where relevant:

- The original EIA Report for 3D seismic survey in PEL 83 (ERM, 2017).
- The EIA Amendment Report (Namisun, 2023).

Relevant sections were therefore extracted from the above-mentioned Specialist studies and reports.

With reference to section 7.2, a detailed (re)assessment of impacts (i.e. a detailed quantification of the various criteria) are provided in the following sections, which relate to the new application for Galp's proposed further 3D seismic survey activities.

8.1 IMPACTS ASSOCIATED WITH THE VESSELS MOVEMENT AS WELL AS HELICOPTER FLIGHTS

8.1.1 DISTURBANCE AND BEHAVIOURAL CHANGES IN SEABIRDS, SEALS, TURTLES AND CETACEANS DUE TO VESSEL MOVEMENT AND SUPPORT AIRCRAFT

a) Nature and intensity of impact, duration and geographical extent (and consequence)

Elevated underwater and aerial noise can affect marine fauna, including cetaceans, by:

- Causing direct physical injury to hearing.
- Masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey).
- Causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas.

[11] Various references were made in the Specialist Reports, which will not be repeated in this report. For the detailed list of references refer Specialist Reports (Appendix F and G).

Vessel Noise

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation. Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms. Natural ambient noise will vary considerably with weather and sea state, ranging from about 80 to 120 dB re 1 μPa for the frequency range 10 – 10k Hz. Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping, with the largest contributors being containerships, dry bulk and liquid tanker vessels, which emit 75% of the underwater shipping noise source energy. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 μPa at 1 m. Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas.

Consequence

As the proposed survey area falls within with the main offshore shipping routes that pass around southern Africa, the shipping noise component of the ambient noise environment is expected to be the dominant component within and around the survey area. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90 - 130 dB re 1 μPa for the frequency range 10 Hz – 10 kHz (SLR Consulting Australia, 2019). The noise generated by the survey vessel, thus falls within the hearing range of most fish and marine mammals and would be audible for considerable ranges before attenuating to below threshold levels. However, unlike the noise generated by the sound source, underwater noise from vessels is not considered to be of sufficient amplitude to cause direct harm to marine life, even at close range. Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed seismic surveys is expected to be low and consequently the intensity of potential physiological injury or behavioural disturbance as a result of vessel noise would be rated as low. Furthermore, the duration of the impact on the populations would be limited to the short-term (3 months) and extend regionally between the survey area and the logistics base. The potential physiological injury or behavioural disturbance as a result of vessel noise would thus be of **low Consequence**.

Aircraft

The hazards of aircraft activity to birds include direct strikes as well as disturbance, the degree of which varies greatly. The negative effects of disturbance of birds by aircraft include loss of usable habitat, increased energy expenditure, reduced food intake and resting time and consequently impaired body condition, decreased breeding success and physiological changes. Nesting birds may also take flight and leave eggs and chicks unattended, thus affecting hatching success and recruitment success.

Sensitivity of birds to aircraft disturbance are not only species specific, but generally lessened with increasing distance, or if the flight path was off to the side and downwind. However, the vertical and lateral distances that invoke a disturbance response vary widely, with habituation to the frequent loud noises of landing and departing aircraft without ill effects being reported for species such as gulls, lapwings, ospreys and starlings, amongst others. Further work is needed to examine the combined effects of visual and acoustic stimuli, as evidence suggests that in situations where background noise from natural sources (e.g. wind and surf) is continually high, the visual stimulus may have the greater effect.

Consequence

Noise generated by helicopters undertaking crew transfers between the logistics base and the survey vessel could affect seabirds and seals in breeding colonies and roosts on the mainland coast. The nearest seabird colonies to Lüderitz airport are at Lüderitz lagoon, Halifax and Possession Islands, all of which are important bird areas and provide a vital breeding habitat. The Lüderitz lagoon and Halifax colonies fall into the potential flight paths between the airport and the northwestern corner of the licence area, and flight paths would need to be planned to avoid these colonies. North and South Long Islands and the Atlas and Wolf Bay seal colonies, similarly fall within the direct flight path between Lüderitz and the project area. The seal colonies at Atlas Bay, Wolf Bay and Long Islands ~150 km to the northeast of PEL 83 represent the largest colonies in southern Namibia, with smaller colonies at Van Reenen Bay and Baker's Bay, about 120 km inshore of the eastern boundary of the project area. If the Lüderitz airport is used as the logistics base for rotary-wing operations, flight paths would need to be planned to avoid these colonies, particularly the one at Atlas Bay, Wolf Bay and Long Islands, which falls into the direct flight path from the airport to the area of operation. If Walvis Bay is used as the logistics based for rotary-wing operations, there would be no overlap of flight paths with seal colonies.

Indiscriminate low altitude flights over whales, seals, seabird colonies and turtles by helicopters used to support the seismic vessel could thus have an impact on behaviour and breeding success. The intensity of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions and could range from low to high intensity for individuals but of low intensity for the populations as a whole. As such impacts would be regional (although temporary in nature - a few minutes while the helicopter passes overhead) to the flight path and short-term (3 months), impacts would be of **low Consequence**.

b) Probability and Significance

Vessel Noise

The potential impact of vessel noise causing physiological injury to, or behavioural avoidance by, pelagic and coastal sensitive species, is deemed to be of **LOW significance**.

Aircraft

The potential impacts associated with aircraft causing physiological injury to, or behavioural avoidance by, pelagic and coastal sensitive species, is deemed to be of **LOW significance**.

Impact Summary – *Disturbance and behavioural changes in seabirds, seals, turtles and cetaceans due to* due to vessel movement and support aircraft

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**M**	**L**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- The generation of noise from helicopters cannot be eliminated when helicopters are required during emergency evacuations (only). Similarly, the generation of vessel noise cannot be eliminated. The proposed mitigation, specifically maintaining the regulated altitude over the coastal zone and MPAs and flying perpendicular to the coast would reduce the impact significance.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2 Impacts associated with the Seismic acquisition

8.2.1 Acoustic impacts of further 3D Seismic Surveys on Marine Fauna

8.2.1.1 Background information

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation. Acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms. Refer to Figure 38 for approximate sound production and hearing ranges of marine taxa and frequency ranges of selected anthropogenic sound sources.

Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 μPa at 1 m. Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate hundreds of kilometres thereby affecting very large geographic areas.

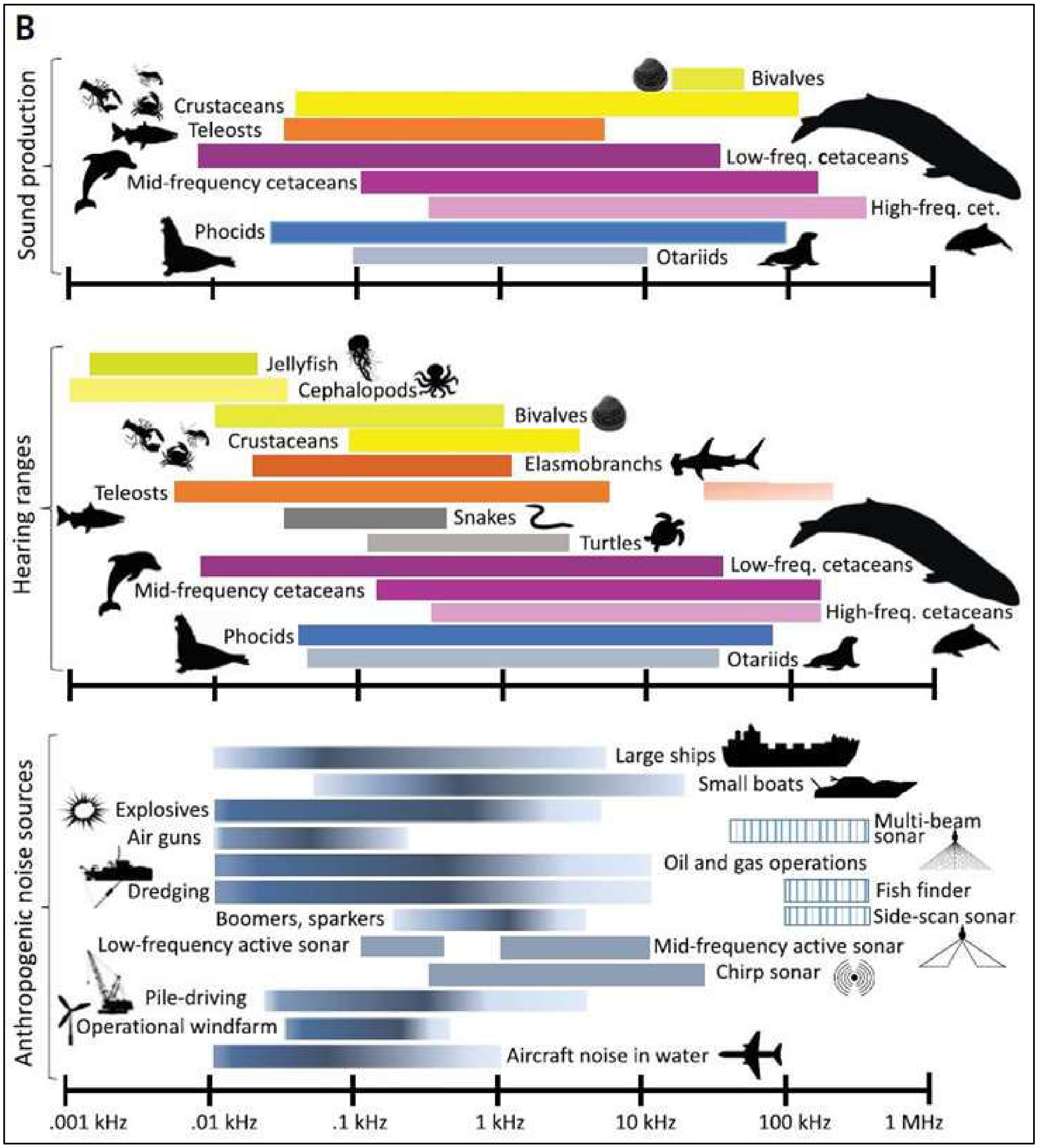


FIGURE 38: APPROXIMATE SOUND PRODUCTION AND HEARING RANGES OF MARINE TAXA AND FREQUENCY RANGES OF SELECTED ANTHROPOGENIC SOUND SOURCES

As PEL 83 is located within the main offshore shipping routes that pass around southern Africa, the shipping noise component of the ambient noise environment is expected to be significant within and around the proposed 3D acquisition area. (See section 6.5.3 for further details). For the duration of the survey an exclusion zone would be established around the survey vessel. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90–130 dB re 1 µPa for the frequency range 10 Hz – 10 kHz.

The airguns used in modern seismic surveys produce some of the most intense non-explosive sound sources used by humans in the marine environment and are the second highest contributor of human-caused underwater noise in total energy output per year. However, the transmission and attenuation of seismic sound is probably of equal or greater importance in the assessment of environmental impacts than the produced source levels themselves, as transmission losses and attenuation are very site specific, and are affected by propagation conditions, distance or range, water and receiver depth and bathymetrical aspect with respect to the source array. Seismic source energy transmitted at longer ranges (> 1 km) is typically dominated by low frequency (< 300 Hz) energy, with high frequency energy observed only at short range (< 1 km). In water depths of 25 - 50 m airgun arrays are often audible above ambient noise levels to ranges of 50 - 75 km, and with efficient propagation conditions such as experienced on the continental shelf or in deep oceanic water, detection ranges can exceed 100 km and 1 000 km[12], respectively.

The signal character of seismic shots also changes considerably with propagation effects. Reflective boundaries include the sea surface, the sea floor and boundaries between water masses of different temperatures or salinities, with each of these preferentially scattering or absorbing different frequencies of the source signal. This results in the received signal having a different spectral makeup from the initial source signal. In shallow water (<50 m) at ranges exceeding 4 km from the source, signals tend to increase in length from <30 milliseconds, with a frequency peak between 10-100 Hz and a short rise time, to a longer signal of 0.25-0.75 seconds, with a downward frequency sweep of between 200 - 500 Hz and a longer rise time. In contrast, in deep water received levels vary widely with range and depth of the exposed animals, and exposure levels cannot be adequately estimated using simple geometric spreading laws. Studies found that the received levels fell to a minimum between 5 - 9 km from the source and then started increasing again at ranges between 9 – 13 km, so that absolute received levels were as high at 12 km as they were at 2 km, with the complex sound reception fields arising from multi-path sound transmission.

[12] Audibility above ambient, however, does not imply impacts resulting in PTS, TTS or behavioural changes.

Acoustic pressure variation is usually considered the major physical stimulus in the hearing of marine mammals and some fish, but all fish are sensitive to sound-driven particle motion. Marine invertebrate epifauna are predominantly sensitive to waterborne particle acceleration, while epifauna and infauna are sensitive to waterborne particle acceleration and ground acceleration. An important component of hearing is the ability to detect sounds over and above the ambient background noise. Auditory masking of a sound occurs when its' received level is at a similar level to background noise within the same frequencies. The signal to noise ratio required to detect a pure tone signal in the presence of background noise is referred to as the critical ratio.

The auditory thresholds of many species are affected by the ratio of the sound stimulus duration to the total time (duty cycle) of impulsive sounds of <200 millisecond duration. The lower the duty cycle the higher the hearing threshold usually is. Although seismic sound impulses are extremely short and have a low duty cycle at the source, received levels may be longer due to the transmission and attenuation of the sound.

8.2.1.2 Impacts of Seismic Noise on Whales and Dolphins

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The potential impact of seismic survey noise on whales and dolphins could include:

- Physiological injury to individuals.
- Behavioural avoidance of individuals (and subsequent displacement from key habitat).
- Masking of important environmental or biological sounds
- Indirect effects due to effects on predators or prey.

Thirty-three species or sub species / populations of cetaceans (whales and dolphins) are known or likely to occur off southern Namibia. The majority of migratory cetaceans in South African waters are baleen whales (mysticetes), while toothed whales (odontocetes) may be resident or migratory. Of the 33 species, the blue whale is listed as 'Critically endangered', the fin and sei whales are 'Endangered' and the sperm, Bryde's (inshore) and humpback whales are considered 'Vulnerable'. Due to its location offshore and proximity to important seabed features such as Tripp Seamount, the sensitivity of migratory cetaceans is thus considered to be high. However, the numbers of individuals encountered during the survey are likely to be low because of the extensive distributions of the various species concerned.

Marked differences occur in the hearing of baleen whales (mysticete cetaceans) and toothed whales and dolphins (odontocete cetaceans). The vocalisation and estimated hearing range of baleen whales (centred at below 1 kHz) overlap the highest peaks of the power spectrum of airgun sounds and consequently these animals may be more affected by disturbance from seismic surveys. In contrast, the hearing of toothed whales and dolphins is centred at frequencies of between 10 and 100 kHz, suggesting that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. Mysticete and odontocete cetaceans are thus assessed separately.

Cetacean vocalisations

Cetaceans are highly reliant on acoustic channels for orientation in their environment, feeding and social communication. Baleen whales produce a wide repertoire of sounds ranging in frequencies from 12 Hz to 8 kHz. Vocalisations may be produced throughout the year, with peaks in call rates during breeding seasons in some species, most notably humpback whales. Odontocetes produce a spectrum of vocalizations including whistles, pulsed sounds and echolocation clicks.

Cetacean hearing

Marine mammals as a group have wide variations in ear anatomy, frequency range and amplitude sensitivity. The hearing threshold is the amplitude necessary for detection of a sound and varies with frequency across the hearing range. Hearing thresholds differ between odontocetes and baleen whales, and between individuals, resulting in different levels of sensitivity to sounds at varying frequencies. For most species, hearing sensitivity corresponds closely to the frequencies at which they vocalise, however it is likely that hearing range is broader than vocalisation range.

Behavioural and electrophysical audiograms are available for several species of small- to medium-sized toothed whales. The high hearing thresholds at low frequency for species tested implies that the low frequency component of seismic shots will not be audible to the small to medium odontocetes at any great distance. However, the higher frequency of an airgun array shot may audible from tens of kilometres away, due to the very low sensitivity thresholds of many toothed whales.

The available information demonstrates that the larger toothed whales and baleen whales will be very receptive to the sound produced by seismic airgun arrays and consequently this group may be more affected by this type of disturbance than smaller toothed whales.

Overlap between the frequency spectra of seismic shots and the hearing threshold curve with frequency for some toothed whale species, suggests that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. They will thus not be affected as severely as many fish, and possibly sea turtles and baleen whales that have their greatest hearing sensitivity at low frequencies.

Physiological injury and stress

Exposure to high sound levels can result in physiological injury to cetaceans through a number of avenues, including shifts of hearing thresholds (as either permanent threshold shifts (PTS) or temporary threshold shifts (TTS), tissue damage, acoustically induced decompression sickness particularly in beaked whales and non-auditory physiological effects including elevated blood pressures, increased heart and respiration rates, and temporary increases in blood catecholamines and glucocorticoids, which may have secondary impacts on reproduction.

Most studies conducted on sound-related injuries in cetaceans, however, investigated the effects of explosive pulses and mid-frequency sonar pulses and the results are thus not directly applicable to non-explosive seismic sources such as those from airgun arrays.

Both PTS and TTS represent actual changes in the ability of an animal to hear, usually at a particular frequency, whereby it is less sensitive at one or more frequencies as a result of exposure to sound. Southall *et al.* (2007) propose a dual criterion for assessing injury from noise based on the peak sound pressure level (SPL) and sound exposure level (SEL) (a measure of injury that incorporates the sound pressure level and duration), with the one that is exceeded first used as the operative injury criterion. For a pulsed sound source such as that generated during seismic seabed surveys, the maximum levels for PTS are 230 dB re:1 µPa (peak) and 203 re:1 µPa2-s for SPL and SEL respectively for the various marine mammal functional hearing groups (Table 23). For TTS these values are 226 dB re:1 µPa (peak) and 188 dB re:1 µPa2-s for SPL and SEL, respectively. There is thus a range at which permanent or temporary hearing damage might occur, although some hearing damage may already occur when received levels exceed 1 838 dB re:1 µPa2-s SEL. The behavioural disruptive threshold for impulsive noise for all functional groups is root-mean-square (RMS) SPL of 160 dB re 1µPa.

TABLE 14: THE PERMANENT THRESHOLD SHIFT (PTS) AND TEMPORARY THRESHOLD SHIFT (TTS) LEVELS FOR MARINE MAMMAL FUNCTIONAL HEARING GROUPS EXPOSED TO EITHER SINGLE OR MULTIPLE IMPULSIVE NOISE EVENTS WITHIN A 24-H PERIOD (PISCES, 2024)

Marine mammal hearing group	PTS and TTS threshold levels – impulsive noise events			
	Injury (PTS) onset		TTS onset	
	Pk SPL, dB re 1µPa	Weighted SEL_{24hr}, dB re $1\mu Pa^2 \cdot S$	Pk SPL, dB re 1µPa	Weighted SEL_{24hr}, dB re $1\mu Pa^2 \cdot S$
Low-frequency cetaceans (mysticetes: southern right, humpback, sei, fin, blue, Bryde's, minke)	219	183	213	168
High-frequency cetaceans (odontocetes: dolphins, toothed, beaked, and bottle nose whales)	230	185	224	170
Very high-frequency cetaceans (Heaviside's dolphins, dwarf and pygmy sperm whales)	202	155	196	140
Sirenians (dugongs, manatees)*	226	203	220	175
Phocid carnivores in water (true seals)*	218	185	212	170
Other marine carnivores in water (sea lions, fur seals)	232	203	226	188

* Do not occur in Orange Basin

The possibility of seismic activity leading to TTS in baleen whales must be considered at distances up to several kilometres. As cetaceans are highly reliant on sound, hearing damage leading to TTS and PTS is likely to result in a reduction in foraging efficiency, reproductive potential, social cohesion and ability to detect predators.

Noise induced stress resulting from exposure to sources of marine sound can cause detrimental changes in blood hormones, including cortisol. The timing of the stressor relative to seasonal feeding and breeding cycles (such as those observed in migrating baleen whales) may influence the degree of stress induced by noise exposure. However, quantifying stress caused by noise in wild populations is difficult as it is not possible to determine the physiological responses of an animal to a noise stressor based on behavioural observations alone. It can, however, negatively affect reproduction, immune systems, growth, health, and other important life functions.

Consequence

There is little information available on the levels of noise that would potentially result in physiological injury to cetaceans, and no permanent threshold shifts have been recorded. Available information suggests that the animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. Deep-diving cetacean species (e.g. sperm whales) may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focussed seismic surveys, where the downward focussed impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

Due to the high level of impulsive signal emissions from the array source, marine mammals are predicted to experience a PTS at proximity to the source array due to the immediate exposure to individual pulses. The Underwater Noise Modelling Study undertaken for the 2017 ESIA 3D survey area in PEL 83 identified that the low-frequency cetaceans expected to occur in PEL83 (e.g. southern right, humpback, fin, sei, blue, Bryde's, minke) were predicted to experience PTS effects within approximately 22 m from the 3D source array in a 'swim past' scenario. The distance for mid-frequency cetaceans was the same. Values for high-frequency (e.g. sperm, killer and beaked whales and the diversity of dolphins) and very high frequency cetaceans (e.g. pygmy sperm whale and dwarf sperm whale) were not provided. Among marine mammals expected to occur in the PEL 83 area, low-frequency cetaceans have the highest zones of PTS impact from multiple pulses (i.e. the maximum horizontal perpendicular distances from assessed survey lines to cumulative impact threshold levels). The zones of PTS due to cumulative exposure was predicted within 490 m from the source array for low-frequency cetaceans and 57 m for medium frequency cetaceans. It must be kept in mind that the cumulative zones of impact are conservative, and that being highly mobile, whales and dolphins are thus likely to have moved considerable distances over the cumulative 24-hr period. Cumulative effects would only be expected where the animals do not move away from the area, e.g. from specific coastal areas used as calving sites or from mid-ocean focal sites such as Tripp Seamount.

The majority of baleen whales migrate to the southern African subcontinent to breed during winter months. Humpback whales migrating north strike the coast at varying places mostly north of St Helena Bay resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards, but no clear migration 'corridor'. The northern migration would begin passing through the project area around April, continuing through to September/October when the southern migration begins and continues through to January/February. Southern right whales arrive in coastal waters in June, building up to a maximum in August/September and departing again in November. The Orange Basin thus lies within the migration paths of humpback and southern right whales, but well offshore of inshore coastal areas frequented by southern right whales for mating and breeding. As the survey is proposed for the summer months (December to May) encounters with migrating whales should be minimal, although some humpbacks on their return journey in November/December and those remaining on the summer feeding grounds off Cape Columbine may still be encountered. However, the survey is likely to frequently encounter resident odontocetes such as common dolphin, Risso's dolphin and pilot whales, which are present year-round, and may encounter sperm whales, particularly in winter.

Although the current distribution of the offshore population of Bryde's whales is located inshore of the proposed 3D survey area, it may be encountered in the inshore portions of the survey area in the Orange Basin during the summer survey period as its seasonality on the West Coast is opposite to the majority of the balaenopterids with abundance likely to be highest in the broader project area in January - March.

Assuming the survey is scheduled to avoid the key migration period (early June to late November), there would be a low likelihood of encountering migrating humpback and southern right whales, but a high likelihood of encountering offshore Bryde's whales. The impact of potential physiological injury to mysticete and odontocete cetaceans as a result of seismic sounds (unmitigated) is thus deemed to be of high intensity. Furthermore, as the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area (regional), the potential for physiological injury is therefore considered to be of **moderate consequence** for resident mysticetes and odontocetes.

Behavioural disturbance

The factors that affect the response of marine mammals to sounds in their environment include the sound level and other properties of the sound, the physical and behavioural state of the animal and its prevailing acoustic characteristics, and the ecological features of the environment in which the animal encounters the sound. The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source, as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than they are one that is approaching them or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present.

The speed of sound increases with increasing temperature, salinity and pressure and stratification in the water column affects the rate of propagation loss of sounds produced by an airgun array. As sound travels, acoustic shadow and convergence zones may be generated as sound is refracted towards areas of slower sound speed. These can lead to areas of high and low noise intensity (shadow zones) so that exposure to different pulse components at distances of 113 km from the seismic source does not necessarily lessen (attenuate) with increasing range. In some cases, this can lead to received levels at 12 km being as high as those at 2 km. Depending on the propagation conditions of the water column, animals may need to move closer to the sound source or apply vertical rather than horizontal displacement to reduce their exposure, thus making overall avoidance of the sound source difficult. Although such movement may reduce received levels in the short-term it may prolong the overall exposure time and accumulated SEL.

Typical behavioural response in cetaceans to seismic airgun noise include initial startle responses, changes in surfacing behaviour, shorter dives, changes in respiration rate, slowing of travel, increase in swimming speed and changes in vocalisations and call rate. These subtle changes in behavioural measures are often the only observable reaction of whales to reception of anthropogenic stimuli, and there is no evidence that these changes are biologically significant for the animals. Possible exceptions are impacts at individual (through reproductive success) and population level through disruption of feeding within preferred areas. For continuous noise, whales begin to avoid sounds at exposure levels of 110 dB, and more than 80% of species observed show avoidance to sounds of 130 dB re:1µPa. For seismic noise, most whales show avoidance behaviour above 160 dB re:1µPa, with displacement from the noise impacted area potentially persisting for an extended period. Behavioural responses are often evident beyond 5 km from the sound source, with the most marked avoidance response recorded for bowhead whales swimming rapidly away from an approaching seismic vessel at a 24 km distance. More recently, basin-wide effects of seismic surveys on cetacean sightings and calling behaviour have been reported.

In an analysis of marine mammal sightings recorded from seismic survey vessels in United Kingdom waters, it was reported that responses to large gun seismic activity varied between species, with small odontocetes showing the strongest avoidance response. Responses of medium and large odontocetes (killer whales, pilot whales and sperm whales) were less marked, with sperm whales showing no observable avoidance effects but may be affected at greater ranges than currently regulated due to subtle effects on their foraging behaviour. Baleen whales showed fewer responses to seismic survey activity than small odontocetes, and although there were no effects observed for individual baleen whale species, fin and sei whales were less likely to remain submerged during firing activity. All baleen whales showed changes in behavioural responses further from the survey vessel, and both orientated away from the vessel and altered course more often during shooting activity. Different species adopt different strategies in response to seismic survey disturbance, with faster smaller odontocetes fleeing the survey area, while larger slower moving baleen whales orientate away from and move slowly from the firing guns, possibly remaining on the surface as they do so. Responses to small airguns were less, and although no difference in distance to firing and non-firing small airguns were recorded, there were fewer sightings of small odontocetes in association with firing airguns. Other reports suggest that there is little effect of seismic surveys on small odontocetes such as dolphins as these have been reported swimming near or riding the bow-waves of operating seismic vessels. Recent evidence has, however, shown that for small, localised odontocete populations exhibiting high site fidelity, displacement away from the ensonified area may itself pose a biological risk.

Although the consequences of displacement are poorly understood, they likely include increased stress and reduce foraging success, with associated effects on survival and reproduction.

No obvious evidence that humpback whales were displaced by 2D and 3D seismic surveys and no apparent gross changes in the whale's migratory path can be linked to the seismic survey. Localised avoidance of the survey vessel during airgun operation was however noted within 4 km of the source at levels over 130 re 1 $\mu Pa^2 s^{-1}$ as was a reduction in social interactions among whales. Whales which are not migrating but using the area as a calving or nursery ground may be more seriously affected through disturbance of suckling or resting. Potential avoidance ranges of 7-12 km by nursing animals and >4 km for migrating humpbacks have been suggested, although these might differ in different sound propagation conditions. As part of the 2017 ESHIA for 3D acquisition in PEL83, an underwater sound modelling study, based on the noise exposure criteria provided by Southall *et al.* (2007)[13], was undertaken using a very simplified modelling approach to assess sound effects leading to injury (PPS) and behavioural responses. When compared to more recent underwater acoustic modelling studies (e.g. SLR Consulting Australia 2024), which apply sophisticated short range algorithms to calculate the transfer functions (both amplitudes and phases) between sources and receivers, the results of the 2017 study can be considered conservative. Consequently, the assessment of noise impacts on different faunal groups would to a large extent reflect the significance ratings should a more complex approach be applied. The 2017 sound modelling study identified that, the maximum horizontal threshold distance from the source to impact behavioural threshold levels for low frequency cetaceans was 71 km, with distances for mid-frequency cetaceans being 7 km. Disturbance of mating behaviour (which could involve a high degree of acoustic selection) by seismic noise could be of consequence to breeding animals.

Consequence

Avoidance of seismic survey activity by cetaceans, particularly mysticete species, begins at distances where levels of approximately 150 to 180 dB are received. More subtle alterations in behaviour may occur at received levels of 120 dB. The Underwater Noise Modelling Study undertaken for the 2017 ESHIA identified that the zones of behavioural disturbance for cetaceans caused by the immediate exposure to individual pulses was within 71 km from the 3D array source for low-frequency cetaceans, assuming a SPL criteria of 150 dB re 1μPa. Although behavioural avoidance of seismic noise in the proposed survey area by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of baleen whale species.

[13] These have subsequently been updated by Southall *et al.* 2019

The timing of the survey relative to seasonal breeding cycles (such as those observed in migrating baleen whales) may influence the degree of stress induced by noise exposure. Displacement from critical habitat is particularly important if the sound source is located at an optimal feeding or breeding ground or areas where mating, calving or nursing occurs. For example, persistent disturbance of foraging behaviour in response to seismic noise can result in reductions in relative fitness of reproductive female Sperm whales leading to abortions and calf abandonment, with mid-frequency sonars shown to reduced foraging efficiency in blue whales. Species that feed intensively within a season and depend on dense prey concentrations can therefore experience significant population consequences, which in turn may pose significant risks to the recovery rates of endangered populations. Based on this knowledge, Norway has since 2019, recommended that seismic activity be restricted in areas and periods with intensive feeding of baleen whales.

The survey area overlaps with the migration routes of humpback whales to and from their breeding grounds. The survey area is located well offshore of the coastal migration route for southern right whales. Although encounter rates peak in migration periods, humpback whales are found off the West Coast year-round. For other species, the paucity of fine scale data from offshore waters on the distribution and seasonal occurrence of most cetacean species prevents prediction where such critical habitat might be with any certainty. Other baleen whale species are also found year-round or have seasonal occurrences, although not well known, but existing data shows year-round presence of mysticetes. However, if the survey is scheduled to occur outside of the main winter northward and southward migration periods (June and November), interactions with migrating whales should be low.

Of greater concern than general avoidance of migrating whales is avoidance of critical breeding habitat or area where mating, calving or nursing occurs. The humpback whales have their winter breeding concentrations off tropical west Africa, between Angola and the Gulf of Guinea and therefore over 1 000 km to the north-east of the proposed 3D survey area in the Orange Basin. Southern right whales currently have their most significant winter concentrations on the South Coast of South Africa between Port Elizabeth and Cape Town but are seen regularly off the southern half of Namibia and would therefore pass along the West Coast. However, as the survey area is located in excess of 200 km offshore, there should be no overlap with potential coastal nursery areas for this species.

Assuming the survey is scheduled so as to avoid the key northward and southward migration periods (early June and late November, respectively), there is a low likelihood of encountering migrating humpback whales. However, due to the increasing numbers of southern right and humpback whales year-round off the southern African West Coast and the Bryde's whales with migration periods opposite to the typical winter migrations, the potential impact (unmitigated) of behavioural avoidance of seismic survey areas by mysticete cetaceans is considered to be of high intensity (resident species), across PEL 83 (regional) and for the duration of the survey (short term - 3 months). Considering the distribution ranges of most species of cetaceans, the impact of seismic surveying in the Orange Basin is considered of **moderate consequence** for both migrating mysticetes and for resident whales, or Bryde's whales that show seasonality opposite to most balaenopterids.

Information available on behavioural responses of toothed whales and dolphins to seismic surveys is more limited than that for baleen whales. No seasonal patterns of abundance are known for odontocetes occupying the proposed 3D survey area but several species are considered to be year-round residents. Furthermore, a number of toothed whale species have a more pelagic distribution thus occurring further offshore, with species diversity and encounter rates likely to be highest on the shelf slope. The impact of seismic survey noise on the behaviour of toothed whales of high intensity across the proposed survey area (regional) and for the duration of the survey (short term - 3 months). The overall Consequence will however not vary between species and will be **moderate**.

Masking of important environmental or biological sounds

Potential interference of seismic emissions with acoustic communication in cetaceans includes direct masking of the communication signal, temporary or permanent reduction in the hearing capability of the animal through exposure to high sound levels or limited communication due to behavioural changes in response to the seismic sound source. Masking can both reduce the range over which the signals can be heard and the quality of the signal's information. Marked differences occur in the hearing of baleen whales and toothed whales and dolphins. The vocalisation and estimated hearing range of baleen whales overlap the highest peaks of the power spectrum of airgun sounds and consequently these animals may be more affected by disturbance from seismic surveys. Whales may respond to masking by calling more frequently, calling louder, calling less frequently or showing no change in calling behaviour. The masking effect of seismic pulses might be reduced by their intermittent production. However, the length of seismic pulses increases with distance from the source, thereby increasing the potential to cause masking at range.

Consequence

Baleen whales appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while toothed whales vocalise at frequencies higher than these. As the by-product noise in the mid- and high frequency range (up to and exceeding 15 kHz) can travel far (at least 8 km), masking of communication sounds produced by whistling dolphins and blackfish[14] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in November/December when accompanied by calves. Although most mother-calf pairs tend to follow a coastal route southward, there is no clear migration corridor and humpbacks can be spread out widely across the shelf and into deeper pelagic waters. Vocalisation of southward migrating whales may thus potentially be regionally comparatively high on commencement of operations in December, reducing thereafter. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses. Should the survey overlap with the key migration and breeding period when there is a high likelihood of encountering migrating Humpback whales (including possible mother-calf pairs) and no other mitigation measures are in place, the intensity of impacts on baleen whales is likely to be high (mother-calf pairs) over the survey area (regional) and short-term duration (3 months), and of moderate intensity (species specific) in the case of toothed whales over the survey area (regional) and duration (short-term - 3 months). The **consequence** for both mysticetes and odontocets would be **moderate**.

Indirect effects on prey species

Exposure to seismic airguns can cause hearing damage to fish and several studies have linked seismic exploration with short-term reductions in fish abundance and changes in distribution away from the seismic survey area. The majority of baleen whales will undertake little feeding within breeding ground waters and rely on blubber reserves during their migrations. Therefore, they may not be affected by changes in fish distribution. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species, but cumulative impacts within species ranges must be considered.

Consequence

As with other vertebrates, the assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species. Although most baleen whales will undertake little feeding within breeding-ground waters along the southern African west coast and rely on blubber reserves during their migrations there is increasing evidence that some species (fin whales, southern rights and humpbacks) are using upwelling areas off the South African West Coast as summer feeding

[14] The term blackfish refers to the delphinids: melon-headed whale, killer whale, pygmy killer whale, false killer whale, long-finned pilot whale, short-finned pilot whale

grounds. The upwelling zone off Cape Columbine has become an important summer feeding area, and baleen whales have been reported to feed between St Helena Bay and Cape Town. Increasing numbers of summer records of humpback and southern right whales, suggest that animals may also be feeding in upwelling areas off Namibia, especially the southern half of the country near the Lüderitz upwelling cell. Nonetheless, any indirect effects on their food source would thus be of low intensity over the survey area (regional) and duration (short-term - 3 months) and therefore of **low consequence**. In the case of odontocetes, the broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would similarly be of low intensity over the survey area (regional) and duration (short-term - 3 months) and therefore of **low consequence.**

b) Probability and Significance

Physiological injury and mortality

The potential impact of seismic noise on physiological injury of mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the moderate consequence, is deemed to be of **MODERATE significance** for the unmitigated scenario. With mitigation, the significance rating is **LOW** due to the reduced consequence and probability ratings.

Behavioural avoidance

The potential impact of seismic noise on behavioural changes (unmitigated) in mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the moderate consequence, is deemed to be of **MODERATE significance**. With mitigation, the significance rating is **LOW** due to the reduced consequence and probability ratings.

Masking of Sounds and Communication

The potential impact of seismic noise on the masking of environmental sounds and communications (unmitigated) in mysticetes and odontocetes, considering their high sensitivity, the high probability of the impact occurring and the moderate consequence, is deemed to be of **MODERATE** significance. With mitigation, the significance rating is **LOW** due to the reduced consequence and probability ratings.

Indirect impacts due to effects on predators or prey

The potential indirect impact of seismic noise on food sources of mysticetes and odontocetes, considering their high sensitivity, the low likelihood of the impact occurring and the low consequence, is thus deemed to be of **LOW** significance.

The reversibility of the potential impacts are rated as fully reversible.

.**Impact Summary – Impacts of seismic noise on mysticetes and odontocetes**

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**H**	**L**	**M**	**M**	**H**	**M**
Mitigated	**L**	**L**	**M**	**L**	**M**	**L**

Management, mitigation and monitoring measures

- The proposed mitigation measures, which are essentially designed to keep animals out of the immediate area of impact and thereby reduce the risk of deliberate injury to marine mammals.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.1.3 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON SEALS

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The potential impact of seismic survey noise on seals could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey. The Cape fur seal that occurs off the West Coast forages over the continental shelf to depths of over 200 m and is thus unlikely to be encountered in PEL 83.

Physiological injury or mortality

Underwater behavioural audiograms have been obtained for two species of Otariidae (sea lions and fur seals), but no audiograms have been measured for Cape fur seals. Extrapolation of these audiograms to below 100 Hz would result in hearing thresholds of approximately 140-150 dB re 1 µPa for the California sea lion and well above 150 dB re 1 µPa for the Northern fur seal.

Seals produce underwater sounds over a wide frequency range, including low frequency components. The physiological effects of loud low frequency sounds on seals are not well documented but include cochlear lesions following rapid rise time explosive blasts, TTS following exposure to octave-band noise (frequencies ranged from 100 Hz to 2000 Hz, octave-band exposure levels were approximately 60–75 dB, while noise-exposure periods lasted a total of 20–22 min), with recovery to baseline threshold levels within 24 h of noise exposure. Due to the high level of impulsive signal emissions from seismic arrays, seals are predicted to experience a PTS at close proximity to the sound source due to the immediate exposure to individual pulses.

Using measured discomfort and injury thresholds for humans, Green law (1987) modelled the pain threshold for seals and sea lions and speculated that this pain threshold was in the region of 185 200 dB re 1 µPa. The impact of physiological injury to seals from seismic noise is deemed to be low as it is assumed that highly mobile creatures such as fur seals would avoid severe sound sources at levels below those at which discomfort occurs. However, noise of moderate intensity and duration may be sufficient to induce TTS under water in pinniped species as individuals did not appear to avoid the survey area. Reports of seals swimming within close proximity of firing airguns should thus be interpreted with caution in terms of the impacts on individuals as such individuals may well be experiencing hearing threshold shifts. Their tendency to swim at or near the surface will, however, expose them to reduced sound levels when in close proximity to an operating airgun array.

The Underwater Noise Modelling Study undertaken for the 2017 ESIA identified that for seals PTS was predicted to occur within 89 m, with behavioural effects predicted at 22 m from the 3D array. Maximum threshold distance for injury from multiple pulses was estimated at 580 m.

Consequence

The potential impact of physiological injury to seals as a result of seismic noise is deemed to be of moderate intensity and would be limited to the survey area (regional). As seals are known to forage up to 120 nautical miles (~220 km) offshore, the proposed 3D survey area falls into the seaward extent of the foraging range of seals from all the southern Namibian colonies. Furthermore, as the duration of the impact would be limited to the short-term (3 months), the potential physiological injury is therefore considered to be of **moderate consequence**.

Behavioural avoidance

Information on the behavioural response of fur seals to seismic exploration noise is lacking. Reports of studies conducted with Harbour and Grey seals include initial startle reaction to airgun arrays, and range from partial avoidance of the area close to the vessel (within 150 m) to fright response (dramatic reduction in heart rate), followed by a clear change in behaviour, with shorter erratic dives, rapid movement away from the noise source and a complete disruption of foraging behaviour. In most cases, however, individuals quickly reverted back to normal behaviour once the seismic shooting ceased and did not appear to avoid the survey area. Seals seem to show adaptive responses by moving away from airguns and reducing the risk of sustaining hearing damage. Potential for long-term habitat exclusion and foraging disruption over longer periods of exposure (i.e. during full-scale surveys conducted over extended periods) is however a concern.

Cape fur seals generally appear to be relatively tolerant to noise pulses from underwater explosives, which are probably more invasive than the slower rise-time seismic sound pulses. There are also reports of Cape fur seals approaching seismic survey operations and individuals biting hydrophone streamers. This may be related to their relative insensitivity to sound below 1 kHz and their tendency to swim at or near the surface, exposing them to reduced sound levels. It has also been suggested that this attraction is a learned response to towed fishing gear being an available food supply.

Consequence

Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seal species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly reverted to normal behaviour. The potential impact of seal foraging behaviour changing in response to seismic surveys is thus considered to be of low intensity as they are known to show a tolerance to loud noises. Furthermore, as the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area (regional), the potential for behavioural avoidance of seals is considered to be of **low consequence**.

Masking of environmental sounds and communication

Consequence

The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses. The potential impact of masking of sounds and communication in seals due to seismic surveys is considered to be of low intensity as they are known to show a tolerance to loud noises. As the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area (regional), the potential for masking of sounds is considered to be of **low consequence**.

Indirect effects due to the effects of seismic sounds on prey species

Consequence

As with other vertebrates, the assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the species (and the flexibility of the diet), and the effect of seismic surveys on the diet species. Seals typically forage on small pelagic shoaling fish prey species that occur inshore of the 200 m depth contour or associated with oceanic features such as Tripp Seamount. Furthermore, the broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be of low intensity, would be limited to the short-term (3 months) and be restricted to the survey area (regional). The potential for effects of seismic surveys on prey species is thus considered to be of **low consequence**.

b) Probability and Significance

Physiological injury and mortality

The potential impact of seismic noise on physiological injury or mortality of seals, considering their low sensitivity, the low likelihood of the impact occurring and the moderate consequence, is deemed to be of **LOW significance**.

Behavioural avoidance

The potential impact of seismic noise on behavioural changes in seals, considering their low sensitivity, the low likelihood of the impact occurring and the low consequence, is deemed to be of **LOW significance**.

Masking of Sounds and Communication

The potential impact of seismic noise on the masking of environmental sounds and communications in seals, considering their low sensitivity, the low likelihood of the impact occurring and the low consequence, is deemed to be of **LOW significance**.

Indirect impacts due to effects on predators or prey

The potential indirect impact of seismic noise on food sources of seals, considering their low sensitivity, the low likelihood of the impact occurring and the low consequence, is thus deemed to be of **LOW significance**.

The reversibility of the potential impacts is rated as fully reversible.

.Impact Summary – Impacts of seismic noise on seals

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**M**	**M**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- With the implementation of the typical 'soft start' procedures, the residual impacts of physiological injury and mortality reduce.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.1.4 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON TURTLES

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The leatherback and loggerhead turtles that occur in offshore and coastal waters around southern Africa, and likely to be encountered in PEL 83 are considered regionally 'Critically Endangered' and 'Endangered', respectively, in the List of Marine Threatened or Protected Species (TOPS) as part of the NEMBA. Following nesting in December-January, loggerhead turtles migrate back to their foraging grounds along the East and South Coasts. Hatchlings of both species emerge from their nests from mid-January to mid-March with most dispersing south-westward within the Agulhas Current. The Agulhas Current migration corridor will therefore be very active with migrating sea turtles between January and April, some of which may be distributed along the West Coast through mass transport of Agulhas Current water into the southeast Atlantic by warm core rings). Despite their extensive distributions and feeding ranges, the numbers of adult and neonate turtles encountered in PEL 83 may therefore be seasonally high, particularly in the Orange Seamount and Canyon Complex transboundary EBSA, which may be frequented by leatherbacks on their migrations. Consequently, the sensitivity of turtles to seismic noise is considered to be high, particularly neonates and juveniles as they are unable to actively avoid seismic sounds and consequently are more susceptible to seismic noise.

Available data on marine turtle hearing is limited but suggest highest auditory sensitivity at frequencies of 250 – 700 Hz, and some sensitivity to frequencies at least as low as 60 Hz. More recent studies using electrophysiological and behavioural techniques have found that turtles can detect frequencies between 50 Hz and 1 600 Hz, indicating that their hearing ranges overlap with the peak amplitude, low frequency sound emitted by seismic airguns. The overlap of this hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise, although what effect this may have on their fitness or survival is not known.

<u>Physiological injury (including disorientation) or mortality</u>

Due to a lack of research, it is not known what levels of sound exposure (or frequencies) would cause permanent or temporary hearing loss or what effect this may have on the fitness or survival of turtles, although it is assumed that physiological effects at levels of 190 dB re 1 μPa ref 1 m, while other studies have predicted that mortality or potential mortal injury will occur at peak sound pressure levels of over 207 dB re 1 μPa. Evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a diving, swimming or basking turtle would thus be expected to result in physiological injury. This applies particularly to hatchlings and juveniles as they are unable to avoid seismic sounds whilst being transported in the ocean currents, and consequently are more susceptible to seismic noise. For the first few months following emergence, hatchlings are reported to spend most of their time in the upper 5 m of the water column. Juveniles in contract appear to spend most of their time diving to depths, spending only 43% of their time at the surface during the day and 29% of the time at the surface during the night. Both hatchlings and juveniles would therefore be particularly susceptible to airguns at close range.

If subjected to seismic sounds at close range, temporary or permanent hearing impairment may result, but it is unlikely to cause death or life-threatening injury. As with other large mobile marine vertebrates, it is assumed that adult turtles will avoid seismic noise at levels/distances where the noise is a discomfort. Juvenile turtles may be unable to avoid seismic sounds in the open ocean, and consequently may be more susceptible to seismic noise.

The criteria for seismic airguns are provided in Table 15.

TABLE 15: NOISE EXPOSURE CRITERIA IN TURTLES FOR SEISMIC AIRGUNS (PISCES, 2024).

Animal	Zones of impact – maximum horizontal distances from source to impact threshold levels (from single 3D pulses)		Zones of impact – maximum horizontal perpendicular distances from assessed 3D survey lines to cumulative impact threshold levels	
	Injury (PTS) onset Pk SPL re 1 μPa	TTS onset Pk SPL	Injury (PTS) onset Weighted SEL_{24hr} re 1 $\mu Pa^2 \cdot s$	TTS onset Weighted SEL_{24hr} re 1 $\mu Pa^2 \cdot s$
Sea turtles	232 m	226 m	204 m	189 m

Using the peak sound pressure level of 232 dB re 1 μPa, the Underwater Noise Modelling Study undertaken for the 2017 ESIA identified that the maximum horizontal distance from the seismic source to impact threshold levels leading to mortality or potential mortal injury in turtles was 317 m and therefore highly localised at any one time. The maximum horizontal distance from the seismic source to impact threshold levels leading to recoverable injury (TTS) was not reached.

Consequence

As the breeding areas for Leatherback turtles in Gabon occur over 1 500 km to north of the proposed 3D survey area, and on the northeast coast of South Africa, turtles encountered during the survey are likely to be adults migrating to foraging grounds, and dispersing neonates and juveniles. Although turtles have extensive distributions and feeding ranges, the number of turtles encountered in the survey area is expected to be low. Despite their low numbers in the survey area, the intensity of potential physiological injury would be thus rated as high (unmitigated). However, the duration of the impact on the population would be limited to the short-term (3 months) and be restricted to the survey area (regional). The potential physiological injury or mortality of turtles is considered to be of **moderate consequence**.

Behavioural avoidance

Behavioural changes in response to anthropogenic sounds have been reported for some sea turtles. Controlled exposure experiments on captive turtles found an increase in swim speed and erratic behaviour indicative of avoidance, at received airgun sound levels of 160 – 176 dB re 1 μPa. Sounds of frequency of 250 and 500 Hz resulted in a startle response from a loggerhead turtle, and avoidance by 30 m of operating airguns where the received level would have been in the order of 175 - 176 dB re 1 μPa. However, these results may have been influenced by echo associated with the shallow environment in which the test was undertaken.

Further trials carried out on caged loggerhead and green turtles indicated that significant avoidance response occurred at received levels ranging between 172 and 176 dB re 1 μPa at 24 m, and repeated trails several days later suggest either temporary reduction in hearing capability or habituation with repeated exposure. Hearing however returned after two weeks reported that above levels of 166 dB re 1 μPa turtles increased their swimming activity compared to periods when airguns were inactive. Above 175 dB re 1 μPa turtle behaviour became more erratic possibly reflecting an agitated behavioural state at which unrestrained turtles would show avoidance response by fleeing an operating sound source. These would correspond to distances of 2 km and 1 km from a seismic vessel operating in 100 - 120 m of water, respectively. The behavioural threshold of 166 dB re 1 μPa for sea turtles was subsequently adopted by the National Marine Fisheries Services (NMFS).

Information on how individuals might respond behaviourally to seismic sounds remains inconclusive and may be species specific. Acoustic disturbance could potentially lead to exclusion from key habitats, interruption of breeding, foraging or basking behaviours, or may incite responses which may compromise the turtle's energy budgets (e.g. changes to foraging duration, swim speed, dive depth and duration, and restricting access to the surface to breath). Such changes could lead to a reduction in individual fitness (through changes to reproductive outputs or foraging rates), potentially causing detrimental effects at a population level. The underwater sound modelling study (ERM, 2017) did not provide calculated distances for behavioural effects on turtles.

Consequence

Turtles can therefore hear seismic sounds at a considerable distance and may respond by altering their swimming/basking behaviour or alter their migration route. However, as the number of turtles encountered during the proposed 3D survey is expected to be low, the impact of seismic sounds on turtle behaviour would be of low intensity and would persist only for the duration of the survey (short-term - 3 months), and be restricted to the survey area (regional). The impact of seismic noise on turtle behaviour is thus deemed to be of **low consequence**.

Masking of environmental sounds and communication

Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites (within the summer months October to March, with peak nesting during December and January). Turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. The effect of seismic noise in masking environmental cues such as surf noise, which overlaps the frequencies of optimal hearing in turtles, is unknown and speculative.

Consequence

As the breeding areas for Leatherback turtles occur over 1 500 km to north of the survey area in Gabon, and on the north-east coast of South Africa, turtles encountered during the survey are likely to be migrating vagrants. Their low abundance in the survey area would suggest that the impact (should it occur) would be of low intensity. As the impact would persist only for the duration of the survey (short-term - 3 months), and be restricted to the survey area (regional), the impact is deemed to be of **low Consequence**.

Indirect impacts due to effects on prey

Consequence

As with other vertebrates, the assessment of indirect effects of seismic surveys on turtles is limited by the complexity of trophic pathways in the marine environment. The leatherback turtles eat pelagic prey, primarily jellyfish. The low numbers and the broad ranges of potential prey species and extensive ranges over which most turtles feed suggest that indirect impacts would be of low intensity, persisting only for the duration of the survey (short-term - 3 months), and restricted to the survey area (regional). The impact would therefore be of **low Consequence**.

b) Probability and Significance

Physiological injury and mortality

The potential (unmitigated) impact of seismic noise on physiological injury or mortality of turtles, considering their high sensitivity and moderate consequence, is deemed to be of **MODERATE**

significance. In the case of hatchlings and juveniles, the impact can be considered of **MODERATE significance** due to their high sensitivity and the potentially high intensity of the impact.

Behavioural avoidance

The potential impact of seismic noise on behavioural changes in turtles, considering their medium sensitivity, the medium probability of the impact occurring and the low consequence, is deemed to be of **LOW significance**.

Masking of Sounds and Communication

The potential impact of seismic noise on the masking of environmental sounds and communications in turtles, considering their medium sensitivity, the medium probability of the impact occurring and the low Consequence, is deemed to be of **LOW** significance.

Indirect impacts due to effects on predators or prey

The potential indirect impact of seismic noise on food sources of turtles, considering their medium sensitivity, the very low likelihood of the impact occurring and the low Consequence, is thus deemed to be of **LOW** significance.

The reversibility of the potential impacts are rated as fully reversible.

.**Impact Summary – Impacts of seismic noise on turtles**

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**H**	**L**	**M**	**M**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Implement ‘soft start’ procedures.
- Terminate shooting until such time as the animals are outside of the 500 m mitigation zone.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.1.5 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON FISH

a) Nature and intensity of impact, duration and geographical extent (and consequence)

Fish have two different systems to detect sounds namely 1) the ear (and the otolith organ of their inner ear) that is sensitive to sound pressure and 2) the lateral line organ that is sensitive to particle motion. Certain species utilise separate inner ear and lateral line mechanisms for detecting sound; each system having its own hearing threshold, and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases. Most fish (and all elasmobranchs) primarily detect particle motion.

In fish, the proximity of the swim-bladder to the inner ear is an important component in the hearing as it acts as the pressure receiver and vibrates in phase with the sound wave. Vibrations of the otoliths, however, result from both the particle velocity component of the sound as well as stimulus from the swim-bladder. The resonant frequency of the swim-bladder is important in the assessment of impacts of sounds as species with swim-bladders of a resonant frequency similar to the sound frequency would be expected to be most susceptible to injury. Although the higher frequency energy of received seismic impulses needs to be taken into consideration, the low frequency sounds of seismic surveys would be most damaging to swim-bladders of larger fish. The lateral line is sensitive to low frequency (between 20 and 500 Hz) stimuli through the particle velocity component of sound and would thus be sensitive to the low frequencies of airguns, which most energy at 20-150 Hz.

The sound waves produced during seismic surveys are low frequency, with most energy at 20-150 Hz (although significant contributions may extend up to 500 Hz) and overlap with the range at which fish hear well. A review of the available literature suggests that potential impacts of seismic pulses to fish (including sharks) species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, reduced reproductive success and spawning, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

Physiological injury and mortality

Studies have shown that fish can be exposed directly to the sound of seismic survey without lethal effects, outside of a very localised range of physiological effects. Exposure of fishes to very high intensity low and mid-frequency sonars resulted in no mortality, nor did exposure to seismic airguns. Physiological effects of impulsive airgun sound on fish species include swim-bladder damage, transient stunning, short-term biochemical variations in different tissues typical of primary and secondary stress response, and temporary hearing loss (TTS) due to destruction of the hair cells in the hearing maculae and haemorrhaging, eye damage and blindness. Although TTS has been demonstrated in a number of species from a diverse array of sounds, in all cases it only occurred after multiple exposures to intense sounds (<190 dB re 1 µPa rms) or as a result of long-term exposure to less intense sounds.

Consequence

The noise exposure criteria for fish is summarised in Table 16. Tripp Seamount lie ~85 km south of the proposed 3D survey area, and any demersal species associated with these important fishing banks would receive the seismic noise within the far-field range, and outside of distances at which physiological injury or avoidance would be expected. Impacts on demersal species are thus deemed of low intensity across the survey area (regional) and for the survey duration (short-term) and are considered to be of **low consequence**.

TABLE 16: NOISE EXPOSURE CRITERIA IN FISH FOR SEISMIC AIRGUNS (PISCES, 2024)

Type of animal	Mortality and potential mortal injury	Impairment			Behaviour
		Recovery injury	TTS	Masking	
Fish: no swim bladder (particle motion detection)	>219 dB SEL_{24hr}, or >213 dB Pk SPL	>216 dB SEL_{24hr} or >213 dB Pk SPL	>>186 dB SEL_{24hr}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder is not involved in hearing (particle motion detection)	210 dB SEL_{24hr} or >207 dB Pk SPL	203 dB SEL_{24hr} or >207 dB Pk SPL	>>186 dB SEL_{24hr}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: swim bladder involved in hearing (primarily pressure detection)	207 dB SEL_{24hr} or >207 dB Pk SPL	203 dB SEL_{24hr} or >207 dB Pk SPL	186 dB SEL_{24hr}	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae	>210 dB SEL_{24hr} or >207 dB Pk SPL	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes: peak sound pressure levels (Pk SPL) dB re 1 μPa; Cumulative sound exposure level (SEL_{24hr}) dB re 1 $\mu Pa^2 \cdot s$. All criteria are presented as sound pressure even for fish without swim bladders since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

Given the high mobility of most fish that occur offshore of the 200 m isobath, particularly the highly migratory pelagic species likely to be encountered in deeper water, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result. Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. Many of the pelagic sharks and tunas likely to be encountered in offshore waters also do not have a swim bladder and are thus less susceptible to seismic sounds than those species that do have swim bladders.

The underwater noise modelling study undertaken for the 2017 ESIA identified that the maximum horizontal distance from 3D seismic source to impact threshold levels leading to mortality or potential mortal injury was 159 m, for fish lacking swim bladders (e.g. some tunas, sharks and most mesopelagic species) and 317 m for fish with swim bladders. Zones of immediate impact from single pulses for recovery injury were the same.

Should an encounter occur, the potential physiological impact on individual migratory pelagic fish, would be of high intensity. Furthermore, the duration of the impact on the population would be limited to the short-term (3 months) and be restricted to the survey area (regional). The impact is therefore considered to be of **moderate Consequence**.

Behavioural avoidance

Behavioural responses to impulsive sounds are varied and include leaving the area of the noise source, changes in vertical and horizontal distribution, spatial changes in schooling behaviour, and startle response to short range start up or high level sounds. Behavioural responses such as avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented at received levels of a between 130 and 180 dB re 1 μPa, with disturbance ceasing at noise levels below this. In some cases, behavioural responses were observed at up to 5 km distance from the firing airgun array, but a 78% decline in multispecies presence at a site 7.9 km away from the survey path during active seismic surveying has been observed. In contrast, others found no effect of seismic survey on the fish species composition of a coral reef in northern Australia, it was reported that no short-term (days) or long-term (months) effects of seismic exposure on the composition, abundance, size structure, behaviour, or movement of demersal fish fauna on the Northwest Shelf of Western Australia.

Based on the noise exposure criteria provided by Popper *et al.* (2014), relatively high to moderate behavioural risks are expected at near to intermediate distances (tens to hundreds of meters) from the source location. Relatively low behavioural risks are expected for fish species at far field distances (thousands of meters) from the source location. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. Although changes in fish distribution have been reported during and after airgun operations, they generally returned to the original site within hours or days after the end of the seismic operation. In some cases, behaviour patterns returned to normal within minutes of commencement of surveying indicating habituation to the noise or showed little to no reaction at all. Disturbance of fish is believed to cease at noise levels below 160 dB re 1μPa. The ecological significance of such effects is therefore expected to be low, except in cases where they influence reproductive activity, interfere with foraging or feeding, disruption of migrations and habitat selection or result in delayed mortality. Sub-lethal impacts of acoustic disturbance such as changes in activity patterns and energy budgets can result in altered food intake and growth rates, indirectly affecting the age at sexual maturity, survival and fecundity, thereby ultimately leading to population level consequences. As hearing sensitivity can vary with life-cycle stage, season, locality and duration of shooting, it is difficult to determine with accuracy the impact of seismic sound on the behaviour of fish.

Consequence

Behavioural responses such as deflection from migration paths or avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented at received levels of about 130 - 180 dB re 1 μPa. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact on individual fish behaviour could therefore be of <u>high intensity</u> (particularly in the near field of the airgun array). Impacts to behavioural responses would be limited to the survey duration (<u>short-term</u>), and the survey area (<u>regional</u>). Consequently, it is considered to be of **moderate Consequence**.

<u>Reproductive success / spawning</u>

Although the effects of airgun noise on spawning behaviour of fish have not been quantified to date, it is predicted that if fish are exposed to powerful external forces on their migration paths or spawning grounds, they may be disturbed or even cease spawning altogether. The deflection from migration paths may be sufficient to disperse spawning aggregations and displace spawning geographically and temporally, thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.

Consequence

The spawning areas of the small pelagic shoaling species are distributed on the continental shelf and along the shelf edge from Lambert's Bay to Mossel Bay, with the major spawning grounds for most species (anchovy, round herring, horse mackerel, chub mackerel) located east of Cape Point and hake spawning occurring on the western Agulhas Bank. There is therefore no overlap of the proposed 3D survey area with the migration routes and spawning areas of these commercially important species, with the exception of Orange Roughy, who would receive the sound in the far-field range. If behavioural responses to seismic noise result in deflection from coastal migration routes or disturbance of spawning, further impacts may occur that may affect recruitment to fish stocks. The intensity of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Despite the current low biomass of sardine, particularly west of Cape Agulhas, recent successive years of low recruitment and the dependence of future recruitment on successful West Coast spawning the intensity of the potential impact of the 3D survey can be considered low for the duration of the survey (short-term) as the survey area lies well offshore of the spawning areas and is not known to be a spawning area for large pelagic species. The impact is thus considered to be of **low consequence**.

Masking of environmental sounds and communication

Consequence

While some nearshore reef species are known to produce isolated sounds or to call in choruses, communication and the use of environmental sounds by fish off the southern Namibian coast are unknown. Demersal species in continental slope habitats or associated with Tripp Seamount would receive the seismic noise in the far field and vocalisation, should it occur, is unlikely to be masked. Impacts arising from masking of sounds are thus expected to be of low intensity due to the duty cycle of seismic surveys in relation to the more continuous biological noise. Such impacts would occur across the survey area (regional) and for the duration of the survey (short-term - 3 months). The impact is thus considered to be of **low consequence**.

Indirect impacts due to effects on predators or prey

Consequence

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks, tunas or diving seabirds to pelagic shoaling fish species stunned by seismic noise. In such cases, where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory fish species in association with seismic survey noise. The pelagic shoaling species that constitute the main prey item of migratory pelagic species typically occur inshore of the 200 m depth contour. Although large pelagic species are known to aggregate around seamounts to feed, considering the extensive range over which large pelagic fish species can potentially feed in relation to the survey area, and the low abundance of pelagic shoaling species that constitute their main prey across most of the 3D survey area the intensity of the impact would be low, restricted to the survey area (regional) and persisting over the short-term only (3 months). The impact would thus be of **low consequence**.

b) Probability and Significance

<u>Physiological injury and mortality</u>

The potential impact of seismic noise on physiological injury or mortality of fish, considering their high sensitivity and medium Consequence, is thus deemed to be of **MEDIUM significance** (unmitigated).

<u>Behavioural avoidance</u>

The potential impact of seismic noise on behavioural changes in large migratory pelagic fish, considering the high sensitivity, the low to medium likelihood of the impact occurring and moderate Consequence, is deemed to be of **MEDIUM significance** (unmitigated).

<u>Reproductive success / spawning</u>

The potential impact of seismic noise on the reproductive success and spawning of nearshore commercial fish species, considering their high sensitivity, the low to medium likelihood of the impact occurring and the low consequence, is deemed to be of **LOW significance**.

<u>Masking of environmental sounds and communication</u>

The potential impact of seismic noise on the masking of sounds of fish, considering the high sensitivity, the low likelihood of the impact occurring and the low consequence is thus deemed to be of **LOW significance**.

<u>Indirect impacts due to effects on predators or prey</u>

The potential indirect impact of seismic noise on food sources for fish, considering their high sensitivity, the low likelihood of the impact occurring and the low consequence, is thus deemed to be of **LOW significance**.

The reversibility of the potential impacts are rated as fully reversible.

.**Impact Summary – Impacts of seismic noise on fish**

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**H**	**L**	**M**	**M**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- The potential impacts cannot be eliminated due to the nature of the seismic sound source required during surveying. Proposed mitigation measures are essentially designed to keep animals out of the immediate area of impact and thereby reduce the risk of deliberate injury to fish.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.1.6 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON SEABIRDS

a) Nature and intensity of impact, duration, geographical extent (and consequence), probability and significance

The significance of potential acoustic impacts of further 3D seismic Surveys on Seabirds are assessed as low, in the unmitigated scenario by the Marine Ecology Specialist study. The assessment is briefly summarised below.

Potential impacts of seismic pulses to diving birds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The seabird species are all highly mobile and would be expected to flee from approaching seismic noise sources at distances well beyond those that could cause physiological injury, but initiation of a sound source at full power in the immediate vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds. The potential for physiological injury or behavioural avoidance in non-diving seabird species, being above the water and thus not coming in direct contact with the seismic pulses, is considered negligible and is not further assessed.

Physiological injury

Should an encounter with diving pelagic seabirds occur, the potential physiological impact on individual pelagic and coastal diving birds would be of HIGH intensity, but as the likelihood of encountering large numbers of diving seabirds is low, due to their extensive distributions and feeding ranges the intensity is considered moderate. Furthermore, the duration of the impact on the population would be limited to the short-term (3 months) and be restricted to the survey area (regional). The potential for physiological injury is therefore considered to be of **low** consequence.

The potential impact of seismic noise on physiological injury or mortality of pelagic seabirds, considering their moderate sensitivity, the moderate likelihood of the impact occurring and low consequence, is deemed to be of **low significance**.

Behavioural avoidance

Due to the extensive distribution and feeding ranges of pelagic seabirds, the impact for pelagic seabirds would thus be of low intensity within the survey area (regional) over the duration of the survey period (short-term - 3 months). For African Penguins and Cape Gannets, the impact for would be of high intensity, but as the likelihood of encountering large numbers in offshore areas is low, the intensity is considered moderate. Similarly, for pelagic seabirds the impact would be of high intensity, but due to their extensive distributions and feeding ranges, the likelihood of encountering significant numbers is low, and the intensity is therefore considered moderate. The duration of the impact on the population would be limited to the short-term (3 months) and be restricted to the survey area (regional). The behavioural avoidance of feeding areas by coastal diving seabirds and diving pelagic seabirds is thus considered to be of **low Consequence**.

The potential impact of seismic noise on behavioural changes in pelagic seabirds, considering their medium sensitivity the medium likelihood of the impact occurring and low consequence, is deemed to be of **LOW significance**.

Indirect impacts due to effects on prey

Although seismic surveys have been reported to affect fish catches up to 30 km from the sound source, with effects persisting for a duration of up to 10 days, for the current project relatively low behavioural risks are expected for fish species at far-field distances (1 000s of metres). This could have implications for plunge-diving seabirds such as African Penguins that forage in restricted areas within a given radius of their breeding sites. Similarly, pelagic seabirds that feed around seamounts may also be affected. As the survey area is located beyond the foraging range of African penguins and Cape gannets, and Tripp Seamount is located ~50 km north of the proposed survey area, seismic effects on the prey species of coastal seabirds, or pelagic seabirds that feed around seamounts is not expected. The impact on potential food sources for pelagic and coastal diving seabirds would thus be of low intensity within the survey area (regional) over the duration of the survey period (short-term - 3 months). The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be of **low consequence**.

The impact on potential food sources for pelagic seabirds would thus be of low intensity within the survey area (local) over the duration of the survey period (short-term) (3 months). The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be of **low** consequence.

The potential indirect impact of seismic noise on food sources for pelagic seabirds, considering their medium sensitivity, the very low likelihood of the impact occurring and the low consequence, is thus deemed to be of **LOW significance**.

Impact Summary – Impacts of seismic noise on seabirds

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**M**	**M**	**M**	**M**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- As the proposed survey area is located far offshore, it is not deemed necessary to implement mitigation measures to avoid the pre- and postmoult periods for African penguins. In addition to the mitigation measures recommended for cetaceans, further measures are included in the ESMP for 3D Seismic Surveys in Appendix H, i.e. to terminate seismic shooting on observation of penguins and feeding aggregations of diving seabirds within the 500 m mitigation zone.

8.2.1.7 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON MARINE INVERTEBRATES

a) Nature and intensity of impact, duration, geographical extent (and consequence), probability and significance

The significance of potential acoustic impacts of further 3D seismic Surveys on marine invertabrats are assessed as low, in the unmitigated scenario by the Marine Ecology Specialist study. The assessment is briefly summarised below.

Many marine invertebrates have tactile organs or hairs (termed mechanoreceptors), which are sensitive to hydro-acoustic near-field disturbances, and some have highly sophisticated statocysts, which have some resemblance to the ears of fishes and are thought to be sensitive to the particle acceleration component of a sound wave in the far-field. Potential impacts of seismic pulses on invertebrates would include physiological injury or mortality in the immediate vicinity of the airgun sound source, and behavioural avoidance. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely and are thus not assessed.

Physiological injury and behavioural avoidance

As the proposed 3D survey area is located in waters in excess of 1 500 m depth, the received noise by benthic invertebrates at the seabed would be within the far-field range, and outside of distances at which physiological injury would be expected. The impact is therefore deemed of low intensity across the survey area (regional) and for the four-month survey duration (short) and is therefore considered to be of **low consequence**.

The potential impact of seismic noise on physiological injury or mortality and behavioural avoidance of pelagic cephalopods could potentially be of high intensity to individuals, but as distribution of mobile neritic and pelagic squid is naturally spatially highly variable and the numbers of giant squid likely to be encountered is low, the intensity would be considered LOW across the survey area (regional) and for the survey duration (short - 3 months) resulting in a **low** consequence.

The potential impact of 3D seismic noise on benthic, and neritic and pelagic invertebrates, considering the low sensitivity, the low likelihood of the impact occurring is thus deemed to be of **LOW significance**.

Impact Summary – Impacts of seismic noise on *marine invertebrates*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**L**	**L**	**L-M**	**L**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Implement 'soft start' procedures.
- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.1.8 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS ON PLANKTON (INCLUDING ICHTHYOPLANKTON)

a) Nature and intensity of impact, duration, geographical extent (and consequence), probability and significance

As the movement of phytoplankton, zooplankton and ichthyoplankton is largely limited by currents, they are not able to actively avoid the seismic vessel and thus are likely to come into close contact with the sound sources, potentially experiencing multiple exposures during acquisition of adjacent lines. Potential impacts of seismic pulses on plankton would include physiological injury or mortality in the immediate vicinity of the airgun sound source.

As PEL83 is located offshore of the LUCORC area, which considered to be an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems, overlap with the peak spawning products of commercially important species would be insignificant if at all. However, as plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, and the survey area lies well offshore of the West Coast northward egg and larval drift and return migration of recruits, any impacts would be of LOW intensity for phytoplankton, zooplanktonand ichthyoplankton. Although the impact is restricted to within a few hundred metres of the airguns, it would extend over the entire survey area (REGIONAL) during the course of the survey. Should impacts occur, they would persist over the SHORT-TERM (days). The consequence would therefore be **low**. As plankton abundances in the offshore waters of the proposed 3D survey area will be negligible, the Consequence of the impact would be **low**.

The potential impact of seismic noise on phytoplankton and zooplankton, considering the medium sensitivity and low Consequence, is thus deemed to be of **LOW significance** both with and without mitigation. Due to the medium sensitivity of ichthyoplankton, but the low likelihood of the impact occurring in offshore waters, the impacts are deemed to be of **LOW significance**.

Impact Summary – Impacts of seismic noise on *plankton and ichthyoplankton*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**L**	**L**	**L-M**	**L**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- As the proposed survey area is located far offshore, it is not deemed necessary to implement mitigation measures to avoid the key spring spawning periods thereby mitigating potential impacts on plankton to some degree. No other direct mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.

8.2.1.9 ACOUSTIC IMPACTS OF FURTHER 3D SEISMIC SURVEYS AT ECOSYSTEM LEVEL

With growing evidence of the ecosystem-wide effects of seismic noise and the potential consequences of sub-lethal anthropogenic sounds affecting marine animals at multiple levels (e.g. behaviour, physiology, and in extreme cases survival), there is increasing recognition for the need to consider the effects of anthropogenic noise at population and ecosystem level. The sub-lethal effects of sound exposure may seem subtle, but small changes in behaviour can lead to significant changes in feeding behaviour, reductions in growth and reproduction of individuals but can have effects that go beyond a single species and may cause changes in food web interactions.

Due to the difficulties in observing population-level and/or ecosystem impacts, numerical models are needed to provide information on the extent to which sound or other anthropogenic disturbances may affect the structure and functioning of populations and ecosystems. Attempts to model noise-induced changes in population parameters were first undertaken for marine mammals using the population consequences of acoustic disturbance (PCAD) or Population Consequences of Disturbance (PCoD) approach. The PCAD/PCoD framework assesses how observed behavioural responses on the health of an individual translates into changes in critical life-history traits (e.g. growth, reproduction, and survival) to estimate population-level effects. Since then various frameworks have been developed to enhance our understanding of the consequences of behavioural responses of individuals at a population level. This is typically done through development of bio-energetics models that quantify the reduction in bio-energy intake as a function of disturbance and assess this reduction against the bio-energetic need for critical life-history traits. The consequences of changes in life-history traits on the development of a population are then assessed through population modelling. These frameworks are usually complex and under continual development but have been successfully used to assess the population consequences and ecosystem effects of disturbance in real-life conditions both for marine mammals, fish and invertebrates. The PCAD/PCoD models use and synthesize data from behavioural monitoring programs, ecological studies on animal movement, bio-energetics, prey availability and mitigation effectiveness to assess the population-level effects of multiple disturbances over time.

Ecosystem-based management is a holistic living resource management approach that concurrently addresses multiple human uses and the effect such stressors may have on the ability of marine ecosystems to provide ecosystem services and processes (e.g. recreational opportunities, consumption of seafood, coastal developments). Within complex marine ecosystems, the integrated ecosystem assessment framework, which incorporates ecosystem risk assessments, provides a method for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components. It therefore has the potential to address cumulative impacts and balance multiple, often conflicting, objectives across ocean management sectors and explicitly evaluate trade-offs. It has been repeatedly explored in fisheries management and more recently in marine spatial planning.

However, due primarily to the multi-dimensional nature of both ecosystem pressures and ecosystem responses, quantifying ecosystem-based reference points or thresholds has proven difficult. Ecosystem thresholds occur when a small change in a pressure causes either a large response or an abrupt change in the direction of ecosystem state or function. Complex numerical modelling that concurrently identifies thresholds for a suite of ecological indicator responses to multiple pressures is required to evaluate ecosystem reference points to support ecosystem-based management.

The required data inputs into such models are currently limited in southern Africa. Expert elicitation is therefore a useful method to synthesize existing knowledge, potentially extending the reach of explicitly quantitative methods to data-poor situations.

8.2.2 Impact of Survey Vessel Lighting on Pelagic Fauna

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The survey activities would be undertaken in the offshore marine environment, more than 100 km offshore, far removed from any sensitive coastal receptors (e.g. bird or seal colonies), but could still directly affect migratory pelagic species (pelagic seabirds, turtles, marine mammals and fish) transiting through PEL 83. The strong operational lighting used to illuminate the survey vessel at night may disturb and disorientate pelagic seabirds feeding in the area. Operational lights may also result in physiological and behavioural effects of fish and cephalopods as these may be drawn to the lights at night where they may be more easily preyed upon by other fish and seabirds.

Consequence

Offshore platform structures are known to concentrate both seabirds and their prey due to structural stimuli, food concentrations, oceanographic processes and lights and flares. Potential attraction may increase during fog when greater illumination is caused by refraction of light by moisture droplets. In relation to the huge numbers of migrant birds overflying the seas, collisions with man-made structures seem to be rare, although sometimes several thousand birds may be affected in a single event, particularly during adverse weather conditions. It is expected, however, that seabirds and marine mammals in the area would become accustomed to the presence of the project vessels and drill rig within a few days. Since the seismic acquisition area is located within the main traffic routes that pass around southern Africa, which experience high vessel traffic, animals in the area should be accustomed to vessel traffic and associated lighting.

Although little can be done on the project vessels to prevent seabird collisions, reports of collisions or death of seabirds on vessels. Should they occur, the light impacts would primarily take place in the survey area and along the route taken by the support vessels between the survey area and Lüderitz.

Operational lights may also result in physiological and behavioural effects on turtle's, fish and cephalopods, as these may be drawn to the lights at night where they may be more easily preyed upon by other fish, marine mammals and seabirds. The dispersal of turtle hatchlings is reported to be disrupted by light, causing them to linger, become disoriented in the nearshore and expend energy swimming against ocean currents. Although seals are known to forage up to 120 nautical miles (~220 km) offshore, the offshore location of the proposed survey area fall to the west of the foraging range of seals from the West Coast colonies. Odontocetes are also highly mobile, supporting the notion that various species are likely to occur in PEL 83 and thus potentially attracted to the area.

Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed 3D survey is expected to be low. Due to anticipated numbers and the proximity of survey area to the main traffic routes, the increase in ambient lighting in the offshore environment would be of low intensity and regional in extent (although limited to the area in the immediate vicinity of the vessel) over the short-term (3 months). For support vessels travelling from Walvis Bay increase in ambient lighting would likewise be restricted to the immediate vicinity of the vessel over the short-term. The potential for behavioural disturbance as a result of vessel lighting would thus be of **low Consequence**.

b) Probability and Significance

The potential for collision of birds with the survey vessel due to lighting or behavioural disturbance by vessel lighting is deemed to be of **LOW significance**, due to the medium sensitivity of the receptors, the low likelihood of the impact occurring and the low Consequence.

Impact Summary – Survey Vessel Lighting impacts

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**M**	**L**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- The use of lighting on the seismic vessel cannot be eliminated due to safety, navigational and operational requirements. However, management and mitigation measures are presented in the ESMP for 3D Seismic Surveys in Appendix H.

8.2.3 IMPACT OF OCEAN BOTTOM NODE PLACEMENT

a) Nature and intensity of impact, duration and geographical extent (and consequence)

Any benthic biota in the footprint of the ROV skids or the modular node receivers would either be disturbed or crushed. Deepwater nodes can be up to 50 kg in weight in water and as they are heavy enough to remain on the seafloor they would likely disturb or crush any soft-bodied invertebrate macrofauna in their footprint.

Physical disturbance of the seabed, through the resuspension of sediments by ROV thrusters may also occur during placement of the node receivers, resulting in increased turbidity near the seabed, potentially with physiological effects on benthic communities (indirect negative impact). Disturbance of seabed sediments during node placement could potentially increase turbidity of the near-bottom water layers thereby placing transient stress on sessile and mobile benthic organisms, by negatively affecting filter-feeding efficiency of suspension feeders or through disorientation of mobile species due to reduced visibility.

Disturbance of sediments due to ROV activity

Consequence

Any disturbance of benthic biota through increased turbidity and elevated suspended sediment concentrations in near-bottom waters would be of low intensity and limited to the turbidity plume generated by the ROV thrusters (LOCAL) (a few metres around the ROV and/or ROV flight track). However, in most cases sub-lethal or lethal responses would occur only at concentrations well in excess of those anticipated due to resuspension of sediments by ROV thrusters. Marine communities of continental shelf waters along the southern Namibian coast can be expected to have behavioural and physiological mechanisms for coping with increased turbidity in their near bottom habitats. Any turbidity effects would be transient only as sediments would redeposit after the ROV has departed the area. Any impacts would thus persist over the short-term (hours) only resulting in the impact being of **low consequence**.

Disturbance and crushing of benthic macrofauna

Consequence

Placement of the modular node receivers could potentially disturb and damage seabed habitats and crush any epifauna and infauna within the equipment footprint. Considering the available area of similar habitat on and off the edge of the continental shelf in the Namib Biozone, this disturbance of, and reduction in, benthic biodiversity can be considered of low intensity, highly localised and limited to the footprint of the node receivers (local). Any impacts would persist over the short-term only, as nodes will be retrieved. The impact for crushing of benthic macrofauna is thus considered to be of **low consequence**.

b) Probability and Significance

Although disturbance of seabed sediments and crushing of benthic macrofauna is possible, the impacts associated with the accidental loss of equipment are deemed to be of **LOW significance**.

Impact Summary – *Disturbance of seabed sediments and crushing of benthic macrofauna due to OBN placement*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**L**	**L**	**L**	**L**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.4 IMPACT OF HULL FOULING AND BALLAST WATER DISCHARGE

a) Nature and intensity of impact, duration and geographical extent (and consequence)

Artificial structures deployed at sea serve as a substrate for a wide variety of larvae, cysts, eggs and adult marine organisms. The transportation of equipment from one part of the ocean to another would therefore also facilitate the transfer of the associated marine organisms. Survey vessels, seismic equipment and support vessels are used and relocated all around the world. Similarly, the ballasting and de-ballasting of these vessels may lead to the introduction of exotic species and harmful aquatic pathogens to the marine ecosystems).

The marine invertebrates that colonize the surface of vessels can also easily be introduced to a new region, where they may become invasive by outcompeting and displacing native species. Marine invasive species are considered primary drivers of ecological change in that they create and modify habitat, consume and outcompete native fauna, act as disease agents or vectors, and threaten biodiversity. Once established, an invasive species is likely to remain in perpetuity.

Consequence

Alien species have the potential to displace native species, cause the loss of native genotypes, modify habitats, change community structure, affect food web properties and ecosystem processes, impede the provision of ecosystem services, impact human health and cause substantial economic losses.

The survey vessel, and possibly the support / escort vessels, will more than likely have spent time outside of Namibia's EEZ prior to surveying. This exposure to foreign water bodies and possible loading of ballast water increases the risk of introducing invasive or non-indigenous species into Namibian waters. The risk of this impact is, however, significantly reduced due by the implementation of ballast water management measures in accordance with the IMO guidelines. The risk is further reduced due to the far offshore location of the survey area. Since the survey area is far removed from the coast, which together with the dominant wind and current direction, will ensure that any invasive species drift mainly in a north-westerly direction away from the coast. In addition, the water depths in the survey area (~500 m up to 2 500 m) will ensure that colonisation of invasive species on the seabed is unlikely. De-ballasting in the survey area will thus not pose an additional risk to the introduction of invasive species.

In terms of hull fouling, the survey area is located along one of the main traffic routes that pass around southern Africa. Thus, the introduction of invasive species into Namibian waters due to hull fouling of project vessels is unlikely to add to the current risk that exists due to the numerous vessels that operate in or pass through Namibian coastal waters, through and inshore of the survey area, on a daily basis.

Considering the location of the survey area and compliance with the IMO guidelines for ballast water, the impact related to the introduction of alien invasive marine species is considered to be of low intensity (due to it having a minimal effect on receptors) in the short-term (should invasive species be able to establish) and of regional extent. Thus, the **Consequence** is, therefore, considered to be **low**.

b) Probability and Significance

The potential for introductions of non-native marine species through hull fouling or ballast water discharge is deemed to be **LOW**, due to the very low sensitivity of the offshore receptors, the low likelihood of the impact occurring and the low Consequence.

Impact Summary – *Impacts of marine biodiversity through the introduction of non-native species in ballast water and on ship hulls*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**M**	**L**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.2.5 Impacts of Waste Discharges to Sea

a) *Nature and intensity of impact, duration and geographical extent (and consequence)*

The discharge of wastes to sea could create local reductions in water quality, both during transit to and within the survey area. Deck and machinery space drainage may result in small volumes of oils, detergents, lubricants and grease, the toxicity of which varies depending on their composition, being introduced into the marine environment. Sewage and gallery waste will place a small organic and bacterial loading on the marine environment, resulting in an increased biological oxygen demand.

These discharges will result in a local reduction in water quality, which could impact marine fauna in a number of different ways:

- Physiological effects: Ingestion of hydrocarbons, detergents and other waste could have adverse effects on marine fauna, which could ultimately result in mortality.
- Increased food source: The discharge of galley waste and sewage will result in an additional food source for opportunistic feeders, speciality pelagic fish species.
- Increased predator - prey interactions: Predatory species, such as sharks and pelagic seabirds, may be attracted to the aggregation of pelagic fish attracted by the increased food source.

Consequence

The contracted survey / support vessels will have the necessary sewage treatment systems in place, and the vessel will have oil/water separators and food waste macerators to ensure compliance with MARPOL 73/78 standards. MARPOL compliant discharges would therefore introduce relatively small amounts of nutrients and organic material to oxygenated surface waters, which will result in a minor contribution to local marine productivity and possibly of attracting opportunistic feeders. The intermittent discharge of sewage is likely to contain a low level of residual chlorine following treatment but given the relatively low total discharge and rapid dilution in surface waters this is expected to have a minimal effect on seawater quality.

Furthermore, the survey area is suitably far removed from sensitive coastal receptors and the dominant wind and current direction will ensure that any discharges are rapidly dispersed north-westwards and away from the coast. There is no potential for accumulation of wastes leading to any detectable long-term impact.

Due to the distance offshore, it is only pelagic fish, birds, turtles and cetaceans that may be affected by the discharges, and these are unlikely to respond to the minor changes in water quality resulting from vessel discharges. The most likely animal to be attracted to the survey vessels will be large pelagic fish species, such as the highly migratory tuna and billfish, as well as sharks and odontocetes (toothed whales). Pelagic seabirds that feed primarily by scavenging would also be attracted.

Other types of wastes generated during the exploration activities will be segregated, duly identified transported to shore for ultimate valorisation and/or disposal at a licensed waste management facility. The disposal of all waste onshore will be fully traceable.

Based on the relatively small discharge volumes and compliance with MARPOL 73/78 standards, offshore location and high energy sea conditions, the potential impact of normal discharges from the survey / support vessels will be of low intensity, low duration and regional in extent (although localised at any one time around the project vessels). The **Consequence** is therefore considered **LOW**.

b) Probability and Significance

The impacts associated with normal waste discharges from the survey vessel is deemed to be of **LOW significance**, due to the medium sensitivity of the offshore receptors, the possibility of the impacts occurring and the low Consequence.

Impact Summary – *Impacts of normal vessel discharges on marine fauna*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**M**	**L**	**M**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- In addition to compliance with MARPOL 73/78 regulations regarding waste discharges mentioned above, further measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.2.6 IMPACTS ON MARINE TRAFFIC AND TRANSPORT

a) Nature and intensity of impact, duration and geographical extent (and consequence)

A large number of vessel types navigate along the Namibian Coast, including general cargo, bulk, containers, tankers, passenger vessels and fishing vessels. As the seismic survey vessel will have an exclusion zone around it and cannot readily change course due to the seismic survey equipment, there is potential for other navigators to be forced to change course if their intended course passes through the path of the survey vessel. This has the potential to cause an increase in fuel consumption and a delayed transit time for the vessels concerned.

It could therefore have a direct negative impact in terms of Temporary cessation or displacement of marine traffic and transport

Consequence

The proposed survey is expected to have a short-term adverse effect on marine traffic and transport through potential restrictions on such activities within the survey area. The impact is expected to be local in extent (i.e. confined to the survey area). No notable changes to the resource (i.e. shipping industry) would be expected. Impact intensity is expected to be low. The determining consequence is therefore low.

b) Probability and Significance

The impacts associated with seismic survey activities resulting in a negative direct impact on marine traffic and transport through temporary displacement of such activities within the survey area is deemed to be of **LOW significance**, due to the low sensitivity of the offshore receptors, the unlikelihood of the impact occurring and the low Consequence.

Impact Summary – *Impacts on marine traffic and transport*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**L**	**L**	**L**	**L**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Vessels involved in the survey will adopt industry standard warning and navigation equipment and procedures in order to reduce the risk of interaction with other vessels that may be present in the area. These will include the use of radar, foghorns, and issuing a Notice to Mariners through the Hydrographic Office and port captains of the Port of Luderitz, Walvis Bay, Cape Town and the Port of Saldanha to warn that the survey is taking place and conveying the limited manoeuvrability of the survey vessel.
- Further measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.2.7 Displacement of Fishing Vessels due to Temporary Safety Zone around Survey Vessel

a) Nature and intensity of impact, duration and geographical extent (and consequence), probability and significance

The array and the hydrophone streamers need to be towed in a set configuration behind the tow-ship, which means that the survey operation has little manoeuvrability whilst operating. For this reason, the vessel is considered as a fixed marine feature that is to be avoided by other vessels. A safety zone will be enforced which aims to ensure the safety of navigation, avoiding or reducing the probability of damage to the towed streamer cables. The temporary exclusion of vessels from entering the safety zone around a seismic survey vessel poses a direct impact to fishing operations in the form of loss of exclusion from fishing grounds to any fishing sector that operates within PEL 83. The sectors identified as being active within the licence area include large pelagic longline, demersal trawl, demersal longline and tuna pole-line. The impact is short-term (up to 3 months for the duration of the survey campaign) with the extent being limited to within a distance of 6 Nm (~11.11 km) of the survey vessel (local in extent). The licence area does not overlap with the fishing grounds of the small pelagic purse-seine, midwater trawl, line fish, Deepsea crab or rock lobster sectors. Thus there would be no impact on these sectors of exclusion from fishing grounds due to the presence of the survey vessel. Although the licence area coincides with a fisheries management area for the deepwater trawl sector, the sector is currently non-operational and there is no impact expected on the fishery.

Large pelagic longline[15]

The licence area coincides with fishing areas for large pelagic species, with 2.6% of the overall catch of the large pelagic longline sector having been reported within the licence area. The intensity of the potential impact of exclusion from fishing areas is considered to be moderate (fishing activity can continue in a modified way i.e. in adjacent fishing areas). Given the low extent and low duration, the consequence of the impact is LOW. The **significance** of the impact is expected to be **MODERATE**, based on the high probability that the impact would occur. The sector operates year-round and across the full extent of the licence area with activity highest in the nearshore portion of the licence area.

Demersal trawl

The catch reported within the licence area is equivalent to 1.33% of the overall landings reported by the sector. The intensity of the potential impact of exclusion is considered to be moderate (fishing activity can continue in a modified way i.e. in adjacent fishing areas). Given the low extent and low duration, the consequence of the impact is LOW. The **significance** of the impact is expected to be **LOW**, based on the moderate probability that the impact would occur. The sector operates year-round except for a month's closure during October. Activity is highest in the

[15] Pelagic longline vessels set a drifting mainline, which are up to 100 km in length, and a vessel's manoeuvrability is severely restricted during the hauling of longlines. Thus, a vessel cannot easily manoeuvre out of the way of an approaching seismic vessel. In the event of an emergency, a line may be dropped to be hauled in at a later stage. Drifting lines could still result in entanglement within the towed seismic array.

nearshore portion of the licence area and up to a maximum seafloor depth of approximately 850 m.

Demersal longline

The catch reported within the licence area is equivalent to 1.1% of the overall landings by the sector. The intensity of the potential impact of exclusion is considered to be moderate (fishing activity can continue in a modified way i.e. in adjacent fishing areas). Given the low extent and low duration, the consequence of the impact is considered to be LOW. The **significance** of the impact is expected to be **LOW**, based on the moderate probability that the impact would occur. The sector operates year-round except for a month's closure during October. Activity is highest in the nearshore portion of the licence area and up to a maximum seafloor depth of approximately 650 m.

Tuna pole-line

The catch and effort within the licence area is equivalent to 1.05% and 1.38%, respectively, of the overall catch and effort reported by the sector. The intensity of the potential impact of exclusion is considered to be moderate (fishing activity can continue in a modified way i.e. in adjacent fishing areas). Given the low extent and low duration, the consequence of the impact is considered to be LOW. The **significance** of the impact is expected to be **LOW**, based on the moderate probability that the impact would occur. Fishing activity takes place in the nearshore portion of the licence area predominantly during February, with some activity reported during January and March.

Deep-water trawl

The licence area coincides with a management area demarcated for deep-water trawl; however, the fishery has not been operational since 2007 and is currently closed. There is no impact expected on the sector.

Impact Summary – *Impact of Exclusion of Fisheries from Fishing Ground*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**L**	**L**	**H** (large pelagic longline) **M** (demersal trawl, demersal longline, tuna pole-line)	**M** (large pelagic longline) **L** (demersal trawl, demersal longline, tuna pole-line)
Mitigated	**M**	**L**	**L**	**L**	**M**	**L**

					(demersal trawl, demersal longline, tuna pole-line)	(demersal trawl, demersal longline, tuna pole-line)

Management, mitigation and monitoring measures

- Key measures relate to communication with the Fishing Industry.
- Further measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.2.8 IMPACT OF UNDERWATER NOISE ON CATCH RATES

a) Nature and intensity of impact, duration and geographical extent (and consequence), probability and significance

In addition to the potential impacts of exclusion to fishing areas, international research has shown that the noise energy generated during seismic surveys may cause mortality, physiological damage, masking effects and/or behavioural responses in fish and invertebrates. As such, the possible effects of seismic sound on species relevant to the Namibian fisheries are considered. Differences in morphology and behaviour between species means that species vary in their vulnerability to seismic noise, and generalisations across groups are not easily made.

A number of studies have reported reductions in catch rates of fish during and after seismic surveys. The observed declines in catch rates differed considerably from study to study as did the distance from the seismic sound source at which reductions in catch rates were measured. The results of a number of experiments indicated a range from 1 km to greater than 33 km. The observed duration of impacts ranged from approximately 12 hours to up to 10 days. Variability in findings is related to the sensitivity of different fish species to noise, the gear-type used across different fisheries, and abiotic factors e.g. water depth, which affects the transmission of sound in water.

Seismic surveys can cause significant mortality to zooplankton within at least 1.2 km range (the maximum distance sampled so far) of airgun firing. Unlike fish, zooplankton cannot move rapidly enough to escape a seismic array. As zooplankton are fundamental to marine food webs, reductions in zooplankton could have knock-on effects for fish populations and thus cause future reductions in catches. However, predicting the exact impact of these effects, in time and scale, and drawing direct causation would be an unlikely and complex task.

The sensitivity of each of the fishing sectors identified in this assessment depends on the proportional overlap of the affected area with fishing grounds as well as the vulnerability of the fish species targeted by each of the sectors. The greatest risk of physiological injury from seismic sound sources is for species with swim bladders (e.g. hake and other demersal species targeted by demersal longline and demersal trawl fisheries, small pelagic species targeted by the midwater and purse-seine fisheries). In many of the large pelagic species the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower. However, two of the four tuna species targeted in Namibian fisheries, *Thunnus albacares* (yellowfin) and *T. obesus* (bigeye), do have swim bladders and so may be physically vulnerable.

The underwater noise modelling study undertaken for the 2017 ESIA identified that the maximum horizontal distance from 3D seismic source to impact threshold levels leading to mortality or potential mortal injury was 159 m, for fish lacking swim bladders (e.g. some tunas, sharks and most mesopelagic species) and 317 m for fish with swim bladders. Zones of immediate impact from single pulses for recovery injury were the same.

Existing experimental data regarding recoverable injury for fish eggs and larvae is sparse and no guideline recommendations have been provided. However, based on a subjective approach, noise impacts for fish eggs and larvae are expected to be moderate at the near field (i.e. in the distance of tens of meters) from the source location, low at intermediate (i.e. in the distance of hundreds of meters) and far field (i.e. in the distance of thousands of meters) from the source location.

The zones of impact for mortality, mortal injury, recoverable injury and behavioural disturbance are not expected to coincide with fishing grounds of the pelagic purse-seine, midwater trawl, line fish, deepsea crab or rock lobster sectors. There is no impact of elevated sound levels expected on these sectors.

The zones of impact for mortality, mortal injury, recoverable injury and behavioural disturbance coincide with large pelagic longline fishing areas. The intensity of the impact on the large pelagic longline sector has been rated moderate and the extent of the impact has been rated as local (within 4 km of the survey area). Behavioural effects can be considered short-term, with duration of the effect being less than or equal to the duration of exposure. The potential impact on catch rates could therefore be considered to be of short-term duration. The impact is rated as low consequence and overall **low significance** due to the moderate probability of the impact occurring.

Sound levels are likely to attenuate to below the threshold at which a behavioural response from fish would be expected at 4 km from the source array. Therefore, it is considered unlikely that the catch rates of the tuna pole sector would be affected at Tripp Seamount.

Impact Summary – *Impact of underwater noise on catch rates*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M** (large pelagic longline) **L** (demersal trawl, demersal longline, tuna pole-line)	**L**	**L**	**L**	**M** (large pelagic longline, demersal trawl, demersal longline, tuna pole-line)	**L** (large pelagic longline, demersal trawl, demersal longline, tuna pole-line)
Mitigated	**M** (large pelagic longline) **L** (demersal trawl, demersal longline, tuna pole-line)	**L**	**L**	**L**	**M** (large pelagic longline, demersal trawl, demersal longline, tuna pole-line)	**L** (large pelagic longline, demersal trawl, demersal longline, tuna pole-line)

Management, mitigation and monitoring measures

- A process of notification to affected parties should be implemented as this would allow the fishing industry to avoid the survey area and relocate effort into alternative grounds.
- Prior to the commencement of survey activities, the Association of Namibian Fishing Industries and the Namibian Large Pelagic Longlining Association should be informed of the navigational co-ordinates of the proposed survey acquisition area, timing and duration of proposed activities and any implications relating to the exclusion zone that would be requested, as well as the movements of support vessels related to the project.
- Further measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.3 UNPLANNED EVENTS

8.3.1 FAUNAL STRIKES WITH PROJECT VESSELS AND EQUIPMENT

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The potential effects of vessel presence and towed equipment on turtles and cetaceans include physiological injury or mortality.

Consequence

Ship strikes are globally the biggest threat to large whales, having direct, long-term and population-level consequences. Although most scientific publications to date have focussed on collisions between vessel and whales and manatees, there is growing evidence that at least 75 marine species, including smaller whales, dolphins, porpoises, dugongs, manatees, whale sharks, sharks, seals, sea otters, turtles, penguins, and fish are at risk of collision, especially within coastal areas frequented by smaller vessels. As the proposed 3D survey area is located in a region of high vessel traffic, potential collisions between marine fauna and vessels would not be limited to project-specific vessels. Given the slow speed of the vessel while towing the seismic array, ship strikes whilst surveying are unlikely, but may occur during the transit of the vessel to or from the survey area. Ship strikes by the supply / guard vessels may also occur.

Due to their extensive distributions and feeding ranges, the number of cetaceans encountered by project vessels in the offshore environment is expected to be low.

The large amount of equipment towed astern of survey vessels also increases the potential for collision with or entrapped in seismic equipment and towed surface floats. Entanglement of cetaceans in gear is possible in situations where tension is lost on the towed array.

Basking turtles are particularly slow to react to approaching objects and may not be able to move rapidly away from approaching airguns. In the past, almost all reported turtle entrapments were associated with the subsurface structures ('undercarriage') of the tail buoys attached to the end of each seismic cable.

However, the potential for collision between adult turtles and the seismic vessel, or entanglement of turtles in the towed seismic equipment and surface floats, is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, and the extended distance from their nesting sites, the number of turtles encountered during the proposed seismic surveys is expected to be low. Should collisions or entanglements occur, the impacts would be of high intensity for individuals but of low intensity for the population. Furthermore, as the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area (regional), the potential for collision and entanglement in seismic equipment is therefore considered to be of **low Consequence**.

The potential for strikes and entanglement of cetaceans in the towed seismic equipment, is similarly highly dependent on the abundance and behaviour of cetaceans in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, the number of cetaceans encountered during the proposed seismic surveys is expected to be low. Should entanglements occur, the impacts would be of high intensity for individuals but of low intensity for the population as a whole. Furthermore, as the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area (regional), the potential for entanglement in seismic equipment is therefore considered to be of **low Consequence**.

b) Probability and Significance

The potential for collision with or entanglement by turtles and cetaceans during the seismic survey or the transit of the vessel to or from the survey area is deemed to be of **LOW significance**, due to the high sensitivity of the receptors, but very low likelihood of the impact occurring and the low Consequence.

Impact Summary – *Impacts on turtles and cetaceans due to ship strikes, collision and entanglement with towed equipment.*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**M**	**L**	**L**	**L**
Mitigated	**L**	**L**	**M**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Refer to the ESMP for 3D Seismic Surveys in Appendix H.

8.3.2 ACCIDENTAL LOSS OF EQUIPMENT

a) Nature and intensity of impact, duration and geographical extent (and consequence)

The potential impacts associated with lost equipment include:

- Potential disturbance and damage to seabed habitats and crushing of epifauna and infauna within the equipment footprint.
- Potential physiological injury or mortality to pelagic and neritic marine fauna due to entanglement in streamers, arrays and tail buoys drifting on the surface or in the water column.

Consequence

The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The availability of hard substrata on the seabed provides opportunity for colonisation by sessile benthic organisms and could provide shelter for demersal fish and mobile invertebrates thereby potentially increasing the benthic biodiversity and biomass in the continental slope and abyssal regions. The benthic fauna inhabiting islands of hard substrata in otherwise unconsolidated sediments of the outer shelf and continental slope are, however, very poorly known but would likely be different from those of the surrounding unconsolidated sediments. In the unlikely event of equipment loss, associated impacts would be of low intensity and be highly localised and limited to the site over the short-term (any lost object, depending on its size, will likely sink into the sediments and be buried over time). The **Consequence** for equipment lost to the seabed is therefore considered **low**.

The loss of streamers and floats would result in entanglement hazards in the water column before the streamers sink under their own weight. In the unlikely event of streamer loss, associated impacts would similarly be of low intensity and be highly localised and limited to the site (although would potentially float around regionally) over the short-term. The **Consequence** for equipment lost to the water column is therefore considered **low**.

b) Probability and Significance

The impacts associated with the accidental loss of equipment are deemed to be of **LOW significance**, due to the medium sensitivity of the offshore receptors, the very low likelihood of the impact occurring and the very low Consequence.

Impact Summary – *Impacts on benthic and pelagic fauna due to accidental loss of equipment to the seabed or the water column.*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L**	**L**	**L**	**L**	**L**	**L**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Refer to the ESMP for 3D Seismic Surveys in Appendix H. Amongst others, to undertake frequent checks to ensure items and equipment are stored and secured safely on board each vessel.

8.3.3 ACCIDENTAL OIL RELEASE TO THE SEA DUE TO VESSEL COLLISIONS, BUNKERING ACCIDENT AND LINE / PIPE RUPTURE – IMPACTING FAUNA

a) Nature and intensity of impact, duration and geographical extent (and consequence)

Marine diesel spilled in the marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage) (direct negative impact). Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress and incorporation of carcinogens into the food chain. If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

Consequence

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. The physical properties that affect the behaviour and persistence of an oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the oil's chemical composition (e.g. the amount of asphaltenes, resins and waxes). Spilled oil undergoes physical and chemical changes (collectively termed 'weathering'), which in combination with its physical transport, determine the spatial extent of oil contamination and the degree to which the environment will be exposed to the toxic constituents of the released product.

As soon as oil is spilled, various weathering processes come into play. Although the individual processes may act simultaneously, their relative importance varies with time. Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer-term processes of oxidation, sedimentation and biodegradation.

As a general rule, oils with a volatile nature, low specific gravity and low viscosity (e.g. marine diesel) are less persistent and tend to disappear rapidly from the sea surface. In contrast, high viscosity oils containing bituminous, waxy or asphaltenic residues, dissipate more slowly and are more persistent, usually requiring a clean-up response.

Being highly toxic, MGO and VLSFO would negatively affect any marine fauna it comes into contact with and will have an immediate detrimental effect on water quality. Any release of liquid hydrocarbons thus has the potential for direct, indirect and cumulative effects on the marine environment. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton (particularly copepods), pelagic eggs and fish larvae, and habitat loss or contamination.

The consequences and effects of small (2 000 – 20 000 litres) diesel fuel spills into the marine environment are summarised below:

Diesel is a light oil that, when spilled on water, spreads very quickly to a thin film and evaporates or naturally disperses within a few days or less, even in cold water. Diesel oil can be physically mixed into the water column by wave action, where it adheres to fine-grained suspended sediments, which can subsequently settle out on the seafloor. As it is not very sticky or viscous, diesel tends to penetrate porous sediments quickly, but also to be washed off quickly by waves and tidal flushing. In the case of a coastal spill, shoreline cleanup is thus usually not needed. Diesel oil is degraded by naturally occurring microbes within one to two months. Nonetheless, in terms of toxicity to marine organisms, diesel is considered to be one of the most acutely toxic oil types. Many of the compounds in petroleum products are known to smother organisms, lower fertility and cause disease. Intertidal invertebrates and seaweed that come in direct contact with a diesel spill may be killed. Fish kills, however, have never been reported for small spills in open water as the diesel dilutes so rapidly. Due to differential uptake and elimination rates, filter-feeders (particularly mussels) can bio-accumulate hydrocarbon contaminants. Crabs and shellfish can be tainted from small diesel spills in shallow, nearshore areas.

Chronic and acute oil pollution is a significant threat to both pelagic and inshore seabirds. Diving sea birds that spend most of their time on the surface of the water are particularly likely to encounter floating oil and will die as a result of even moderate oiling which damages plumage and eyes. The majority of associated deaths are as a result of the properties of the oil and damage to the water repellent properties of the birds' plumage. This allows water to penetrate the plumage, decreasing buoyancy and leading to sinking and drowning. In addition, thermal insulation capacity is reduced requiring greater use of energy to combat cold.

Impacts of oil spills on turtles are thought to primarily affect hatchling survival. Turtles encountered in the project area would mainly be migrating adults and vagrants. Similarly, little work has been done on the effect of an oil spill on fur seals.

The effects of oil pollution on marine mammals is poorly understood, with the most likely immediate impact of an oil spill on cetaceans being the risk of inhalation of volatile, toxic benzene fractions when the oil slick is fresh and un-weathered. Common effects attributable to the inhalation of such compounds include absorption into the circulatory system and mild irritation to permanent damage to sensitive tissues such as membranes of eyes, mouth and respiratory tract. Direct oiling of cetaceans is not considered a serious risk to the thermoregulatory capabilities, as cetacean skin is thought to contain a resistant dermal shield that acts as a barrier to the toxic substances in oil. Baleen whales may experience fouling of the baleen plates, resulting in temporary obstruction of the flow of water between the plates and, consequently, reduce feeding efficiency. Field observations record few, if any, adverse effects among cetaceans from direct contact with oil, and some species have been recorded swimming, feeding and surfacing amongst heavy concentrations of oil with no apparent effects.

In the unlikely event of an operational spill or vessel collision, the magnitude of the impact would depend on whether the spill occurred in offshore waters where encounters with pelagic seabirds, turtles and marine mammals would be low due to their extensive distribution ranges, or whether the spill occurred closer to the shore where encounters with sensitive receptors will be higher. Based on the results of the oil spill modelling undertaken in the Orange Basin (PRDW 2013) a diesel slick in the survey area would be blown in a north-westerly direction due to the dominant winds and currents in the survey area. The diesel would most likely remain at the surface for <36 hours with no probability of reaching sensitive coastal habitats. In offshore environments, impacts associated with a spill or vessel collision would thus be of low intensity, regional (depending on the nature of the spill) over the short-term (<5 days). The **Consequence** for a marine diesel spill is therefore considered **low**.

However, in the case of a spill or vessel collision *en route* to the survey area, the spill may extend into coastal MPAs and reach the shore affecting intertidal and shallow subtidal benthos and sensitive coastal bird species, in which case the intensity would be considered high, but still remaining regional over the short-term. The Consequence would be **moderate**.

b) Probability and Significance

The impact methodology used to assess the impact significance calculates an overall low pre-mitigation significance. However, considering the high sensitivity of receptors and the low (offshore) and moderate Consequence (nearshore), the potential impact on the marine fauna is in reality considered to range from **LOW significance (offshore**) to MEDIUM significance (nearshore) without mitigation. The likelihood of the impact occurring is, however, low.

Impact Summary – *Impacts of an operational spill or vessel collision on marine fauna*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**L / M**	**L**	**M**	**L / M (moderate for nearshore)**	**L**	**L / M (moderate for nearshore)**
Mitigated	**L**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

In addition to compliance with MARPOL 73/78 regulations and to the best industry practices and project standards, further measure is presented in the ESMP for 3D Seismic Surveys in Appendix H.

8.3.4 Impact of Accidental Release of Oil at Sea on Fisheries Sectors

a) Nature and intensity of impact, duration and geographical extent (and consequence), probability and significance

Oil spilled in the marine environment would have an immediate detrimental effect on water quality, with toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) or sub-lethal (e.g. respiratory damage) effects on marine fauna. An oil spill can also result in several indirect impacts on fishing. These include:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort.
- Mortality of animals (including eggs and larvae) leading to reduced recruitment and loss of stock (e.g. mariculture); and
- Gear damage due to oil contamination.

Oil contamination could potentially have the greatest impact on commercial fisheries for rock lobster and sessile filter feeders (e.g. mussels) and grazers (e.g. abalone). Mortality is expected to be high on filter feeders and, to a lesser extent, grazers. These species have low mobility and no means to escape contamination and ultimately mortality. Thus, mariculture facilities (e.g. in Lüderitz and Walvis Bay) could be impacted if a spill extended into these areas. For a large oil spill, fishing / mariculture activities and revenues could be affected over a wide area until such time as the oil has either been dispersed or broken down naturally.

The licence areas coincide with fishing grounds thus a small operation spill could affect fishing operations depending on the actual spill location. The dominant wind and current direction will ensure that any spill in the survey area moves mainly in a north-westerly away from Tripp Seamount and coast. Thus, any spill offshore, which will disperse rapidly, is unlikely to have an impact on these sensitive features. Spawning areas for the main commercial fish species occur northward of this area and general plankton abundance is expected to be comparatively low. It is therefore unlikely that any small-scale pollution effect would have a significant biological impact on the main commercial fish species. Due to the nature of the origin of these spawn products, they are expected to be widely dispersed and unlikely to significantly impact recruitment to the fishery.

For small spills of diesel or hydraulic fuel during normal operations, the dominant weathering processes are evaporation and dispersion over the short-term. In the unlikely event of an operational spill, the intensity of the impact would depend on whether the spill occurred in offshore waters (i.e. during bunkering) or closer to the shore (e.g. vessel accident) where encounters with sensitive receptors will be higher. Due to the dominant winds and currents in the drill area, a diesel plume would be blown in a north-westerly direction and away from the coast and spawning areas. In offshore water, the intensity of a small spill on all fisheries is expected to be low. Nearshore, the intensity may be higher due inshore recruitment areas, therefore is considered medium. Based on the intensity, duration and extent, the impact is considered to have an overall low consequence.

The effects of oil spills would potentially have the greatest impact on sessile filter feeding (e.g. mussels and oysters) and grazing species (e.g. abalone) resulting in mortality through physical clogging and or direct absorption. Although unlikely, a small operational spill close to Lüderitz Lagoon from vessels travelling to and from the survey location could impact mariculture activities, which take place in sheltered bays and are highly sensitive to water quality variability. For mariculture, any pollution associated with either uncontained oil drifting into Walvis Bay or Lüderitz Bay, or increases in hydrocarbons and or heavy metals as well as any associated anoxia could be devastating for the industry resulting in complete loss of any stock being held in the designated water areas.

The potential impact on fishing is local in extent and of short-term duration. The impact is considered to be of **LOW** overall **significance**.

Impact Summary – *Impact of Accidental Release of Oil at Sea on Fisheries Sectors*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**L**	**L**	**L**	**L**
Mitigated	**M**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.3.5 IMPACT ON FISHERIES SECTORS OF LOSS OF EQUIPMENT AT SEA

a) *Nature and intensity of impact, duration and geographical extent (and consequence), probability and significance*

The potential impacts (direct) associated with lost equipment include:

- Potential snagging of demersal gear with regards to equipment that sinks to the seabed.
- Potential entanglement hazards with regards to lost streamers, arrays and tail buoys drifting on the surface or in the water column.

The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The loss of streamers and floats would result in entanglement hazards in the water column before the streamers sink under their own weight. In the unlikely event of streamer loss, associated impact could be of low intensity and be highly localised and limited to the site (although would potentially float around regionally) over the short-term. The impact consequence for equipment lost to the water column is considered low and of **LOW** overall **significance** to fisheries sectors.

Impact Summary – *Impact on Fisheries Sectors of Loss of Equipment at Sea*

Mitigation	Intensity	Duration	Extent	Consequence	Probability of occurrence	Significance
Unmitigated	**M**	**L**	**L**	**L**	**L**	**L**
Mitigated	**M**	**L**	**L**	**L**	**L**	**L**

Management, mitigation and monitoring measures

- Any significant loss of equipment should be reported to SANHO should it pose a navigational hazard to shipping. The operator should recover any detached streamer cables which pose a risk to shipping in the area
- Further measures are provided in the ESMP for 3D Seismic Surveys in Appendix H.

8.4 CUMULATIVE IMPACTS

With reference to section 7.2, the potential cumulative impacts were considered where relevant, taking the interaction between the existing environment, any existing or planned third-party activities (i.e. other companies' exploration activities in the surrounding area) with the Galp's proposed ongoing activities. It must be noted, however, that an SEA has not been undertaken for all the current and planned offshore exploration (and associated) activities in this part of the Orange Basin.

8.4.1 CUMULATIVE IMPACT ON MARINE ECOLOGY

There are many other rights holders in the Namibian and adjacent South African offshore environment, but most of these are not undertaking any exploration activities at present or would be concurrently with the proposed 3D survey, particularly not in the far offshore environment. Thus, the possible range of the future prospecting, mining, exploration and production activities that could arise will vary significantly in scope, location, extent, and duration depending on whether a resource(s) is discovered, its size, properties and location, etc. As these cannot at this stage be reasonably defined, it is not possible to undertake a reliable assessment of the potential cumulative environmental impacts. It is also possible that the proposed, or future, exploration fails to identify an economic petroleum resource, in which case the potential impacts associated with the production phase would not be realised.

Furthermore, the assessment methodology used in the EIA by its nature already considers past and current activities and impacts. In particular, when rating the sensitivity of the receptors, the status of the receiving environment (benthic ecosystem threat status, protection level, protected areas, etc.) or threat status of individual species is taken into consideration, which is based to some degree on past and current actions and impacts (e.g. the IUCN conservation rating is determined based on criteria such as population size and rate of decline, area of geographic range / distribution, and degree of population and distribution fragmentation).

Potential cumulative impacts on individuals and populations as a result of other seismic surveys undertaken previously, concurrently or subsequently are difficult to assess. A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. Despite the density of seismic survey coverage over the past 17 years, the southern right whale population is reported to be increasing by 6.5% per year and the humpback whale by at least 5% per annum over a time when seismic surveying frequency has increased, suggesting that, for these population at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities.

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day (Wartzok *et al.* 2004; Southall *et al.* 2007). If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, l*et al*one the population as a whole. However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant. The increasing numbers of southern right and humpback whales around the Southern African coast, and their lingering on West Coast feeding grounds long into the summer, suggest that those surveys conducted over the past 17 years have not negatively influenced the distribution patterns of these two migratory species at least. Information on the population trends of resident species of baleen and toothed whales is unfortunately lacking, and the potential effects of seismic surveys on such populations remains unknown.

Consequently, suitable mitigation measures must be implemented during seismic data acquisition to ensure the least possible disturbance of marine fauna in an environment where the cumulative impact of increased background anthropogenic noise levels has been recognised as an ongoing and widespread issue of concern that can have chronic effects on marine fauna. Should other concurrent seismic exploration activities be undertaken off southern Namibia or in the adjacent Orange Basin in South Africa, cumulative impacts can be expected.

Despite the difficulty in undertaking a reliable assessment of the potential cumulative environmental impacts of future seismic acquisition off southern Namibia due to likely variation in the scope, extent and duration of proposed surveys, the cumulative impacts of potential surveys occurring concurrently needs to be considered.

Assuming the worst case scenario of multiple surveys occurring simultaneously during the summer survey window in 2025 and/or 2026, associated impacts to marine fauna could be of MEDIUM intensity if vessels are operating in close proximity to one another (adjacent blocks) and potential extend into adjacent South African waters, over the short-term (assuming they take place over the same summer survey window). In the unlikely event that multiple surveys (2 or more) would be undertaken concurrently, the impacts to marine fauna could be of low to moderate significance.

Should surveys be run simultaneously, relevant Licence Holders must ensure that a distance of at least 40 km is maintained between survey vessels[16] until sufficient objective evidence is obtained that a reduced buffer distance is acceptable. Furthermore, data sharing among seismic operators should be encouraged to minimize duplicate surveying. Duplicated surveys need to be justified. Re-analysis of old seismic data using new signal processing or analysis techniques should be encouraged

[16] This 40 km buffer maintained by any other survey vessels aligns to advice by the US Department of Interior (2014) and is considered sufficient on the basis that it provides a corridor between vessels where airgun noise approaches ambient levels such that animals may pass between, and/or the potential cumulative effect beyond this distance is considered to be negligible.

8.4.2 CUMULATIVE IMPACT ON FISHERIES

The impacts on each of the relevant fishing sectors could be increased due to the combination of impacts from other projects that may take place during the same period. Cumulative impacts include past, present and future planned activities which result in change that is larger than the sum of all the impacts. Cumulative effects can occur when impacts are: 1. Additive (incremental); 2. Interactive; 3. Sequential or 4. Synergistic and would include anthropogenic impacts (including fishing and hydrocarbon industries) as well as non-anthropogenic effects such as environmental variability and climate change.

In Namibia, a number of wells have recently been drilled by Total Energies in Blocks 2912 and 2913B (2021-2024), Shell in PEL 39 (2021-2023) and Galp in PEL 83 (2024). A number of seismic surveys were also undertaken in the southern Namibian offshore from 2022 to 2024.

An ESIA process to conduct an exploration drilling programme in Licence Block 2813B and 2914A is currently underway. It is also expected that further seismic acquisition and well drilling activities will continue within the nearby PEL 39 and Block 2913B over the next three years. These activities could take place concurrently with Galp's planned drilling and seismic exploration programmes should the ECCs be granted. Based on the transitory nature of seismic surveys, the relatively small area of influence at any given time and the required distances between different exploration activities to avoid interference with data acquisition, it is not expected that significant cumulative impacts would be experienced should multiple surveys be undertaken in parallel or within the same survey window period within PEL 83 and neighbouring licence blocks. Although noise impacts could result in behavioural effects and localised displacement of fish, fish would remain in the overall region. Given the relatively short duration of exploration activities, the overall cumulative impact from exploration on the large pelagic longline and tuna pole-line sectors is considered low to moderate whereas the cumulative impact on the demersal trawl, demersal longline and line-fish sectors is low.

While there are many other rights holders in the offshore environment (e.g. marine diamonds and gemstones, heavy minerals, precious metals and ferrous and base metals), most of these are located well inshore of PEL 83 and are not undertaking any exploration activities at present.

The possible range of the future prospecting, mining, exploration and production activities that could arise will vary significantly in scope, location, extent, and duration depending on whether a resource(s) is discovered, its size, properties and location, etc. As these cannot at this stage be reasonably defined, it is not possible to undertake a reliable assessment of the potential cumulative environmental impacts. However, recent hydrocarbon discoveries from the area indicate that further oil and gas exploration and potentially production will likely occur. Alternatively, it is also possible that the proposed, or future, exploration fails to identify an economic petroleum resource, in which case the potential impacts associated with the production phase would not be realised.

In the Benguela region, it has been suggested that the seasonal movement of Longfin Tuna northwards from the West Coast of South Africa into southern Namibia may be disrupted by the noise associated with an increasing number of seismic surveys. While the potential exists to disrupt the movement of albacore tuna in the Benguela, this disruption, if it occurs, would be localised spatially and temporarily and would be compounded by environmental variability. In Australia, no direct cause and effect in changes in movement or availability of Bluefin Tuna could be attributed to seismic surveys (Evans et al., 2018), with observed changes being attributed to inter-annual variability. Due to the dearth of information on the impacts of seismic noise on truly pelagic species links between changes in migration patterns and subsequent catches thus remains speculative.

In addition to the above the following should also be considered to take account of catch variability and stock declines, which can be attributed to the following:

- Increasing fishing effort exacerbated by improved fish finding technology (vessel monitoring systems, use of sonar, sea surface temperature spatial mapping using satellite technology).
- Environmental variability such as cold and warm water events e.g. Benguela El Niño events have been shown to result in a change in the vertical distribution of tuna stocks within the water column, resulting in reduced catch rates.
- Migration and feeding patterns that change abundance levels annually and are linked to the environment.
- Inconsistent or irregular catch reporting.

8.4.3 UNPLANNED EVENTS

With reference to section 8.3, unplanned events may conceivably occur as a result of accidents or abnormal operating conditions, including (amongst others) accidental spills from vessel accidents. As described above, there could be an increase of vessels operating in adjacent blocks (from various companies undertaking activities overlapping), possibly increasing the likelihood of incidences / accidents that could occur. Key in this regard is ongoing communication between the relevant Companies and Ministries involved.

9 WAY FORWARD

The way forward is as follows:

- MME and MEFT review the documentation and provide record of decision.

10 ENVIRONMENTAL IMPACT STATEMENT AND CONCLUSION

It is Namisun's opinion that the environmental aspects and potential impacts relating to the proposed ongoing / further exploration activities in PEL 83 have been successfully identified, described and re-assessed.

These activities include the following (i.e. similar activities to what was previously assessed, approved and undertaken by Galp in PEL):

- 3D towed streamer seismic survey (i.e. changes in area / location from previously assessed / approved campaign) as well as Ocean Bottom Node (OBN) seismic acquisition.
- Appraisal wells drilling campaign (i.e. similar activities, but changes only in number of wells to be drilled over a period of 3 years).

The potential impacts relating to the proposed further exploration activities were re-assessed, as part of: 1) a new application for the 3D seismic (i.e. towed streamer and OBN) surveys and related activities (addressed in this report); and 2) an amendment application for the further exploration & appraisal wells drilling campaign (i.e. an amendment to the current ECC) (refer to the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling (submitted at the same time as this report to MEFT and MME)). Key consideration in this EIA process and the (re)assessment of impacts are the following:

- The original (approved) "Environmental Impact Assessment for 3D seismic survey in Petroleum Exploration License (PEL) 83, Namibia" (ERM, 2017) and associated specialist studies (appendices) that formed part of the EIA (including, amongst others, an Underwater Noise Modelling Study).
- The original (approved) "EIA Report for the offshore exploration well drilling project in PEL 83" (SLR, 2019) and associated specialist studies (appendices) that formed part of the EIA (including, amongst others, an including amongst others the Noise Studies and Oil Spill Modelling Study)[17].
- The approved "EIA Amendment Report for the proposed offshore exploration well drilling in PEL 83 (Orange Basin) off the coast of Namibia: Well Testing" (Namisun, 2023)[17].
- Further specialist studies undertaken as part of the EIA process to update the baseline description and (re)assess impacts:
  - Marine Ecologist Specialist Study.
  - Commercial Fisheries Specialist Study
- Environmental Baseline Survey and Bathymetry Survey (Fugro, 2024) undertaken in November 2023.

---

[17] These reports with associated specialist studies were specifically referred to in the EIA Amendment (i.e. Scoping with Assessment) Report for Well Drilling

- Further consultations and meetings with I&APs.

The potential impacts relating to the proposed further 3D Seismic survey (and associated) activities in PEL 83 are summarised in Table 17.

It is recommended that, if MEFT provides a positive decision on the application for the proposed project changes, they should include a condition to the clearance that Galp must implement all commitments in the Amended ESMP. The management and mitigation measures and monitoring requirements were reviewed and updated by the Environmental Team, in the respective ESMP for 3D Seismic Surveys, as a results of the EIA process and (re)assessment of impacts.

TABLE 17: SUMMARY OF (RE) ASSESSMENT FINDINGS FOR THE 3D SEISMIC SURVEY AND ASSOCIATED ACTIVITIES

Activity	***Potential Impact***	***Impact Rating***	
		Unmitigated	***Mitigated***
Vessel movements as well as helicopter flights (i.e. emergencies only)	Disturbance and behavioural changes in seabirds, seals, turtles and cetaceans due to due to vessel movement and support aircraft	**L**	**L**
Seismic acquisition	Impacts of seismic noise on mysticetes and odontocetes	**M**	**L**
	Impacts of seismic noise on seals	**L**	**L**
	Impacts of seismic noise on turtles	**L**	**L**
	Impacts of seismic noise on fish	**L**	**L**
	Impacts of seismic noise on seabirds	**M**	**L**
	Impacts of seismic noise on marine invertebrates	**L**	**L**
	Impacts of seismic noise on plankton and ichthyoplankton	**L**	**L**
	Impact of Survey Vessel Lighting on Pelagic Fauna	**L**	**L**
	Disturbance of seabed sediments and crushing of benthic macrofauna due to OBN placement	**L**	**L**
	Impacts of marine biodiversity through the introduction of non-native species in ballast water and on ship hulls	**L**	**L**
	Impacts of normal vessel discharges on marine fauna	**L**	**L**
	Impacts on marine traffic and transport	**L**	**L**

Activity	***Potential Impact***	***Impact Rating***	
		Unmitigated	***Mitigated***
	Impact of Exclusion of Fisheries from Fishing Ground	**M** **(large pelagic longline)** **L** **(demersal trawl, demersal longline, tuna pole-line)**	**L** **(demersal trawl, demersal longline, tuna pole-line)**
	Impact of underwater noise on catch rates	**L** **(large pelagic longline, demersal trawl, demersal longline, tuna pole-line)**	**L** **(large pelagic longline, demersal trawl, demersal longline, tuna pole-line)**
Unplanned events	Impacts on turtles and cetaceans due to ship strikes, collision and entanglement with towed equipment	**L**	**L**
	Impacts on benthic and pelagic fauna due to accidental loss of equipment to the seabed or the water column	**L**	**L**
	Impacts of an operational spill or vessel collision on marine fauna	**L / M** **(moderate for nearshore)**	**L**
	Impact of Accidental Release of Oil at Sea on Fisheries Sectors	**L**	**L**
	Impact on Fisheries Sectors of Loss of Equipment at Sea	**L**	**L**

11 REFERENCES

CAPMARINE. 2024. ECC AMENDMENT APPLICATION FOR SEISMIC EXPLORATION AND APPRAISAL WELL-DRILLING IN PEL83, ORANGE BASIN, NAMIBIA: COMMERCIAL FISHERIES SPECIALIST REPORT

ENVIRONMENTAL RESOURCES MANAGEMENT. 2017: ENVIRONMENTAL IMPACT ASSESSMENT FOR 3D SEISMIC SURVEY IN PETROLEUM EXPLORATION LICENSE (PEL) 83, NAMIBIA.

FUGRO. 2023. ENVIRONMENTAL BASELINE SURVEY AND BATHYMETRY SURVEY

HOLNESS, S., KIRKMAN, S., SAMAAI, T., WOLF, T., SINK, K., MAJIEDT, P., NSIANGANGO, S., KAINGE, P., KILONGO, K., KATHENA, J., HARRIS, L., LAGABRIELLE, E., KIRCHNER, C., CHALMERS, R. & M. LOMBARD, 2014. SPATIAL BIODIVERSITY ASSESSMENT AND SPATIAL MANAGEMENT, INCLUDING MARINE PROTECTED AREAS. FINAL REPORT FOR THE BENGUELA CURRENT COMMISSION PROJECT BEH 09-01.

MINISTRY OF FISHERIES AND MARINE RESOURCES (MFMR), 2021. CURRENT STATUS REPORT: KNOWLEDGE BASELINE FOR MARINE SPATIAL PLANNING IN NAMIBIA. SECOND EDITION. MFMR, WINDHOEK: NAMIBIA.

NAMIBIA STATISTICS AGENCY (NSA) 2019. THE NAMIBIA LABOUR FORCE SURVEY 2018 REPORT. WINDHOEK: NSA.

NAMIBIA STATISTICS AGENCY (NSA) 2024. INFORMATION ABOUT THE NATIONAL CENSUS OF 2023 RETRIEVED FROM WWW.NSA.ORG.NA.

NAMISUN. 2023. EIA AMENDMENT REPORT FOR THE PROPOSED OFFSHORE EXPLORATION WELL DRILLING IN PEL 83 (ORANGE BASIN) OFF THE COAST OF NAMIBIA: WELL TESTING.

NAMISUN 2023A. ENVIRONMENTAL SCOPING (INCLUDING IMPACT ASSESSMENT) REPORT FOR THE PROPOSED LIQUID MUD PLANT FOR SERVICES PÉTROLIERS SCHLUMBERGER (SLB) IN THE PORT OF WALVIS BAY. UNPUBLISHED REPORT.

NAMISUN. 2023B. KELP BLUE TRADING (PTY) LTD’S KELP CULTIVATION PROJECT NEAR LÜDERITZ, //KHARAS REGION: COMMERCIAL SCALE PROJECT.

NAMISUN. 2024. EIA FOR FURTHER EXPLORATION ACTIVITIES IN PEL 83 (ORANGE BASIN) OFF THE COAST OF NAMIBIA:

- PROPOSED FURTHER 3D TOWED STREAMER SEISMIC ACQUISITION, OBN SEISMIC ACQUISITION AND ASSOCIATED ACTIVITIES
- PROPOSED FURTHER EXPLORATION WELLS DRILLING

PISCES ENVIRONMENTAL SERVICES (PTY) LTD. 2024. EIA FOR THE PROPOSED 3D SEISMIC ACQUISITION IN PEL 83 OFF THE COAST OF SOUTHERN NAMIBIA: MARINE ECOLOGY IMPACT ASSESSMENT.

PISCES ENVIRONMENTAL SERVICES (PTY) LTD. 2024. FOR PROPOSED EXPLORATION AND APPRAISAL WELL-DRILLING IN PEL83 OFF THE COAST OF SOUTHERN NAMIBIA: MARINE ECOLOGY IMPACT ASSESSMENT.

PRDW, 2019. PROPOSED OFFSHORE EXPLORATION WELL DRILLING IN PEL 83, ORANGE BASIN, NAMIBIA. OIL SPILL AND DRILLING DISCHARGE MODELLING SPECIALIST STUDY, PRESTEDGE RETIEF DRESNER WIJNBERG (PTY) LTD CONSULTING PORT AND COASTAL ENGINEERS, 120PP.

ROGERS, J., 1977. SEDIMENTATION ON THE CONTINENTAL MARGIN OFF THE ORANGE RIVER AND THE NAMIB DESERT. UNPUBL. PH.D. THESIS, GEOL. DEPT., UNIV. CAPE TOWN. 212 PP.

SLR. 2019. PROPOSED OFFSHORE EXPLORATION WELL DRILLING IN PEL83, ORANGE BASIN, NAMIBIA. FINAL EIA REPORT AND ESMP.

SLR. 2023. APPLICATION FOR AMENDMENT OF ENVIRONMENTAL CLEARANCE CERTIFICATE EXPLORATION AND APPRAISAL WELL DRILLING IN PETROLEUM EXPLORATION LICENSE 39 (PEL 0039) FOR SHELL NAMIBIA UPSTREAM B.V. SLR PROJECT NO.: 733.19019.00002, REPORT NO.: 1. MEFT REFERENCE: APP-001119. UNPUBLISHED REPORT.

SLR. 2023A. ESIA FOR PROPOSED EXPLORATION AND APPRAISAL WELL DRILLING IN BLOCK 2912 OFF THE SOUTH COAST OF NAMIBIA, PREPARED FOR TEEPNA.

ALL REFERENCES MADE IN THE TWO SPECIALIST REPORTS, REFERRED TO IN THIS REPORT, ARE NOT ALL REPEATED IN THE RELEVANT SECTIONS (OF THIS REPORT) AND CAN BE VIEWED IN THESE TWO RESPECTIVE REPORTS (SEE APPENDICES F AND G OF THE EIA SCOPING (INCLUDING IMPACT ASSESSMENT) REPORT – NAMISUN, 2024).

APPENDIX A: CV

APPENDIX B: INFORMATION SHARING RECORD

APPENDIX C: MINUTES OF MEETINGS AND COMMENTS RECEIVED

APPENDIX D: STAKEHOLDER DATABASE

APPENDIX E: ISSUES AND RESPONSE REPORT

APPENDIX F: MARINE ECOLOGY SPECIALIST REPORTS

APPENDIX G: COMMERCIAL FISHERIES SPECIALIST REPORT

APPENDIX H: ESMP FOR THE PROPOSED 3D SEISMIC SURVEY ACTIVITIES

APPENDIX I: ORIGINAL (EXPIRED) ECC