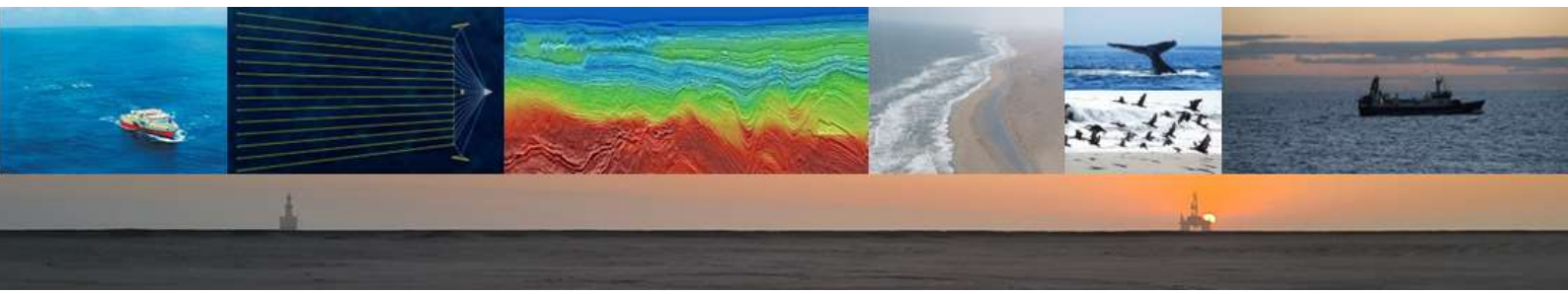
PGS Exploration (UK) Limited

Final Environmental Impact Assessment (EIA) Report to Support the Application for a New Environmental Clearance Certificate (ECC) for the Proposed Multiclient/Proprietary 2D / 3D Seismic Survey covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613,
WALVIS, ORANGE, AND LÜDERITZ BASINS OFFSHORE NAMIBIA



November 2023

PGS Exploration (UK) Limited
4 The Heights, Brooklands, Weybridge
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UNITED KINGDOM

SUMMARY INFORMATION

Proponent
PGS Exploration (UK) Limited

MEFT New ECC Application Reference No.
APP-002496

Project Title / Subject on the New ECC
New Environmental Clearance Certificate (ECC) for the Proposed
Multiclient/Proprietary 2D / 3D Seismic Survey covering
Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A,
2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of
Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613,
Walvis, Orange, and Lüderitz Basins Offshore Namibia

Petroleum Exploration Activities
Multiclient/Proprietary 2D / 3D Seismic Survey Operations

Location of the Proposed Survey Area of Interest for Mew ECC Application
Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B,
2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B,
2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613,
Walvis, Lüderitz and Orange Basins, Offshore Namibia.

National Regulatory Framework
Environmental Management Act
(EMA), 2007, (Act No. 7 of 2007) and
Environmental Impact Assessment (EIA) Regulations No. 30 of 2012

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Environmental Assessment Practitioners (EAPs)
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CITATION: ***Risk-Based Solutions (RBS), 2023***. *Final Environmental Impact Assessment (EIA) Report to Support the Application for a New Environmental Clearance Certificate (ECC) for the Proposed Multiclient/Proprietary 2D / 3D Seismic Survey covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, Walvis, Orange, and Lüderitz Basins Offshore Namibia.*

DR SINDILA MWIYA, TEAM LEADER / ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP), PERMITTING / DE-RISKING ADVISORS / ENVIRONMENTAL CONSULTANTS DECLARATION

I, Dr Sindila Mwiya, working for Risk-Based Solutions (RBS) CC, the Permitting / De-Risking Advisors / Environmental Consultants and being the Environmental Assessment process Team Leader and EAP for the preparation of the Final Environmental Impact Assessment (EIA) Report to support the application for a new Environmental Clearance Certificate (ECC)for the proposed Multiclient/Proprietary 2D / 3D Seismic Survey over the Area of Interest (AOI) covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, Walvis, Lüderitz and Orange Basins, Offshore Namibia, by PGS Exploration (UK) Limited (the Proponent), hereby declares that:

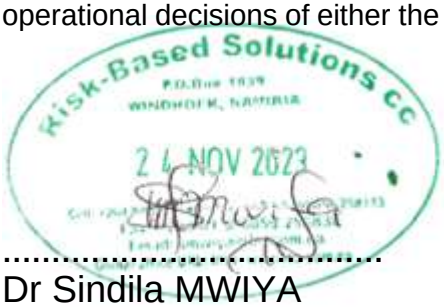
1. This Final Environmental Impact Assessment (EIA) Report has been prepared in accordance with the provisions of the Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991), Petroleum Laws Amendment Act, 1998, (Act 24 of 1998), the Environmental Management Act, 2007, (Act No. 7 of 2007), all other applicable national laws, and Regulations and Good International Industry Practice (GIIP).

2. I am highly qualified and experienced in environmental assessments and management, marine seismic survey operations, offshore oil and gas exploration and production operations and hold a PhD with research interests, academic training, and technical knowledge in Engineering Geology, Geotechnical, Geoenvironmental and Environmental Engineering, Artificial Intelligence and Knowledge-Based Systems with special focus on EIAs, EMPs, EMSs, SEAs, SEMPs and ESG with respect to subsurface resources (minerals, petroleum, water) and energy in arid and semiarid environments.

3. I am an Engineering and Environmental Geologist with extensive technical knowledge and experience in conducting environmental assessments, management, and monitoring for offshore and onshore subsurface resources (petroleum, solid state minerals, water, geothermal), exploration and utilisation and have undertaken more than 300 projects since 2004, including more than seventy (70) oil and gas exploration and production related environmental assessments, management, and monitoring projects in different parts of the World.

4. I have performed the work relating to this project in an objective manner, even if the outcomes will result in views or Records of Decision that may not be favourable to the Stakeholders or the Proponent, and.

5. I am an independent consultant not related to the Proponent, I co-own and operate an independent company (Risk-Based Solutions CC) which is not related to the Proponent. Except for the fees payable for professional consulting services rendered to the Proponent, I have no shares, interests, or involvement in the license, financial or other affairs or business or operational decisions of either the Proponent or the decision-making structures of Government.



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Dr Sindila MWIYA
Environmental Assessment Practitioners (EAPs)\Team Leader
Permitting / De-Risking Advisors / Environmental Consultants
RISK-BASED SOLUTIONS (RBS) CC

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NON-TECHNICAL SUMMARY

1. Background

Petroleum Geo-Services (PGS) Exploration (UK) Limited here in referred as ("**PGS**") (the "Proponent") intends to apply for an Environmental Clearance Certificate (ECC) over an Area of Interest (AOI) covering portions of the Walvis, Lüderitz and Orange Basins, offshore Namibia. The Proponent intend to acquire Multiclient/Proprietary 2D/3D seismic survey activities covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613.

The Proposed AOI falls in water depths ranging from ca-200 m to more than ca-4000m, from east to west, respectively. respectively. The Multiclient/Proprietary 2D/3D seismic survey activities are planned to be implemented from January 2024. The proposed survey will be undertaken over multiple survey events and seasons using one (1) or two (2) own or third-party chartered survey vessels compliant to the International Convention for the Prevention of Pollution from Ships (MARPOL) and Namibian Maritimes legal requirements.

Seismic survey method is the application of controlled generation of sound / acoustic waves by a seismic source to obtain an image of the subsurface. The generated acoustic wave that travels deep into the earth, is reflected by the various rock formations of the earth, and returns to the surface where it is recorded and measured by receiving devices called hydrophones. In offshore environment, the energy source releases compressed air to generate seismic signals at regular intervals as the towing ship is moving. Signals reflected from geological interfaces below the seafloor are recorded by multiple hydrophones and transmitted to the seismic vessel for electronic processing. By analysing the time, it takes for the seismic waves to travel between the rock formations and the surface, geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface maps showing potential subsurface geological structures called reservoirs.

The Multiclient/Proprietary 2D/3D seismic survey activities are listed activities in Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) and Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and cannot be undertaken without valid Environmental Clearance Certificate ("ECC"). PGS Exploration (UK) Limited is required to have undertaken environmental assessment comprising Scoping, Environmental Impact Assessment ("EIA") and Environmental Management Plan ("EMP") to support the application for ECC. In fulfilment of this environmental requirements, PGS Exploration (UK) Limited appointed Risk-Based Solutions (RBS) CC as the Environmental Consultant to prepare all the required supporting reports and apply for an ECC with respect to the proposed 2D / 3D seismic survey in the Walvis, Lüderitz and Orange Basins, offshore Namibia.

This Environmental Impact Assessment (EIA) Report has been prepared by Risk-Based Solution on behalf of the Proponent to support the application for an ECC for the proposed Multiclient/Proprietary 2D / 3D seismic survey over the selected AOI. The EIA Report covers the impacts assessment that the proposed 2D / 3D seismic survey is likely to have on the receiving marine environment. The scope of the EIA covers survey area and the immediate surrounding areas with respect to routine and non-routine or accidental events / activities associated with the proposed survey mobilisation and pre-survey preparations, actual survey, and post survey / demobilisation operations. The mitigation measures are detailed in a separate Environmental Management Plan (EMP) Report.

The environmental assessment process has been undertaken in accordance with the provisions of Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991) and associated amendments, the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, 2007 as well as international best practices. Key project alternatives have been considered and include project location and the no-action alternative (no impacts), other marine users and potential user conflicts, influence on the ecosystem function, services, use values and non-use or passive use have all been considered. Public and stakeholders' consultations process have been undertaken during the months of August and September 2023. No objection has been received following public and stakeholder consultation process.

2. Summary of the Receiving Environment

Namibia's entire marine sector falls within the Benguela Current Large Marine Ecosystem (BCLME), which runs along the west coast of southern Africa from the Cape of Good Hope, South Africa to Cabinda Province in Angola. The BCLME is particularly productive in terms of fisheries resources, which in turn attract predators such as game fish, seabirds, and marine mammals. Apart from resident and breeding fauna, the high productivity seasonally supports transient migrant species of birds and mammals. The following is the summary of the key components of the receiving environment that may be impacted by the proposed 2D and 3D seismic survey operations:

(i) **Fish stock and commercial Fisheries**: The fish fauna of the cold-temperate BCLME region is characterised by a relatively low diversity of species compared with warmer oceans. However, the upwelling promotes and supports huge biomasses of specific species. The abundance and distribution of Namibia's marine fish vary markedly over time, due to over-fishing and natural upheaval events such as Benguela and El Niños, harmful algal blooms, Low intrusions and H_2S eruptions that result from local and remote forcing, restricting the habitat available for pelagic and demersal fish species. There is a socio-economically important commercial fishery within the Namibian Exclusive Economic Zone (EEZ). Commercial fisheries target benthic fauna as well as fish. Marine fish species can generally be divided in three categories: Demersal (species living or breeding on the seafloor), meso-pelagic (species associated with both the seafloor and the pelagic environment), and Pelagic (species found within the water column). The following is the summary of the key commercial fisheries likely to associated with the surrounding areas of the proposed seismic survey AOI:

- The pelagic purse seine fishery targets anchovy and juvenile horse mackerel. Purse seine fishing works by encircling a surface shoal with a large net some 60 – 90 m deep. The main purse seine fishing grounds are inshore of the proposed seismic grid, so this fishery should not be impacted by the seismic operations.

- The Deep-Sea Red crab fishing grounds lie with the northern section of the survey AOI. The Deep-Sea Red crab fishery is very small; only a couple of vessels operating from June to August between -500 m and -900 m water depths. This fishery will be impacted through exclusion, however, the timing of the proposed may mitigate, with NO impact at all.

- Hake and Monkfish trawlers operate across the entire length of the Namibian shelf. Know fishing grounds intersect the eastern/inshore fringes of the proposed survey grid.

- The rock lobster fishery operates inshore in southern Namibia and will not be impacted at all by the seismic activities, and.

- Large migratory pelagic fish species such as tuna, swordfish and several shark species are target by long-line fishers. This fishery is widespread, with no specified fishing grounds, although they may be expected offshore of the shelf break. Because these large pelagic target species are highly migratory, this fishery is widespread, with no specified fishing grounds. However, most vessels utilise the Ports of Lüderitz and Walvis Bay and operate offshore of the shelf break in southern Namibia.

(ii) **Cetaceans**: At least 33 species of cetaceans have been recorded in Namibian waters. There is a shortage of data relating to Namibian shelf-break and deeper waters, with a large portion of the data being from historic whaling records. Review of that data has indicated possible misidentification, particularly of large rorquals. Modern passive acoustic monitoring and observations have added to the knowledge base, however, data relating to abundance, population sizes and trends, distribution, or seasonality of most cetacean species in oceanic waters off the Namibian continental shelf (1 000 – 2 000 m) is lacking. As these pelagic species tend to be widely distributed across thousands of kilometres, it is difficult to predict the likelihood of encountering them at any given time. There have been anecdotal recent sightings of Sperm whales near Tripp Sea Mount (Weir, 2011; Benthic Solutions, 2019). False Killer whales frequent

open ocean waters, although they are not seen with any regularity. Orcas roam throughout the oceans, making their occurrence difficult to predict.

(iii) **Cape Fur seal:** Cape Fur seal is a common resident with numerous breeding sites on the mainland and nearshore islands and reefs, most notably at the Cape Cross Seal Reserve (the largest breeding site), north of Walvis Bay and also at Cape Frio on the northern border with Angola. Cape Fur seals generally forage in shallow, shelf waters, but can range to distances of over 150 km from the coast.

(iv) **Seabirds:** Namibia's coastline sustains large populations of breeding and foraging sea- and shorebird species. Numerous species of seabirds breed on islands or at mainland sites along the southern Namibian coast. The African penguin, Bank cormorant, Cape cormorant and Cape gannet have been classified as Vulnerable Species owing to significant decreases in populations. Most of the seabirds that breed on Namibian shores have a nearshore/inshore foraging range of between 10 and 30 km. Exceptions include the African penguin, which has been seen up to 60 km offshore and the Cape gannet, which is known to travel 140 km offshore in search of food. As the AIO is mostly beyond 200 km offshore, it is unlikely that these birds will be seen in the survey area. Many sea- and shorebirds over-winter in Namibia. The highest pelagic seabird densities are found offshore of the shelf-break during the winter months, when Southern Ocean species move north to temperate and subtropical regions. The highest potential impacts from this survey are likely to be on sea-going birds that forage offshore and rest on the water, and those that plunge-dive for food, and.

(v) **Sea turtles**: The occurrence of sea turtles within the Benguela Current Large Marine Ecosystem (BCLME), Leatherback in particular, is thought to be on the increase as a result of the availability of their preferred food, jelly fish, which have dramatically increased since the collapse of sardine and anchovy populations.

3. Impact Assessment Summary

The proposed 2D / 3D seismic survey area falls within the highly prospective Walvis, Lüderitz and Orange Basins, offshore Namibia oil and gas frontiers regions of southern offshore Namibia. The results and data from the proposed survey is likely to increase the interest by multinational oil and gas companies in conducting oil and gas exploration activities. The increase in exploration activities could lead to additional commercial discovery of economic petroleum resources and such a discovery will positively transform the socioeconomic landscape of Namibia.

On the other hand, it is generally assumed that intense anthropogenic noise sources have the potential to harm and otherwise negatively impact marine life, in particular mammals. The severity of impacts is divided into pathological damage, temporary impairment and behavioural responses. Pathological damage ranges from hearing disturbance such as frequency threshold shifts and temporary masking of certain sounds to, in the most extreme, mortality. The response of a marine mammals to an anthropogenic sound will depend on numerous factors including the frequency, duration, temporal pattern and amplitude of the sound, the distance of the animal from the sound source and whether the sound is perceived to be approaching or moving away. Behavioural responses of marine fauna to seismic source noise range from imperceptible to distress-induced altered patterns, which will include changes in diving time, swimming directions and resting periods.

Most of the impacts resulting from the proposed project activities will occur in the marine receiving environment within the survey area, and possibly immediately surrounding area, with some very limited to no potential to impact to the Walvis Bay or Lüderitz Ports facilities and receiving coastal and onshore environments. The number of mammals migrating through the BCLME is relatively low and wide-spread with whale primary and secondary peak migration periods from May - July and October – November respectively, with a variety of cetaceans, including mysticetes likely to be found in the Namibian water throughout the year. If mitigation measures such as soft-starts, visual observation and exclusion limits are applied, the impacts of seismic noise can be lessened to acceptable levels.

According to the results of the sound modelling study undertaken for this project, taking the effect of soft start into account, the potential injury range for very-high frequency cetaceans reduces to 151 m

or less and 84 m for low frequency cetaceans. The injury threshold for high-frequency cetaceans will not be exceeded with soft start. This effectively reduces the risk of injury to marine mammals to negligible levels. The following is the summary of the likely overlaps between the proposed Multiclient/Proprietary 2D/3D seismic survey AOI and key commercial fisheries:

(i) Hake and Monk: The AOI has a narrow overlap with hake and monk fishing grounds. The surveys may overlap the annual biomass surveys for monk and hake, which are conducted in November and January to February, respectively. It is worth noting that the AOI does not overlap with the spawning grounds of the monk and hake species.

(i) Orange roughy: The AOI overlap with the distribution of orange roughy. Orange roughy aggregates on seamount and like features mainly for spawning in July but also for foraging purposes. There are seven known aggregation grounds for orange roughy off Namibia and they all overlap with the AOI. Currently, Orange roughy fishing is on moratorium since 2009, therefore no commercial fishing activities are taking place. However, the proposed seismic surveys may coincide with the orange roughy biomass survey which is usually carried in July.

(ii) Deep Sea Red Crab: The proposed area of interest overlaps with the distribution area of the deep-sea red crab which is mainly distributed in deeper waters north of Walvis Bay. Therefore, seismic survey may interfere with fishing activities of the deep-sea red crab and the annual biomass survey which is carried out in August.

(iii) West coast rock lobster: The west coast rock lobster is an inshore species, which inhabit rocky seabed at the depth of up to 100m. This resource will not be impacted by the proposed seismic surveys.

(iv) Horse Mackerel: The area of interest does not overlap with the distribution, fishing and biomass survey ground for horse mackerel.

(v) Small pelagic: The area of interest partially overlaps with the biomass survey area which is usually carried out in October. This also implies that the area of interest partially overlaps with the distribution grounds for small pelagic species.

(vi) Line fish: Line fish fishery is mainly inshore. Therefore, the distribution of line fish species and fishing activities will not be impacted by the seismic survey, and.

(vii) Large pelagic: Large pelagic fisheries comprised of deep-sea species, which are managed by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Due to their habitat distribution and migrations, this fishery may be affected by seismic survey.

The proposed 2D / 3D seismic survey operations will not be conducted concurrently due to logistical and equipment requirements as well as licenses holders\ blocks\clients demand-driven nature of the key areas \ blocks to be survey.

As shown in Table 1, short and long-term likely negative impacts of the seismic noise, light disturbance, aircraft noise, vessel exclusion zone, waste generation, air emissions, major accidental spill of diesel/oil, small accidental spills, and ballast water have all been assessed against the receiving marine environment without the application of any mitigation measures covering: Air quality, water quality, marine mammals, cape fur seals, cetaceans, marine turtles, sea birds, shore birds, fish, fisheries and tuna fishery (Table 1).

The overall negative impacts likely to be associated with the proposed 2D / 3D seismic survey on the receiving marine environment are expected to be short-lived, especially if the mitigation measures provided in the EMP Report are implemented and monitored throughout the proposed survey duration.

4. Conclusions

The overall likely negative impacts that the proposed Multiclient / Proprietary 2D/3D seismic survey operations in the Walvis, Lüderitz and Orange Basins, offshore Namibia, and falling in water depths

ranging from ca-200 m to -4000m, will have on the receiving marine environment, will be limited to the actual survey area covering the offshore edge of the Namibian fishing grounds. Based on the acoustic modelling results, a mitigation zone of 500 m is considered sufficient to effectively eliminate the risk of injury to marine mammals. The overall impact of this proposed survey is regarded as being of moderate significance in the short-term and low significance in the long-term, assuming mitigation measures as detailed in the EMP Report are implemented and monitored.

The proposed 2D / 3D seismic survey operations can coexist with other proposed and ongoing marine related activities in the area if mitigation measures and precautionary principles linked to international best practices as recommended by the Joint Nature Conservation Committee (JNCC) of the EnerGeo Alliance, formerly known as the International Association of Geophysical Contractors (IAGC), are implemented and monitored during each survey event.

5. Recommendations

It is hereby recommended that the proposed Multiclient / Proprietary 2D/3D seismic survey activities covering the Walvis, Lüderitz and Orange Basins, offshore Namibia, shall go-ahead and be granted with an ECC. Based on the findings of the specialist assessment undertaken for this project and overall outcomes of this EIA Report (Table 1), it is hereby recommended that a separate EMP Report shall be prepared detailing all the key mitigation measures that the Proponent shall implement and monitor.

The first annual survey event for the proposed Multiclient / Proprietary 2D/3D seismic survey activities is recommended to start from December where possible, if the ECC is granted by the Environmental Commissioner (Table 2).

However, if the survey has to start before December due to the limited favourable weather window for conducting seismic survey in the Namibian waters which is from November-March, the Proponent shall implement the precautional principles, mitigation measures linked to international best practices as recommended by the JNCC of the EnerGeo Alliance for protecting cetaceans during geophysical operations in addition to the other key mitigation measures as detailed in the EMP Report.

To mitigate impacts on migratory cetaceans, particularly mysticetes, it is recommended that seismic surveying along the shelf break not to be undertaken during the primary and secondary whales peak migration periods from May-July and October–November respectively. Although cetaceans, including mysticetes may be found in the Namibian water throughout the year, the commencement of the survey outside the peak migration periods, coupled with the implementation of the appropriate operational mitigation measures and the low likelihood of encountering many mysticetes outside the peak migration periods will further lessen any potential negative impacts.

During the seismic survey operations effective communication with other marine users, especially the MFMR and the fishing companies operating in the area shall be key to the successful implementation of the proposed Multiclient / Proprietary 2D/3D seismic survey. When operating in the eastern shallow waters of the proposed survey area, it is imperative to send notifications to all the other marine users through the Ministry of Mines and Energy, Ministry of Works and Transport (Maritimes Affairs), Ministry of Fisheries and Marine Resources who should in turn distribute the notices to all their key stakeholders. Within the deep-water portion of the proposed survey AOI, operations may be undertaken without major influences on the other marine users except for the poor winter weather between June-October and the primary and secondary whale peak migration periods from May - July and October – November respectively.

Table 1: Summary of the impact assessment results without the implementation of the mitigation measures.

Potential Impacting Factors	Impacted Sectors – WITHOUT mitigation measures applied – Survey Activities									
	Air quality	Water quality	Cape Fur Seal	Cetaceans	Sea Turtles	Sea Birds	Shore Birds	Fish	Fisheries	Tuna Fishery
Seismic Noise – short term	No impact	No impact	Insignificant impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	No impact	Low-Moderate impact	Low-Moderate impact	Moderate - High impact
Seismic Noise – long term	No impact	No impact	Insignificant impact	Low impact	Insignificant impact	Insignificant impact	No impact	Low impact	Low impact	Low-Moderate impact
Light disturbance	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	No impact	No impact	No impact	No impact
Aircraft Noise –short term	No impact	No impact	Moderate - High impact	Low impact	No impact	Low impact	Moderate - High impact	No impact	No impact	No impact
Aircraft Noise –long term	No impact	No impact	Low impact	No impact	No impact	No impact	Low impact	No impact	No impact	No impact
Vessel exclusion zone – short term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Moderate impact	Moderate impact
Vessel exclusion zone – long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Low impact	Low impact
Waste generation	No impact	Moderate impact	Moderate impact	Low impact	Moderate - High impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	Low impact	Low impact
Air Emissions	Moderate impact	No impact	No impact	No impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact	No impact
Major accidental spill of diesel/oil	Insignificant impact	High impact	Moderate impact	Moderate impact	Moderate impact	Low-Moderate impact	High impact	Moderate impact	Moderate - High impact	Moderate - High impact
Small accidental spills	No impact	Low impact	Insignificant impact	Insignificant impact	Insignificant impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact
Ballast water	No impact	Moderate - High impact	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	Low impact	No impact

Table 1: RBS developed coexistence Knowledge-Based System Model Methodology (KBSMM) log framework fully validated and populated during the process of updating the EIA Report and identifying suitable window/s of opportunities for undertaking the proposed Multiclient/Proprietary 2D/3D seismic survey activities with respect to the receiving environment in the Walvis, Lüderitz and Orange Basins, offshore Namibia.

MONTH	KEY FISHING SEASON (KEY SPECIES)	MAIN SPAWNING ACTIVITIES (KEY SPECIES)			MINISTRY OF FISHERIES AND MARINE RESOURCES STOCK SURVEYS		KEY CETACEOUS PRESENCES / MIGRATORY TIMES		OTHER KEY USERS	WEATHER WINDOW	COMMENTS ON OFFSHORE SEISMIC SURVEY OPPORTUNITY WINDOW
January	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster		Hake spawning occurs throughout the year with main spawning period between July -October	Cape Monk spawn throughout the years, with peaks in Jul & Sep for females & Aug for males	Hake Stock Survey	Rock Lobster Monthly Stock Survey		Cetacean including Whales may be found in the Namibian waters	❖ Marine Diamond Exploration and Mining in shallow water less than -200m. ❖ The Survey area covers an area which is a busy international shipping lane	Good	Impact – Hake Stock Survey (less than-1000m), Tuna migrating (Trip Seamount) **SURVEY PLANNED TO START 2024**
February	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Hake Stock Survey (less than-1000m), Tuna migrating (Trip Seamount)
March	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Tuna migrating (Trip Seamount)
April	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster									Moderate Mixed	Impact – Tuna migrating (Trip Seamount)
May	Hake Trawl, Monk						Whales Migration Primary Peak Period				No Impacts but unfavorable weather
June	Snoek, Hake Trawl, Monk	Snoek, and Orange Roughy								Very Poor	No Impacts but unfavorable weather
July	Hake Trawl, Monk										Impact – Orange Roughy spawning (shallow waters), Snoek migrating in deepwater
August	Hake Trawl, Monk										Impact – Orange Roughy aggregated spawning, Snoek migrating in deepwater
September	Surface Longline, Hake Trawl, Monk									Poor	Impact – Snoek migrating in deepwater
October	Pole and line Tuna, Surface Longline, Monk	Rock Lobster			Rock Lobster Stock Survey		Whales Migration Secondary Peak Period			Moderate Mixed	Impact – Shallow water rock Lobster Stock Survey, Tuna migrating (Trip Seamount)
November	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster				Monk Stock Survey					Good	Impact – Monk Stock Survey (less than-1000m), Tuna migrating (Trip Seamount)
December	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Tuna migrating (Trip Seamount)

The Proponent shall avoid the area and month/s when MFMR is undertaking stock assessment surveys (Table 2) and always implement the Joint Nature Conservation Committee (JNCC) of the EnerGeo Alliance, formerly known as the International Association of Geophysical Contractors (IAGC), key recommended mitigation measures for protecting cetaceans during geophysical operations. The proposed mitigation measures as detailed in the EMP Report includes the following:

1. Seasonality, timing and establishment of an operational safety and mitigation exclusion zones.
2. Use of Marine Mammal Observers (MMOs) and Fisheries Liaison Officers (FLOs).
3. Use of Passive Acoustic Monitoring (PAM) system.
4. Soft starts' and 'pre-activation' observations.
5. Delay of ramp up for marine mammals seen or heard inside safety zone of 500 m.
6. Termination of activation in the 500m exclusion zone with respect to marine mammals.
7. The use of Turtle friendly tail buoys.
8. The use of support vessel(s).
9. Pollution and spill prevention and management.
10. The use of the lowest practicable seismic source volume as defined by the operator.
11. Compliance to all MARPOL (marine pollution) Regulations and waste disposal procedures, and.
12. Adoption of the precautionary principles in the absence of any specific mitigation measures being provide in this EMP, the Proponent shall always adopt the precautionary approach.

In the absence of any specific mitigation measures being provided in the EMP, the Proponent shall always adopt the precautionary approach. This EIA Report has been prepared in accordance with the provisions of Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991) and associated amendments, Environmental Management Act No. 7 of 2007, EIA Regulations Government Notice No. 30, Government Gazette No. 4878 of 6 February 2012, other relevant Namibian laws, regional and international environmental and petroleum exploration standards, and practices applicable for offshore seismic survey operations.

1. BACKGROUND

1.1 General Project

Petroleum Geo-Services (PGS) Exploration (UK) Limited here in referred as ("**PGS**") (the "Proponent") is proposing to conduct Multiclient (MC) or Proprietary 2D/3D seismic survey over and Area of Interest (AOI) covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, situated in the Walvis, Lüderitz and Orange Basins, offshore, Namibia (Figs. 1.1-1.3).

Namibia lies along the south-western coast of Africa, and is bordered by Angola in the north, Zambia and Zimbabwe in the northeast, Botswana to the east, South Africa in the south, and the Atlantic Ocean to the west. It occupies an area of 824 290 km^2. Namibia is a geographically large country with a small population of about 2.6 million and about 57% live in rural areas. Despite Namibia being classified as am upper-middle-income country, the country has high socioeconomic inequalities, high youth unemployment and high rural poverty. The water depths of the survey area range from ca-500m to ca-4000m from east to west, respectively.

The proposed 2D / 3D seismic survey is planned to start from January 2024 if the Proponent is granted an Environmental Clearance Certificate (ECC). The duration of each 3D or 2D seismic survey event will be variable but averaging seventy (70) days at sea. The activities associated with proposed project have been characterised and grouped as follows:

(i) Routine and physical presence of the survey and support vessels in the area including the Ports of Walvis Bay or Lüderitz, physical presence of survey and support vessels, Physical disturbance of the survey operations., sound generation from proposed 2D or 3D seismic survey seismic source, including sound of the survey and support vessels engines, increased light levels from routine vessels operations, atmospheric emissions from routine operations of the survey and support vessels, and planned marine discharges, and.

(ii) Accidental events covering: Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils, loss of vessel, equipment or material, collision with marine wildlife during vessel operations, and loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.

The following is the summary of the proposed project implementation stages as assessed in this Environmental Impact Assessment (EIA) Report with mitigation measures provided in the Environmental Management Plan (EMP) Report:

(i) Mobilisation.

(ii) Pre-survey preparations.

(iii) Actual survey operations, post survey operations, and.

(iv) Non-routine or accidental events.

Both the survey and support vessels will use existing facilities in the Ports of Walvis Bay or Lüderitz for supplies, fuelling and crew changeover as may be required and if required.

1.2 PGS Exploration (UK) Limited (The Proponent)

PGS is an integrated marine geophysics company with offices in 14 countries. Modern geophysics applies big data concepts to record and image Earth's subsurface and is one of the largest uses of compute power on the planet. The business supports the energy industry, including oil and gas, offshore renewables, Carbon Capture and Storage (www.pgs.com). Product offerings span from survey planning and data acquisition, through advanced imaging, to reservoir analysis and interpretation. The company has multiple offshore seismic vessels, processing and imaging megacenters, three (3) main offices in Oslo, London and Houston, with presence in over ten (10) countries with headquarters in Oslo, Norway.

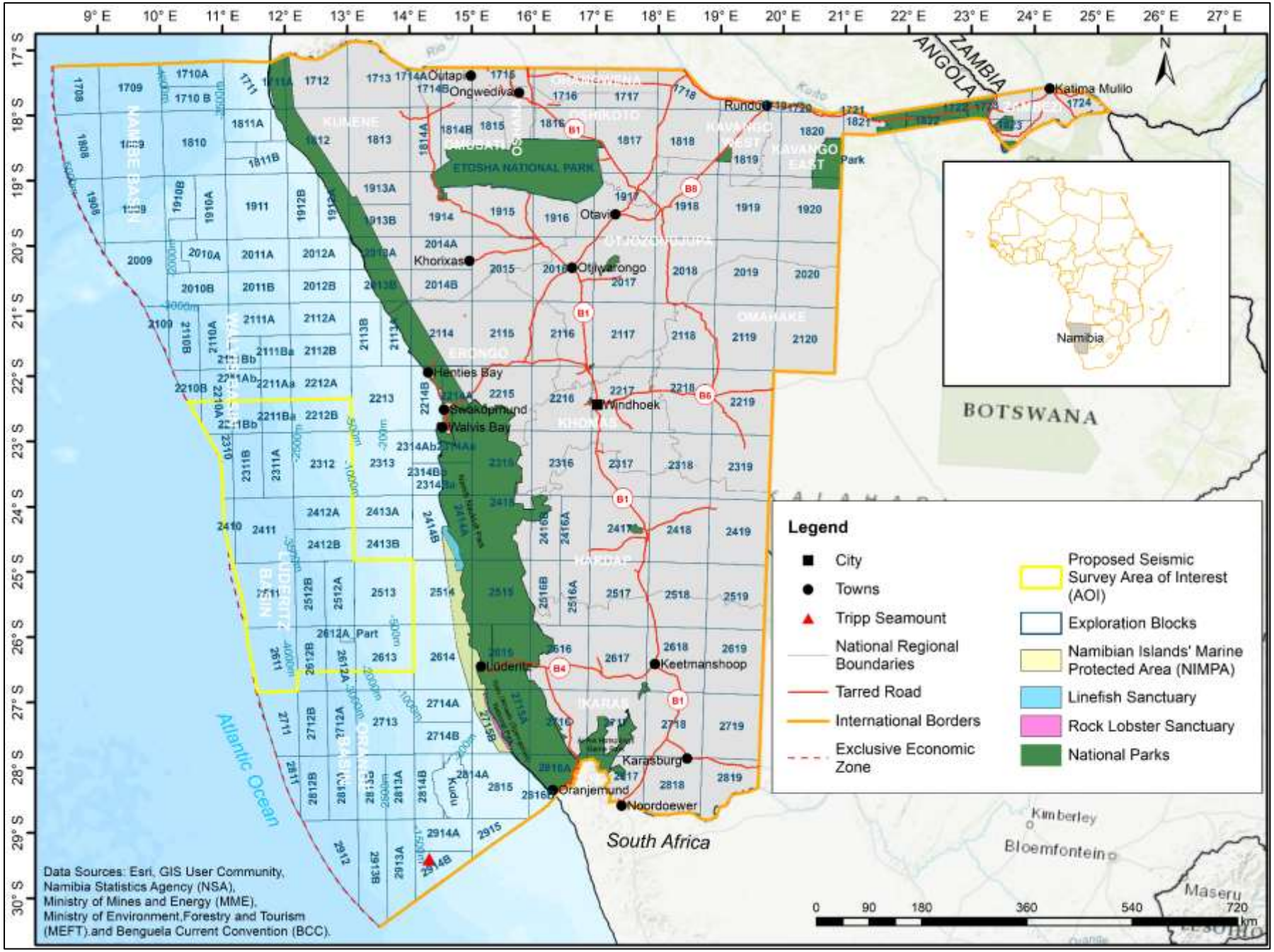


Figure 1.1: Regional location of the proposed 2D / 3D seismic survey coverage areas in the Walvis, Lüderitz and Orange Basins, offshore central Namibia.

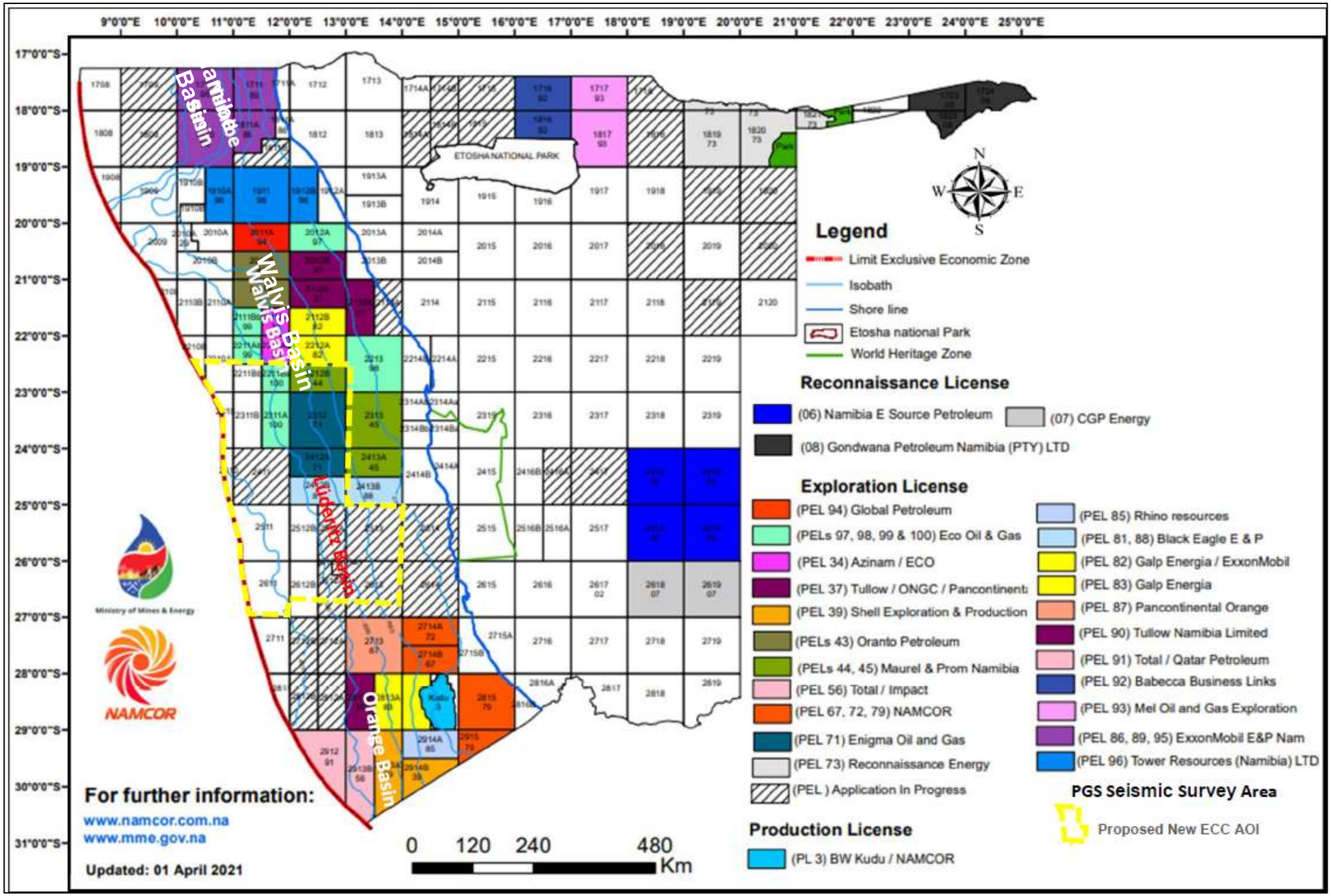


Figure 1.2: Hydrocarbon map of Namibia showing the proposed Multiclient/Proprietary 2D/3D seismic survey AOI falling in the Walvis, Lüderitz and Orange Basins, offshore Namibia (Modified Source: www.mme.gov.na).

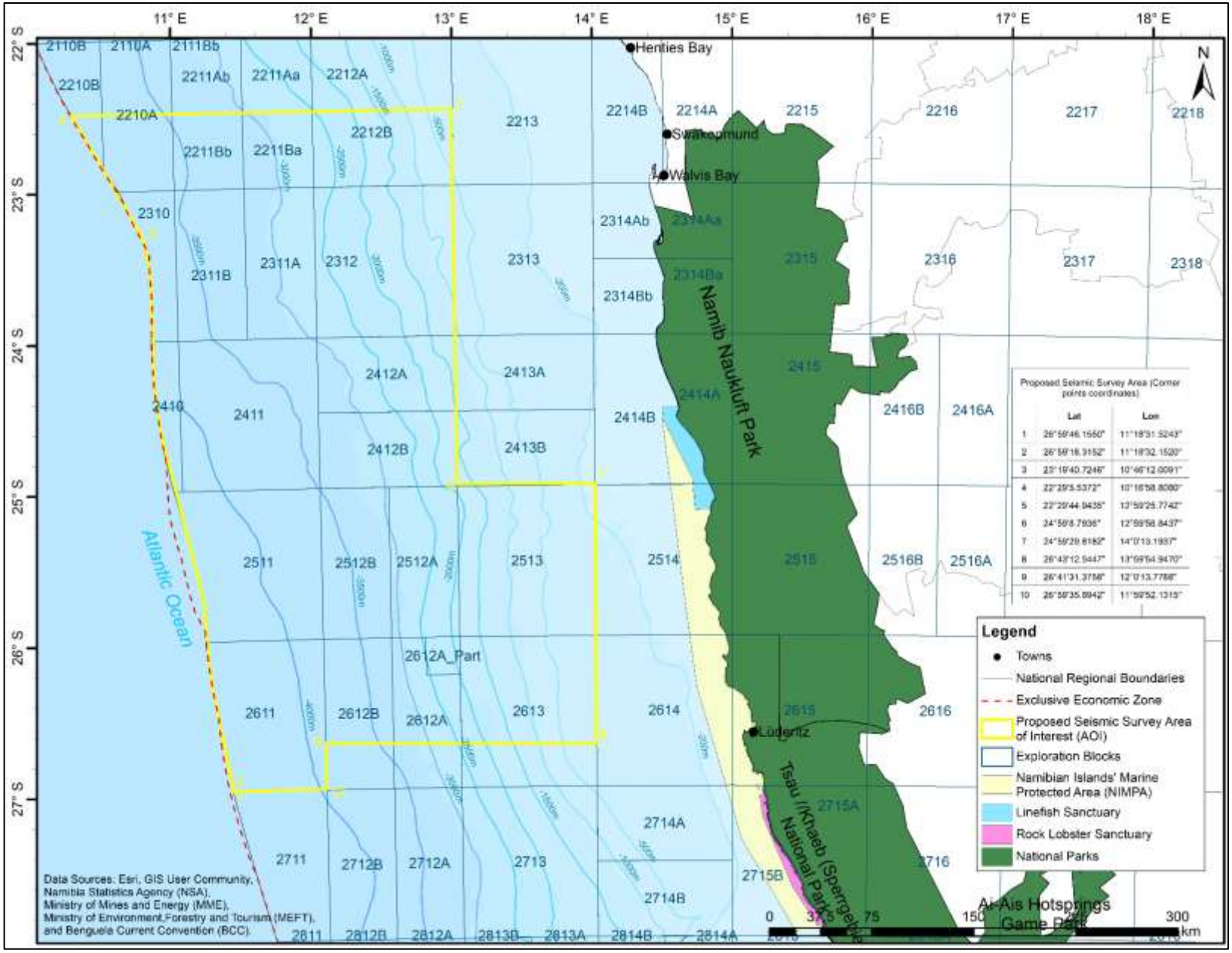


Figure 1.3: PGS proposed Multiclient/Proprietary 2D/3D seismic survey AOI covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, Walvis, Lüderitz and Orange Basins offshore Namibia with water depths ranging from ca-200 m to -4000m from east to west, respectively.

1.3 Project Motivation, Multiclient (MC), and Proprietary Surveys

1.3.1 Proposed Project Needs, and Desirability

Although offshore seismic survey operations in Namibia began as far back as 1968, a lot more still needs to be done to have a full understanding of the petroleum systems of the deep-water offshore Namibia. The datasets from the proposed 2D / 3D seismic survey by PGS will provide critical insight into the subsurface geological evolution, offshore basin architecture, depositional, structural history and delineate potential subsurface geological structures. The data sets to be acquired will:

(i) Expand the overall offshore seismic survey data coverage for Namibia (Figs. 1.4 and 1.5), and.

(ii) Enhance the interpretation contrast, confidence, and overall quality of the results over the anticipated subsurface structures within the AOI.

The results and data from the proposed survey are likely to increase the interest by multinational oil and gas companies in conducting oil and gas exploration activities in Namibia. The increase in exploration activities could lead to additional commercial discovery of economic petroleum reserves. Recent discovery of light oil by TotalEnergies Venus prospect in Petroleum Exploration License (PEL) 56 and Shell Upstream Namibia BV Graff-1 in PEL 39 are likely to propel Namibia into an oil and gas producing country in the next six (6) to ten (10) years (Fig. 1.6). The proposed 3D seismic survey can be classified as a localised operation, with short-term duration and aimed at supporting the development of fossil fuel opportunities offshore Namibia while at the same time will provide datasets that could support the development of other resources such as offshore wind energy, suitable industrial hydrogen sites and minerals resources.

1.3.2 Multiclient (MC), Proprietary Surveys and the Environmental Clearance Certificate

1.3.2.1 Overview

Geophysical and geological related surveys and data sets are acquired, processed, owned, stored and licensed on either a Multiclient (MC) or proprietary (Exclusive) contractual business arrangements.

1.3.2.2 Multiclient (MC) Surveys

Under a MC system, the seismic survey is conducted by a seismic contractor company over an area that might be covering either a single or multiple Petroleum Exploration Licenses (PELs) and unlicensed areas. The collected MC datasets are licensed to a number of clients on a non-exclusive basis. The data acquired is held under a MC seismic data library owned by the contractor and later may be transferred to a partner/s / Government depending on the contractual and confidentiality arrangements. The cost and findings from MC seismic survey data sets are shared among the different parties involved which may include: Seismic contractor, Government and Licence (PEL) holder/s.

1.3.2.3 Proprietary / Exclusive Surveys

Proprietary also called Exclusive seismic survey is undertaken for a single client or partnership, and the area of coverage is often limited to specific licensed (PEL) area. The cost of the survey and ownership of the data under a proprietary seismic survey business arrangement falls under the responsibilities of the individual license (PEL) holder. On relinquishment of the petroleum exploration rights, the seismic data sets collected is handed over to the Government.

1.3.2.4 Environmental Clearance Certificate for Multiclient (MC) or Proprietary Surveys

An Environmental Clearance Certificate (ECC) granted to a Proponent who is a seismic contractor may be used to acquire both MC and Proprietary (Exclusive) seismic survey, on conditions that all the contractual arrangements and data ownership requirements among the various parties involved in the partnership including the Government have been agreed. However, an ECC granted to a Proponent who is a license (PEL) holder may be used to acquire only Proprietary or Exclusive seismic survey data in line with provisions of the Petroleum Agreement with respect to the data ownership. The ECC applied for this project covers both MC and Proprietary (Exclusive) seismic survey business arrangements.

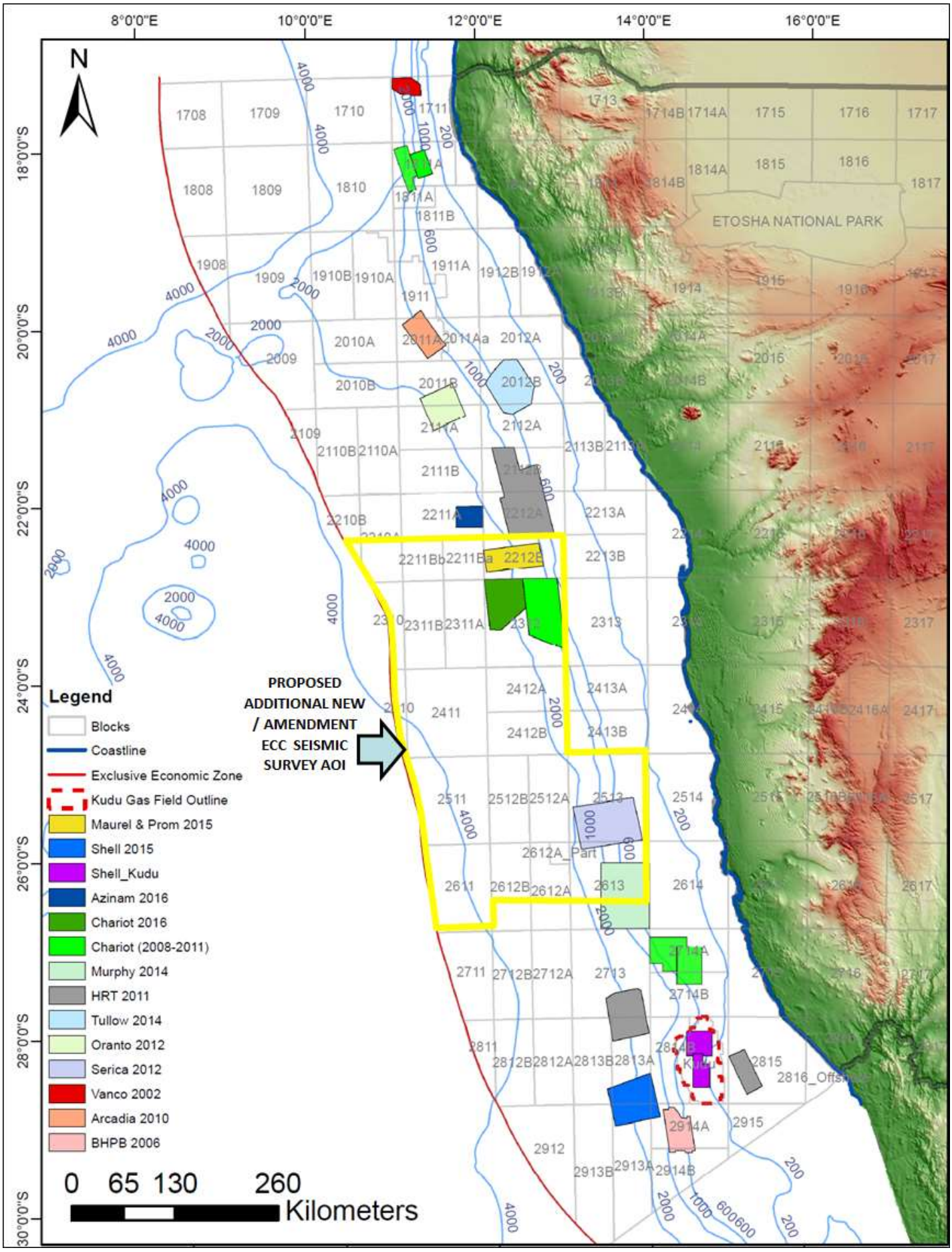


Figure 1.4: Overview of the 3D seismic survey database coverage of Namibia as of 2016 with respect to the proposed Multiclient/Proprietary 2D/3D seismic survey AOI covering Walvis, Lüderitz and Orange Basins offshore Namibia (Source: www.namcor.com.na).

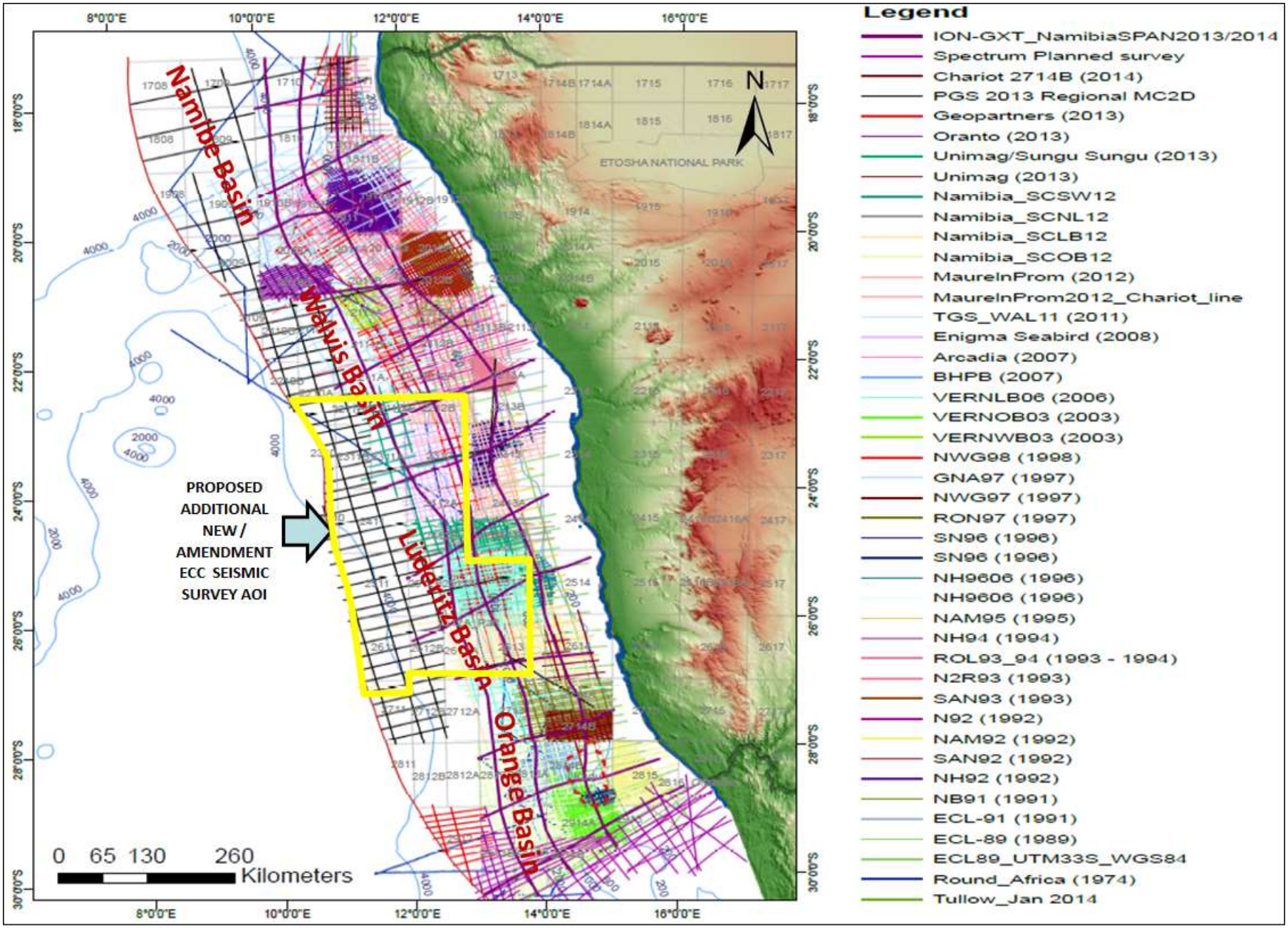


Figure 1.5: Overview of the 2D seismic survey database coverage of Namibia as of 2016 with respect to the proposed Multiclient/Proprietary 2D/3D seismic survey AOI covering Walvis, Lüderitz and Orange Basins offshore Namibia (Source: www.namcor.com.na).

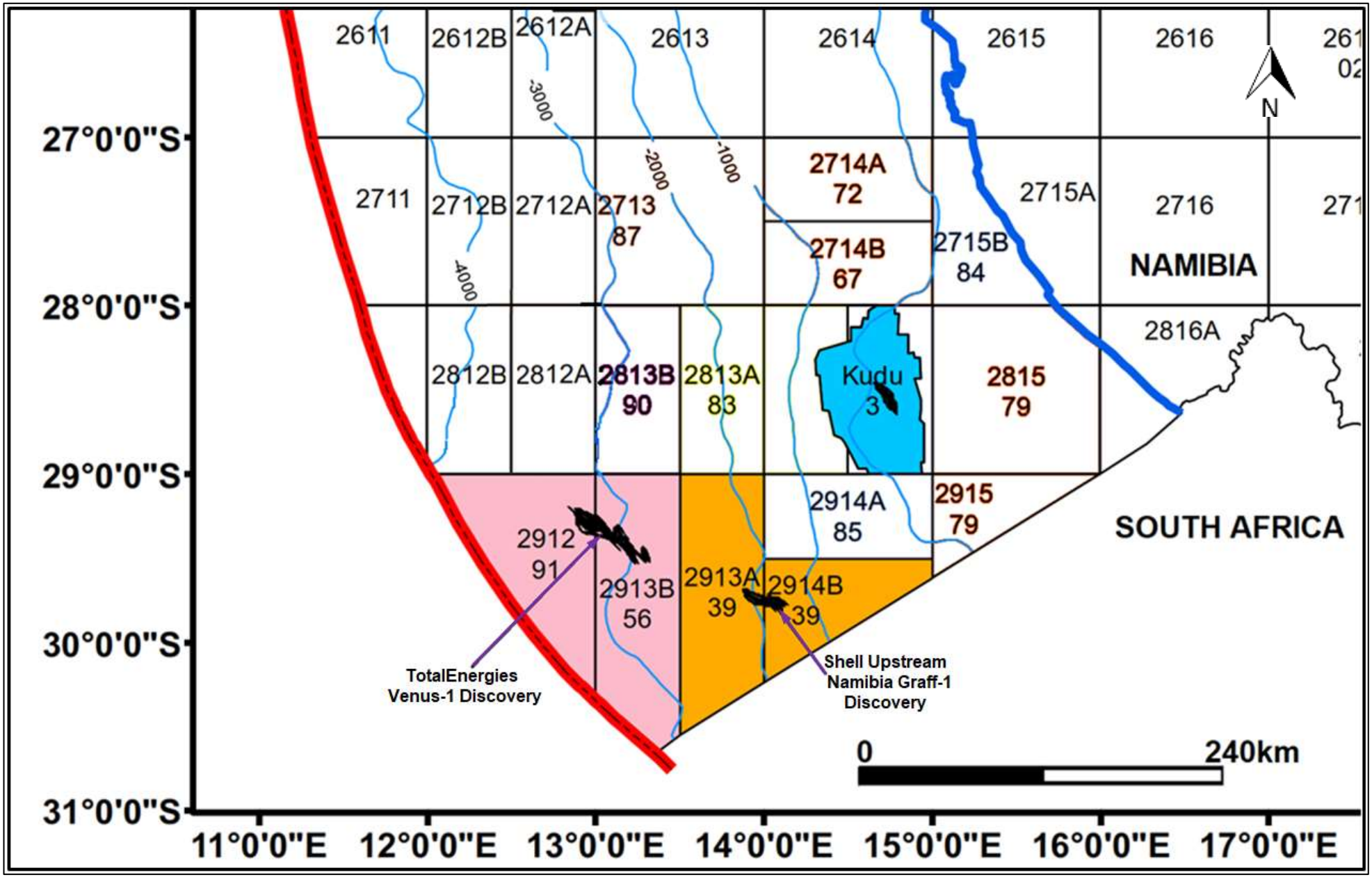


Figure 1.6: Locations of the known oil and gas discoveries offshore Namibia showing the Kudu Gas Field, the TotalEnergies Venus-1 discovery in Petroleum Exploration License (PEL) 56 covering Blocks 2912 and 2913B and the Shell Upstream Namibia BV Graff-1 discovery in PEL 39 covering Blocks 2913A and 2913B situated in the deep-water Orange Basin (Base map Source: www.mme.gov.na).

1.4 Permitting and Environmental Assessment Process

1.4.1 Permitting Process

Oil and gas exploration and production regulatory framework in Namibia provides for strict contractual obligations by a Proponent with respect to environmental performances. The proposed activities (2D / 3D seismic survey) fall under Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991) is administered by the Petroleum Commissioner in the Ministry of Mines and Energy as the Competent Authority. Under Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991) the implementation of a 2D / 3D seismic survey operations requires the Proponent to adhere to the Environmental Impact Assessment (EIA) Regulations, 2012 and the Environmental Management Act, 2007, (Act No. 7 of 2007) administered by the Environmental Commissioner in the MEFT.

Under the Environmental Impact Assessment (EIA) Regulations, 2012 and the Environmental Management Act, 2007, (Act No. 7 of 2007), the proposed 2D and 3D seismic survey cannot be undertaken without an Environmental Clearance Certificate (ECC). The Proponent (PGS) is required to have prepared EIA and EMP Reports to support the application for the ECC for the proposed seismic survey operations.

In fulfilment of the environmental requirements, the Proponent appointed Risk-Based Solutions (RBS) CC as the environmental / permitting de-risking Consultant, led by Dr Sindila Mwiya and supported by Ms Emerita Ashipala as the Environmental Assessment Practitioners (EAPs) to prepare this EIA and a separate Environmental Management Plan (EMP) Reports to support the application for the ECC. This EIA report has been prepared in accordance with the provisions of the EIA Regulations, 2012 and the Environmental Management Act, 2007, (Act No. 7 of 2007).

1.4.2 Assessment Approach

The Environmental Assessment process for this project has been undertaken in accordance with the applicable regulations and assessment procedure as shown in Fig. 1.7 and Annex 1. The assessment process also took into considerations corporate governance requirements of the Proponent as well as all other relevant Namibian laws, regional (Southern Africa Development Community – SADC) and international environmental best practices and petroleum exploration protocols, standards, and practices applicable for marine seismic survey (Annex 1).

The general framework of the baseline data collection was as follows (Annex 1):

- Scoping (determination of geographical and other boundaries; preliminary assessment).
- Review of existing regulatory framework and institutional arrangements.
- Public and stakeholder consultation process.
- Specialist Assessments / studies to support the environmental / impact assessments.
- Reporting, impact identification and development of suggested mitigation measures, and.
- EIA Reporting, development of an Environmental Management Plan (EMP) with roles and responsibilities.

1.4.3 Spatial Scope, and Survey Coverage

The spatial scope of the proposed 2D / 3D seismic survey and impact assessment and management thereof covers the following (Fig. 1.7):

- Current outlined initial survey area covering and any future survey extension falling within the Walvis, Lüderitz and Orange Basins, Offshore Namibia defined as the immediate impact zone: The receiving environment in this area likely to be directly influenced by the survey activities will includes a radius of 500 m safety exclusion zone around the survey vessel and surrounding

areas where discharges to sea and sound may propagate and affect marine wildlife and immediate environment, and.

- ❖ Survey area broader impact zone include all the surrounding socioeconomic zones likely to be affected by the proposed survey operations and logistics including support vessels.

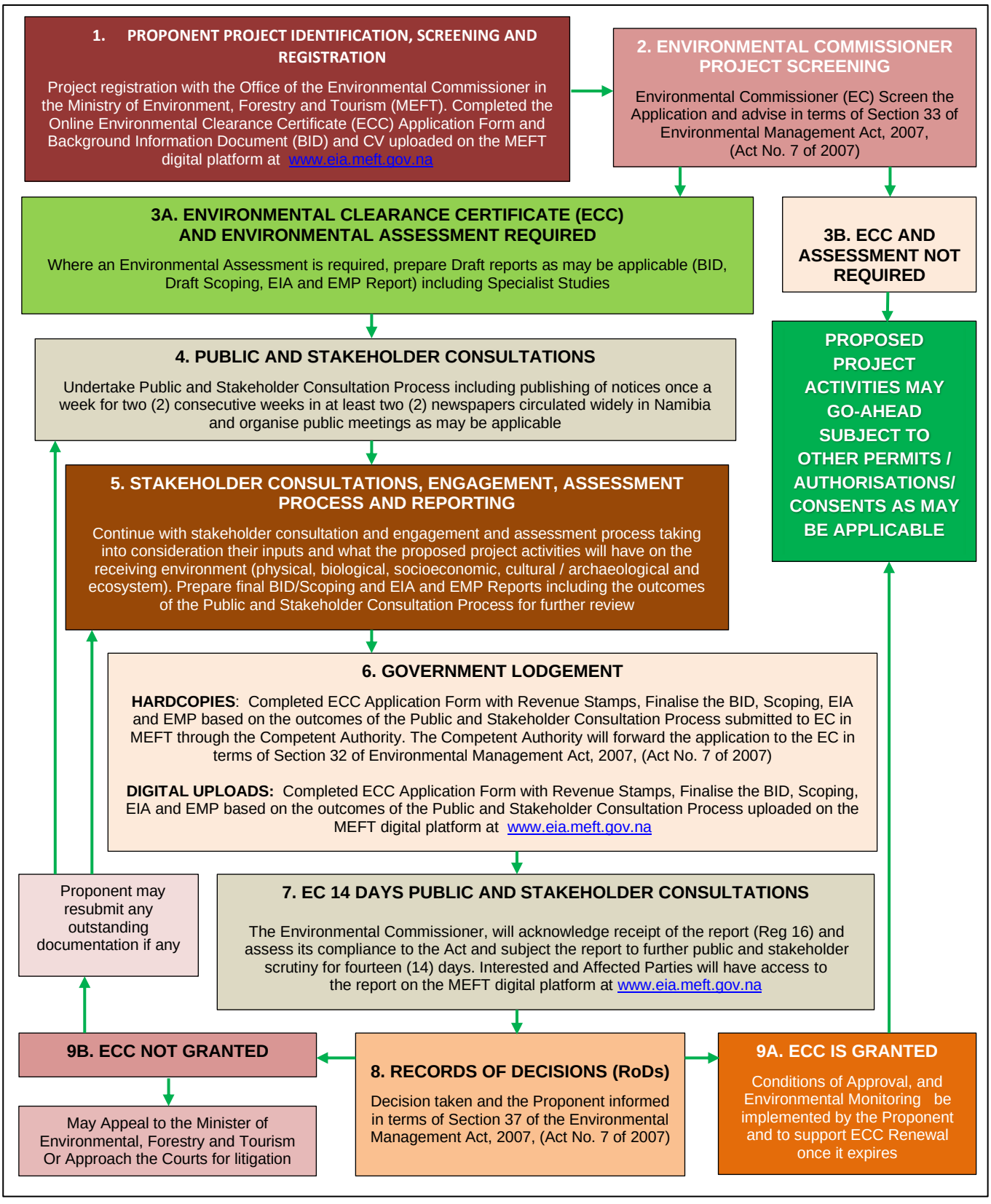


Figure 1.7: RBS schematic presentation of Namibia's Environmental Assessment procedure.

1.4.4 Data Sources, Reliability and Quality

Data source discussed in this section has been derived from the literature review of the publications by Government Ministries such as the Ministry of Fisheries and Marine Resources (MFMR) (www.mfmr.gov,na), Ministry of Environment, Forestry and Tourism (MEFT) (www.meft.gov.na), Ministry of Works and Transport (Department of Maritimes Affairs) (www.mwt.gov.na), Ministry of Mines and Energy (MME) (www.met.gov.na) and other organisations such as Namibia National Petroleum Corporation of Namibia (Namcor) (www.namcor.com.na), Benguela Current Commission (BCC) (www.benguelacc.org), Namibian Coast Conservation and Management project (NACOMA) (www.nacoma.org.na), and marine mammals, birds, commercial fishing and fisheries specialists and acoustic mathematical modelling studies undertaken by specialist consultants.

The quality and reliability of the available data sets used in this scoping report is of very high standard and is based on research publications and desktop studies validate by site-specific surveys such as the annual resources surveys undertaken by the Ministry of Fisheries and Marine Resources, Gardline site-specific predrilling survey undertaken for Repsol, other surveys undertaken by operators with respect to seismic and drilling operations.

Additional validation has been provided by environmental monitoring results undertaken by Risk-Based Solution (RBS) with respect to seismic and drilling operations undertaken in the Namibian offshore environment in the last eighteen (18) years for companies such as Shell Namibia B. V. Limited (Namibia/ the Netherlands), BW Offshore (Singapore), Tullow Oil (UK), Petrobras Oil and Gas (Brazil) / BP (UK), REPSOL (Spain), HRT Africa (Brazil / USA), Chariot Oil and Gas Exploration (UK), Serica Energy (UK), Eco (Atlantic) Oil and Gas (Canada / USA), ION GeoVentures (USA), PGS UK Exploration (UK), TGS-Nopec (UK), Maurel & Prom (France), GeoPartners (UK), and Sintezneftegaz Namibia LTD (Russia).

1.4.5 Desktop, Specialist Assessments and Mitigation Measures

Desktop studies were conducted to review the available reports, and to design plans and maps to compile relevant marine biophysical and socioeconomic information of the project area. Marine biophysical studies covered the review of the proposed 2D and 3D seismic survey method existing environmental baseline such as oceanographic setting, circulations and characteristics, marine mammals, birds, commercial fishing and fisheries data sets. Based on the review of the existing data sets and recommendations of the Background Information Document (BID) / Scoping report, the following specialist assessments have been undertaken as part of the EIA process.

(i) Living marine resources covering fish, fishing seasons, birds, mammals and related ecosystem variability, and.

(ii) Acoustic modelling with respect to the likely negative impact of the proposed 2D and 3D seismic survey on key living marine resources likely to be found in the proposed area of interest.

In terms of the key mitigation measures, international best industry practice and guidelines for minimising the risk of injury and disturbance to marine mammals from seismic survey have been developed by the Joint Nature Conservation Committee (JNCC) and recommended by the EnerGeo Alliance to which the Proponent is a member.

Best industry practices which are based on the Best Practicable Environmental Option (BPEO) have proved to be effective in a number of different countries like Canada, Australia, Norway and the United States. These guidelines have been developed based on noise attenuation modelling, international experiences during seismic acquisition and a cautious approach to the disturbance of marine mammals from Seismic Survey.

The following are the example summary of some of key mitigation measures that have been included in the EMP report and to be implemented by the Proponent with respect to the proposed 2D and 3D seismic survey:

- ❖ Seasonality and survey implementation timing.
- ❖ Establishment of buffer zones.

- ❖ Use of Marine Mammal Observer (MMO).
- ❖ Use of Fisheries Liaison Officers (FLOs).
- ❖ Use of Passive Acoustic Monitoring (PAM) Technology.
- ❖ Soft starts' and 'pre-activation' observations.
- ❖ Termination of activation in the 500m exclusion zone.
- ❖ Marine Animal Monitoring and Mitigation Plan aboard the Survey Vessel.
- ❖ The use of Turtle friendly tail buoys, and.
- ❖ Compliance to all MARPOL (Marine Pollution) Regulations and Waste Disposal Procedures.

1.4.6 Public and Stakeholder Consultation Process

The overall objectives of conducting public and stakeholder consultation process were to inform all the Interested and Affected Parties (I&APs) about the proposed project activities, disclose the Terms of Reference, the assessment and management reports.

Public and stakeholder consultation activities were undertaken during the months of October and November 2023. The key consultation approaches focused on the following activities:

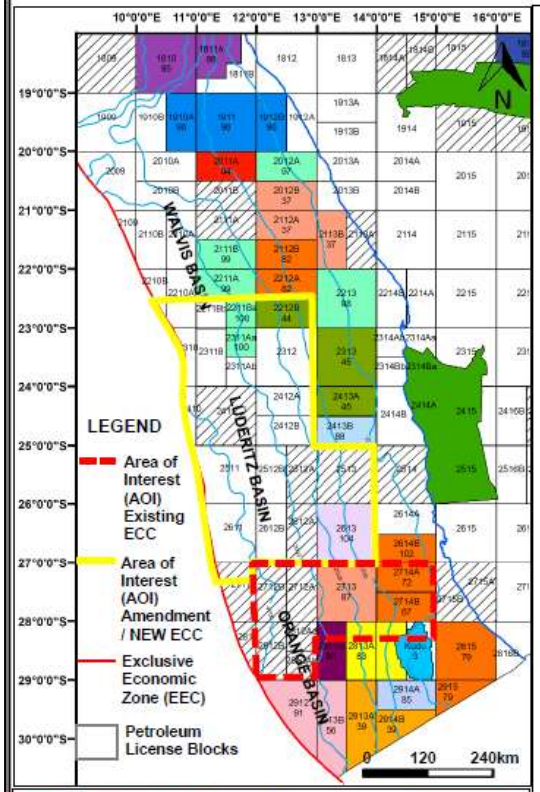
1. Preparation of the appropriate materials such public notice, BID, posters, presentation, and leaflets (Annex 1).
2. Directly contacting and engaging with the key stakeholders such as fishing companies and other affected parties.
3. Use of newspaper publications notices / adverts for the and placement of public notices at strategic places in Lüderitz (Figs. 1.8 and 1.9), and.
4. Organised a public meeting in Lüderitz on Tuesday 7th November 2023, held at the Benguela Community Hall, From 09hrs00-12hrs00.

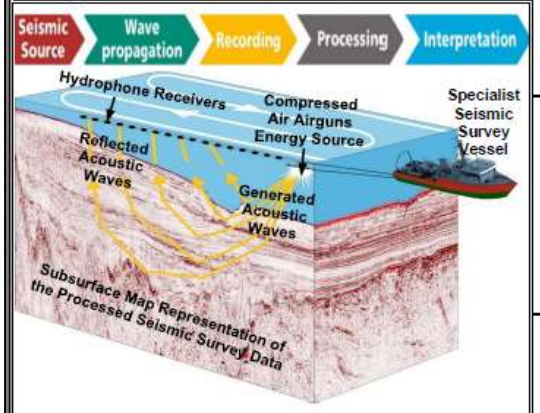
In accordance with provisions of the national regulations and corporate requirements of the Proponent, the identification and assessment of stakeholders and issues of importance to them, were key steps that were undertaken as part of the EIA process for the proposed activities.

The assessment of the key stakeholders in terms of their likely interest and role to the EIA Process with respect to the proposed activities have been continuously evaluated and updated as the EIA process progressed.

PUBLIC NOTICE FOR APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

PGS Exploration (UK) Limited (Proponent) Proposed Multiclient/Proprietary 2D / 3D Area of Interest (AOI), Orange, Lüderitz and Walvis Basins, Offshore Namibia





PGS EXPLORATION (UK) LIMITED (PROPONENT) intends to apply for an Amended and New Environmental Clearance Certificates (ECCs) over the outlined Area of Interest (AOI) with respect to the proposed potential Multiclient/Proprietary 2D / 3D seismic survey location specific projects that may be originated within the outlined AOI. The outlined AOI covers Blocks 2511, 2611, 2512B, 2512A, 2513, 2612B, 2612A, 2613, 2412B, 2411, 2410, 2310, 2311B, 2311Aa, 2311Ab, 2312, 2212B, 2211Ba, 2211Bb, 2210A and 2210B, falling in the Orange, Lüderitz and Walvis Basins, offshore deep-water, south-central Namibia. The Proposed AOI falls in water depths ranging from ca-200m to more than ca-4000m, from east to west, respectively. Although the outlined AOI represents a large area coverage, the actual likely location specific Multiclient/Proprietary 2D/3D seismic survey projects to be originated within the outlined AOI will be limited to the specific Petroleum Exploration Licenses (PELs) with potential high prospectivity opportunities. The likelihood of implementing specific projects within the proposed AOI will largely depend on the expression of interests by the PELs holders or the Government through NAMCOR wanting to acquire Multiclient/Proprietary 2D/3D seismic data sets for their respective AOIs.

The overall aim of undertaken Multiclient/Proprietary 2D/3D seismic survey seismic surveys is to map the subsurface of the key potential targeted areas within the outlined AOI. Although offshore seismic surveys operations in Namibia began as far back as 1968, a lot more still need to be done to have a full understanding of the subsurface geology, and petroleum systems of the deep-water offshore Namibia. The datasets from the potential Multiclient/Proprietary 2D/3D seismic surveys will provide critical insight into the regional and local subsurface geological evolution, deep-water offshore basin architecture, depositional, structural history and delineate potential drill-ready subsurface potential reservoirs likely to be situated kilometres below the seafloor. Seismic survey data sets generated can also be utilised in the search for natural suitable Carbon Capture and Storage (CCS) banking terrains as one of the possible options for Climate Change long-term global mitigation strategies. In oil and gas exploration, seismic survey data sets reduce the risk of drilling multiple dry wells, improve the chances for commercial discovery and reduces the environmental impacts of drilling more wells in the search for oil and gas resources.

The marine seismic survey is conducted using a specialist survey vessel towing an energy source in form of a compressed air source and hydrophone receivers. During the survey, compressed air is released to generate seismic acoustic signals/waves at regular intervals. The generated acoustic waves travel deep into the subsurface of the earth and get reflected by various rock formations of the subsurface at different depths below the seafloor. The returned signals get recorded and measured by receiving devices called hydrophones. Geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential subsurface geological structures called reservoirs that may contain potential commercial hydrocarbons resources. This is achieved by analysing the two-way travel times of the seismic waves through the various subsurface rock layers and the surface. 2D seismic survey is a regional mapping / imaging methodology aimed at de-risking an exploration project by establishing a validated Sedimentary Basin Scale Model of an exploration AOI. 3D seismic survey on the other hand, is a detailed local mapping / imaging methodology aimed at de-risking an exploration project by establishing a local validated Prospect/s or Lead/s Scale Models of an exploration AOI. 3D and 2D seismic surveys data sets are acquired on local to subregional dense and regional widely spaced survey grids / spacings, respectively.

The potential Multiclient/Proprietary 2D / 3D seismic survey location specific projects to be undertaken within the AOI, will be conducted using a MARPOL / Namibian Maritimes Laws compliant vessels and will adopt the well-established international best practices such as seasonality and survey implementation timing, establishment of buffer zones, use of Marine Mammal Observers (MMOs) & Fisheries Liaison Officers (FLOs), use of Passive Acoustic Monitoring (PAM) technology, soft starts' and 'pre-firing' observations, termination of firing in the 500m exclusion zone and use of turtle friendly tail buoys. The potential seismic survey activities within the proposed AOI cannot be undertaken without an Environmental Clearance Certificate (ECC) as provided for in the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. The Proponent is required to have undertaken environmental assessment process and the preparation of the EIA and Environmental Management Plan (EMP) Reports to support the application for ECC. In fulfilment of these environmental requirements, the Proponent has appointed Risk-Based Solutions (RBS) CC as the Environmental Consultant, led by Dr Sindila Mwiya and supported by Ms Emerita Ashipala as the Environmental Assessment Practitioners (EAPs) to prepare the EIA and EMP Reports. All Interested and Affected Parties (I&APs) are hereby invited to register and submit written comments / objections / inputs with respect to the potential Multiclient/Proprietary 2D / 3D seismic survey to be undertaken within the proposed outlined AOI in Orange, Lüderitz and Walvis Basins, offshore Namibia. A Background Information Document (BID) and Project Reports are available for comments upon registration as a stakeholder / Interested and / Affected Party (I&AP). NOTE: In terms of the provisions of the EIA Regulation 23 (1), an I&AP is required to disclose, on registration any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the ECC application.

REGISTER BY EMAIL WITH: Ms Emerita Ashipala (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email**: emerita.ashipala@gmail.com. For more technical clarifications on marine /offshore subsurface mapping using seismic survey operations, the receiving environment and oil and gas exploration and production, please contact Dr Sindila Mwiya EAP/Technical Permitting Advisor/ International Resources Consultant, **Email:** frontdesk@rbs.com.na

A PUBLIC MEETINGS HAS BEEN ORGANISED IN LÜDERITZ AS FOLLOWS:
LÜDERITZ: Tuesday 7th NOVEMBER 2023, PLACE: Benguela Community Hall, Lüderitz Town, TIME: From 09hrs00-12hrs00

REGISTRATION AND WRITTEN SUBMISSIONS DEADLINE IS: FRIDAY, 17th NOVEMBER 2023

Risk-Based Solutions (RBS) CC (URL: www.rbs.com.na)
Your Technical Specialist Consultants, Permitting & De-Risking Advisors in Natural Resources covering Petroleum Exploration & Production/ Minerals Exploration & Mining / Energy / Water / Environmental Assessments & Management (ESG, SEA, EIA, EMP, EMS)
Find Us @ 10 Schützen Street, Erf No. 7382, Sivieda House-Home of RBS, Tel: +264-61-306058 / 224780 / 236598

Figure 1.8: Copy of the Public Notice published in multiple local Newspapers for two (2) consecutive weeks starting the 27th October 2023 as part of the EIA process to support the application for a new ECC over the proposed AOI.

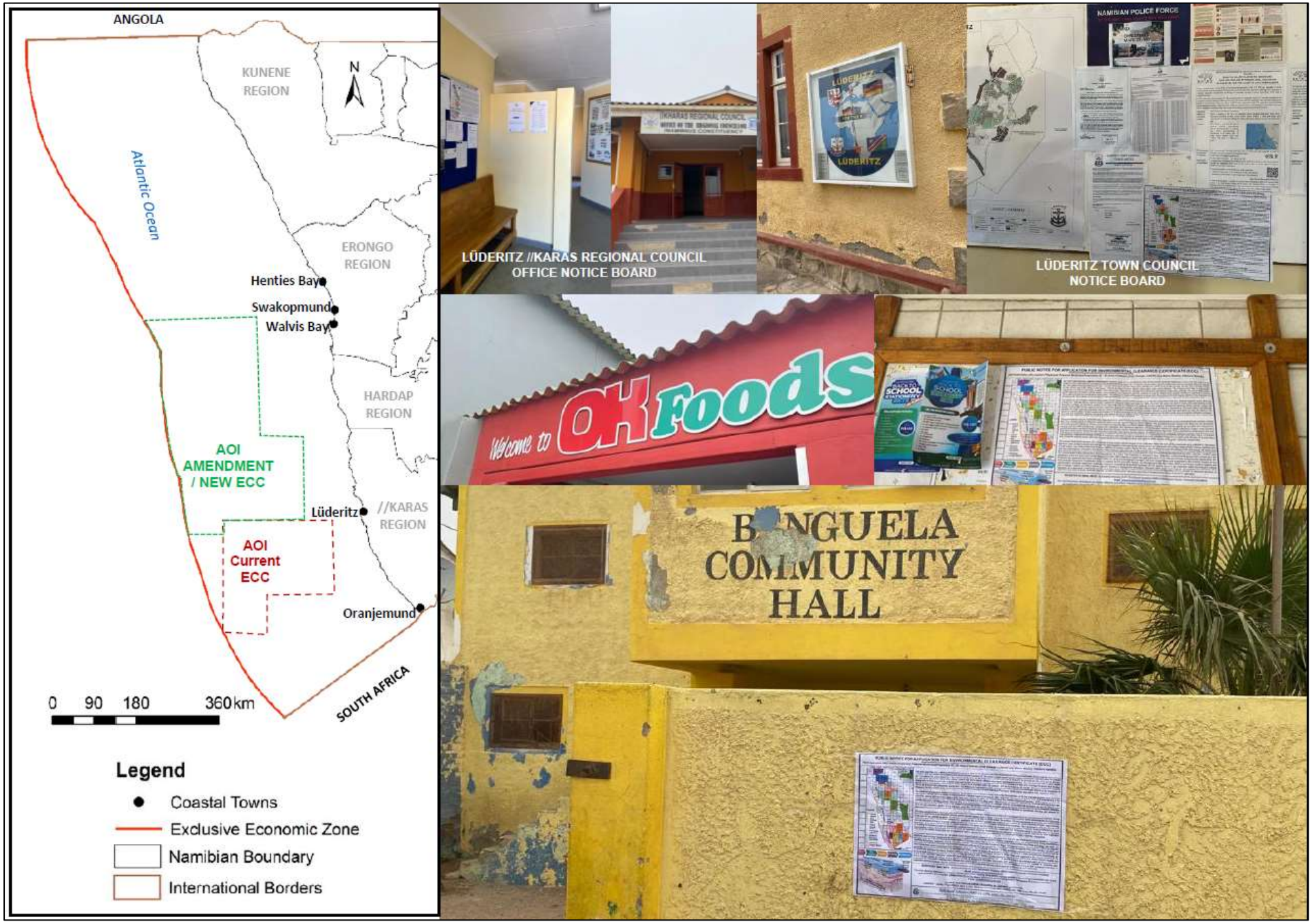


Figure 1.9: Public notices placed at multiple strategic places in Lüderitz in October and November 2023 as part of the EIA process to support the application for the new ECC over the proposed AOI.

1.4.7 Assumptions and Limitations

The following assumptions and limitations underpin the methodology and approach that has been adopted for this study, the overall outcomes, and recommendations thereof:

- The description of the proposed activities as well as all the plans, maps, survey boundary / coordinates and appropriate data sets received from the Proponent, project partners, regulators, Competent Authorities, and specialist assessments are assumed to be current and valid at the time of conducting the studies and compilation of the EIA and EMP reports.

- The impact assessment outcomes, mitigation measures and recommendations provided are valid for the entire duration of each of the Multiclient / Proprietary 2D/3D seismic survey activities to be undertaken.

- A precautionary approach has been recommended in instances where baseline information was insufficient or unavailable or site-specific locations of the proposed project activities is not yet available, and.

- Mandatory timeframes as provided for in the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) have been observed and will apply to the review and provision of the Records of Decisions by the Competent Authority, the Petroleum Commissioner in the Ministry of Mines and Energy and the Environmental Regulator, the Environmental Commissioner, Department of Environmental Affairs in the Ministry of Environment, Forestry, and Tourism.

1.5 Structure and Outline of this EIA Report

The following is the summary structure and outline of this EIA Report:

- **Section 1: Background** covering general project overview, the Proponent, project motivation, permitting and regulatory requirements, multiclient (MC), proprietary surveys and the Environmental Clearance Certificate, environmental assessment process and structure and outline of this EIA Report

- **Section 2: Project Description** covering proposed project activities (2D/3D seismic survey operations).

- **Section 3: Legislature and Regulations** with respect to the proposed Survey.

- **Section 4: Receiving Environment** covering summaries of the physical, biological and socioeconomic environments.

- **Section 5: Impacts Assessment** covering assessment methods and approaches, criteria and results of the positive and negative impacts assessment processes.

- **Section 6: Conclusions and Recommendations.**

- **Section 7: References / Bibliography and Further Reading**

2. PROJECT DESCRIPTION

2.1 Summary of the Proposed Survey

The following is the general summary specifications of the proposed Multiclient / Proprietary 2D/3D seismic survey operations by PGS (Figs. 2.1-1.4):

- **Proposed activities** – Multiclient or Proprietary (Exclusive) 2D/3D seismic survey**.**

- **Location** – Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, Walvis, Orange, and Lüderitz Basins Offshore Namibia. (Figs. 1.1-1.3).

- **Summary Example of the of the Seismic Specification:**
  - Source array details including:
    - Array pressure time history signature (preferably in electronic format – e.g. .sig file).
    - Power spectral density (amplitude spectrum) plots (preferably in electronic format – e.g. .sig file).
    - airgun volume.
    - peak and rms sound pressure level.
    - shot rate.
    - total number of shots per 24 h period.
      - Total number of shots per 24 h period = Approx. 5,206
      - Total number of shots for the full survey = Approx. 458,180
    - copy of Gundalf or Nucleus report.
  - Vessel sail speed and line change times: Expected vessel speed = 4.2 knots. Line change duration expected to be 3.4 hours (nominal).
  - Shot spacing: 16.667m flip-flop-flap (50m per same source).
  - Source activation time (hours per day):
    - Source to be activated once every Approx. 7.7 seconds.

- **Water Depth of the AOI** – Ranges from ca-200m to -4000m from east to west respectively.

- **Nearest Namibian Port** –Port of Lüderitz or Walvis Bay.

- **Operating company** – PGS.

- **Survey vessel(s)** – To be confirmed and multiple vessels (2) may be used.

- **Type of Survey** – 2D/3D streamers depending on the type of survey to be undertaken per survey event.

- **Desired acquisition time** – First survey event of the proposed Multiclient / Proprietary 2D/3D seismic survey to start in December 2023 if an ECC is granted by the Environmental Commissioner, and.

- **Estimated survey duration**–Seventy (70) days per survey event and multiple survey events will be undertaken over the next three (3) years.

2.2 General Description of a Typical Seismic Survey

Seismic survey is a key tool that resources companies exploring for hydrocarbons (oil and natural gas) use to map the subsurface and kilometres below the ground either on land (onshore) on in the sea (offshore) (Figs. 2.1 and 2.2). The basic principle of seismic survey method is the application of controlled generation of sound / acoustic waves by a seismic source to obtain an image of the subsurface. The generated acoustic wave that travels deep into the earth, is reflected by the various

rock formations of the earth and returns to the surface where it is recorded and measured by receiving devices called hydrophones (Figs. 2.1-2.3).

Airguns are the most common sound source used in modern offshore seismic surveys (Figs. 2.1-2.3). An airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air prior to discharge. Arrays of airguns are made up of towed parallel strings (Figs. 2.1-2.3).

A single airgun could typically produce sound levels of the order of 220 - 230 dB re 1 mPa @ 1 m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1 m. Most of the energy produced is in the range of between 0 - 120 Hz bandwidth, although energy at much higher frequencies is also produced and recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of between 100 – 1, 000 Hz, while the optimum wavelength for deep seismic work is in the 10 - 80 Hz range.

During the survey operation, the seismic vessel records the data from all the hydrophones, including accurate coordinates of the vessel and its hydrophones. As shown in Figs. 2.1-2.3, the proposed Multiclient / Proprietary 2D/3D seismic survey will employ numerous streamers and many hydrophones, providing enough data to give a detailed subsurface profile of the rock layers as illustrated in Figs. 2.1-2.3. The depths of the reflecting layers are calculated from the time taken for the sound to reach the hydrophones via the reflector. this is known as the two-way travel time.

The pulse of sound from the guns radiates out as a hemispherical wave front, a portion is reflected towards the hydrophones from rock interfaces. The path of the minute portion of the reflected wave-front intercepted by a hydrophone group is called a ray path. Hydrophone groups spaced along the streamer pick out ray paths that can be related to specific points on the reflector surface.

Graphs of the intensity of the recorded sound plotted against the two-way time are displayed as wiggle traces. Seismic recording at sea always uses the Common Depth Point (CDP) method. A sequence of regularly spaced seismic shots is made as the survey vessel accurately navigates its course. Shots are usually timed to occur at distances equal to the separation of the hydrophone groups. In this way up to 120 recordings of the echoes from any one of 240 reflecting points can be collected. Each represents sound, which has followed a slightly different ray path, but has all been reflected from the same common depth point.

By analysing the time, it takes for the seismic waves to travel between the rock formations and the surface, geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential drill-ready subsurface geological structures called reservoirs that may contain hydrocarbons (Figs. 2.1-2.3).

2.3 Envisaged Logistical Arrangements Support

The vessel/s, helicopter and all other supporting equipment will to be used for the proposed Multiclient / Proprietary 2D/3D seismic survey will be in full compliance with all the requirements of the international convention on the prevention of pollution from ship (MARPOL) policies and practices as well as all the national marine related regulations administered by the Department of Maritime Affairs in the Ministry of Works and Transport (MWT) and Ministry of Fisheries and Marine resources (Figs. 2.4 and 2.5 and Plate 2.2).

The Ports of Lüderitz and Walvis Bay will serve as the operations base as may be required for the supply of materials, consumables, port requirements and services where needed.

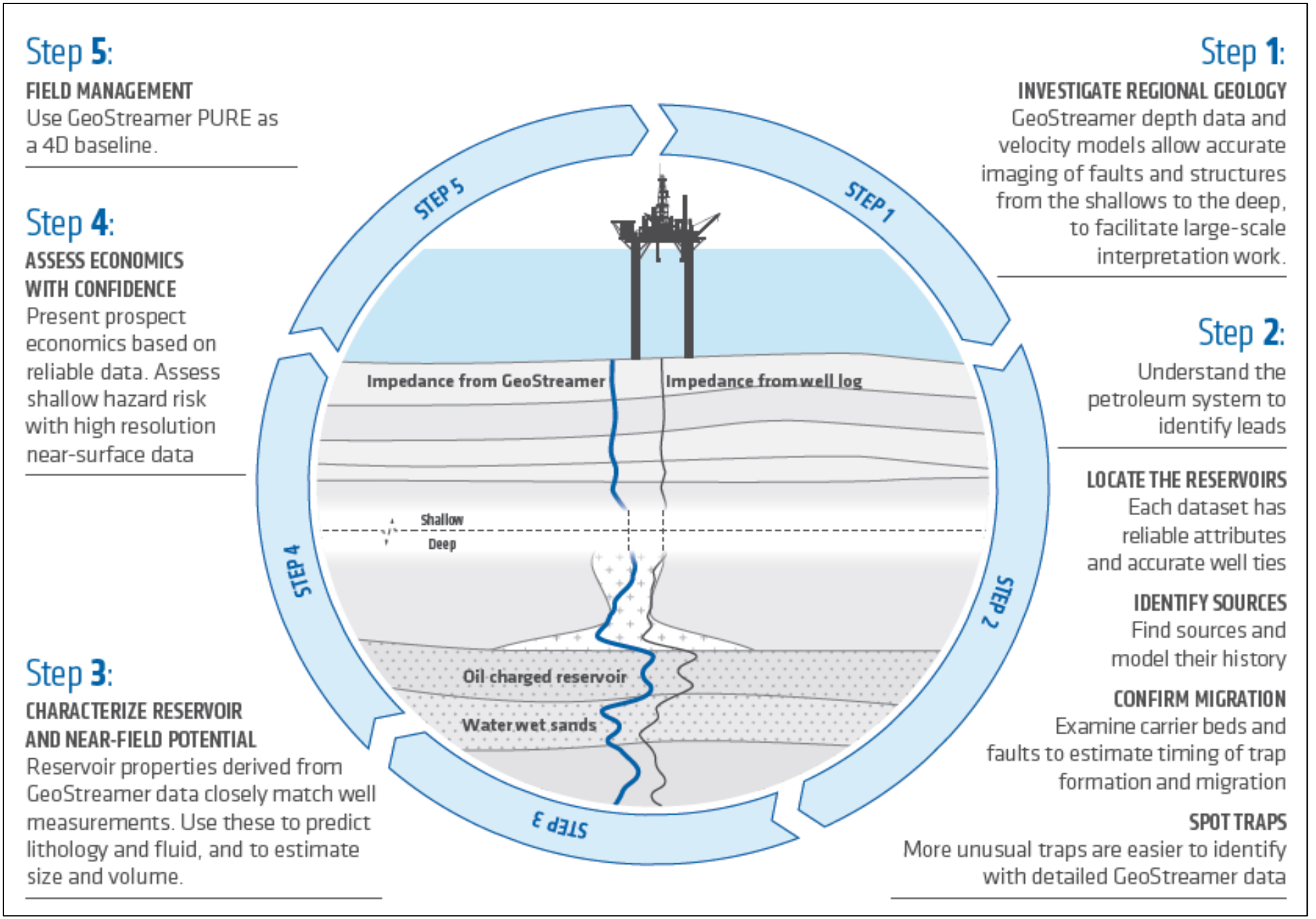


Figure 2.1: Seismic survey data support to an exploration journey (Extract from PGS Infographic, supporting your exploration journey: www.pgs.com/publications/infographics).

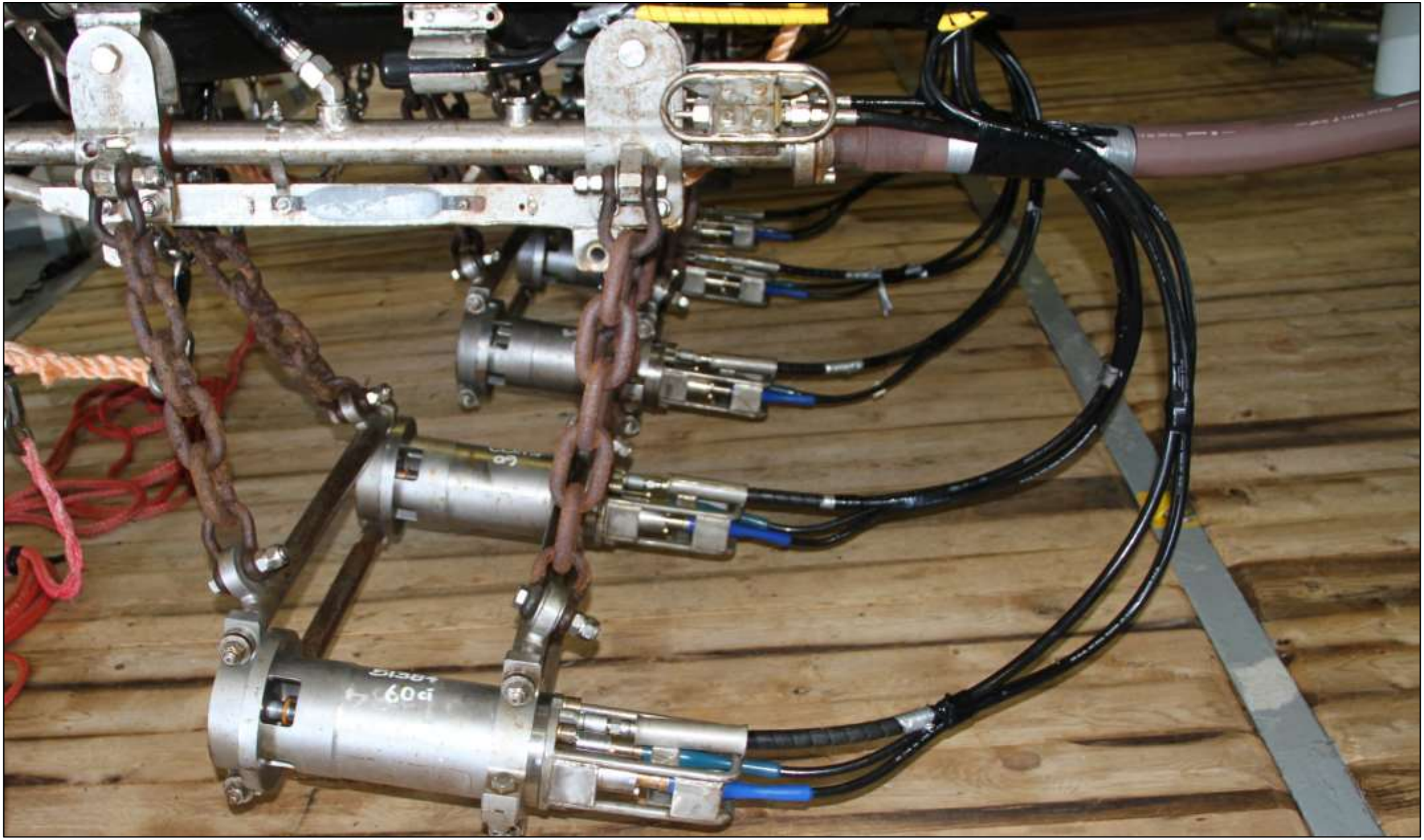


Plate 2.1: Example of the air guns used in marine seismic survey operations.

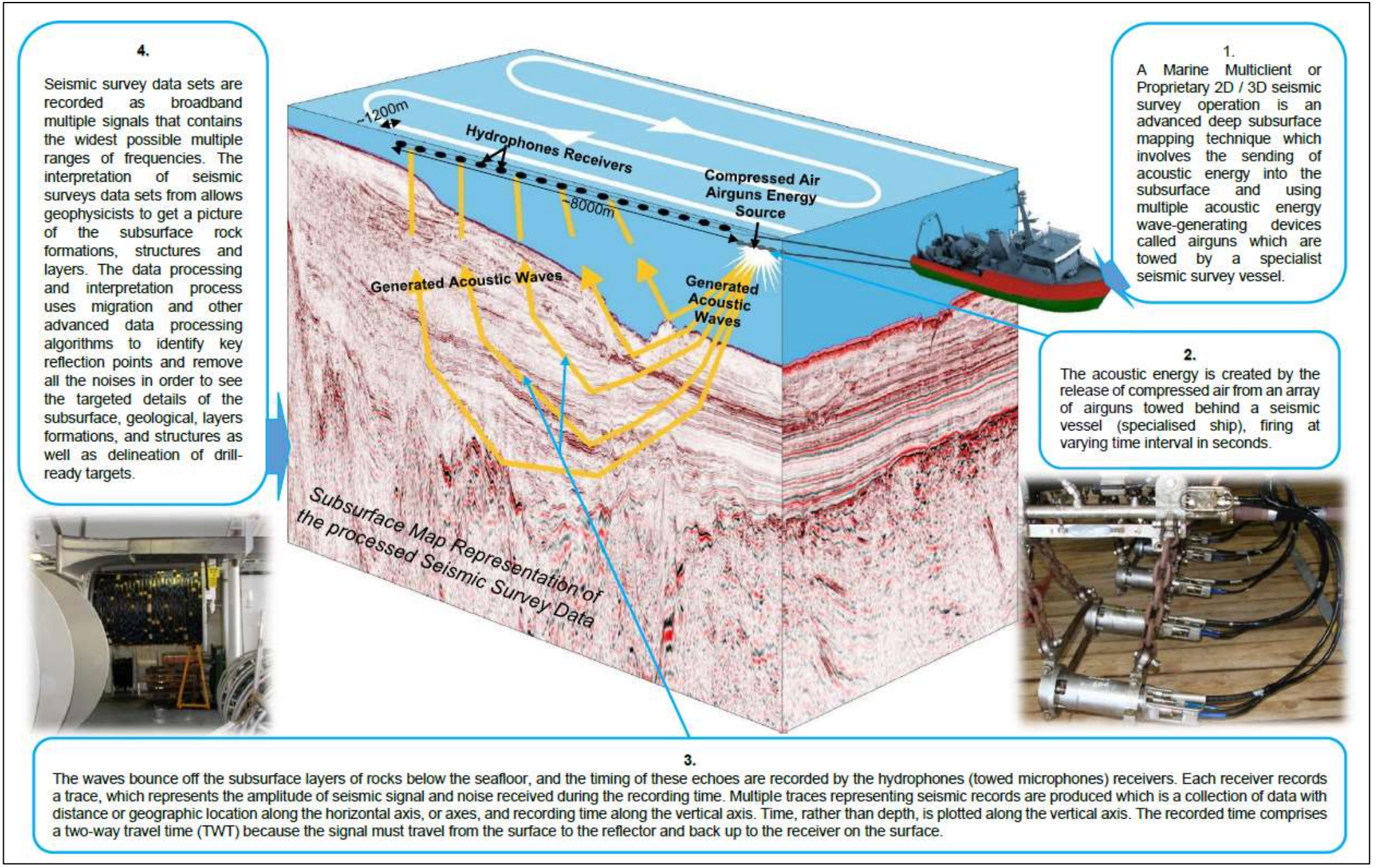


Figure 2.2: Illustration of the of the principles of marine / offshore seismic survey method.

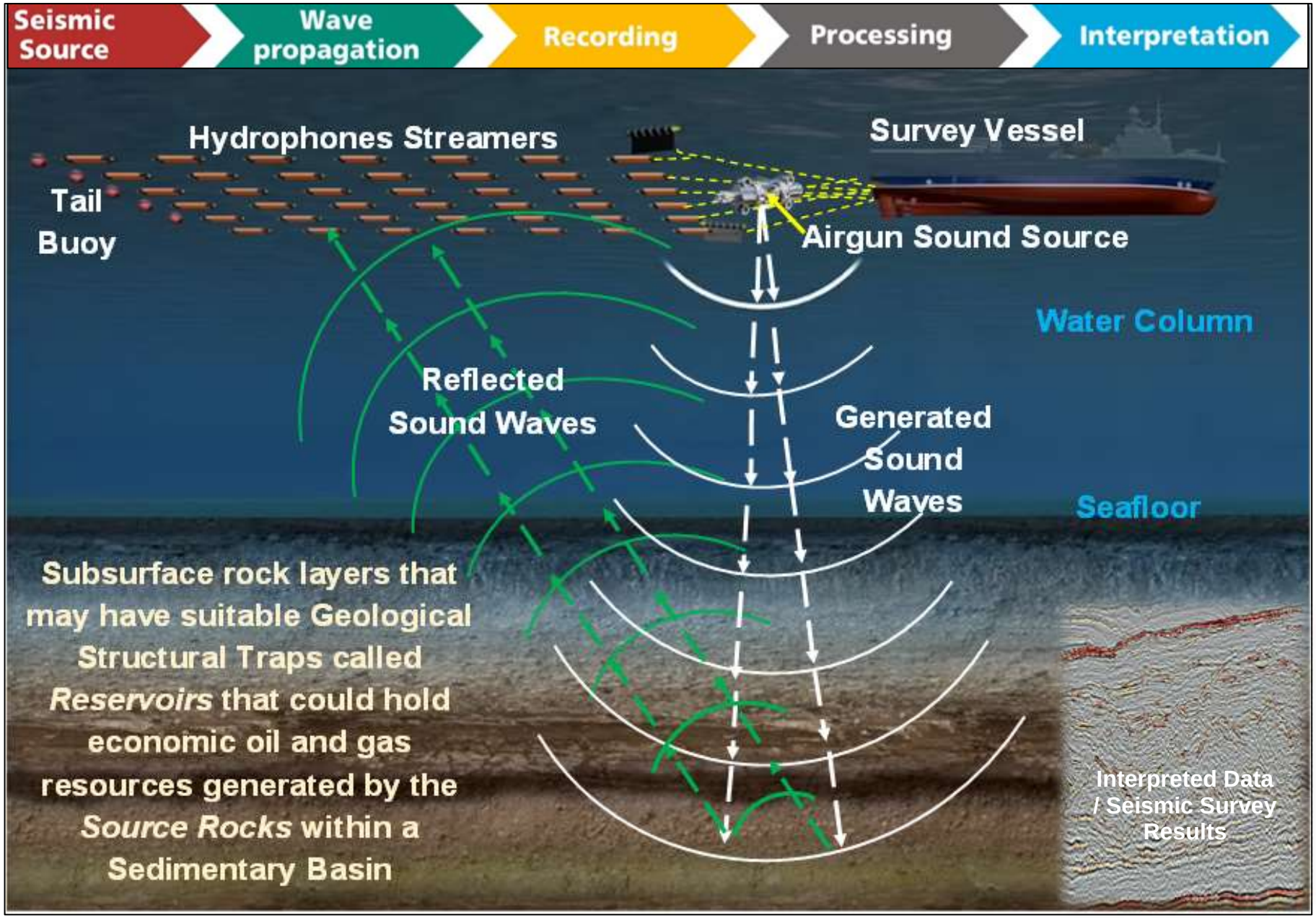


Figure 2.3: Illustration of the application of marine seismic survey method involving data collection and analyses of the times for seismic waves to travel between the various subsurface rock formations. Geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential drill-ready subsurface geological structures called reservoirs that may contain commercial hydrocarbons (Image Source: www.youtube.com/watch?v=FN8IAb0rG9A).

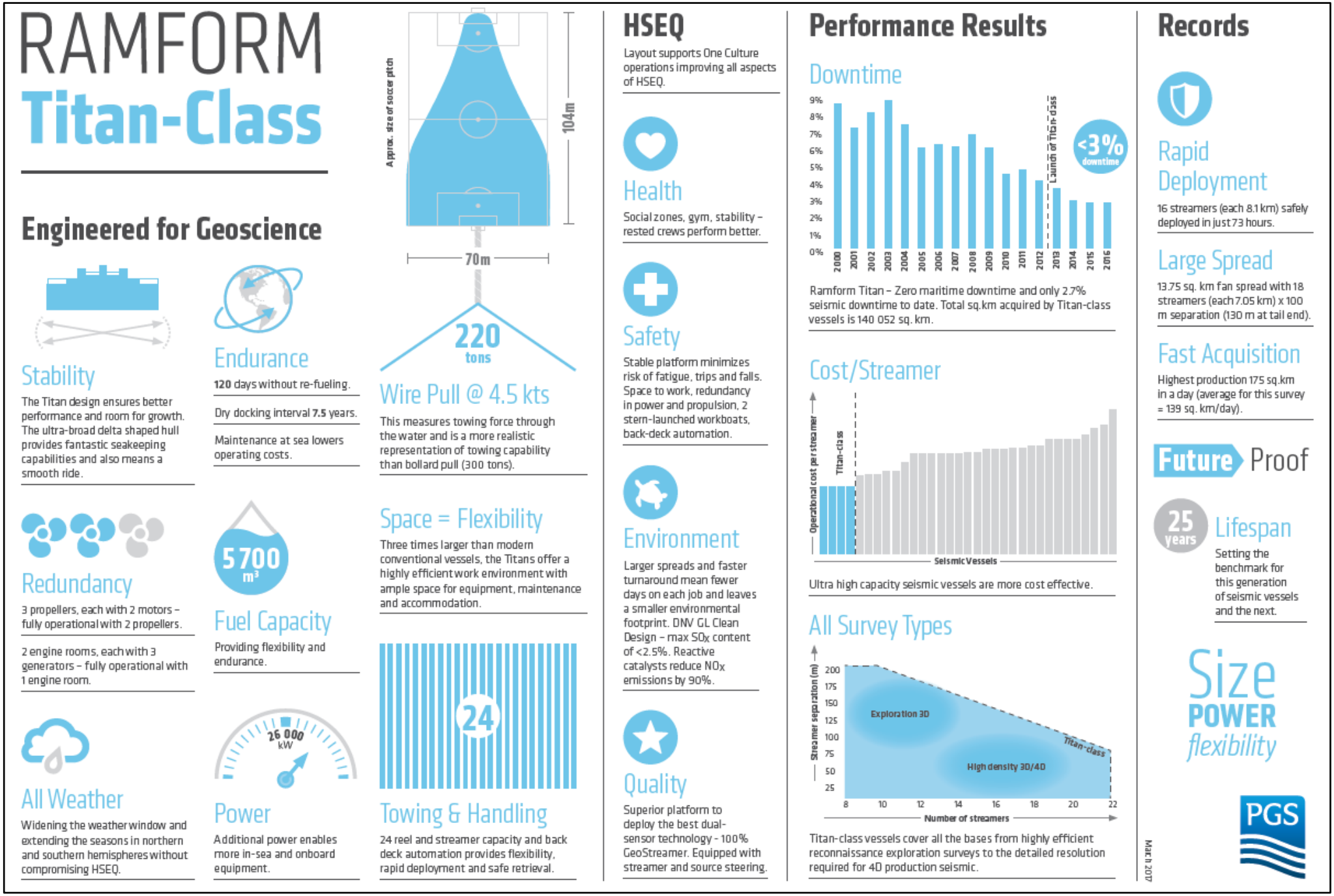


Figure 2.4: Specifications of the ultra-high-capacity Ramforms, both Titan-class and S-class (Source: www.pgs.com).

Plate 2.2: Ramform Titan one of the seismic survey vessels used by PGS (Source: www.pgs.com).

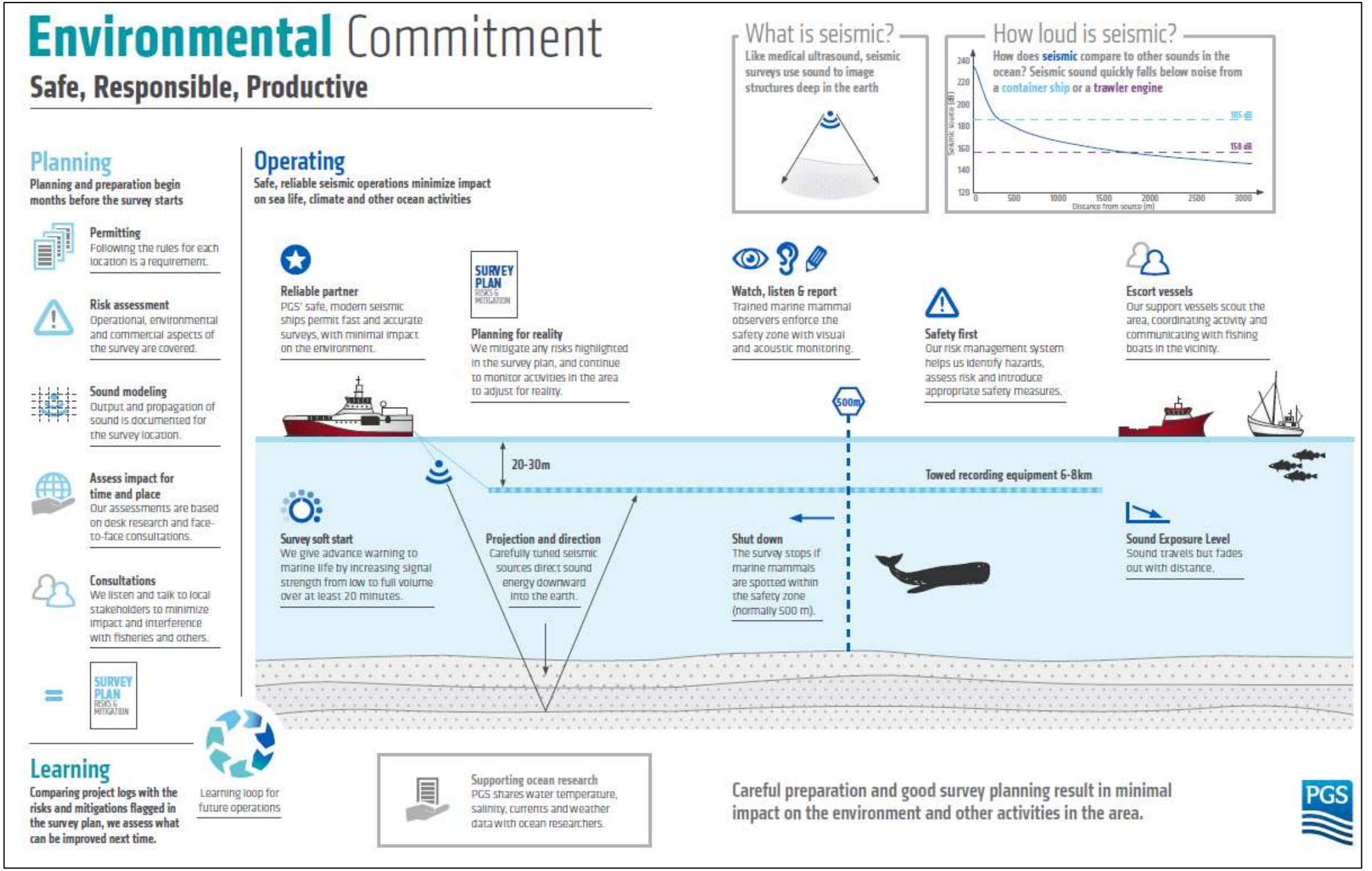


Figure 2.5: PGS Environmental Commitments to environmental management and international best practices (Source: www.namcor.com.na).

3. LEGISLATURE AND REGULATIONS

3.1 Overview

The statutes, common, customary, and international laws are the four (4) sources of laws as enshrined in the constitution which is the supreme law of Namibia. All other laws must be in line with the Namibian Constitution. The most important legislative instruments and associated permits, licenses, and compliances applicable to the proposed 2D/3D seismic survey include: Petroleum, environmental management, living marine resources management, atmospheric and marine pollution prevention, health, and labour as well as other indirect laws linked to the accessory services.

3.2 Petroleum Exploration and Production Legislation

The Ministry of Mines and Energy (MME) is the competent authority for petroleum exploration and production activities in Namibia. In accordance with the Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991), and to promote petroleum exploration activities in Namibia, the Ministry of Mines and Energy has the mandate to issue three types of licenses namely. Reconnaissance, Exploration and Production Licences. A reconnaissance licence is issued under Section 26 of the Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991), including any renewal of such licence.

Reconnaissance activities are carried out for or in connection with the search for petroleum by geological, geophysical and photo-geological surveys and include any remote sensing techniques. Exploration licence is issued under Section 34 of the Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991) and includes any renewal of such licence. A production licence is issued under Section 50 and includes any renewal of such licence.

3.3 Environmental Regulations

Environmental Assessment (EA) process in Namibia is governed by the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 gazetted under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007). The proposed 2D / 3D seismic survey falls within the categories of listed activities that cannot be undertaken without an Environmental Clearance Certificate. This EIA Report has been prepared in order to support the application for Environmental Clearance Certificate for the proposed 2D / 3D seismic survey covering the Walvis, Lüderitz and Orange Basins, offshore Namibia.

3.4 Regulatory Agencies

Regulatory authorities relevant to the proposed activities, proposed 2D / 3D seismic survey in the Walvis, Lüderitz and Orange Basins, offshore Namibia are listed in Table 3.1.

Table 3.1: Government agencies regulating environmental protection in Namibia.

Agency	Role in Regulating Environmental Protection
Ministry of Environment, Forestry, and Tourism (MEFT)	Issues Environmental Clearance Certificates in line with the provisions of the Environmental Management Act (2007) and the Environmental Impact Assessment Regulations, 2012
Ministry of Mines and Energy (MME)	The competent authority for petroleum exploration and production activities in Namibia.
Ministry of Works, and Transport (MWT)	The Directorate of Maritime Affairs (DMA) in the MWT is the government's lead agency responsible for National Oil Spill Contingency Planning (NOSCP), organisation and response. It therefore plays a significant role with respect to prevention and management of pollution of the maritime environment arising from shipping activities.
Ministry of Fisheries and Marine Resources (MFMR)	The MFMR has authority over all living marine resources management in Namibia. The Ministry forms part of the review panel for EIAs which bear relevance to the marine environment

3.5 Key Relevant International Obligations

3.5.1 UNCLOS 1982

The United Nations Law of the Sea Convention (UNCLOS) of 1982 requires member states to adopt legislation to reduce marine pollution from sea-bed activities in the Exclusive Economic Zone (EEZ) and on the continental shelf (Articles 208 and 214), and from land-based sources (Articles 194 and 207). It also contains provisions relating to marine pollution resulting from dumping of waste at sea (Articles 210 and 216).

Overall, the convention deals with the prevention of marine pollution and the compensation for damage caused by this pollution. It contains provisions relating to the prescription and enforcement of pollution standards. in addition, it emphasises on unilateral action by states with regard to pollution control and provides for contingency plans against pollution.

3.5.2 MARPOL 73/78

The International Convention for the Prevention of Pollution from Ships, 1973 was adopted in 1973 (MARPOL 73). This convention was subsequently modified by the Protocol of 1978 (MARPOL 78) and hence abbreviated MARPOL 73 / 78. It provides regulations covering the various sources of ship-generated pollution (IMO, 1992). Namibia is a party to Annexes I, II, III, IV and V of MARPOL 73/78. The various Annexes are highly applicable to the activities associated with the proposed survey operations. Guidance on the various provisions of the MARPOL 73/78 with respect to the proposed exploration activities are summarised as follows:

- Management of Oil: MARPOL Annex 1: Regulations for the Prevention of Pollution by Oil, Regulation 9 (1) (b) Control of discharge of oil. Any discharge into the sea of oil or oily mixtures from ships to which this Annex applies shall be prohibited except when all the following conditions are satisfied.

- Sewage: MARPOL Annex IV: Regulations for the Prevention of Pollution by Sewage from ships, Regulation 8 Discharge of sewage. Refer to the Recommendation on International Performance and Test Specifications for Oily-Water Separating Equipment and Oil Content Meters adopted by the Organization by resolution A.393 (X).

- Galley Wastes: MARPOL Annex V: Regulations for the Prevention of Pollution by Garbage from Ships, Regulation 3(1)(b), (1)(b)(ii) and (1)(c) Disposal of garbage outside special areas.

- Solid waste: MARPOL Annex V: Regulation 3(1) (a) and (1) (b), and.

- Atmospheric Emissions: MARPOL Annex VI: Regulations for the Prevention of Air Pollution from Ships Regulation 12: Ozone Depleting Substances.

3.5.3 Summary of Regulatory Register

The following is the summary of the regulatory register for all applicable legislations with respect to the proposed 2D / 3D seismic survey:

1. Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007).

2. Environmental Impact Assessment (EIA) Regulations No. 30 of 2012.

3. Public Health Act 36 of 1919 (as last amended by Act 21 of 1988).

4. Merchant Shipping Act 57 of 1951.

5. Sea Shore Ordinance 37 of 1958.

6. Aviation Act 74 of 1962 (as last amended by the Aviation Amendment Act 10 of 1991 and the Aviation Amendment Act 27 of 1998) (and the Namibian Civil Aviation Regulations 2001).

7. National Monuments Act 28 of 1969 (as amended by the National Monuments Amendment Acts 22 of 1970 and 30 of 1971, the Expropriation Act 63 of 1975, and the National Monuments Amendment Act 35 of 1979).

8. Hazardous Substance Ordinance 14 of 1974.

9. Atmospheric Pollution Prevention Ordinance 11 of 1976.

10. Dumping at Sea Control Act 73 of 1980.

11. Marine Traffic Act 2 of 1981 (as amended by the Marine Traffic Amendment Act 5 of 1983, the Marine Traffic Amendment Act 15 of 1991, and the Namibia Ports Authority Act 2 of 1994).

12. Prevention and Combating of Pollution of the Sea by Oil Act 6 of 1981 (as amended by the Prevention and Combating of Pollution of the Sea by Oil Amendment Act 59 of 1985, Act 63 of 1987, and Act 24 of 1991, and the Namibian Ports Authority Act 2 of 1994).

13. Territorial Sea and Exclusive Economic Zone of Namibia Act 3 of 1990 (and the Territorial Sea and Exclusive Economic Zone of Namibia Amendment Act 30 of 1991).

14. Petroleum Products and Energy Act 13 of 1990 (as amended by the Petroleum Products and Energy Amendment Act 29 of 2004, Act 3 of 2000 and Act 16 of 2003.

15. Foreign Investment Act 27 of 1990.

16. Namibian Ports Authority Act 2 of 1994 (as amended in 2000 and the accompanying 2001 Port Regulations).

17. Nature Conservation Amendment Act 5 of 1996.

18. The Marine Resources Act 27 of 2000 (and the Regulations relating to the Exploitation of Marine Resources 2001).

19. Environment Investment Fund of Namibia Act 13 of 2001.

20. Wreck and Salvage Act 5 of 2004.

21. National Heritage Act 27 of 2004 (and the Regulations/Appointments/Declarations made under the National Monuments Act 28 of 1969 and the Regulations 2005).

22. Atomic Energy and Radiation Protection Act 5 of 2005 (and the Radiation Protection and Waste Disposal Regulations 2011).

23. Labour Act 11 of 2007 (and the Labour Amendment Act 2 of 2012).

24. Tobacco Products Control Act 1 of 2010 (and the Regulations).

25. Disaster Risk Management Act 10 of 2012.

26. International Conventions and Protocols:

    a) International Plant Protection Convention (IPPC) 1951 (as last amended in 1997).

    b) Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (The Ramsar Convention on Wetlands) 1971.

c) Declaration of the United Nations Conference on the Human Environment 1972.

d) Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) 1972 (as amended).

e) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (and amendments)

f) International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 (as modified by the Protocol of 1978 adopted by the Inter-Governmental Maritime Consultative Organization ("IMCO") in London on 3 November 1973).

g) International Convention for the Safety of Life at Sea (SOLAS) 1974 (as amended).

h) United Nations Convention on the Law of the Sea (UNCLOS) 1982.

i) Vienna Convention for the Protection of the Ozone Layer 1985 and Montreal Protocol on Substances that Deplete the Ozone Layer 1987.

j) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989.

k) International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1990.

l) United Nations (UN) Framework Convention on Climate Change 1992 and Kyoto Protocol to the UN Framework Convention on Climate Change 1997.

m) Convention on Biological Diversity (CBD), Rio de Janeiro, 1992.

n) Stockholm Convention on Persistent Organic Pollutants (POPs) 2001 (as amended in 2009 and 2011).

o) United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage 2001.

p) Convention for the Safeguarding of the Intangible Cultural Heritage 2003.

q) Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005.

r) Revision of International Standards for Phytosanitary Measures (ISPM) No. 15 Regulation of Wood Packaging.

27. Regional Agreements:

a) Southern African Development Community (SADC) Protocol on Mining 1997.

b) Southern African Development Community (SADC) Protocol on Energy 1998.

4. RECEIVING ENVIRONMENT

4.1 Physical Environment and Climate

The AOI falls within the Benguela Current Large Marine Ecosystem (BCLME) which extends from the Agulhas Bank at 27°E, along the west coasts of South Africa and Namibia, northwards to the Angola-Benguela Frontal Zone between 14-16°S.

The BCLME encompasses the Exclusive Economic Zones (EEZ) of Angola, Namibia and part of South Africa's EEZ. The Benguela Current is unique in that it is bounded both to the south and the north by warm currents, viz the Agulhas Current and the Angola Current. The oceanographic boundaries are highly dynamic and influence the ecosystem as a whole. The BCLME has a temperate climate and plays an important role in global climate and ocean processes (Heileman and O'Toole, 2012).

The southern Namibian coastline is characterised by the frequent occurrence of fog, which occurs on average more than 100 days per year at Oranjemund, being most frequent during the months of February through May (Fig. 4.1).

Average precipitation per annum ranges from 16.4 mm at Lüderitz to 51.5 mm at Oranjemund. Due to the combination of wind and cool ocean water, temperatures are mild throughout the year (Fig. 4.2). Coastal temperatures average around 16°C, gradually increasing inland (Barnard 1998). Oranjemund experiences an average low temperature range in July of 9-17°C, and average high temperature ranges in January of 16-20°C (Wijnberg 1995).

Highest temperatures (>30°C) tend to occur in winter during 'berg' wind conditions. During autumn and winter, the south Atlantic anticyclone weakens and migrates north-westwards causing catabatic, or north-easterly 'berg' winds. These powerful offshore winds can exceed 50 km/h, producing sandstorms that considerably reduce visibility at sea and on land.

Although they occur only 8-22% of the time, they have a strong effect on the coastal temperatures, which often exceed 30°C during 'berg' wind periods (Zoutendyk 1992. Shannon & O'Toole 1998. CSIR 1998. Lane & Carter 1999).

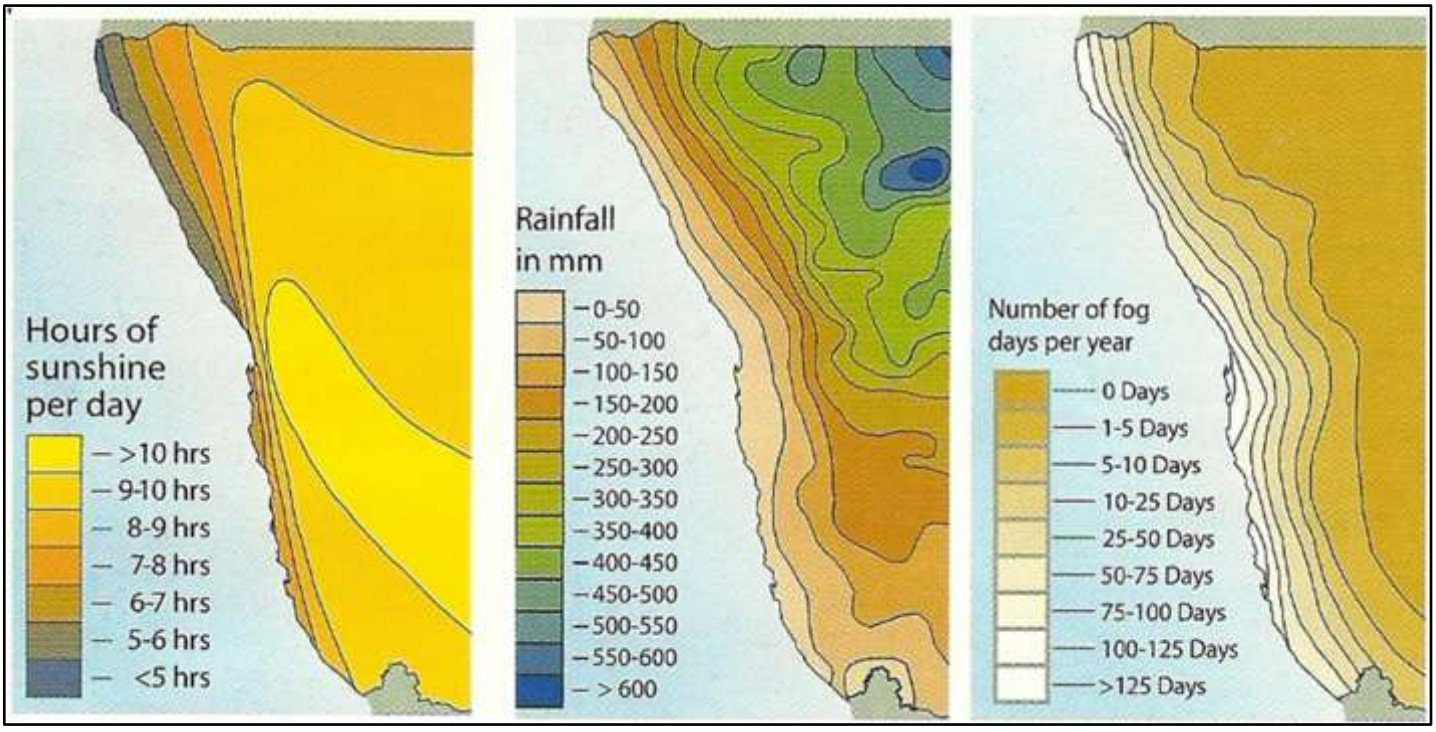


Figure 4.1: Map showing hours of sunshine per day, rainfall in mm, and number of fog days per year (Molloy and Reinikainen, 2003).

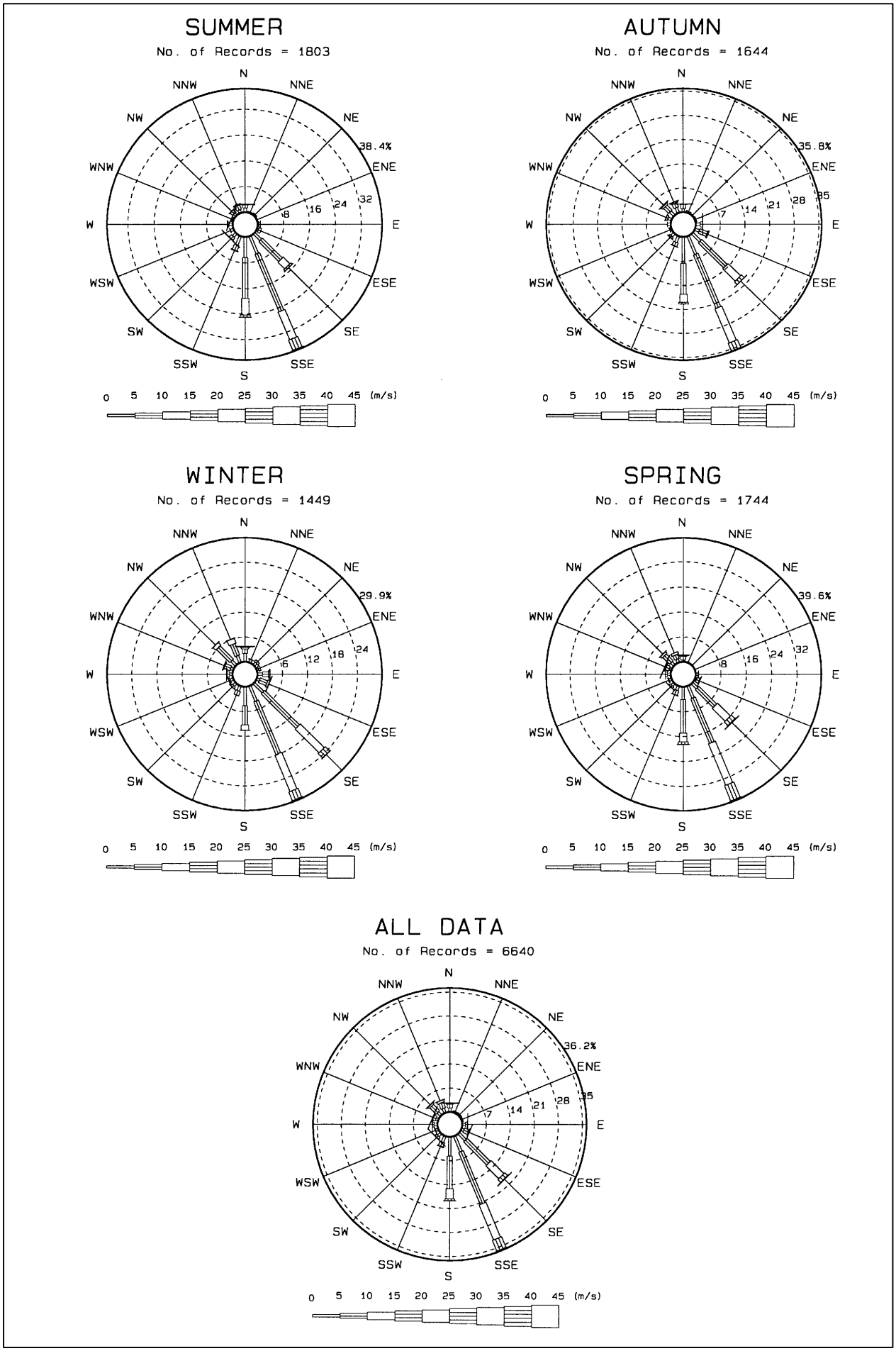


Figure 4.2: Seasonal wind roses for the offshore area 28°- 29°S. 15°-16°E (Oranjemund) (Source: Voluntary Observing Ship (VOS) data from the Southern Africa Data Centre for Oceanography (SADCO)).

4.2 Oceanographic Setting

4.2.1 Seawater Temperature

South Atlantic Central Water (SACW) comprises either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Temperatures range between 6°C and 16°C, and salinities between 34.5‰ and 35.5‰ (parts per thousand) (Shannon 1985).

4.2.2 Waves and Tides

Wind-induced waves, on the other hand, have shorter wave periods (~8 seconds), are generally steeper than swell waves, and tend to come from a more south-easterly direction (CSIR 1996). Daily wave height measurements from a wave recorder stationed off Port Nolloth indicate an 'event' scale distribution of wave heights, with large wave events persisting for a maximum of 7 days, but 2–4-day periods being more common (Lane & Carter 1999).

Generally, wave heights decrease with water depth and distance longshore. On occasion, the prevailing south-westerly winds can reach gale force velocities in excess of 70 km/hr, producing swells up to a maximum height of 10 m. 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 (as measured at Port Nolloth), but only 0.6 m during neap tide periods.

4.2.3 Water Masses and Circulation

The major feature of the Benguela Current along the coastline is upwelling. It is seasonal in the south but is a semi-permanent feature at Lüderitz and areas to the north due to perennial southerly winds (Fig. 4.3). Wind stress is a persistent forcing influence that induces intense upwelling along the coast between the Orange River Mouth and Walvis Bay (Duncombe Rae 2005).

In the nearshore zone along the southern Namibian coastline, strong wave activity from the south and southwest (generated by winds and waves in the South Atlantic and Southern Ocean) drives a predominantly northward long-shore current (Fig. 4.4).

Surface currents appear to be topographically steered, following the major topographic features (Nelson & Hutchings 1983). Current velocities vary accordingly (~10-35 cm/s), with increased speeds in areas of steep topography and reduced velocities in areas of regular topography (Figs. 4.5 and 4.6).

4.2.4 Assessment of Weather Window for undertaking the 2D / 3D seismic survey

According to Fig. 4.4, the months of November – March are the most favourable weather option window No. 1 for undertaking the proposed 2D / 3D seismic survey. April – May and September– October months are the moderately 2nd favourable weather option windows No. 2 for undertaking the proposed 2D / 3D seismic survey (Fig. 4.7).

The weather option windows of opportunity to undertake the proposed 2D / 3D seismic survey shown in Fig. 4.7 may be the best in terms of the weather conditions but could be constrained other marine environmental elements such as fisheries and marine mammals as well as operational constraints such as timely availability of suitable survey vessel.

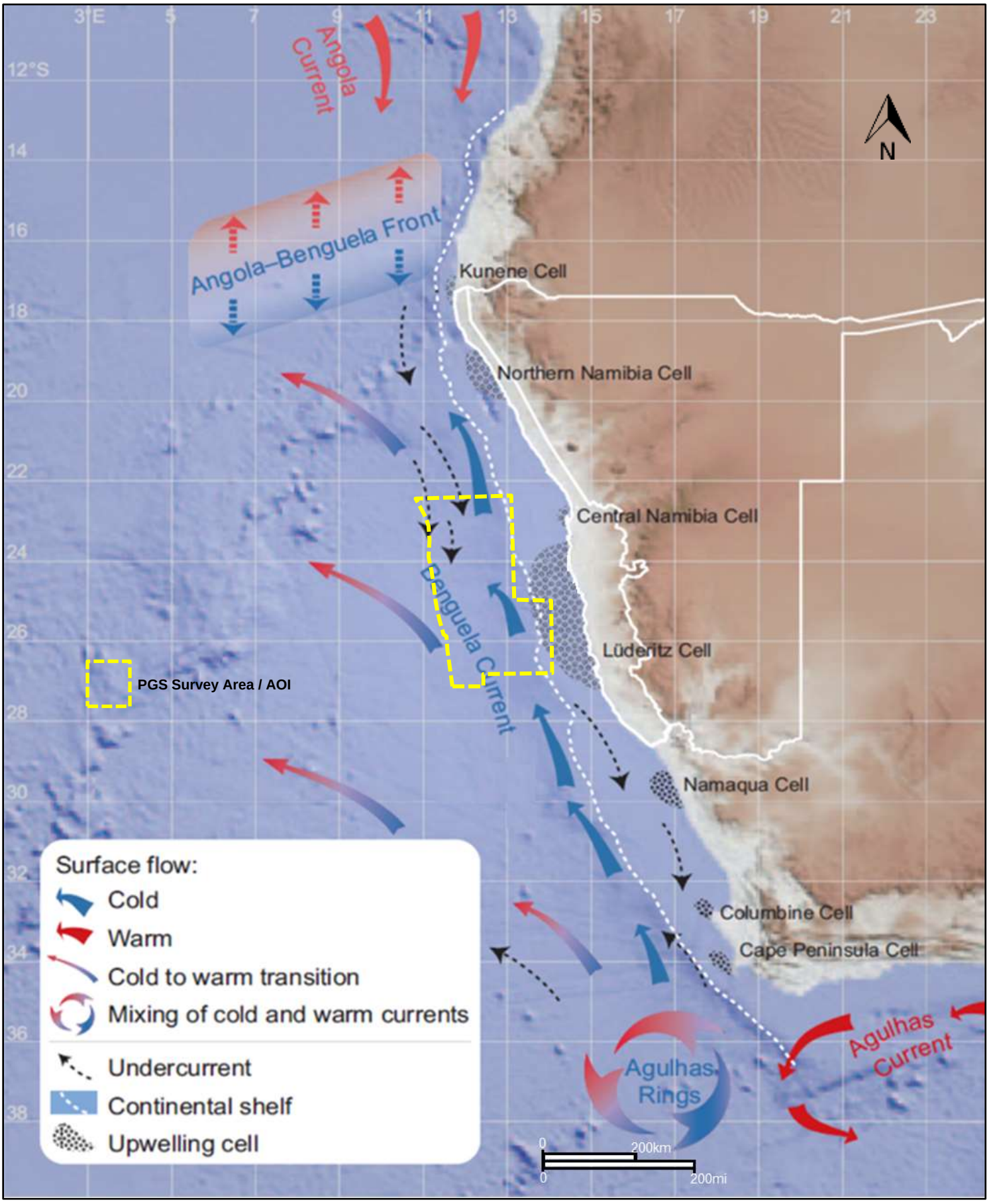


Figure 4.3: Main features of the Benguela System showing the location of the proposed survey area within the BCLME (Source: Ministry of Environment, Forestry, and Tourism, 2012).

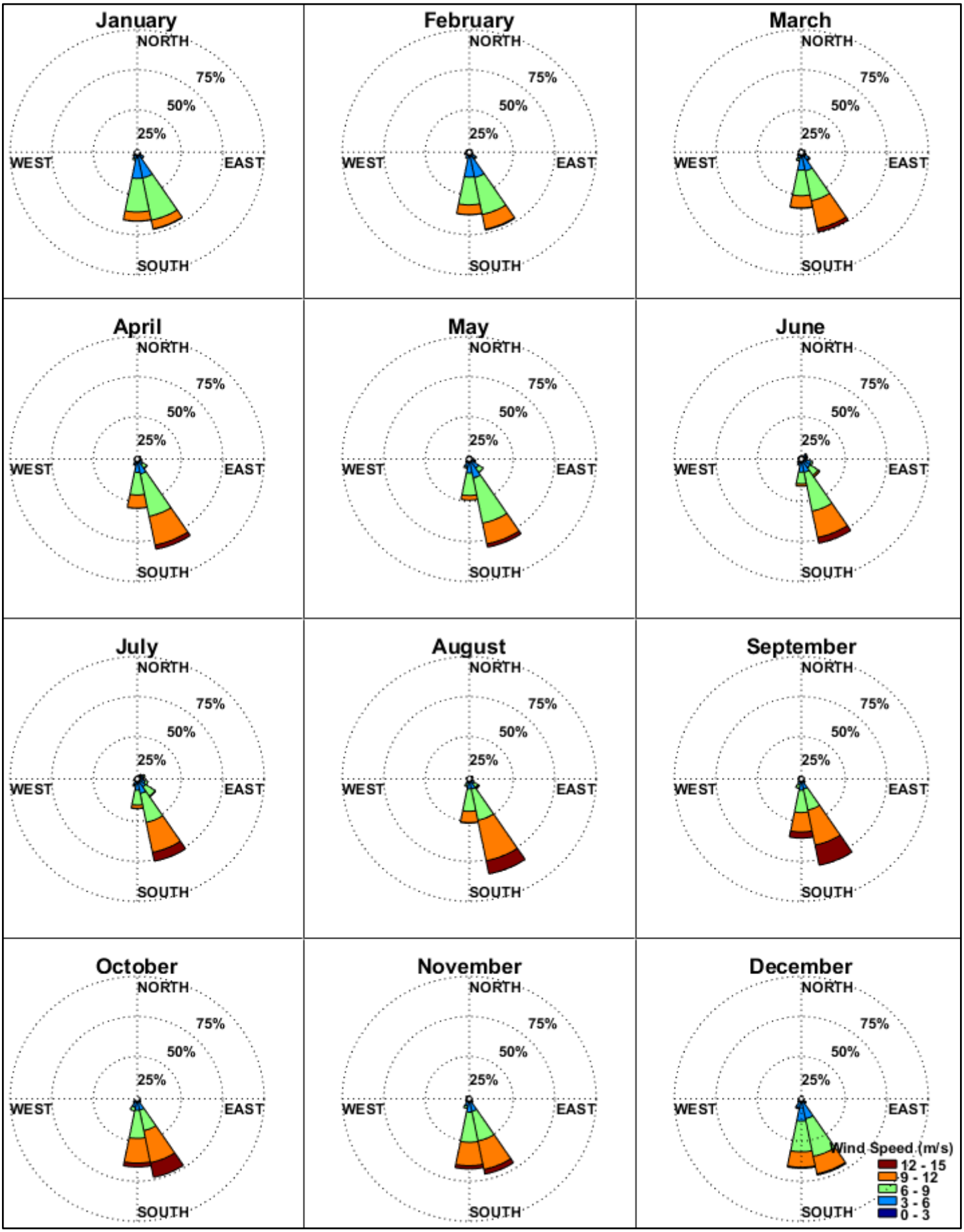


Figure 4.4: Monthly CFSR wind roses near PEL 44. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from) (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

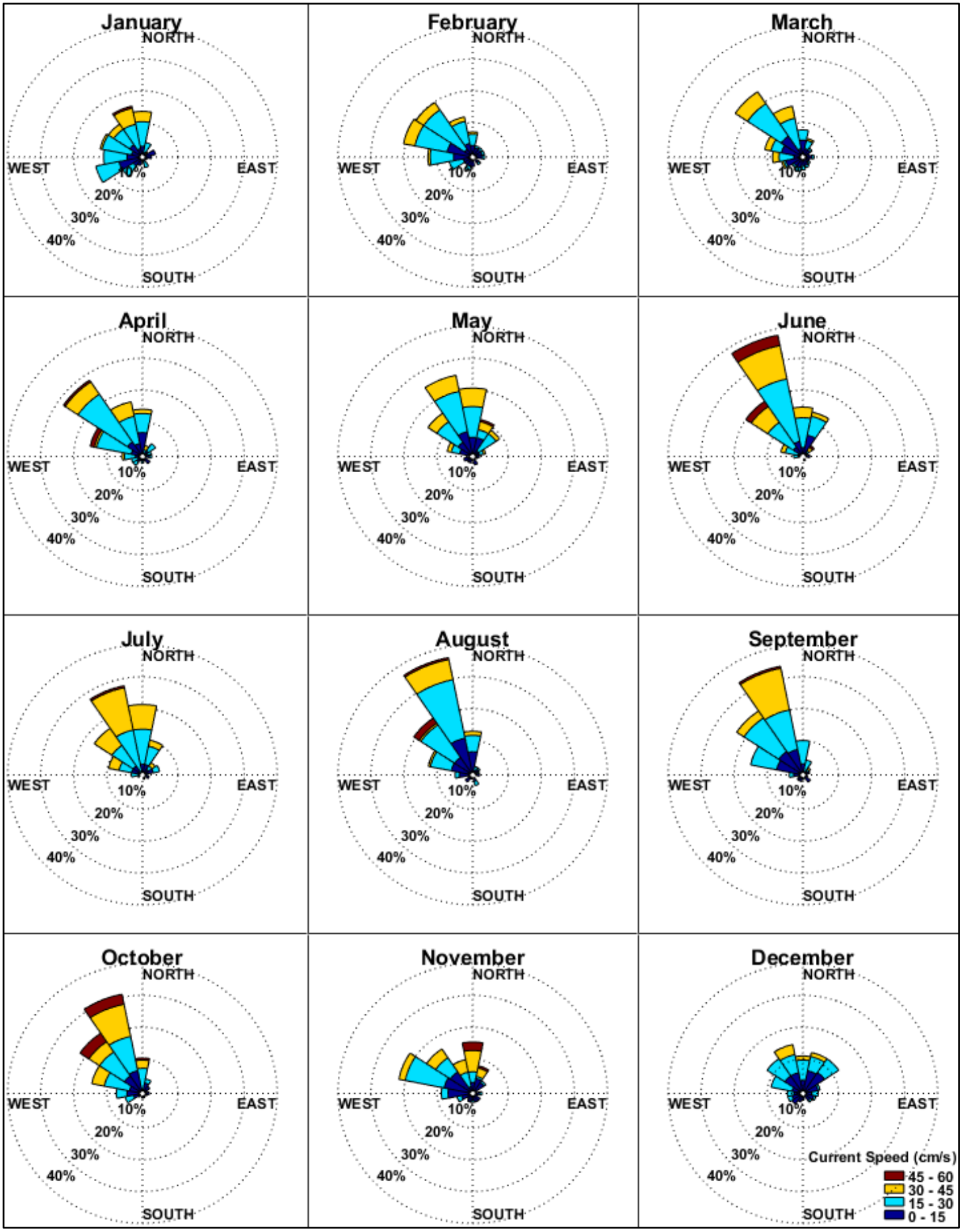


Figure 4.5: Monthly HYCOM surface current roses, offshore Namibia (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

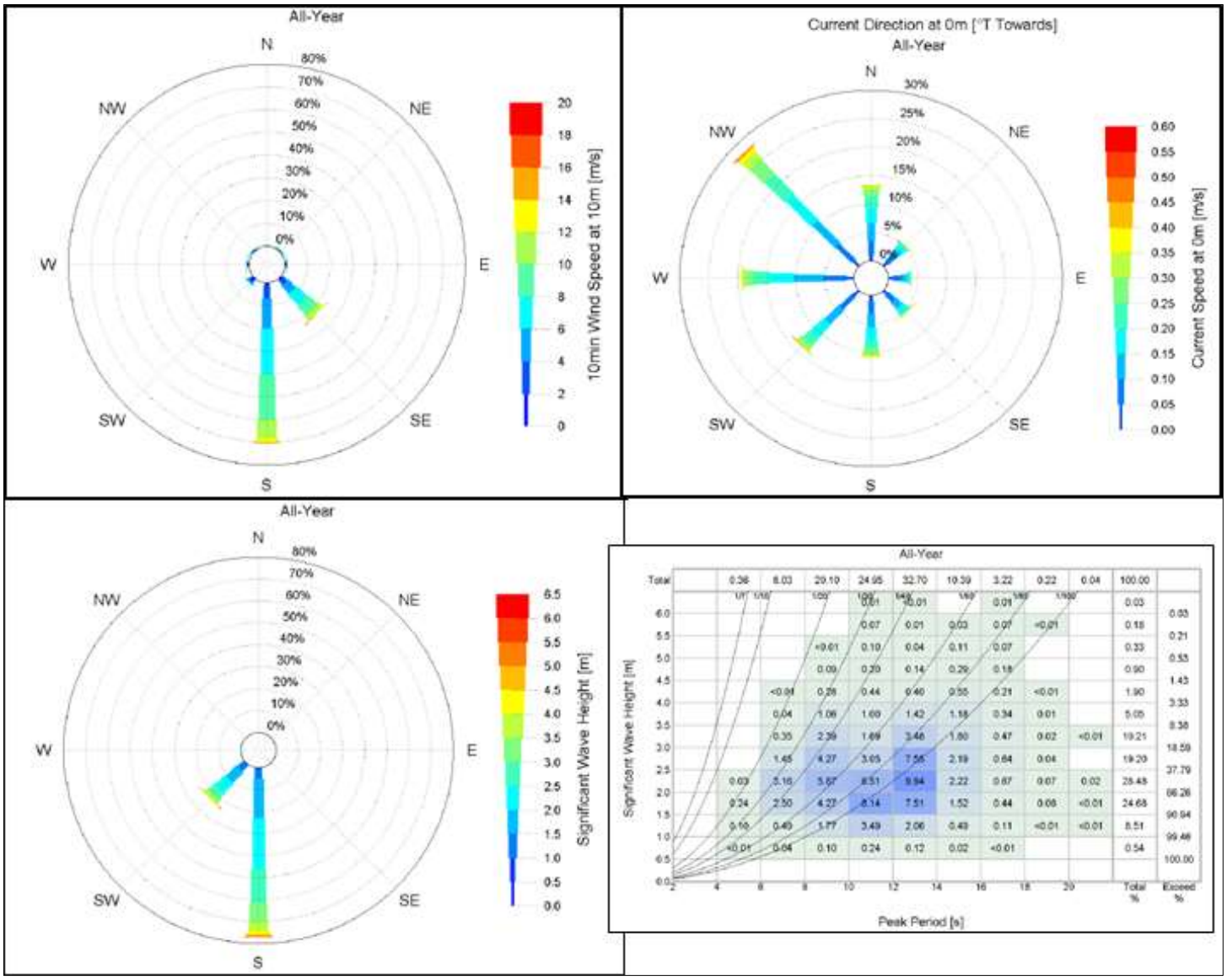


Figure 4.6: Comparative analysis of the all-year operational wind, current and wave criteria expected around the proposed survey area (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

	Q1			Q2			Q3			Q4		
	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Technical Elements for Seismic Acquisition	G	G	G	M	M	VP	VP	VP	P	M	G	G
Operational Safety/ Wellbeing Elements	G	G	G	M	M	VP	VP	VP	P	M	G	G

The main factor which affects operational safety and technical elements in particular is weather and swell height

Very Poor
Poor
Moderate/Mixed
Good

Figure 4.7: Weather related technical elements affecting seismic acquisition offshore Namibia and that must be taken into consideration when evaluating the potential suitable window for conducting the proposed 2D / 3D seismic survey.

4.3 Biological Environment

4.3.1 Regional Bathymetric

The ocean is not one homogenous block of water. Covering over 70% of the Earth's surface, the ocean spans from the balmy equator to the frigid poles. The ocean is also very deep with temperatures getting colder and water pressure increasing at greater depths. These changes mark different zones in the sea and within the different zones' animals require certain adaptations to survive these zones (Fig. 4.8).

The Sunlight Zone is the top Ocean layer from sea surface 0m to 200 meters, also known as the Photic Zone. This zone varies greatly from the tropics to the poles. Tropical coral reefs are one of the most biodiverse ecosystems on the planet, home to schools of tropical fish, shrimps, seastars, and more. However, the Epipelagic Zone is also home to temperate kelp forests and swimming penguins of Antarctica.

The Mesopelagic Zone or the Twilight Zone occurs from 200 meters to 1, 000 meters. Sunlight in this ocean layer is faint and temperature fluctuates greatly. The Twilight Zone is home to the thermocline, an area where temperature changes quickly with depth. Most of the food in this layer comes from the Epipelagic Zone and that fish will travel upwards at night to eat it. These include lanternfish (Myctophids) and bristlemouths (Gonostomatids). Also found in this layer are the blobfish (Psychrolutes species) and the prickly shark (Oxynotus bruniensis). Krill, comb jellies, squid, and many other animals can also be found here.

The Bathypelagic Zone is also called the Midnight Zone as sunlight never reaches its depths of 1,000 - 4,000 meters. The only light found is from bioluminescent animals. Temperatures are usually a constant 4 °C and at the deepest edge of the Midnight Zone pressure is at 5, 850 pounds per square inch. Sperm whales will dive to these depths to find food. The Midnight Zone is also home to many animals including angler fish, eels with giant jaws, and tube worms of hydrothermal vents. In other parts of the World, marine biologists have found deep sea corals at depths of 2,000 m. Very little or no information exists on the marine life beyond 1, 000 m within the Namibian waters. The Abyssopelagic Zone, or simply the Abyss, occurs from 4,000 meters down to 6,000 meters. Even at these crushing depths and frigid temperatures marine biologists have found fish.

4.3.2 Seabed Sediments

The continental shelf of Namibia is split into two distinct regions; north of 18°40'S the Kunene Shelf is the narrowest (averaging 44 km) while the shelf is the widest off Walvis Bay (averaging 119 km) and near the Orange River mouth (Fig. 4.8, Bianchi et al. 1999 and Willemse, 2002). Two main double shelf breaks occur in the Walvis Bay area and are at depths of 140 and 400 metres respectively. In the southern part of the area around 28°S the shelf break makes a significant inshore-directed turn so that the complete shelf is generally narrower.

The largest geomorphic feature on the Kunene Slope is a semicircular, 19 kilometres wide plateau at 2,100 kilometres depth called the Frio Bench (Fig. 4.8).

The Operations Base falls in the Walvis shelf and upper slope characterised by a number of bathymetric features. At Palgrave Point a northwest trending shoal at 50 m depth extends out to a point approximately 24 km from shore (Fig. 4.8). The Cape Cross Bank is a cone-shaped feature that rises to a sharp peak at 90 metres and lies along 22°S onshore lineament defined by a string of acid-alkaline volcanic plugs and therefore the bank is considered to be volcanic. Similarly, the Swakop bank on the outer shelf, which rises to a 16 km-wide plateau at around 300 kilometres is believed to be related to a 22.5°S marginal fracture that includes the onshore volcanic Erongoberg massif (Fig 4.8).

The inner shelf break extends almost unbrokenly from the Walvis Ridge Abutment to Sylvia Hill, a distance of nearly 600 kilometres. The Walvis Ridge Terrace, measuring 130 kilometres in arcuate length and up to 50 kilometres in width lies astride the Walvis Ridge Abutment between 1,200 and 1,300 metres (Fig. 4.8).

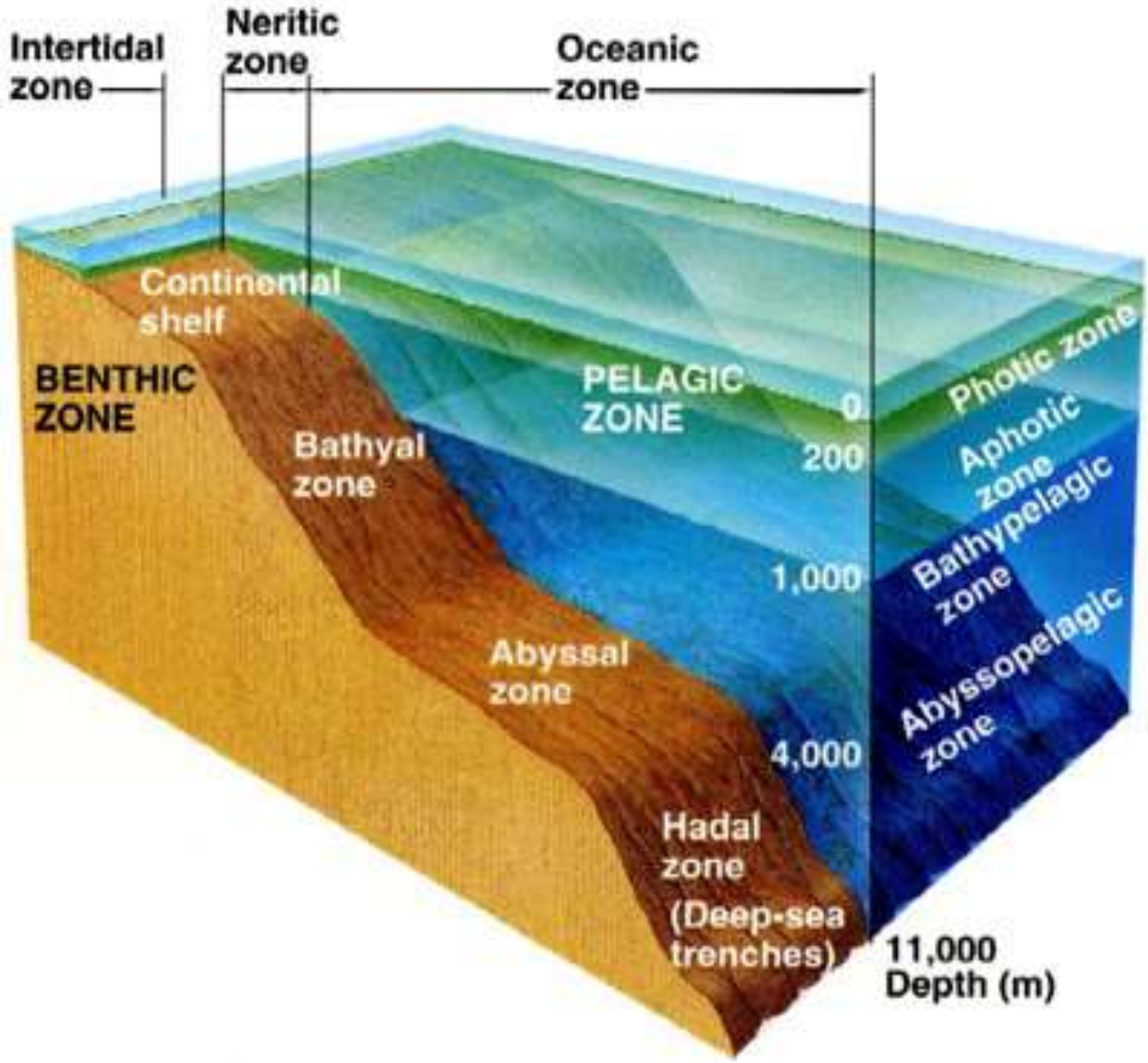


Figure 4.8: Overview of the ocean zones. The proposed survey area falls within the Aphotic (ca-200 m) and Abyssal Zones (ca-4000) with steep to very steep seafloor profile (Source: www.marinebio.org).

4.3.3 Pelagic and the Benthic Zones

The oceans are divided into two broad realms. the pelagic and the benthic (Fig. 4.8). Pelagic refers to the open water in which swimming and floating organisms live. Organisms living there are called the pelagos. From the shallowest to the deepest, biologists divide the pelagic into the epipelagic (less than 200 meters, where there can be photosynthesis), the mesopelagic (200 - 1,000 m, the "twilight" zone with faint sunlight but no photosynthesis), the bathypelagic (1,000 - 4,000 m), the abyssopelagic (4,000 - 6,000 m) and the deepest, the hadopelagic (the deep trenches below 6,000 m to about 11,000 m deep). The last three zones have no sunlight at all (Fig. 4.8).

Benthic zones are defined as the bottom sediments and other surfaces of a body of water such as an ocean or a lake. Organisms living in this zone are called benthos. They live in a close relationship with the bottom of the sea, with many of them permanently attached to it, some burrowed in it, others swimming just above it. In oceanic environments, benthic habitats are zoned by depth, generally corresponding to the comparable pelagic zones: the intertidal (where sea meets land, with no pelagic

equivalent), the subtidal (the continental shelves, to about 200 m), the bathyal (generally the continental slopes to 4,000 m), the abyssal (most of the deep ocean seafloor, 4,000 - 6,000 m), and the hadal (the deep trenches 6,000 to 11,000 m).

There are several types of deep benthic surfaces, each having different life forms. First, most of the deep seafloor consists of mud (very fine sediment particles) or "ooze" (defined as mud with a high percentage of organic remains) due to the accumulation of pelagic organisms that sink after they die. Unlike the shoreline, sandy habitats are rarely found in the deep sea because sand particles, created by wave action on coral and rocks at shorelines, are too heavy to be carried by currents to the deep.

4.3.4 Seafloor Sediments and Habitats Characteristics

Generally, seabed sediments are characterised by textural gradients parallel to the coast, becoming finer seaward (Bianchi *et al.* 1999). Inshore this pattern is altered by rivers and biological deposition. A feature of note is a 500 km long mud belt between Cape Frio and Conception Bay. The high productivity of the upwelled Benguela water causes the sediments to be biogenic (Bianchi *et al.,* 1999). The continental shelf off the Namibian coast extends to a maximum of around 150 kilometres from the coast. The continental margin is divisible in two based on shelf morphology and the composition of the surficial sediments. North of 18°40'S is the Kunene Shelf, which is narrow, whilst to the south is the Walvis Shelf which is wider.

Sand, with patches of gravely sand and sandy gravel, occupies the midshore and nearshore areas of both the Kunene and Walvis Shelves (Bremner, 1983. Bremner, et., al., 1988 and Geological Survey of Namibia, 2003). Overlying these coarse sediments is a small deposit of muddy sand and sandy mud adjacent the Kunene River mouth and an extensive belt of similar, though muddier material, on the Walvis Inner Shelf.

According to Bremner, (1983), Bremner, *et., al*., (1988) and Geological Survey of Namibia, (1988), further offshore, muddy sand covers most of the outer shelf. Sandy mud coincides roughly with the outer-shelf break. and is the dominant texture on the upper slope. Only on the Walvis Ridge Terrance does the sediment become coarser (sandy mud) with increasing depth.

Unconsolidated sediments on the continental margin of Namibia are classified into various textural lithofacies using a gravel-sand-mud ternary diagram (Bremner, *et., al*., 1988 and Geological Survey of Namibia, 1988 and 2003). Of the ten possible textural or size grades, only six are present, and two of these, namely sandy gravel, and gravelly sand, are combined because of the limited occurrence of the former.

Large patches of gravelly sediment, composed mainly of relict mollusc shells, are present on the middle shelf of the Walvis Margin at depths of 200 m. In addition, small deposits of terrigenous gravelly sediment occur sporadically all along the coast on the inner shelf (Bremner, 1983. Bremner, *et., al*., 1988 and Geological Survey of Namibia, 2003).

4.3.5 Benthic Organisms

About 200 benthic invertebrates occur in Namibian waters (Sakko, 1998). About 40% are gastropods and prosobranchs. 11.5% bivalves. 5% crustacean. 4% polyplacophorans. 0.5% cephalopods. 15% restricted to the Benguela system (Bustamante, et al 1993. Sakko, 1998). A database by Palaromes et al., (undated) shows that about 70% of these, and 1 Namibian endemic species, the disc lamp shell Discinisca tenuis and 1 endemic to Benguela, Cape mantis shrimp Pterygosquilla armata capensis. The bulk of these benthic invertebrates occurs on the shelf (0 – 200m), and only the sea spider Pallenopsis bulbiferous described by Munilla and Stock (1984) in Namibian waters occurs at depths of 260 – 269 m. Benthic species are expected around the southern offshore waters of Namibia. Table 4.1 shows other species known benthic species but not described in Bianchi et al. (1999).

Table 4.1: Species noted but not described in Bianchi et al. (1999).

Scientific name	Depth (m)
Halosaurus ovenii	440 – 1,700
Synaphobranchus kaupi	236 – 3,200
Leptoderma macrops	500 – 2,000
Triplophos hemingi	200 – 2,000
Nezumia aequalis	200 – 1,000
Dibranchus atlanticus	300 – 1,100
Menaocetus johnsonii	500 – 1,500
Kali macrodon	> 1,500
Kali inidica	> 1,500
Kali parri	> 1,500

4.4 Pelagic Resources

4.4.1 Overview

Namibia's marine environment is among the most productive in the Atlantic Ocean. This is because of the Benguela upwelling system, which provides abundant fisheries resources. Although upwelling happens almost throughout Namibia's coastline, the major upwelling occurs for much of the year off Luderitz (Iyambo, 2001). The rich nutrient water support major fisheries of Namibia which include, Cape hake (*Merluccius capensis* and *Merluccius paradoxus*), monk (*Lophius vomerinus* and *Lophius vaillanti*), orange roughy (*Hoplostethus atlanticus*), deep-sea red crab (*Chaceon maritae*), west-coast rock lobster (*Jasus landii*), Cape horse mackerel (*Trachurus capensis*), southern African sardine (*Sardinops sagax*) and Cape fur seal (*Arctocephalus pusillus*). Furthermore, other commercially important species are caught in most of the above-mentioned fisheries.

Even though most of these resources are still exploited, the majority of them had been depleted by the time Namibia gained independence in 1990 (Iyambo, 2001). Despite new management measures put in place after 1990, some resources faced difficulties to recover, prompting the Ministry of Fisheries and Marine Resources to impose a moratorium on fishing for some of the fisheries such as orange roughy and sardine. Economically, Namibia's fishery industry ranks among the top contributors to the country's GDP. The fishery industry employs a significant number of Namibians, primarily those living in the coastal towns of Lüderitz, Walvis Bay, Swakopmund, and Henties Bay. However, employment in Namibia's fishing sector has been unstable over the years, with frequent reports of retrenchment and job losses, which may be a sign of stock depletion for some species. The main management measures for commercial fisheries in Namibia are:

- Limitation of effort, through access to fishing rights and vessel licensing. The purpose of the fishing rights is to limit entry to the sector specific fishery in order to protect the fisheries resources and maintain sustainability. All fishing vessels are required to obtain a license in order to fishing within the Namibian Exclusive Economic Zone (EEZ).

- The Management of commercial fisheries in Namibia consist of exploitation rights, total allowable catches (TAC), individual quotas (IQs), and quota fees, by catch fees and monitoring and control and fisheries observers' system.

- The commercial exploitation of fish stock in Namibia is managed by the MFMR, which is advised by scientific research at the MFMR' National Marine Information and Research Centre (NaTMIRC) in Swakopmund.

- Limitation of catch, through setting of TACs. The TAC for respective commercial fisheries, is determined annually and are based on scientific advice in terms of size and structure of the stocks as determined by MFMR scientists.

- In some years, there are additional trans-boundary surveys conducted on the Dr. Fridtjof Nansen research vessel, which has conducted several stock assessments of trans-boundary fisheries.

- ❖ The Total Allowable Catches (TAC) are set annually by the Minister based on recommendation by the Marine Resources Advisory Council (MRAC).

- ❖ The 200-metre depth restriction, that prohibits any fishing activities within the 200m meters isobath along the entire coastline of Namibia, this restriction aims to protect juvenile and spawning fish of all fish stocks.

- ❖ All vessels must be fitted with automatic location communicators, as part of the vessel monitoring system (VMS), and.

- ❖ In terms of fisheries management, the commercial fisheries sectors are represented at industry level by sector specific associations, such as the Namibian Hake Association, the Namibian Hake Logline Association, Namibian Monk and Sole Association, Namibian Tuna Association and the Mid-water Trawlers Association of Namibia.

The management measures are enforced by a Fisheries Observers and Fisheries Inspectors, that are employed by the Fisheries Observer Agency and the MFMR.

4.4.2 Commercial Fisheries

4.4.2.1 Cape Hake

In terms of landed volume and revenue, the hake resource is the most important commercial demersal fishery. The fishery accounts for approximately 90% of total demersal catches (Van der Westhuizen, 2001). Hake catches increased in the early 1960s during a time of open excess to resources by foreign fleets, primarily from the Soviet Union and Spain. Around 1972, catches increased to more than 800,000 tons (Van der Westhuizen, 2001).

The International Commission for the Southeast Atlantic Fisheries (ICSEAF) was formed in 1969 to control the exploitation of marine fisheries resources in the South East Atlantic Ocean due to high landings and economic values of most species (Gordoa *et al*., 1995). The creation of ICSEAF resulted in the implementation of Total Allowable Catches (TAC) and a minimum legal mesh size (110 mm) on the hake fishery. Despite management efforts, catches fell below 400 000 tons by 1989 and have remained below 200 000 tons since independence in 1990.

The shallow-water Cape hake (*Merluccius capensis*), deep-water Cape hake (*Merluccius paradoxus*), and Benguela hake (*Merluccius polli*) are the three hake species found off Namibia. The shallow-water hake and deep-water Cape hake are the two most common species. The shallow-water Cape hake distribution covers the entire coastline off Namibia at depths ranging from 50 to over 1000 m, with higher densities between 150 and 450 m (Bianchi *et al*., 1999). Deep-water Cape hake, on the other hand, is found in deeper water than shallow-water Cape hake, typically at depths of 200 to 1000 m (Bianchi *et al*., 1999). In addition, the deep-water Cape hake is distributed along the entire coastline of Namibia from Cape Frio to East London, South Africa. Benguela hake is commonly found in northern part of the Namibian water at the depth of 50 to 550 m (Bianchi *et al*., 1999).

Hake spawning patterns vary by species, with the deep-water Cape hake thought to spawn off South Africa, with juvenile and older fish migrating to Namibian waters (von der Heyden *et al*., 2007). There is evidence of spawning shallow-water Cape hake off Namibia, with spawning occurring throughout the year but peaking in August (Bianchi *et al*., 1999). A closed season on hake fishing is implemented in October to enable for stock replenishment. Hake are opportunistic feeders that graze on a wide variety of fishes, from crustaceans and myctophids when juvenile to lanternfishes, horse mackerel, and juvenile hake as they grow. On the other hand, hake is preyed on by snoek, seals, sharks, and, on rare occasions, seabirds (Bianchi *et al*., 1999).

Hake stock is currently managed through TAC, minimum legal mesh size of trawl nets, and bycatch fees on monk catches in other fisheries. In terms of research, the Ministry of Fisheries and Marine Resources (MFMR) conducts a biomass survey each year from January to February to estimate biomass and perform an overall model assessment of the stock, which allows the MFMR to set TAC and allocate fishing quotas to right holders.

4.4.2.2 Cape Monk

Historically, monk have been caught as a bycatch in bottom trawls that primarily target hake (Maartens and Booth, 2001). This is due to the fact that hake and monk coexist in the benthic zones, making it nearly impossible not to capture either species in the two fisheries. Landed monk records extend from 1973 to 1989, during the International Commission for the Southeast Atlantic Fisheries (ICSEAF), and from 1990 to the current fishing season (2022-2023), under Namibia's Ministry of Fisheries and Marine Resources. As hake catches increased, so did monk catch in the hake fishery, peaking at around 16 000 tons in 1981 and then declining towards 1990, when the foreign fleet left Namibian waters prior to independence. As the market value of monk started to increase, landings of monk also increased post-independence prompting the opening of a monk directed fishery in the early 2000 (Maartens and Booth, 2001).

There are two species of monk found in the Namibian water, the *Lophius vomerinus* and *Lophius vaillanti*. L vomerinus is the more common of the two species, and its spatial distribution extends from Namibia's northern border to South African waters (Froese and Pauly, 2023), mostly at depths ranging from 200 to 400 meters (Bianchi *et al*., 1999). *L. vaillanti*, on the other hand, is found primarily north of the central region of Namibia, with a depth range of 200 to 800m (Bianchi *et al*., 1999). The monk is an opportunistic feeder that feeds on benthic species and occasionally on pilchard, horse mackerel, and round herring (Bianchi *et al*., 1999).

Monk is presently managed through TAC, the minimum legal mesh size of trawl nets, and bycatch fees on monk catches in other fisheries. Every year in November, the Ministry conducts a biomass survey to estimate biomass and perform an overall model assessment of the stock, enabling the MFMR to establish TAC and allocate fishing quotas to right holders.

4.4.2.3 Orange Roughy

Orange roughy (*Hoplostethus atlanticus*) resource exploitation began around 1994, with a direct fishery opening in 1997. However, the fishery could only be sustained for about 11 years, resulting in the implementation of a fishing moratorium since 2009. This fish's biological characteristics, specifically its long lifespan, slow growth and maturation, and aggregating behavior, make it vulnerable to overfishing (Boyer, et al., 2001). It is also reported that approximately 70% of the world's stock has been depleted (Boyer, et al., 2001).

Orange roughy is a long-lived, slow-growing species with low fecundity and mortality. The southern hemisphere's spawning season is thought to be between July and August. It is estimated that it takes 20-30 years for orange roughy to reach maturity, resulting in low stock productivity (Boyer et al., 2001). Orange roughy spawning takes place primarily at four known aggregation grounds off Namibia (Boyer et al., 2001). The species is distributed at the depth of around 400 to over 1 000 m but most abundant between 400 and 800 m (Bianchi *et al*., 1999). Current management measures for orange roughy resource include a fishing moratorium since 2009 and bycatch fees on species catches in other fisheries. Before the moratorium was implemented, the Ministry performed a series of biomass surveys from 1997 to 2007. The biomass survey was also carried out in some years following 2009 to ascertain whether the stock had recovered. However, the fishery has yet to resume. The survey is usually done in July when orange roughy is believed to be spawning (Boyer et al., 2001).

4.4.2.4 Deep Sea Red Crab

The deep-sea red crab (*Chaceon maritae*) is the largest crustacean fishery in Namibia. Historically the fishery which was dominated by Japanese fleets, was first exploited around 1973, with volume landed peaking at 10,000 tons in 1983 (Beyers and Wilke 1980; De and Beyers, 1994). Following that, catches decreased until 1990. After 1990, landings ranged between 2000 and 3000 tons, prompting a 400-meter fishing depth restriction in 1993 to protect female crabs (Le Roux, 2001). In contrast to other demersal fisheries (Cape hake, Cape monk, and orange roughy), the deep-sea crab is captured using beehive traps on longlines. The traps are conical in shape, with a plastic collar at the top that functions as a crab entrance, and they are typically hauled after 24 hours. However, the deep-sea crab is also landed as a bycatch in the demersal fisheries.

The deep-sea red crab is shared by Namibia and Angola. The species is found off the coast of central Namibia and into Angolan waters (Melville-Smith,1989). The deep-sea red crab inhabits muddy bottoms at depths ranging from 100 to 950 meters, but is most common between 300 and 700 meters, and can grow to a carapace width of 16 cm for males and 10 cm for females (Bianchi *et al*., 1999). The deep-sea red crab is presently managed through the allocation of TAC and bycatch fees on other fisheries' catches. In terms of research, the Ministry of Fisheries and Marine Resources (MFMR) carries out an annual deep-sea red crab survey, in August to assess distribution patterns, determine biomass and stock status. Even though traps are used for commercial fishing, the survey is conducted using bottom trawls.

4.4.2.5 West Coast Rock Lobster

The west-coast rock lobster (*Jasus landii*) is another important crustacean fishery in Namibia. Namibia's rock lobster catches records stretch back to the 1950s, with catches ranging between 14 000 and 13 000 tons around the 1960s (Bianchi *et al*., 1999). However, catches started decreasing in the 1970s to around 1 500 tons, and by the mid-1990s, catches had dropped even further to around 250 tons per year (Bianchi *et al*., 1999). The west coast rock lobster is found on the inshore rocky seabed at depths of up to 100 m. The species' main distribution extends from Walvis Bay in Namibia to East London in South Africa (DAFF, 2016). It is also believed that the west coast rock lobster migrates seasonally based on water temperature and oxygen levels (Tomalin, 1993). The species can reach a carapace length of 59 mm and survive for up to 40 years (Bianchi et al., 1999). Mating occurs after male lobsters molt between September and December, and females between April and May. The west coast rock lobster harvest is regulated by a TAC that is allocated to fishermen. The TAC is primarily caught off the coast of Lüderitz at four known rock lobster hotspots between November and April while catching is prohibited between June and October (Shuuluka, et al., 2018). To establish the TAC, the Ministry of Fisheries and Marine Resources conducts research off the coast of Lüderitz. Anglers obtain permits for harvesting lobsters.

4.4.2.6 Horse Mackerel

The Cape horse mackerel (*Trachurus capensis)* fishery 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 targeting smaller quantities of juvenile horse mackerel and by the demersal trawlers as by-catch (while targeting hake and monk). The horse mackerel landed are either sold as frozen whole product or converted to fishmeal. The history of the sector in Namibian waters shows initial low catches reported in the early 1960s but increased to about 600 000 tons annual catch in the early 1980s. Since 1990 landings were on average 300 000 tons per year. The current TAC for horse mackerel is 290 000 tons for the 2023 fishing season. The fishery operates year-round with relatively constant catch and effort by month. The mid-water trawl fleet operates exclusively out of the port of Walvis Bay with fishing grounds extending north of 25ºS to the border of Angola. Juvenile Cape horse mackerel move into deeper water when mature and are fished mostly between the 200 m and 500 m isobaths towards the shelf break.

Horse mackerel (*Trachurus capensis)* from the Carangidae family is a schooling species mainly found over the continental shelf. Horse mackerel dwells from surface water down to a depth of 400 m with shoals rising to feed in surface waters at night while close to the bottom during daytime (Bianchi et al., 1999). Horse mackerel is an opportunistic feeder, feeding on mainly on euphausiids (Boyer et al., 2001), and to a lesser extent on *Sufflogobius bibarbatus*, *Diaphus hudsoni*, *Diaphus meadi*, (Bianchi et al., 1999). Horse mackerel is preyed on by Cape monkfish (Bianchi et al., 1999; Erasmus 2021), Cape fur seal *Arctocephalus pusillus* (Raja alba Lacepède, *M. capensis* (Bianchi et al., 1999). Horse mackerel generally have a protracted spawning season (up to eight months) across a wide area (Abaunza et al. 2003, Dransfeld et al. 2005), In Namibian waters, spawning of Cape horse mackerel occurs throughout the year, but with a spawning peak between December and March (Wysokinski1985)

The horse mackerel fishery is managed through a total allowable catch (TAC), control of fishing effort (minimum mesh size limits of 60 mm in the midwater fishery) and fishing is not allowed at depth shallower than 200m. TAC for the horse mackerel fishery is determined each year based on scientific data. The rate of change of the TAC depends on two indices, the commercial catch per unit of effort (CPUE) and the abundance index from scientific surveys. Annual horse mackerel acoustic surveys are

conducted for biomass determination and to collect biological information. The annual horse mackerel and small pelagic survey take place in March.

4.4.2.7 Small Pelagic (Sardine)

Sardine, *Sardinops sagax* also known as pilchard is a small pelagic species of the Clupeidae family. In the 1950s and 1960s, European fleets spearheaded fishing activities off Namibia, beginning with an inshore pelagic fishery for sardine and Cape anchovy (Bianchi et al., 1999; Boyer et al., 2001; Kirchner et al., 2010). The sardine stock in Namibian waters was estimated to be 11 million tonnes in the late 1960s, but it had declined to less than one million tonnes by the mid-1970s (Boyer et al., 2001; Erasmus et al., 2021a). Sardine stocks continued to decline, prompting the first fishing moratorium in 2001 (Boyer et al., 2001; Roux & Shannon, 2004). Following the lifting of the moratorium, fisheries continued with limited sardine catches, but both catches and biomass estimates continued to fall, resulting in the imposition of a second moratorium since 2018. Sardine is distributed from southern Angola to KwaZulu-Natal in South Africa (Beckley and van der Lingen 1999). However, this population is separated into two discrete stocks by the perennial Lüderitz upwelling cell, which divides the Benguela Current into northern and southern sections (Boyd and Cruickshank 1983). Off the coast off Namibia, the sardine stock ranges along the entire Namibian coast, but in recent years predominantly from 25°S northwards to southern Angola.

Historically, spawning occurred continuously from September to April with two seasonal peaks evident; the first from October to December in an inshore area between Walvis Bay and Palgrave Point and the second from February to March near the 200 m isobaths between Palgrave Point and Cape Frio (Pillar and Barange, 1998; Crawford et al., 1999. Multiple predators including the Cape fur seals preyed on sardine at the time when it was abundant. Sardine feed predominantly on phytoplankton and zooplankton (Crawford et al., 1987). Sardine are surveyed annually during the horse mackerel and small pelagic survey conducted in March, and during the annual dedicated sardine and small pelagic survey conducted in October. The fishery is currently closed following a fishing moratorium that have been in place since2018 due to a significant reduction in the stock.

4.4.2.8 Line Fish

Linfish fishery consist of Snoek (*Thyristsites atun),* Dusky kob (Argyrosomus coronus) (*Argyrosomus inodorus).* Snoek is found off the Namibian coast from November to March, thereafter the stock mves southwards towards the Western Cape, of South Africa. The return migration commences between August and October. (Crowford *et al, 1990*). The movement of the snoek stock correlates with the distribution patterns of some prey species such as small pelagic species (sardine, sardinella, juvenile anchovy) in the southern Benguela system (Crowford *et al, 1990*). Dusky kob and silver kob are members of the sciaenidae family, which lives in subtropical and temperate waters around the world. Silver kob is the most important fish species caught in the line fish fishery (Kirchner 1998). Silver kob is an ideal finfish for mariculture mostly due to its robust growth, ability to spawn in captivity as well as its market value (Tjipute, 2011). Silver kob is harvested by the line fish and ski boat fishery and recreationally by shore- and ski boat-anglers.

Dusky kob is mostly caught with handlines, although in fairly low numbers (Bianchi et al., 1999). This species is the most important in southern Angola's inshore recreational fishery (Cunene Estuary to Namibe) (Potts et al., 2010). Both species are heavily exploited in Namibia by an established recreational fishery that operates in the West Coast Recreational Area (a 200km stretch of coastline between the northern boundary of the Namib Naukluft National Park and the Ugab River) and contributes significantly to the local economy (Stage & Kirchner, 2005). Dusky kob are distributed between northern Namibia (north of Cape Frio) and southern Angola (south of Lucira), although only few individuals have been observed as far south as St Helena Bay on the South African west coast (Lamberth et al. 2008). Silver kob feed primarily on euphausiids and small fish in the surf zone (Boyer and Hampton, 2001). Dusky kob is a fast growing, late maturing species (Potts et al., 2010). Silver kob is a slower growing, early maturing species while Dusky kob can grow up to 200 cm (Bianchi et al., 1999). Silver kob spawn in summer and migrate to the south of Walvis Bay, the southern end of their distribution, returning northwards towards the end of summer (Boyer and Hampton, 2001)

4.4.2.9 Large Pelagic Species

The largest pelagic fish to be encountered on the shelf and waters around the area of interest (AOI) are large pelagic species, including various tunas, billfish, and pelagic sharks. Many of these species are considered to be threatened by the International Union for Conservation of Nature (IUCN), due to overfishing.

Tuna species are usually offshore at the shelf break, their distribution is related to the presence of shoaling pelagic fish. They diets include small fish, shrimps crabs, cray fish larvae and squid. Tuna is classified to be highly migratory species and many of the stocks are a shared resource between coastal states of the South Atlantic. Tuna is managed by regional fisheries management organizations, specifically the International Commission for the Conservation of Atlantic Tunas (ICCAT).

4.4.3 Commercial Fishing Grounds and Catches

4.4.4.1 Fish Spawning, Fish, and Commercial Fisheries Sensitivity

Most of the proposed AOI offers no fish spawning potential because spawning habitats generally requires an elevated area compared to the surrounding seabed with sediments composed of well sorted, coarse sand or fine gravel with little (<2%) or no fine material (<63µm) with exposure to the main flow of water to ensure maximum oxygenation of the sediment and hence the lower layers of fish eggs. The AOI falls in water depth ranging from ca-200 m to ca-4000m and as shown in Fig. 4.9 and Table 4.2, a very small portion of the proposed survey area overlaps with the Hake spawning area. The MFMR doe conduct stock assessment for various species as shown in Table 4.2 and Fig. 4.10.

The fishing industry in Namibia is undoubtedly the most socio-economically sensitive of all the marine activities currently being undertaken in Namibian waters. The commercial fishing industry is a major employer and contributes significantly to Namibia's GDP. The greatest potential impact of the proposed Multiclient/Proprietary 2D/3D seismic survey operations activities on the fishing industry is disturbance of the target species, causing it to move out of its regular locale and resulting in a reduction in catch. However, the bulk of the targeted survey area is situated to the west in the deeper water with no known commercial fishing activities (Fig. 4.10).

Provided key stakeholders in the MFMR and fishing industry are properly and timeously informed of the proposed survey and duration this should not hamper the fishing industry significantly. The offshore and deeper water location of the proposed initial survey area also means there will be no impact on shallow and coastal socioeconomic activities. The following is the summary of the likely overlaps between the proposed Multiclient/Proprietary 2D/3D seismic survey AOI and key commercial fisheries (Figs. 4.9-4.11 and Table 4.2):

(i) Hake and Monk: The AOI has a narrow overlap with hake and monk fishing grounds. The surveys may overlap the annual biomass surveys for monk and hake, which are conducted in November and January to February, respectively. It is worth noting that the AOI does not overlap with the spawning grounds of the monk and hake species.

(ii) Orange roughy: The AOI overlap with the distribution of orange roughy. Orange roughy aggregates on seamount and like features mainly for spawning in July but also for foraging purposes. There are seven known aggregation grounds for orange roughy off Namibia and they all overlap with the AOI. Currently, Orange roughy fishing is on moratorium since 2009, therefore no commercial fishing activities are taking place. However, the proposed seismic surveys may coincide with the orange roughy biomass survey which is usually carried in July.

(iii) Deep Sea Red Crab: The proposed area of interest overlaps with the distribution area of the deep-sea red crab which is mainly distributed in deeper waters north of Walvis Bay. Therefore, seismic survey may interfere with fishing activities of the deep-sea red crab and the annual biomass survey which is carried out in August.

(iv) West coast rock lobster: The west coast rock lobster is an inshore species, which inhabit rocky seabed at the depth of up to 100m. This resource will not be impacted by the proposed seismic surveys.

(v) Horse Mackerel: The area of interest does not overlap with the distribution, fishing and biomass survey ground for horse mackerel.

(vi) Small pelagic: The area of interest partially overlaps with the biomass survey area which is usually carried out in October. This also implies that the area of interest partially overlaps with the distribution grounds for small pelagic species.

(vii) Line fish: Line fish fishery is mainly inshore. Therefore, the distribution of line fish species and fishing activities will not be impacted by the seismic survey, and.

(viii) Large pelagic: Large pelagic fisheries comprised of deep-sea species, which are managed by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Due to their habitat distribution and migrations, this fishery may be affected by seismic survey.

Table 4.2: MFMR stock assessment months and fish spawning timing.

Fishery	Survey month	Area	Fish Spawning Timing
Hake survey	January and February	Entire coastline 17-29º S	Spawning occurs throughout the year, with the main spawning period between July and October.
Horse mackerel and Small pelagic Survey	March	Between 17-25º S	Spawn continuously from September to May with a peak from December to March.
Orange roughy	July	***Hotspot**: between 19 and 20 º S ***Rix**: between 22 and 23 º S ***Frankies**: between 24 and 25 º S ***Johnies**: between 26 and 27 º S ***Pavs**: between 28 and 29 º S ***Tripp Seamount**: between 29 and 30 º S	June to August.
Deep Sea Crab	August	Between 17 and 24 º S	No defined spawning peak season.
Sardine: Small pelagic Purse-Seine	October	From 25-16º S (southern Angola)	Between August and April, with peaks in September/October and March.
Monk	November	Entire coastline 17-29º S	Cape Monk spawn throughout the years, with peaks between July and September for females and August for males.
Large Pelagic Logline	No MFMR dedicated survey		Migratory species, peak spawning period not established.
Tuna Pole	No MFMR dedicated survey		Migratory species, peak spawning period not established.
Rock Lobster	Monthly surveys	Between 26 and 29º S	September to November.

Tuna is widespread and highly mobile, but there is a concentration around Tripp seamount in southern Namibia, excluded and not covered by the proposed survey area. Survey operations will overlap with the known northern areas of the tuna landing areas (Table 4.3, and Fig. 4.11) and therefore communication will need to be good to avoid potential confrontations.

Over the past years the albacore tuna pole and line sector are in the process of commercial collapse due to the decline in catches which the sector attributes to seismic survey operation in South Africa and Namibia. According to the tuna industry, in 2011 during the height of the albacore tuna season, when seismic surveys were undertaken close to Mount Tripp was that the albacore tuna then disappeared and did not return that season.

Table 4.3: Main tuna fishing hotspot co-ordinates.

No.	Latitude	Longitude
1. Tripp Seamount	**29° 38,0 S**	**14° 18,0 E**
2.	27° 45,0 S	14° 45,0 E
3.	26° 50,0 S	13° 45,0 E.
4.	26° 10,0 S	13° 40,0 E
5.	25° 40,0 S	13° 38,0 E

Based on the issues identified in previous studies, the following are the key considerations for the Albacore Tuna Pole and Line Sector as proposed by the sector with respect to seismic survey in the general area:

- The albacore tuna tends to follow the underwater contours of a depth between 400 and 1000 meter (219 to 547 fathoms) along the entire tuna grounds.

- No seismic exploration to be done in the Southern Region of Namibia between 25 – 30 degrees and the Namibia/South African border between 1 October and 30 April, particularly on or around the co-ordinates and migratory route, and.

- Tripp Seamount is an ecosystem, so avoid bottom seismic tests directly over the underwater sea mount. The North West Shelf, offshore of the Orange River combined with the currents and oceanography result in it being a tuna hotsport, and is also a place where Bryde's Whales congregate at the same time, as both are following the same feed. Some fish species move across country borders and regulations such as the SADC Protocol and Benguela Current Commission should be considered. As well as tuna, linefish such as Snoek and Yellowtail are also migratory.

Fig. 4.11 shows the main tuna landing area with respect to the proposed 2D/3D seismic survey area. The main tuna fishing season is January to end of April, with highest landings recorded in March and April. Based on this data, it may be preferable to start the survey.

Any disruption to the tuna as a result of the proposed 2D / 3D seismic survey is expected to be temporary, but consideration must be given to the possibility that the stocks may be driven outside of Namibia's EEZ, where they can be caught by international vessels which are not subject to the quota system as defined by MFMR. Conducting the survey outside of the known migration (and fishing) periods will go some way to mitigate the impact of the proposed survey on this industry.

In past the tuna pole-fishing industry has approached MME to disallow seismic surveying during their fishing season, October to April around the Trip Seamount. They argued that the in the past the reduction in tuna catches coincided with significant seismic exploration activities near the fishing grounds and deduce that seismic exploration is the cause thereof (Russell, 2013). The seismic survey they point to took place in close proximity to Tripp Seamount and ran continuously within a small area. This will not be the case for the proposed survey.

Before the implementation of each survey event, the Proponent shall approach the relevant parties and ascertain whether it is preferable to start the survey on the inshore boundary (i.e., Tripp Seamount area) and work offshore, or start on the western boundary and work inshore. In the first option, the disruption would be in January, based on the proposed survey schedule, while the latter would mean the disruption would most likely be in April.

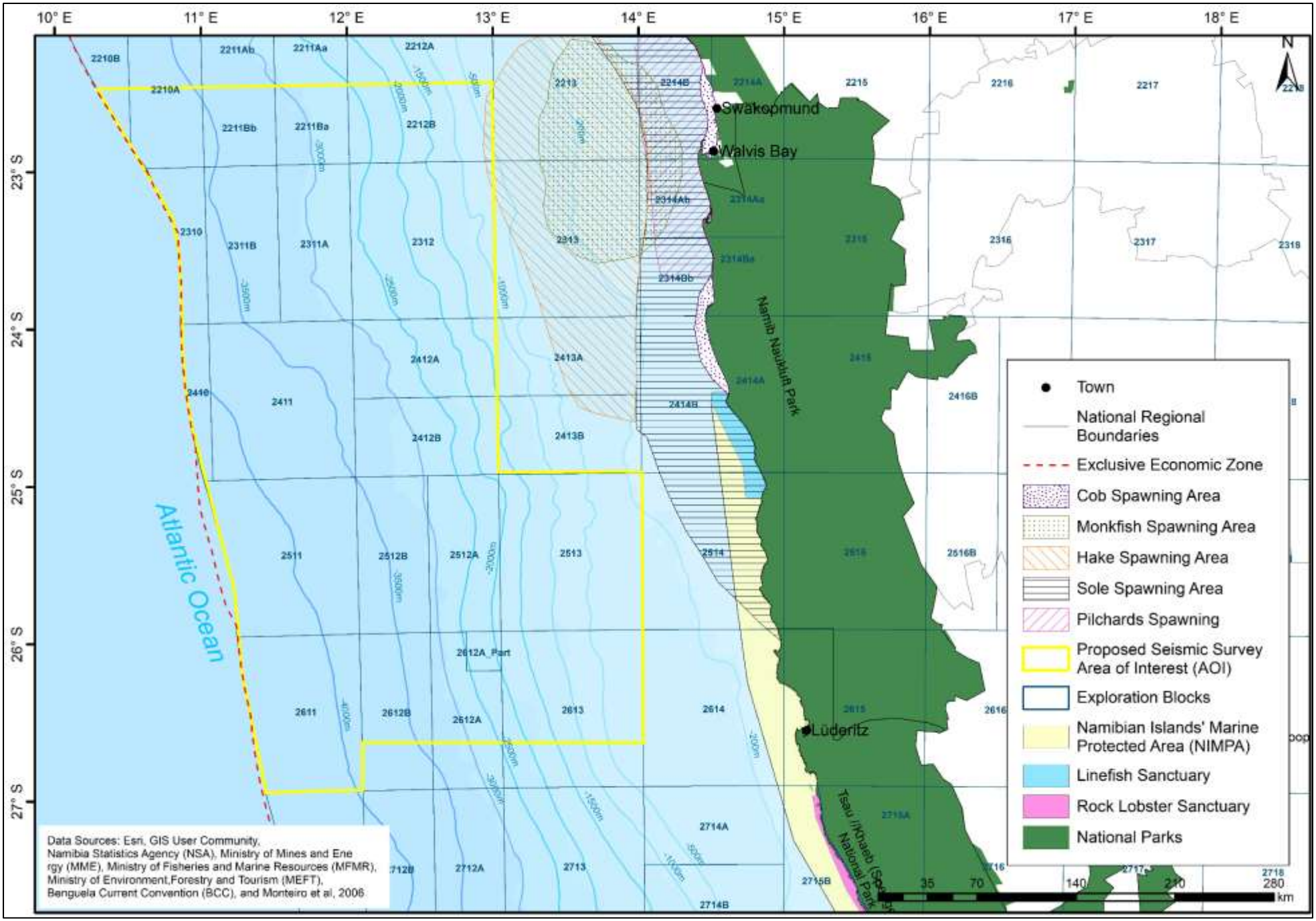


Figure 4.9: Known fish spawning areas relative to the proposed 2D / 3D seismic survey.

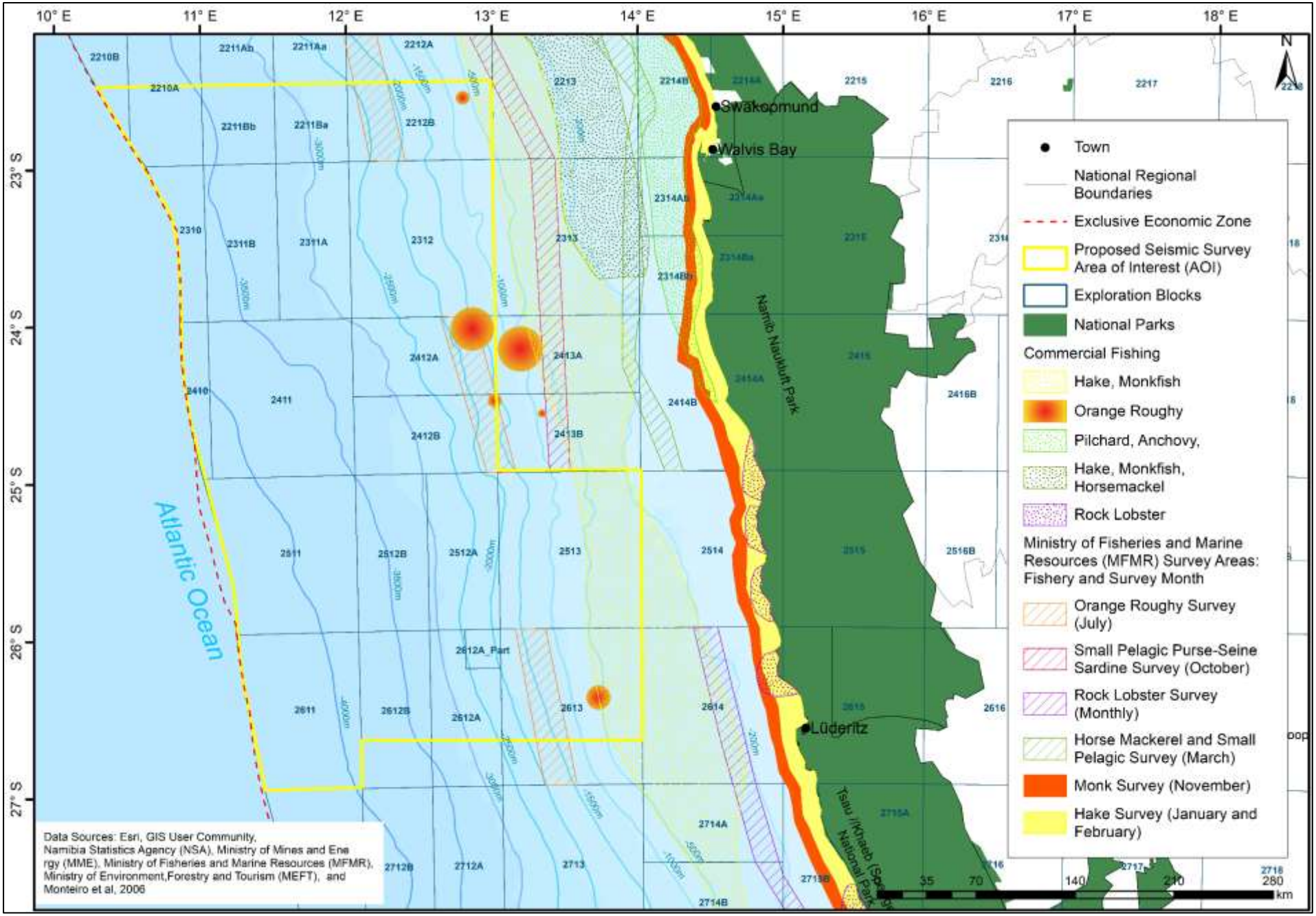


Figure 4.10: Known commercial fishing grounds and MFMR stock assessment areas relative to the proposed 2D / 3D seismic survey area excluding Tuna (Data Source: MFMR and Monteiro et al, 2006).

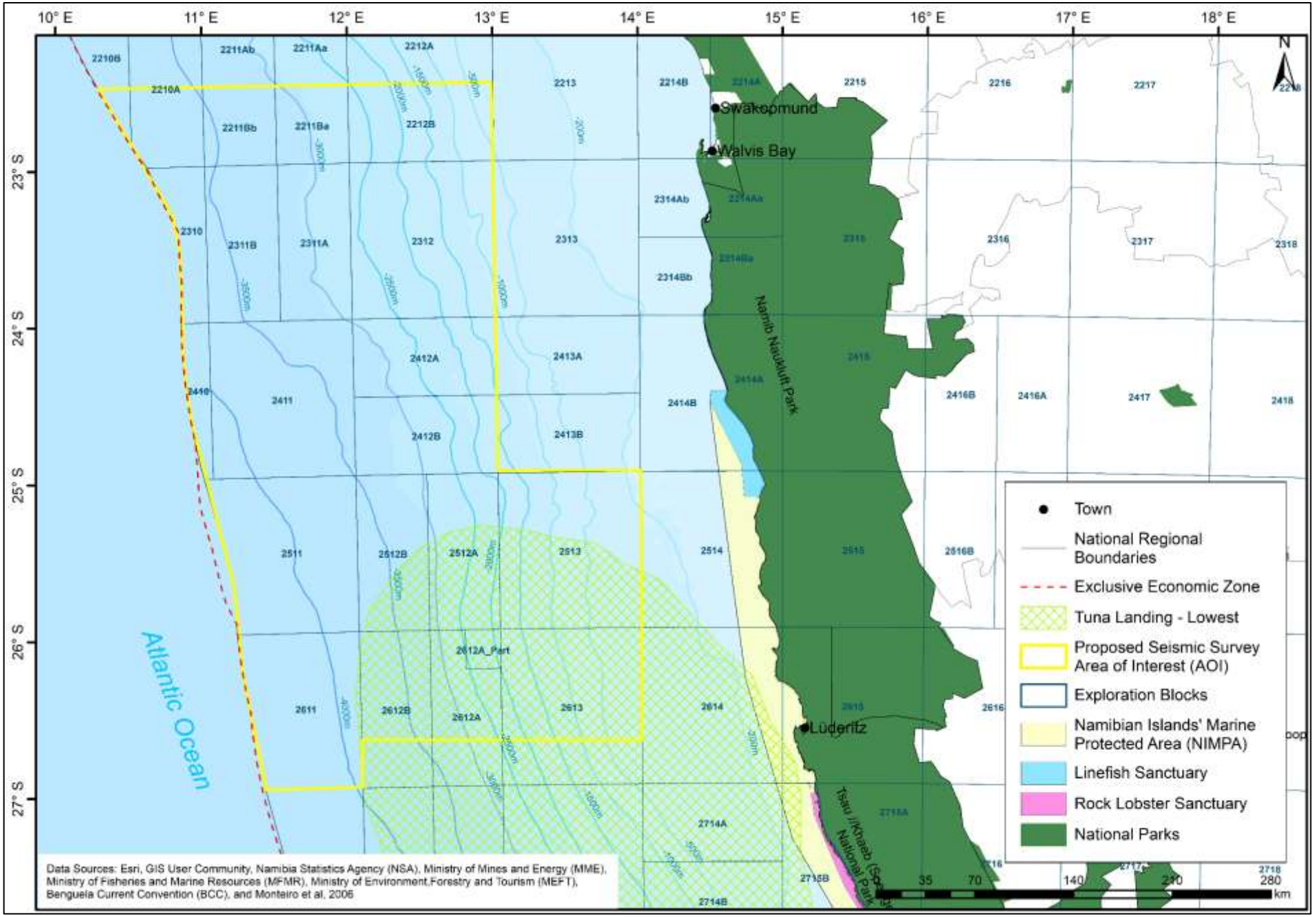


Figure 4.11: Known tuna landing areas relative to AOI with highest catches shown in red and pink around Tripp Seamount Excluded from the proposed survey (green circle) (Extracts from RBS, 2020 Map series).

4.4.4 Sea Turtles

4.4.4.1 Overview

The northern BCLME has a high biomass of jellyfish, a potential food source for several species of marine turtles. Although the climate of coastal Namibia is too cold for successful nesting, the northern BCLME may act as a regionally important feeding area for turtles. Five of the world's seven sea turtle species (Leatherback, Olive Ridley, Green, Hawksbill and Loggerhead turtles) have been seen in Namibian offshore waters. However, they prefer the warmer waters closer to Angola, and inhabit these waters and nest on Africa's continental shores from Mauritania south to Angola on Africa's Atlantic coast, and from South Africa north to Somalia on the Indian Ocean (Sea turtle status, 2017). Inshore, turtles are seen fairly regularly in the Kunene River mouth (Elwin and Braby, 2015), but there have been only rare sightings in recent years in shallower waters closer to Walvis Bay (Elwin and Leeney, 2011). Of the eight species of turtle that are known worldwide, five species occur offshore Namibia:

- Leatherback turtles (Dermochelys coriacea).
- Green turtles (Chelonia mydas).
- Loggerhead turtles (Caretta caretta).
- Hawksbill turtles (Eretmochelys imbricata), and.
- Olive Ridley turtles (Lepidochelys olivacea).

4.4.4.2 General Threats to Sea Turtles

Apart from natural predation turtles are threatened by human action including:

- Human consumption (sea turtles are caught by artisanal fisheries for consumption in Angola).
- Direct targeting (Catches are likely to be the highest in the northern Benguela, where sea turtle abundance and fishing (longline and artisanal) activity is the highest).
- Bycatch (As many as 700 sea turtles are caught by the Namibian pelagic longline fishery targeting tuna, swordfish and sharks each year).
- Plastic pollution (turtles mistake plastic waste for jellyfish and subsequently die of starvation as the plastic blocks their gut), and.
- Poisoning by industrial & military effluents.

4.4.5 Seabirds

4.4.5.1 Overview

Namibia's coastline sustains large populations of breeding and foraging sea- and shorebird species. Numerous species of seabirds breed on islands or at mainland sites along the southern Namibian coast. The African penguin, Bank cormorant, Crowned cormorant and Cape gannet have been classified as Vulnerable Species owing to significant decreases in populations. Most of the seabirds that breed on Namibian shores have a nearshore/inshore foraging range of between 10 and 30 km. Exceptions include the African penguin, which has been seen up to 60 km offshore and the Cape gannet, which is known to travel 140 km offshore in search of food. As the AIO is mostly beyond 200 km offshore, it is unlikely that these birds will be seen in the survey area.

Many sea- and shorebirds over-winter in Namibia. The highest pelagic seabird densities are found offshore of the shelf-break during the winter months, when Southern Ocean species move north to

temperate and subtropical regions. The highest potential impacts from this survey are likely to be on sea-going birds that forage offshore and rest on the water, and those that plunge-dive for food. Sixty-two species of seabirds have been recorded in Namibian waters. Twenty are rare visitors or vagrants. The numerous islands off Namibia's coasts and the relatively sparsely populated and inaccessible coastline sustain large populations of breeding and foraging seabird and shorebird species. Twelve bird species breed along the Namibian coast, favouring the offshore islands or manmade platforms for nesting sites (Simmons et al., 2015).

The southern islands are the breeding grounds for 11 seabird species (Kemper, 2007) and hold the predominance of the global breeding populations for the Bank cormorant, Cape cormorant, Crowned cormorant, Cape gannet, Hartlaub's gull, African Black oystercatcher and African penguin (Kemper, 2007. NACOMA, 2013. Simmons et al., 2015). Most of Namibia's islands lie just offshore of the southern coast and fall within the Namibia Islands Marine Protected Areas (NIMPA). The NIMPA lies north of the proposed survey grid. The central Namibian coastline between Lüderitz and Walvis Bay comprises predominantly sandy beaches backed by the dunes of the Namib Desert. Predators such as Black-backed Jackals and Brown Hyenas roam the strandline in search of food, making the mainland largely unsuitable for the establishment of breeding colonies. All-important seabird colonies are, thus, found on the offshore islands or on the few artificial platforms built between Walvis Bay and Cape Cross. Important migratory bird populations also find shelter in coastal lagoons and bays. Most of the seabirds that breed on Namibian shores have an inshore/ nearshore foraging range of between 10 and 30 km. Exceptions include the African penguin, which has been seen up to 60 km offshore, and the Cape gannet, which is known to travel 140 km offshore in search of food.

As many as three quarters of a million albatrosses, petrels and shearwaters have been reported in Namibian waters, usually foraging far offshore during the winter months. Species include Black-browed, Shy and Yellow-nosed albatross, Sabine's gulls, Cape and White-chinned petrels, Arctic, Pomarine and Subantarctic Skuas, Cory's and Sooty Shearwaters, Wilson's Storm-petrels, and Caspian terns. The highest densities of pelagic seabirds are seen north of Walvis Bay, offshore of the shelfbreak. Virtually all pelagic seabirds scavenge offal and fish discarded from fishing vessels and other vessel waste, and thus may be encountered by the vessels used in this exploration activity. A number of coastal seabird plunge-dive for fish. Only five species are found in Namibia, either as breeding residents or as transient migrants: Brown booby, Red-footed booby, Australian gannet, Cape gannet and Swift tern. All seabirds are protected in Namibian waters (Table 4.4). African penguins, Bank cormorants, Cape cormorants, Crowned cormorants and Cape gannets are currently the most endangered seabirds in Namibia owing to the low numbers of breeding pairs. These species, together with the African Black oystercatcher and Damara tern, are listed in the Namibian Parks & Wildlife Bill as 'Specially Protected' (Currie et al., 2009. Kirkman et al., 2007. Ludynia et al., 2012. Maloney and Shannon. 2008. NACOMA, 2013. Simmons et al, 2015).

Of interest to this report are the seabirds that are feed some distance offshore and that may be impacted by the seismic survey operations. Of highest concern are the endemic, rare and endangered species. The following sensitive bird species are coastal and near-shore species: Lesser flamingo (Phoenicoparrus minor), Damara tern (Sternula balaenarum), African Black oystercatcher (Haematopus moquini), Bank cormorant (Phalacrocorax neglectus), Cape cormorant (Phalacrocorax capensis), Crowned cormorant (Microcarbo coronatus) and African penguin (Spheniscus demersus). While they may be encountered by support services, this impact will not be any more than any other vessel transiting to/from Lüderitz Bay. These near-shore species are unlikely to be impacted by survey activities occurring more than 150 km offshore and in the Central Benguela Region. However, support vessels travelling to and from Lüderitz Bay, may encounter the endangered African Penguin, Bank Cormorant and Cape Gannet, which nest on the offshore islands.

4.4.5.2 General Threats to Seabirds

Whilst all seabirds are protected in Namibia, there are hazards and vulnerabilities that jeopardise the long-term sustainability of birdlife. The main risks facing sea and shorebirds in Namibia are:

- Habitat loss and encroachment by human settlement, development and industry.
- Disturbance or alteration of nesting and brooding sites by human activities (e.g., guano scraping, off-road vehicles and recreational pursuits).

- Displacement by other breeding species (e.g., seals and other birds).
- Predation by other birds, seals and land-based predators.
- Decreased food availability (Crawford et al. 2001, 2006. Kemper, 2007).
- Pollution from increased shipping, both commercial and tourist.
- Small-scale chronic oil pollution from ships discharging waste oil and wrecks leaking oil.
- Fish oil pollution from factories and fishing fleets (mainly affecting Cape and Australasian Gannets and gulls (Kemper, 2007), and.
- Entanglement in discarded fishing tackle (commercial gear and at recreational beaches).
- Entanglement in lobster traps and in aquaculture structures (MFMR unpubl.data).
- Collisions with ship cables.
- Increased air traffic disturbance (industrial, commercial and tourist), and.
- Entanglement in fishing gear (particularly during demersal trawls or long-line fishing).

Anderson et al. (2011) estimated an annual bycatch of ca. 19,190 petrels and 606 albatrosses in the Namibia hake fisheries. A more recent study estimated the annual bycatch mortality in the Namibian demersal trawl fishery at around 8 088, 5010 are albatrosses (MFMR 2014b). Any of the above can have a devastating effect on a population that is already weakened by, for example, the outbreak of a virus.

4.4.6 Marine Mammals

4.4.6.1 Overview

The abundance of plankton and pelagic fish draws a variety of marine mammals to Namibian waters (Figs. 4.12-4.22). Namibia is well known for its large Cape Fur seal colonies. While there are resident dolphin pods, larger cetacean species utilize the waters as feeding and breeding grounds, or are simply transient migrants enroute between Antarctic and tropical waters. The most common dolphins in the BCLME area the Atlantic Bottlenose, Common, Dusky, Risso's, Rough-toothed and Southern Right-whale dolphins. The Heaviside's dolphin is endemic to Namibian coastal waters. There have been rare or occasional sightings of toothed whales such as Sperm, Cuvier's Beaked, False Killer and Long-finned Pilot whales. Orcas are known to feed opportunistically on migrating animals in offshore waters, mostly reported within the CBR in the vicinity of Walvis Bay. Occasionally, baleen whale species have been reported transiting through Namibian shelf waters. (Elwen and Leeney, 2010. Maloney and Shannon, 2008. NACOMA, 2017. Namibian Dolphin Project, 2017. O'Toole, 2009. Roux, J.P., 2008. Travel News Namibia, 2019).

There are two main groups of cetaceans: Mysticetes or baleen whales and Odontocetes or toothed whales and dolphins. Mysticetes are largely migratory, while odontocetes are both migratory and resident. Although as many as 33 species of cetacean have been recorded in Namibian waters, there is still only sparse data on abundance, stock structure and conservation status of most species within the region (Elwen et al., 2010), although data from marine mammal observers and passive acoustic monitoring is improving the database, particularly for deep offshore waters (>200m), where previously information was reliant on historic whaling records.

However, population sizes and trends of most cetacean species recorded in Namibian waters is sparse. Some cetaceans are semi-permanent residents within Namibian waters, others come to breed and still others are long-distance travellers, entering and leaving the Benguela almost without pause, en route to preferred destinations. Heaviside's (or Benguela) dolphin is the only odontocete endemic to the

Benguela Current. There are two main distributions of cetaceans in Namibian waters: inshore species living on the continental shelf in higher density, and oceanic or pelagic species, ranging over thousands of kilometres.

Only a limited number of offshore cetacean species are likely to be encountered in the AOI including (Figs. 4.12-4.22):

- Southern Right-whale dolphins, Orcas, Pilot and False Killer whales.
- Humpback whales and offshore variety of Bryde's whales.
- Sperm whales around Tripp Sea Mount and in deep waters in winter months.

Possible encounters or sightings might include the following species:

- Blue, Fin, Sei, Antarctic Minke and Dwarf Minke whales that travel along the shelf edge, and.
- Risso's dolphins that may be seen in the shallower southerly portion of the AOI.

Most dolphins, including the Heaviside's dolphin, prefer shallow inshore waters and are thus unlikely to be encountered or affected by the seismic operations. There is almost no data relating to abundance, distribution, or seasonality of odontocetes in oceanic waters off the Namibian continental shelf (1 000 – 2 000 m), except for recent sightings of Sperm whales near Tripp Sea Mount (Weir, 2011. Benthic Solutions, 2019). False Killer whales frequent open ocean waters, although they are not seen with any regularity. Orcas roam throughout the oceans, making their occurrence difficult to predict.

Overlaps on the habitants / migratory routes of the various marine mammals found in the Namibian waters relative to the proposed 2D / 3D seismic survey area are illustrated in Figs. 4.12-4.22. To mitigate impacts on migratory cetaceans, particularly mysticetes, it is recommended that seismic surveying along the shelf break not to be undertaken during the primary and secondary whales peak migration periods from May-July and October–November respectively. Although cetaceans, including mysticetes may be found in the Namibian water throughout the year, the commencement of the survey outside the peak migration periods where possible, coupled with the implementation of the appropriate operational mitigation measures and the low likelihood of encountering many mysticetes outside the peak migration periods will further lessen any potential negative impacts.

4.4.6.2 General Threats to Mammals in Namibian Waters

The Sea Fisheries Act (29 of 1992) grants marine mammals full protection within the 200 nautical mile Namibian Exclusive Economic Zone. To date, visual observation records by vessels operating within Namibian waters (as required by MME) suggest that dolphin numbers have been increasing in the last decade. None-the-less, these animals are strongly impacted by human activities both on- and offshore. The discovery of large hydrocarbon reserves off the Namibian coast has led to an increase in deep-penetration seismic survey and drilling for exploration purposes. The increased ship traffic in and out of Lüderitz and Walvis Bay Harbours, and the general noise in the environment, can possibly have a negative effect on whales and dolphins in the Benguela region. There are no official reports of detrimental impacts on cetaceans within the BCLME resulting directly from exploration and/or mining activities.

Increasing numbers of marine tour operators in Lüderitz and Walvis Bay may be placing pressure on seals, dolphins and recovering whale populations. Impacts from aquaculture and mariculture can include pollution and the introduction of alien species. These farms also close off spaces previously accessible to wild marine life, possibly impacting habitat and feeding and breeding patterns. They can lie in the direct path of migrating whales and may trap and cause confusion to dolphins. All vessels, including exploration, mining and fishing vessels, pose a pollution threat and should be monitored by MET, MME and MFMR and port authorities. However, as long as MARPOL regulations are adhered to, the impacts from vessel traffic should be insignificant given the small volumes in Namibia.

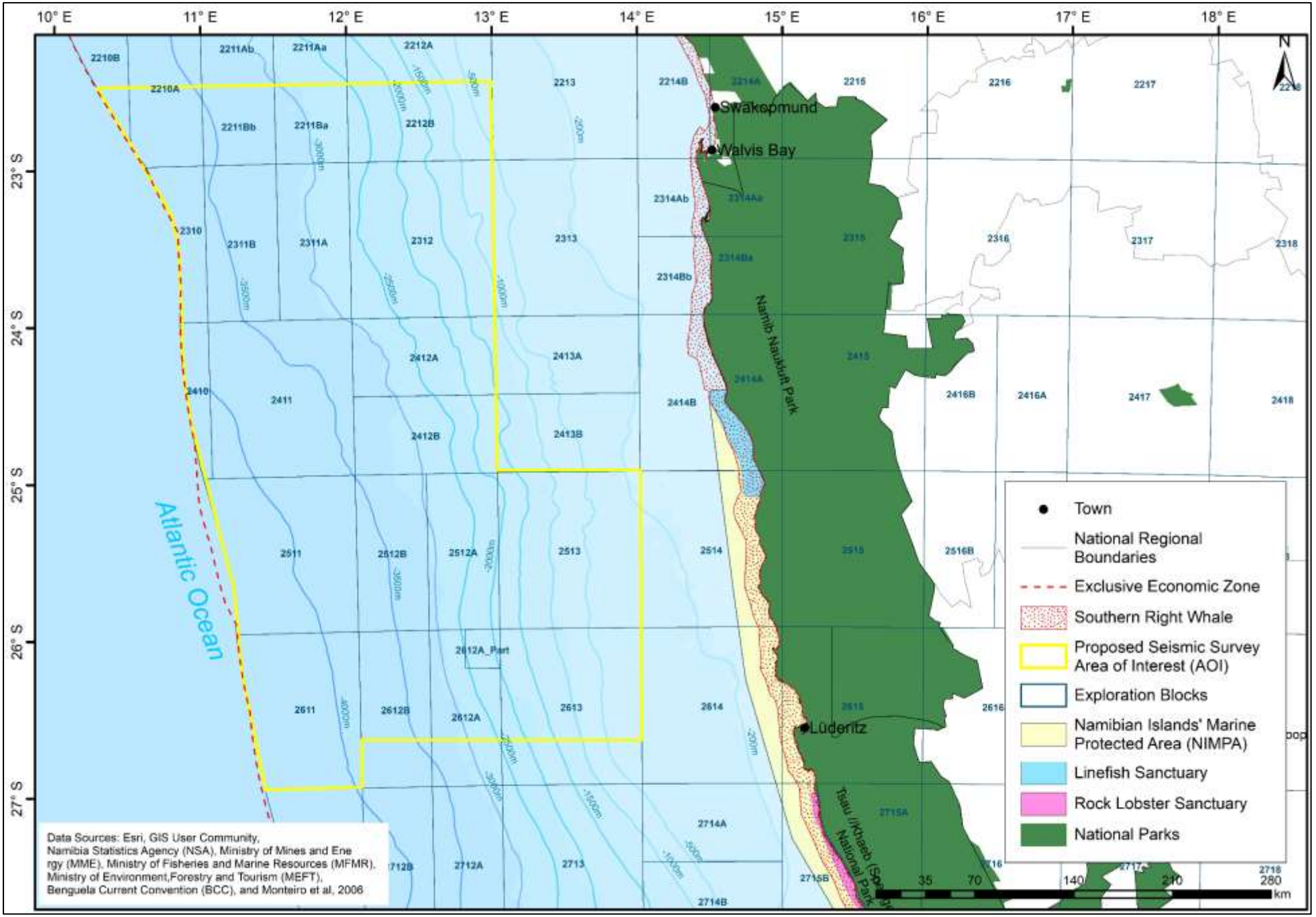


Figure 4.12: Known occurrences of Southern Right whales falling outside the proposed AOI in the eastern coastal shallow waters.

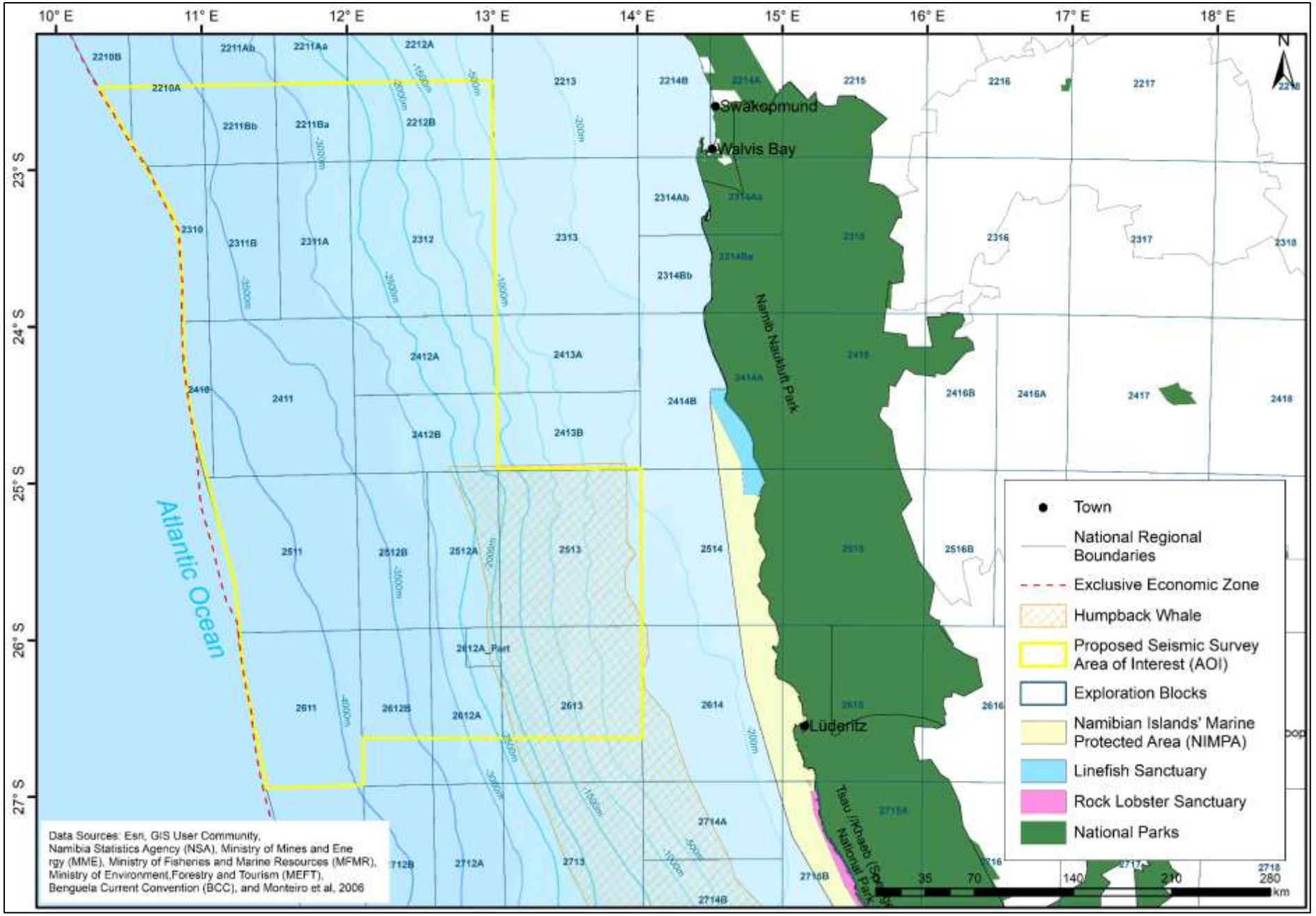


Figure 4.13: Known occurrences of Humpback whales cutting across the south-eastern boundary of the proposed AOI and appropriate mitigation measures shall be provided in the EMP Report.

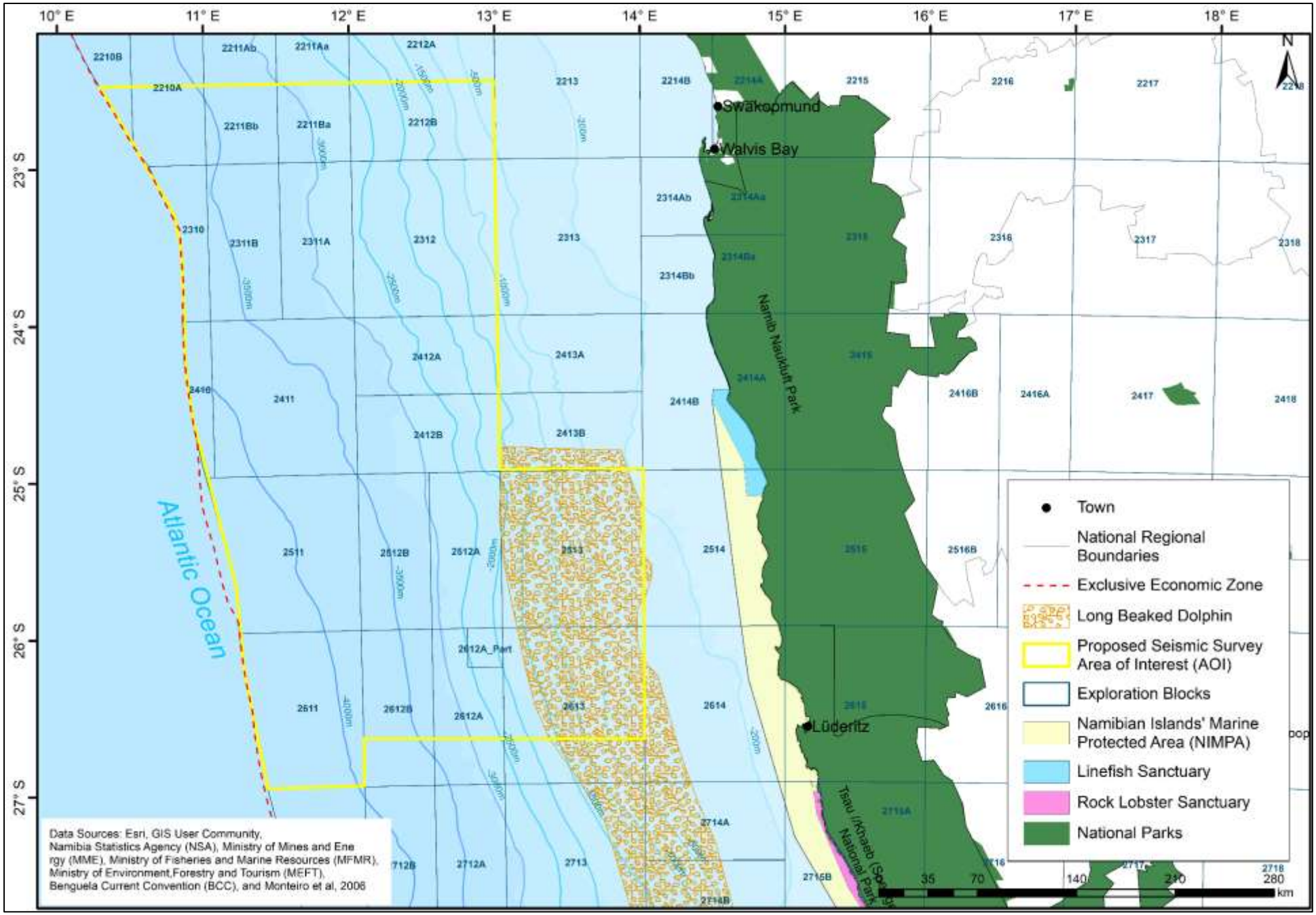


Figure 4.14: Known occurrences range of Long Beaked Dolphins relative to the proposed AOI. Known occurrences of Long Beaked Dolphins cutting cross the south-eastern boundary of the proposed AOI and mitigation measures shall be provided in the EMP Report.

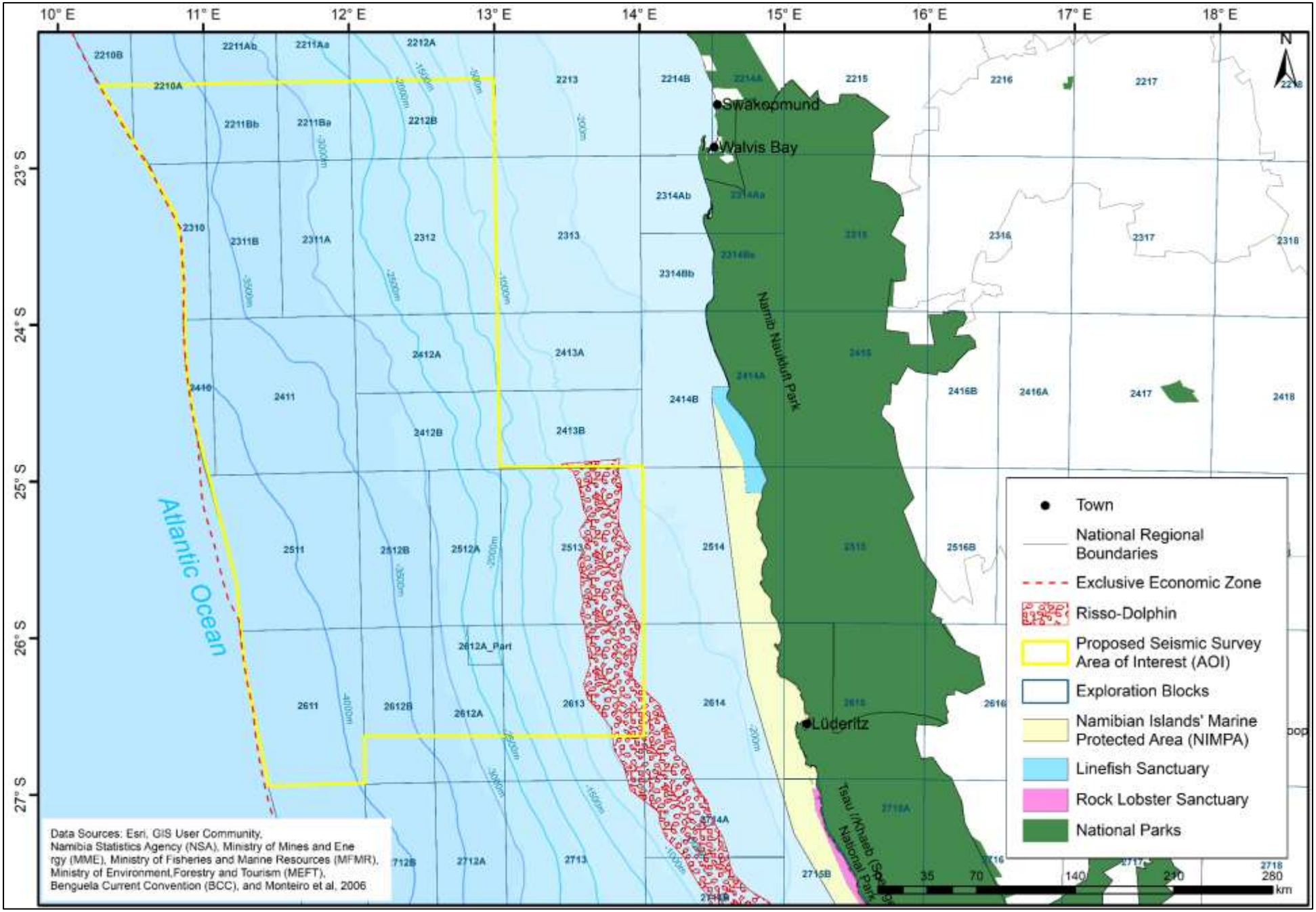


Figure 4.15: Known occurrences of range of Risso-Dolphins relative to the proposed AOI. Known occurrences of Risso-Dolphins cutting cross the south-eastern boundary of the proposed AOI and mitigation measures shall be provided in the EMP Report.

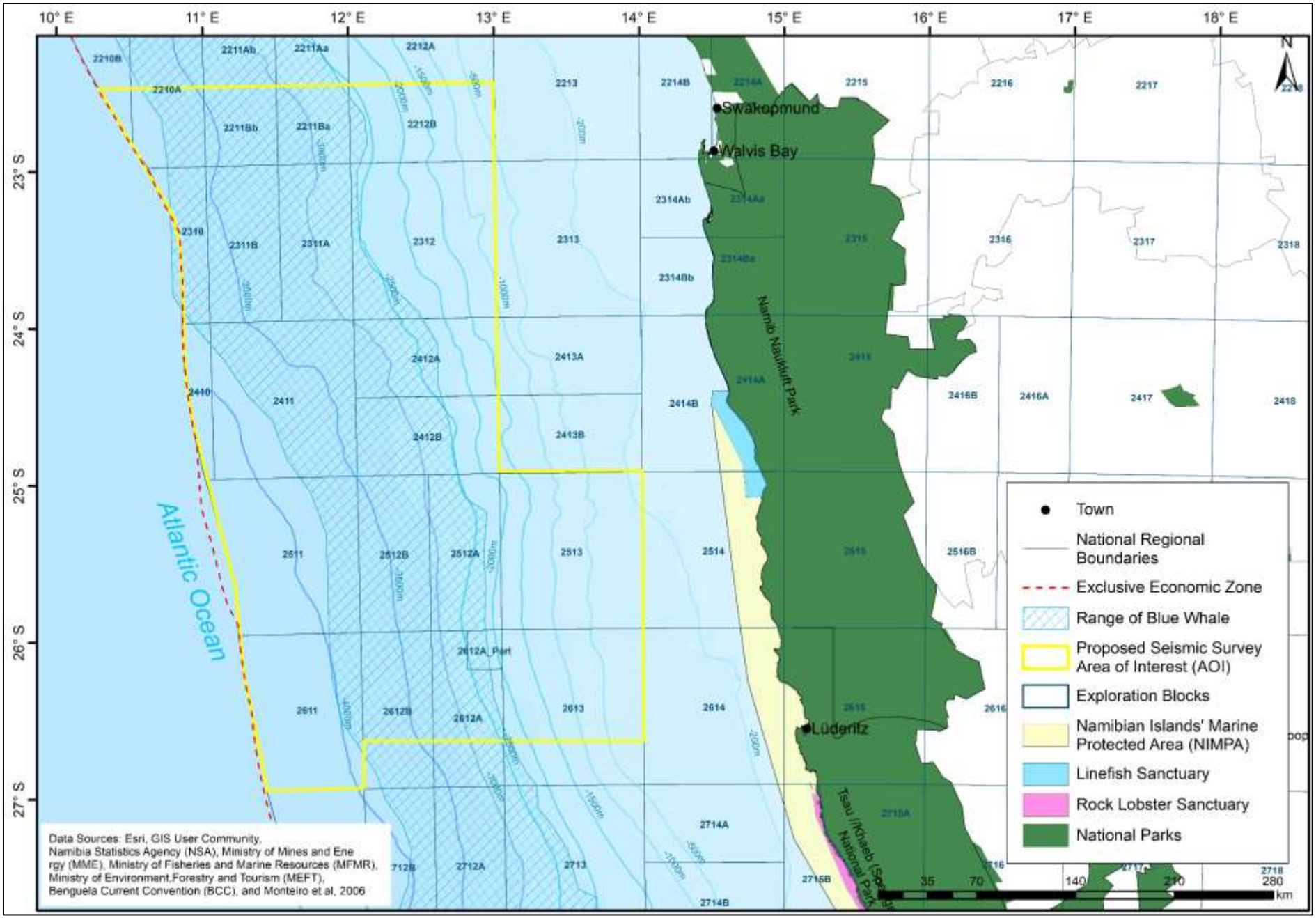


Figure 4.16: Known occurrences of blue whales relative to the proposed AOI. Known occurrences of blue whale cuts cross the central parts of the proposed AOI and appropriate mitigation measures shall be provided in the EMP Report.

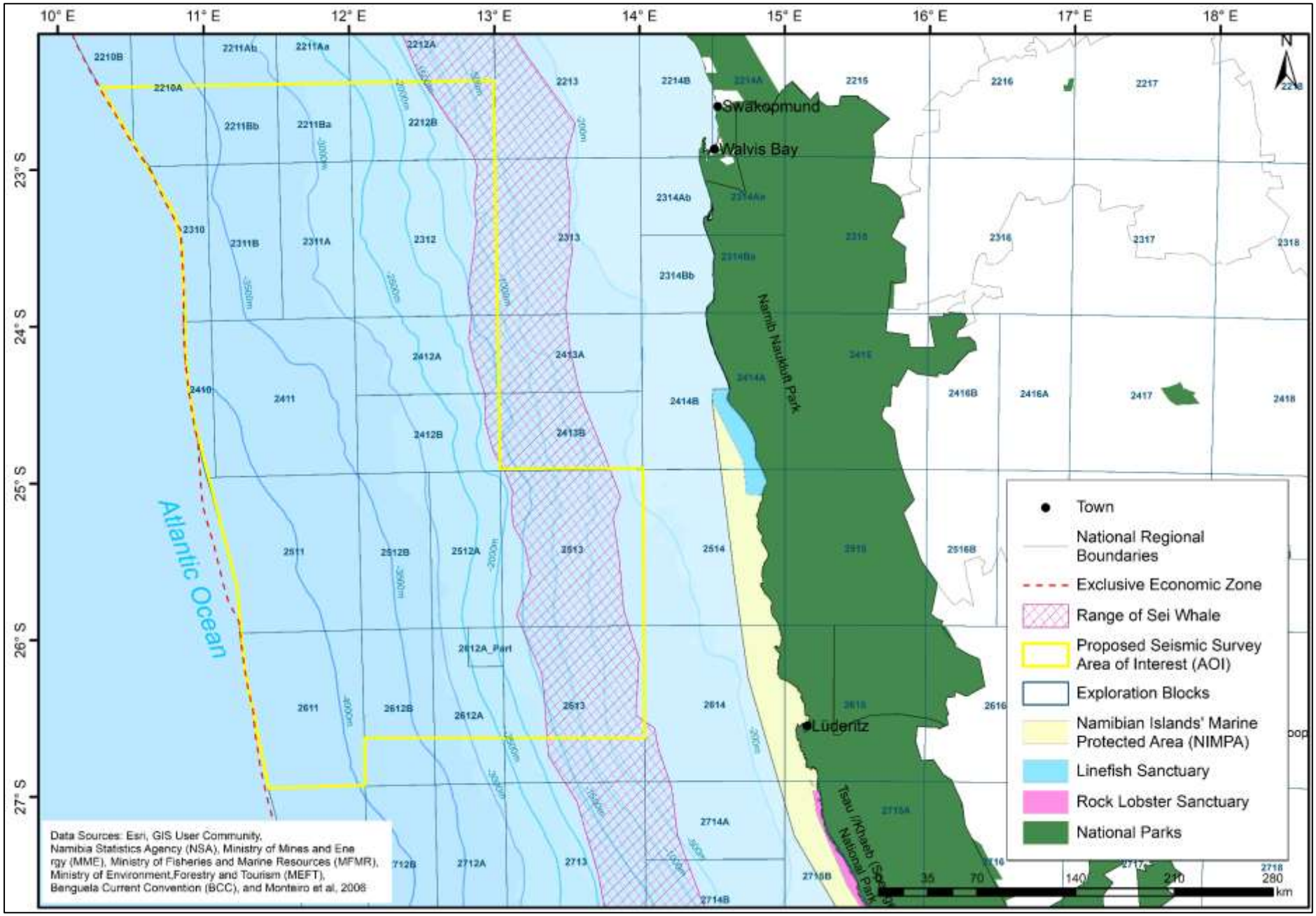


Figure 4.17: Known occurrences of Sei whales with respect to the proposed AOI. The known occurrences area cuts cross the entire eastern boundary of the proposed AOI and appropriate mitigation measures shall be provided in the EMP Report.

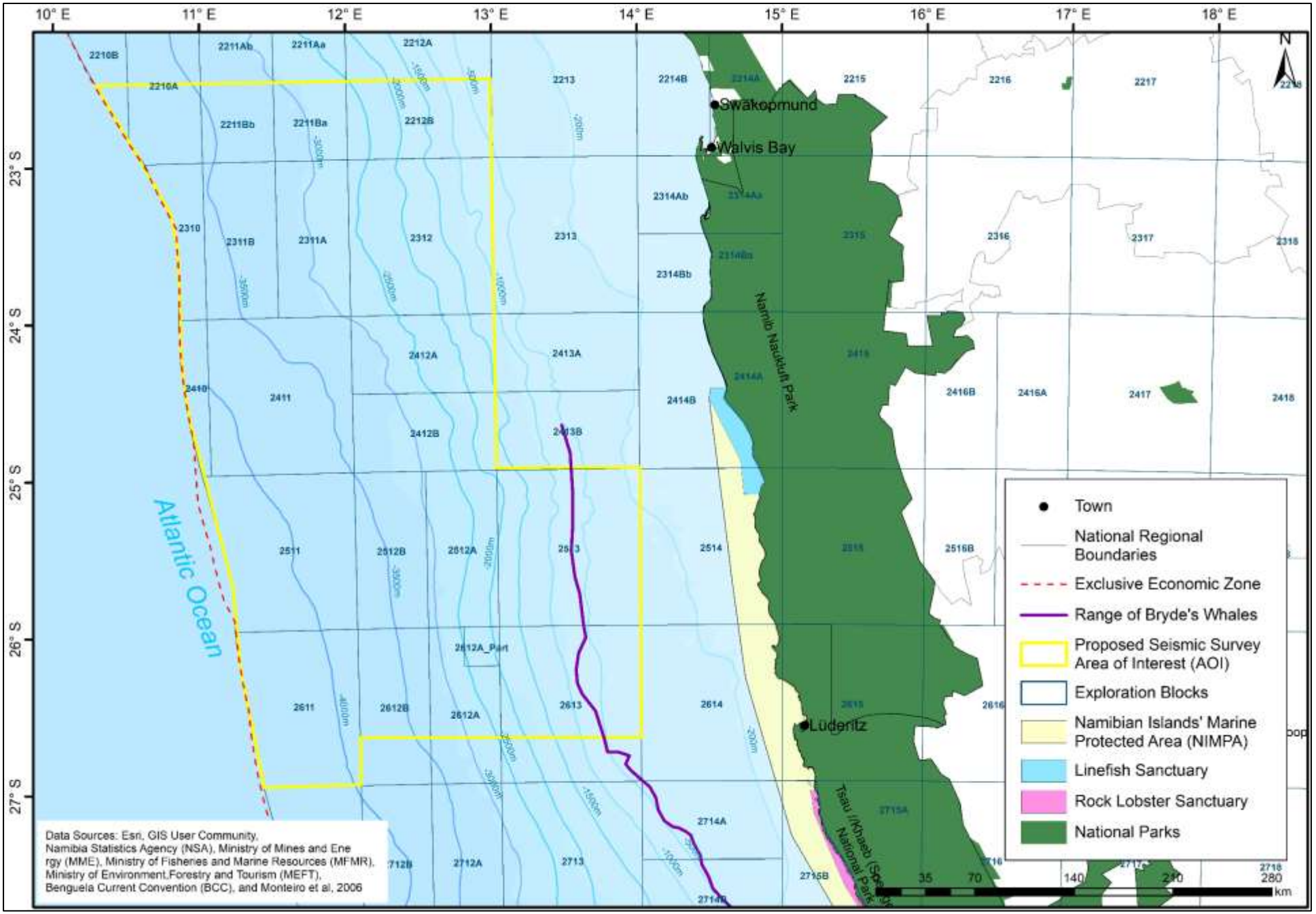


Figure 4.18: Known occurrences of the Bryde's whales relative to the proposed AOI with known occurrences being around -1000m seaward cutting cross the south-eastern boundary of the proposed AOI and mitigation measures shall be provided in the EMP Report.

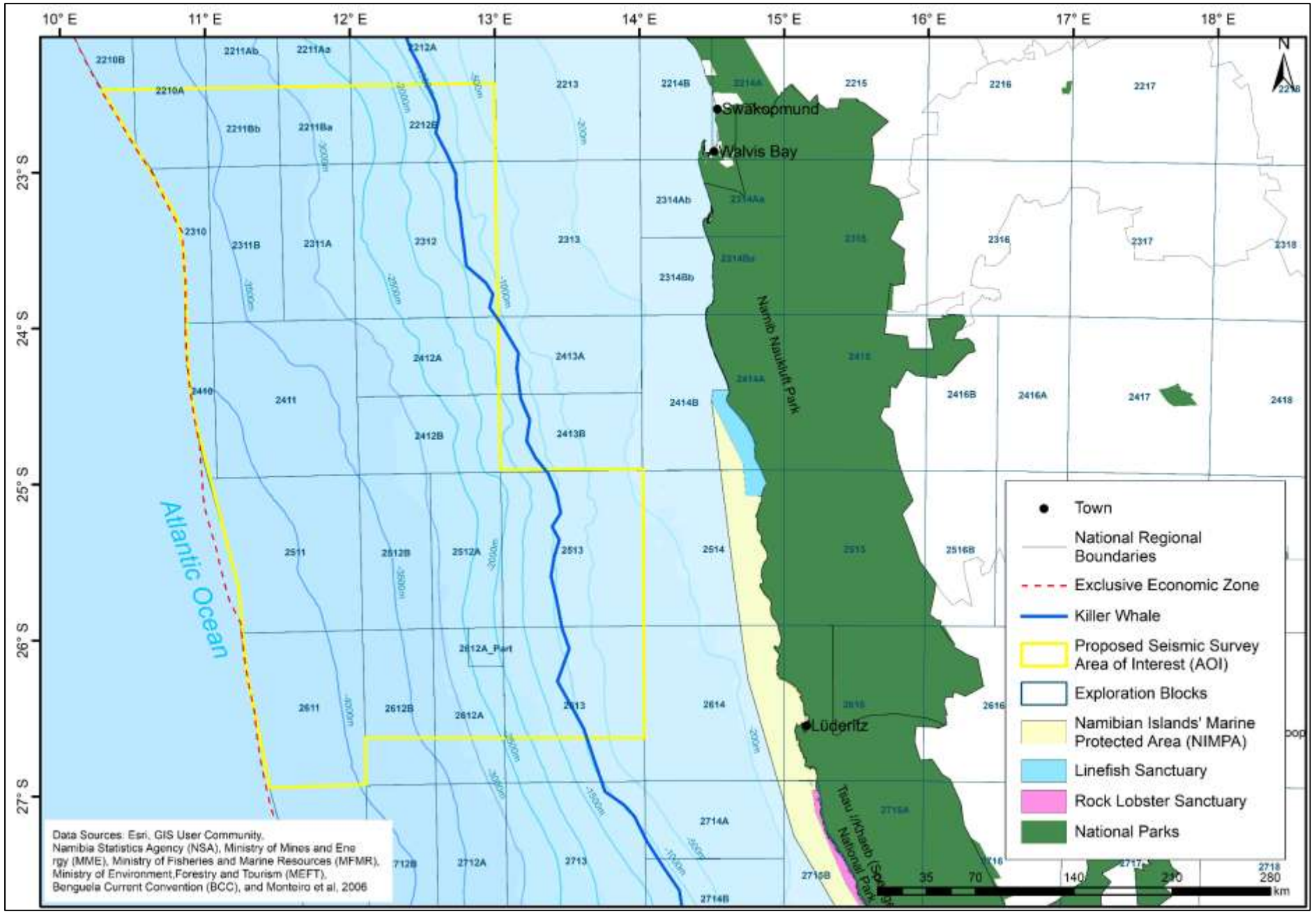


Figure 4.19: Known migratory occurrences of False Killer whales relative to the proposed AOI and the preferred habitat being seaward of -1000m, cutting cross the eastern part of the AOI and appropriate mitigation measures shall be provided in the EMP Report.

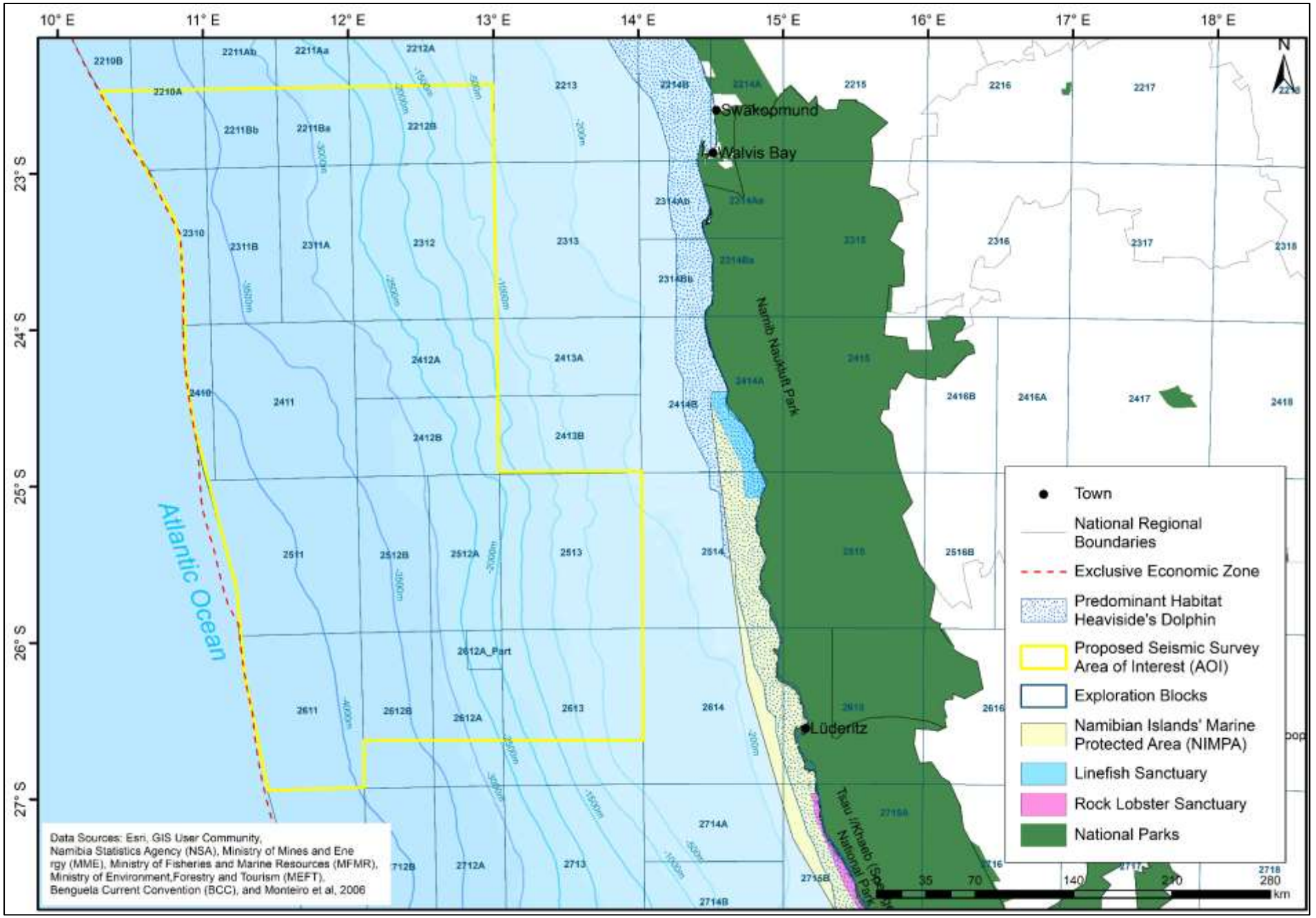


Figure 4.20: Known occurrences of Heaviside's dolphins falling outside the proposed AOI in the eastern coastal shallow waters.

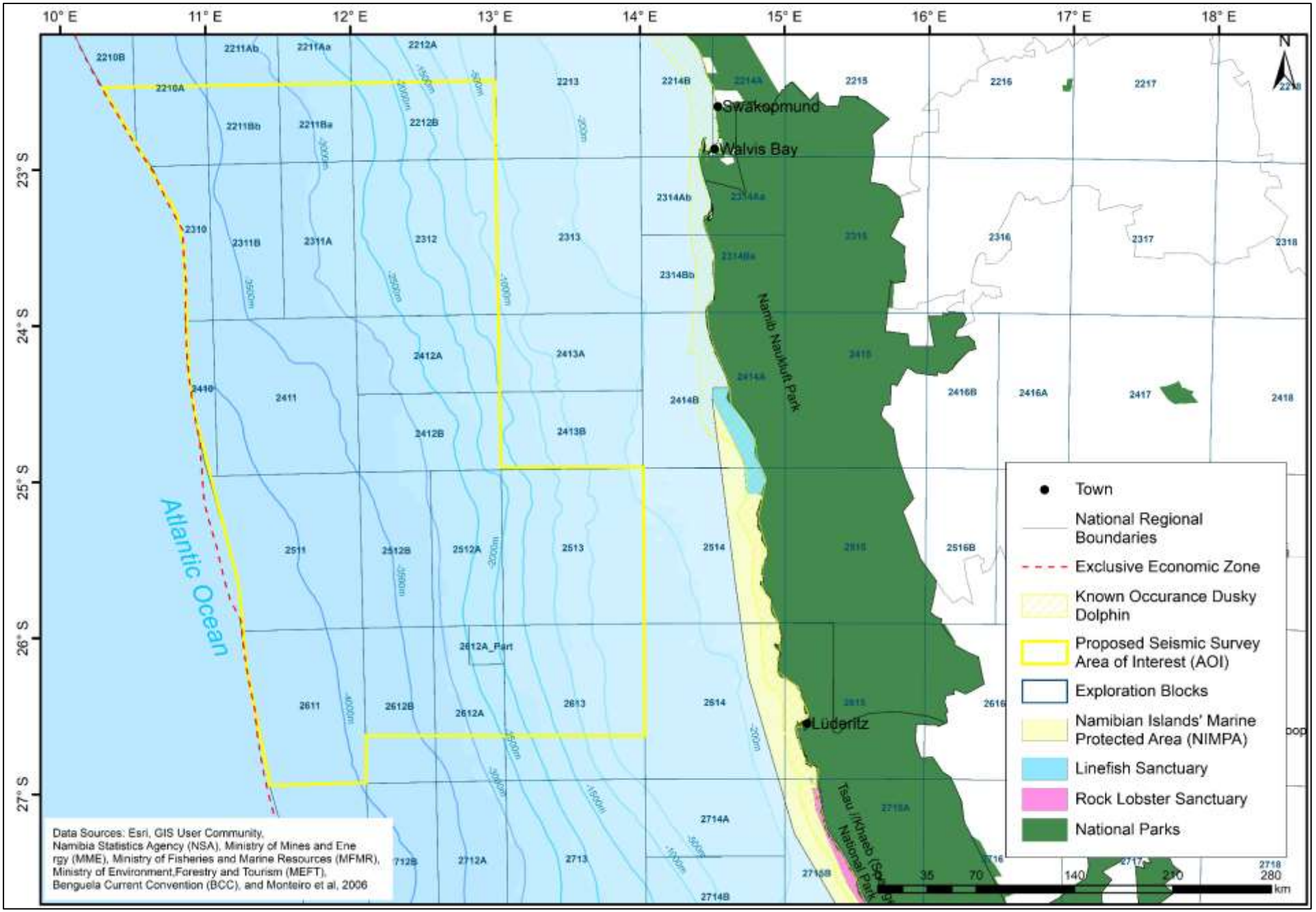


Figure 4.21: Known occurrences of Dusky dolphins relative to the proposed AOI. Known habitats falls outside the AOI in the eastern coastal shallow water areas.

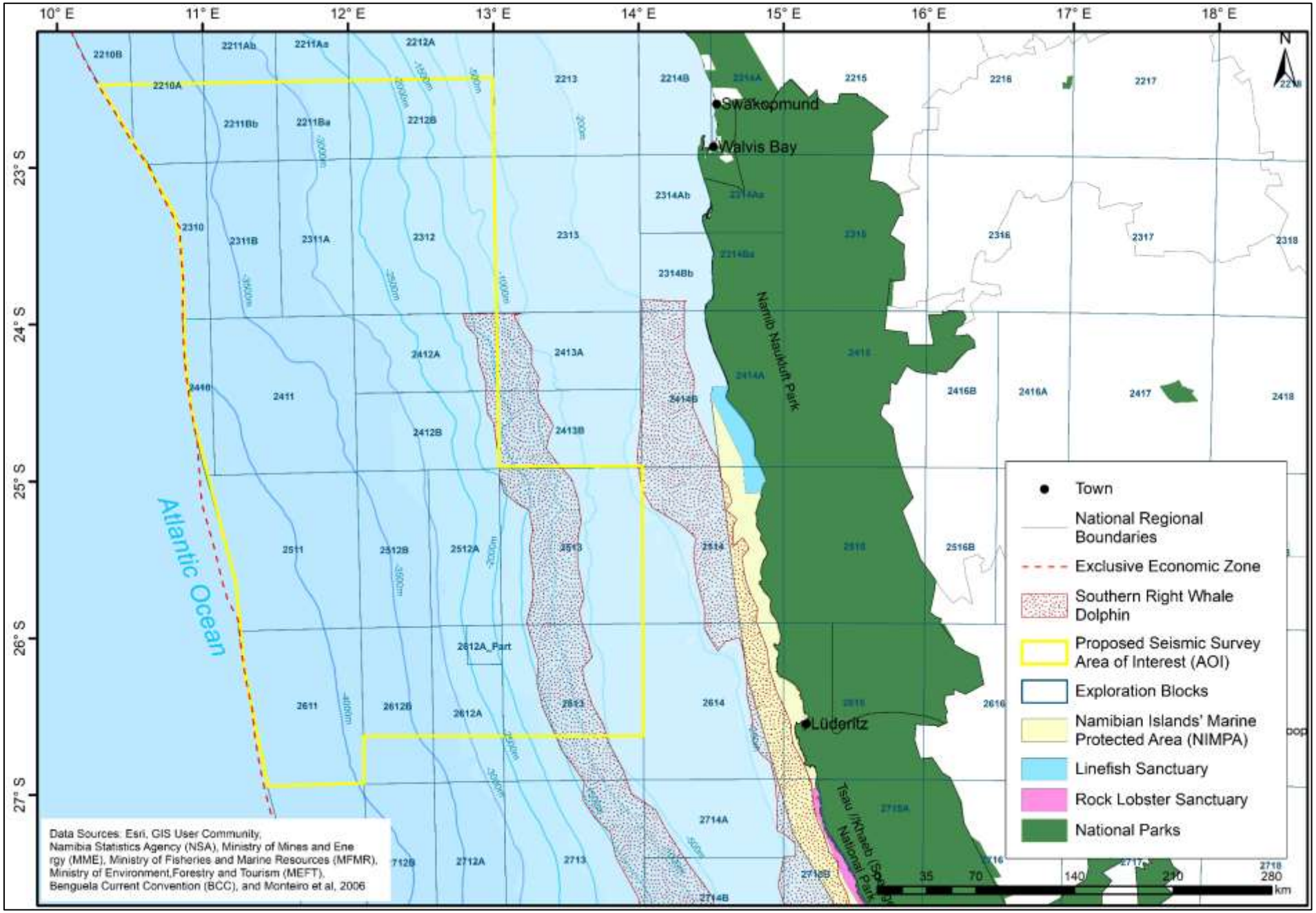


Figure 4.22: Known occurrences of Southern Right-whale dolphins falling within the south-eastern parts of the proposed AOI and appropriate mitigation measures shall be provided in the EMP Report.

4.5 Geological Setting and the Petroleum System

Offshore Namibia has four (4) sedimentary basins namely: Namibe, Walvis, Lüderitz, and Orange Basin (Figs. 4.23 and 4.24). The proposed 2D / 3D seismic survey area falls within the Walvis, Lüderitz and Orange Basins, Offshore Namibia (Figs. 4.23 and 4.24). Sedimentary basins can be classified according to their structural genesis and evolutionary history and the latter can be linked to petroleum system and play development. West African South Atlantic basins between Cameroon and Namibia have experienced similar tectonic and sedimentary basin evolution and are genetically related (Fig. 4.22).

According to Bray and Lawrence, (1999), four basin cycles have been identified (pre-rift, syn-rift, transitional and post-rift), each associated with at least one type of petroleum system (PST). Two PSTs are regionally extensive and very productive: the lacustrine syn-rift and marine post-rift PSTs, while three minor PSTs, the fluvio-marine transitional, restricted hypersaline transitional and deltaic post-rift PSTs, are locally developed (Fig. 4.23).

Play development is closely related to basin tectonic and sedimentary evolution. Syn-rift plays are associated with lacustrine/fluvial facies and trap geometries related to graben development, while post-rift plays include deltaic and shallow to deep marine clastic and carbonate facies in combination with traps which formed due to salt withdrawal (Figs. 4.24 and 4.25).

The number and variety of plays increases with basin evolution, as tectonics and sedimentary patterns become more complicated. Three basin families have been identified. The Basin family 1 includes a lacustrine syn-rift section, followed by a fluvio-marine sand/shale and a restricted hypersaline evaporite unit (the transitional section), and ultimately by a marine post-rift section. It contains the lacustrine syn-rift, fluvio-marine transitional and marine post-rift PSTs.

Basin family 2 is characterized by the same basin evolution but has a thick deltaic wedge in the latest post-rift phase, which gives rise to an additional PST: the deltaic postrift PST. Basin family 3 is defined by the same basin evolution as basin family I, except that the transitional section is dominated by shales instead of evaporites, which are the source for the restricted hypersaline transitional PST (Figs. 4.24 and 4.25).

Recent major pre-salt discoveries in the Brazilian margin have highlighted the importance of the pre-salt lacustrine petroleum system extending along the margins of the South Atlantic Ocean. Within the offshore basins of Namibia, good quality oil-prone source rocks occur in the Aptian rift-to-drift transition and Albian to Cenomanian early drift sections which can be confidently extrapolated into deepwater areas from seismic data (Bary, *et. al*., 1998 and Bray and Lawrence, 1999). According to Bary, *et, al.,* (1998), Basin modelling shows that large area of the Aptian source rock and more restricted areas of the Cenomanian-Turonian source rocks are in oil maturity windows at the present day based on the following (Figs. 4.24 and 4.25):

- The thermal gradient and oil recovered by HRT.
- Apatite fission track analysis (AFTA) data recognize a thermal episode during the late Tertiary, which caused maximum maturity over large parts of the region. In areas where the effects of this episode are less marked, maximum hydrocarbon generation is occurring at the present day. In either case, the timing of generation is favourable.
- Faulting associated with skeleton Albian rifting and volcanic plateau development, differential compaction of the drift sequence, and shelf edge gravity sliding provide vertical migration access to shallow reservoirs in the overlying late drift sequence, and.
- Potential reservoir sands have been proved by previous drilling operations in Upper Cretaceous mound features in relatively shallow waters, like features recognized in deepwater seismic. Potentially large stratigraphic traps enhanced by an underlying structural control associated with gravity slide structures, skeleton rifting, or volcanic plateau development in area of influence of proto-Orange River in the south and Kunene River to the north.

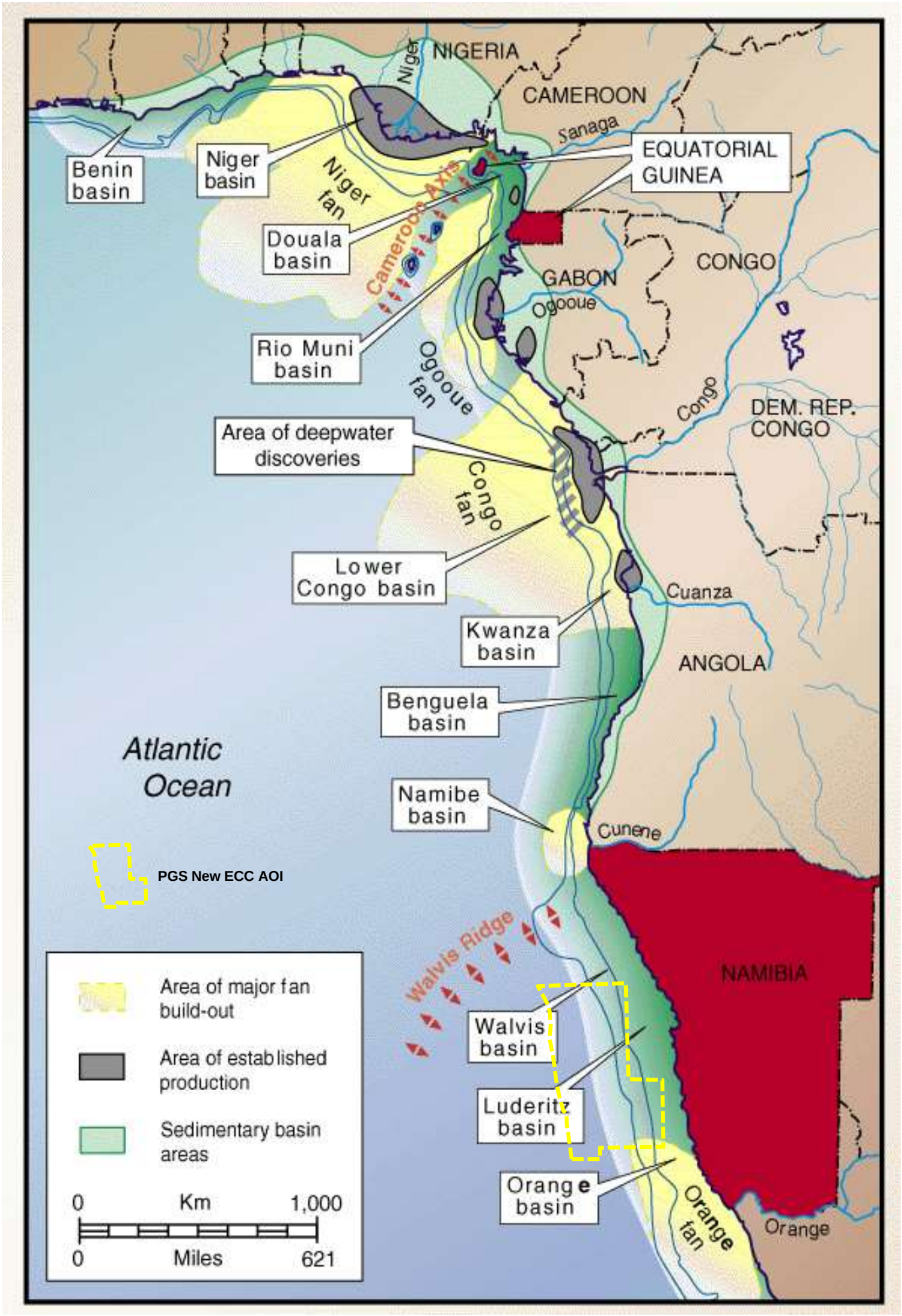


Figure 4.23: Basins of Central and Southern Africa (Bray and Lawrence, 1999).

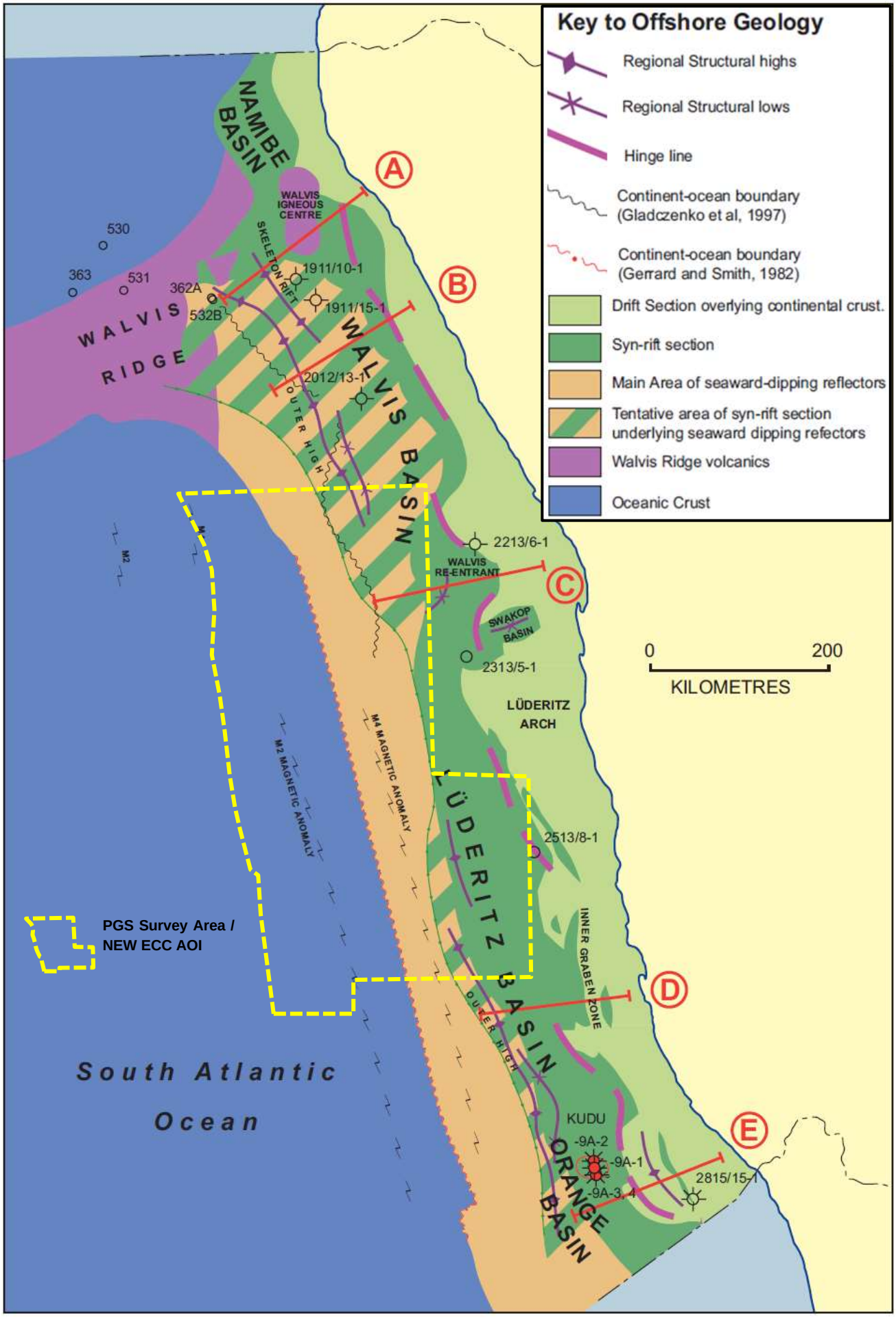


Figure 4.24: The offshore Basins of Namibia with detailed geological cross section lines A-E shown in Fig. 4.5 (Source: Bray *et. al.*, 1998).

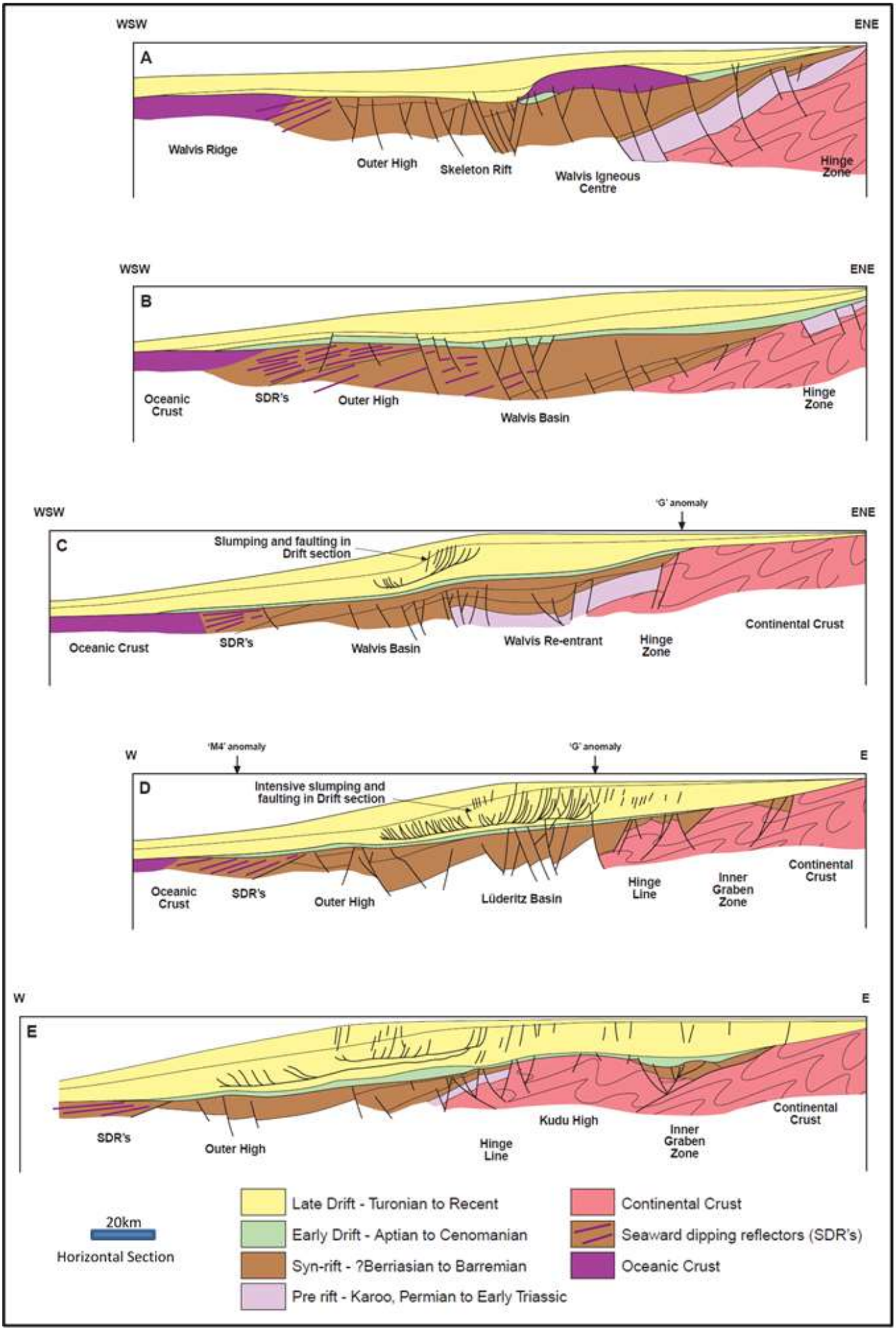


Figure 4.25: Geological section lines A-E shown in Fig. 4.24 (Source: Bray *et. al.*, 1998).

4.6 Socioeconomic Governance, Infrastructure and Archaeology

4.6.1 Political Governance

The Republic of Namibia is a unitary State. Administratively, it is divided into three tiers, with separate spheres of responsibility – central, regional and local governance. The central government consists of the President and the two Houses of Parliament, namely: The National Assembly and the National Council.

The regional sphere is made up of Regional Councils. Each of the regional councils runs one region, which are fourteen in total and these are (Fig. 4.27): Zambezi, Erongo, Hardap, Karas, Khomas, Kunene, Ohangwena, Okavango East, Okavango West, Omaheke, Omusati, Oshana, Oshikoto and Otjozondjupa.

Regional Councils have powers under the Regional Councils Act of 1992, which established a regional council in each region. They can, among other things, advise the President and central government on matters relating to the region. The political head of a region is the Governor, who is appointed by the President.

The regions are divided into constituencies for electoral purposes. Each constituency elects one member to the regional council using a first-past-the-post electoral system. The term of office of the regional council members is six years. The regional councils elect from amongst their members two persons as members of the National Council. The local authorities are established in urban areas, and the regions cover the rural areas.

The regional councils are presently responsible for specified service delivery in rural areas, while the local authorities are responsible for service delivery in urban areas. Currently the only service provision responsibility of the regional councils specified in the Regional Councils Act is the provision of basic services in areas where settlements are proclaimed, but no local authorities are established. There are four types of local government: Municipal (of two types), town, village and settlement councils.

There is no upper or lower tier in Namibian local government. The fourteen (14) Regional Councils run the regions. Municipal, Town and Village Councils are not sub-ordinate to them. The municipal councils are the most autonomous local authorities of the local authority categories. Under the Local Authorities Act of 1992, the Minister responsible for regional and local government may further classify the municipalities into two types: Part I municipalities and Part II municipalities.

Currently there are three Part I municipalities (Windhoek, Walvis Bay and Swakopmund), 15 Part II municipalities, and in total 30 towns and villages in Namibia. Part I municipalities generally have a solid financial basis and considerable autonomy with regard to the determination of property tax and obtaining loans under the provisions of the Local Authorities Act.

Part II municipalities have a more fragile financial basis and are subject to control exercised by the Ministry of Regional and Local Government, Housing and Rural Development. Most of the town councils cannot balance their budgets without substantial transfers from the central government or donors, and their financial autonomy, in general, is limited.

4.6.2 Socioeconomic Setting

According to Namibia Statistics Agency (NSA) Multidimensional Poverty Index (MPI) Report, 2022, more than 43.3 percent of Namibia's population are still living in multidimensional poverty. Unemployment is particularly acute for rural women.

Over 44% of the female rural labour force was unemployed in 2016 compared to 34% in urban areas (a 10% spread); for men, the 2016 unemployment figures were 34% in rural areas compared to almost 27% in urban areas (a 7% spread). Despite Namibia being classified as am upper-middle-income country, the country has high socioeconomic inequalities, high youth unemployment and high rural poverty.

The Namibian economy rests on four main pillars: mining, agriculture, fishery, and tourism. Namibia is middle income country with natural resources including a great variety of minerals, mainly diamonds, uranium, gold, silver, zinc, copper, lead, tin, marble, and granite as well as semi-precious stones among others. Marine diamond production accounted for approximately 10% of the gross domestic product, 40% of export revenue and 7% of annual government revenue in 2022.

Marine minerals exploration and mining operations are undertaken in shallow waters of less than -200m (Fig. 4.27). Portions of three (3) Exploration Prospecting Licenses (EPLs) in the eastern boundary of the AOI overlaps with the proposed 2D / 3D seismic survey area (Fig. 4.27).

4.6.3 Regional Infrastructure and Services

As shown in Fig. 4.28, seafloor submarine communication cables routes overlap with the proposed 2D / 3D seismic survey AOI.

However, the proposed survey operations will not disrupt or destroy the seafloor cables because the survey operations will be undertaken on water surface and will not touch the seafloor environment.

The various activities and logistical arrangements of the proposed survey operations falls in the following regions, towns, and general areas with respect to the available infrastructure and services:

(i) Survey location is located offshore Namibia and its opposite the Kunene, Erongo, Hardap and //Karas Regions coastlines (Fig. 4.26).

(ii) Henties Bay, Swakopmund, Walvis Bay, Lüderitz and Oranjemund, are the coastal town opposite the survey area offshore.

(iii) The Ports of Walvis Bay and Lüderitz that may be used as the shore / operation base is situated in the //Karas Region, and.

(iv) The entire southern coast line from Henties Bay to Oranjemund falls within the coastal national parks with exception of the municipal areas of the coastal towns.

The economies of the coastal towns of Henties Bay, Swakopmund, Walvis Bay, Lüderitz and Oranjemund are dependent on local resources of fishing, mining and tourism.

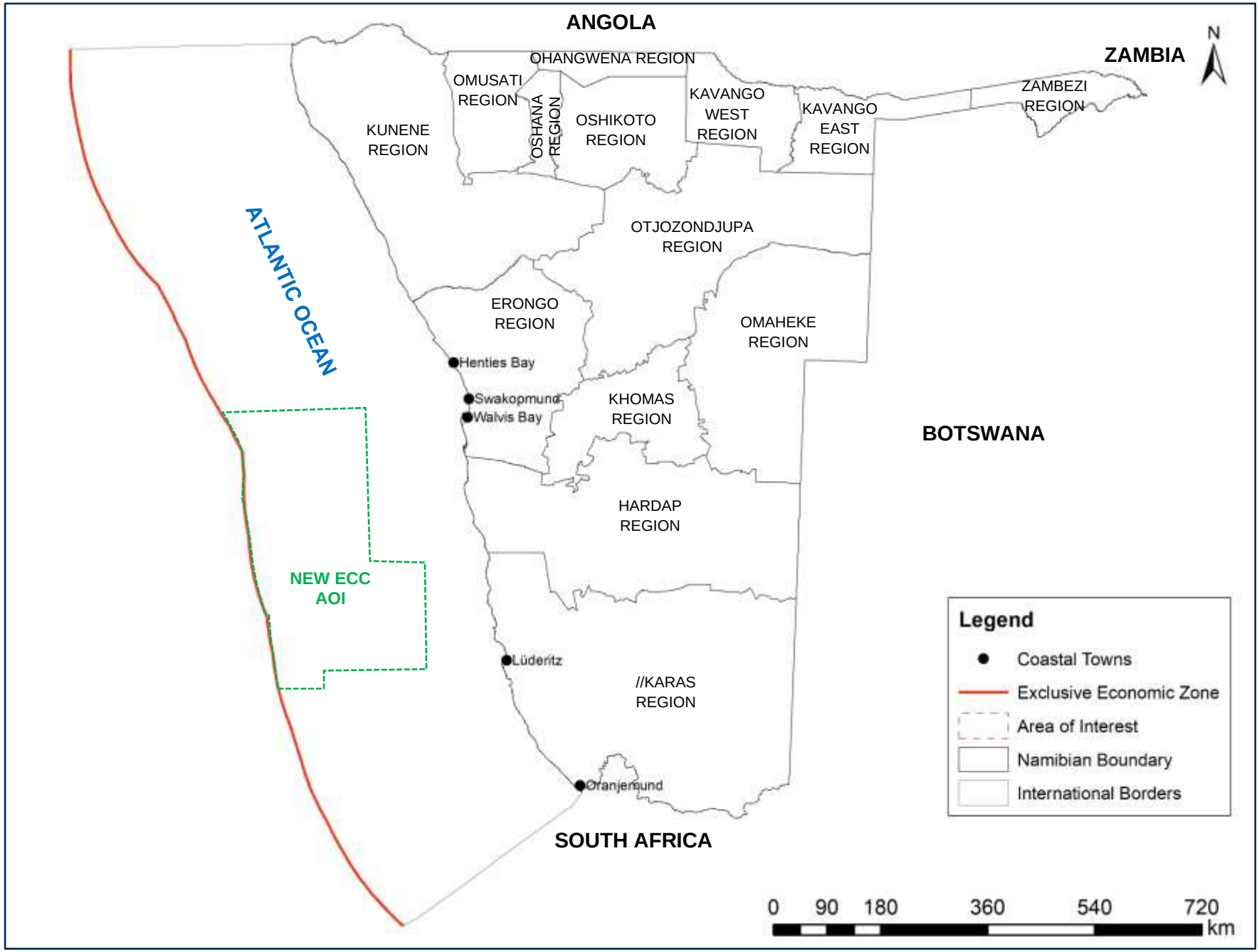


Figure 4.26: Regions of Namibia with respect to the proposed 2D / 3D seismic survey AOI situated offshore Namibia.

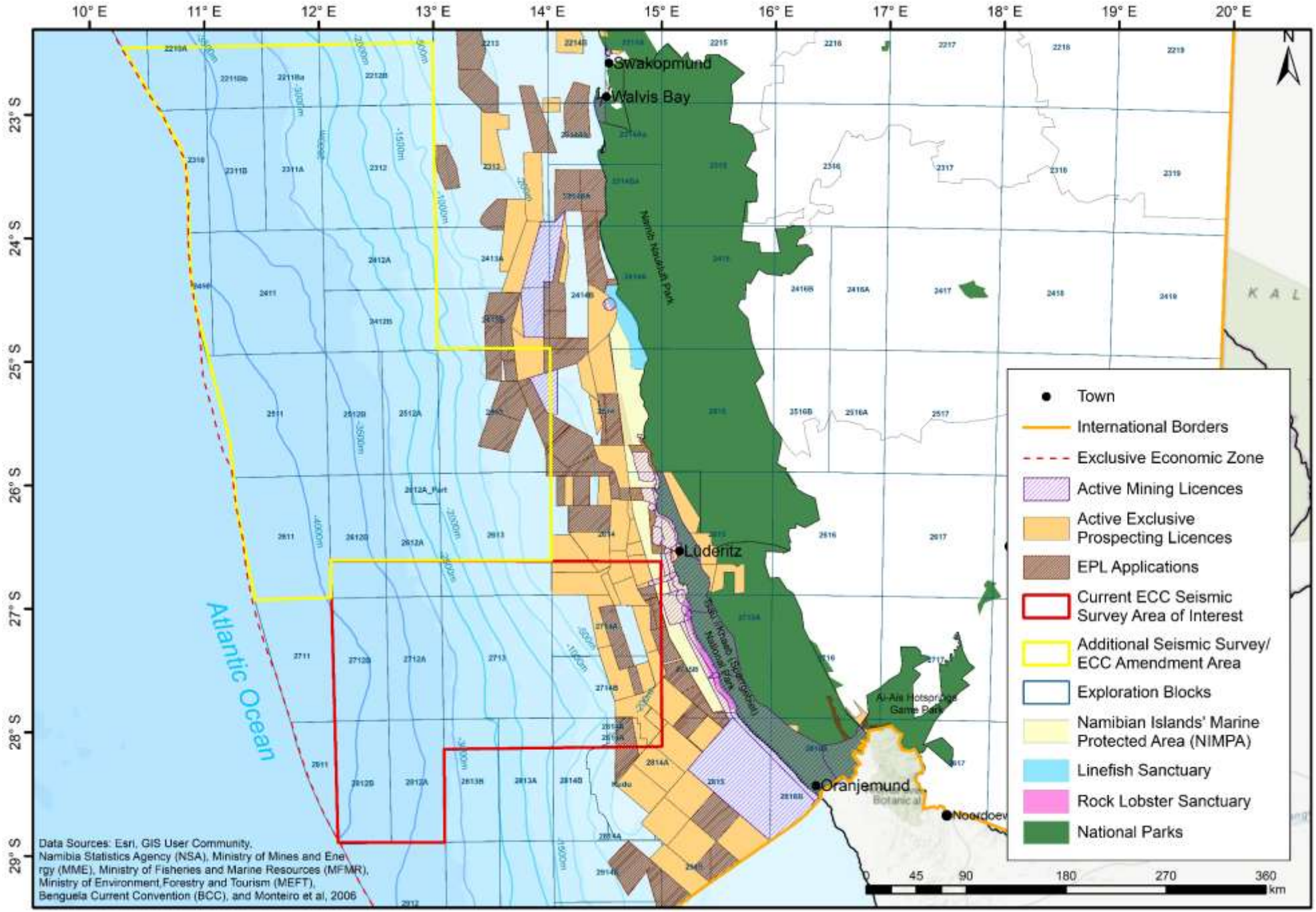


Figure 4.27: Marine minerals licenses area with respect to the proposed 2D / 3D seismic survey AOI (Data Source: www.mme.gove.na).

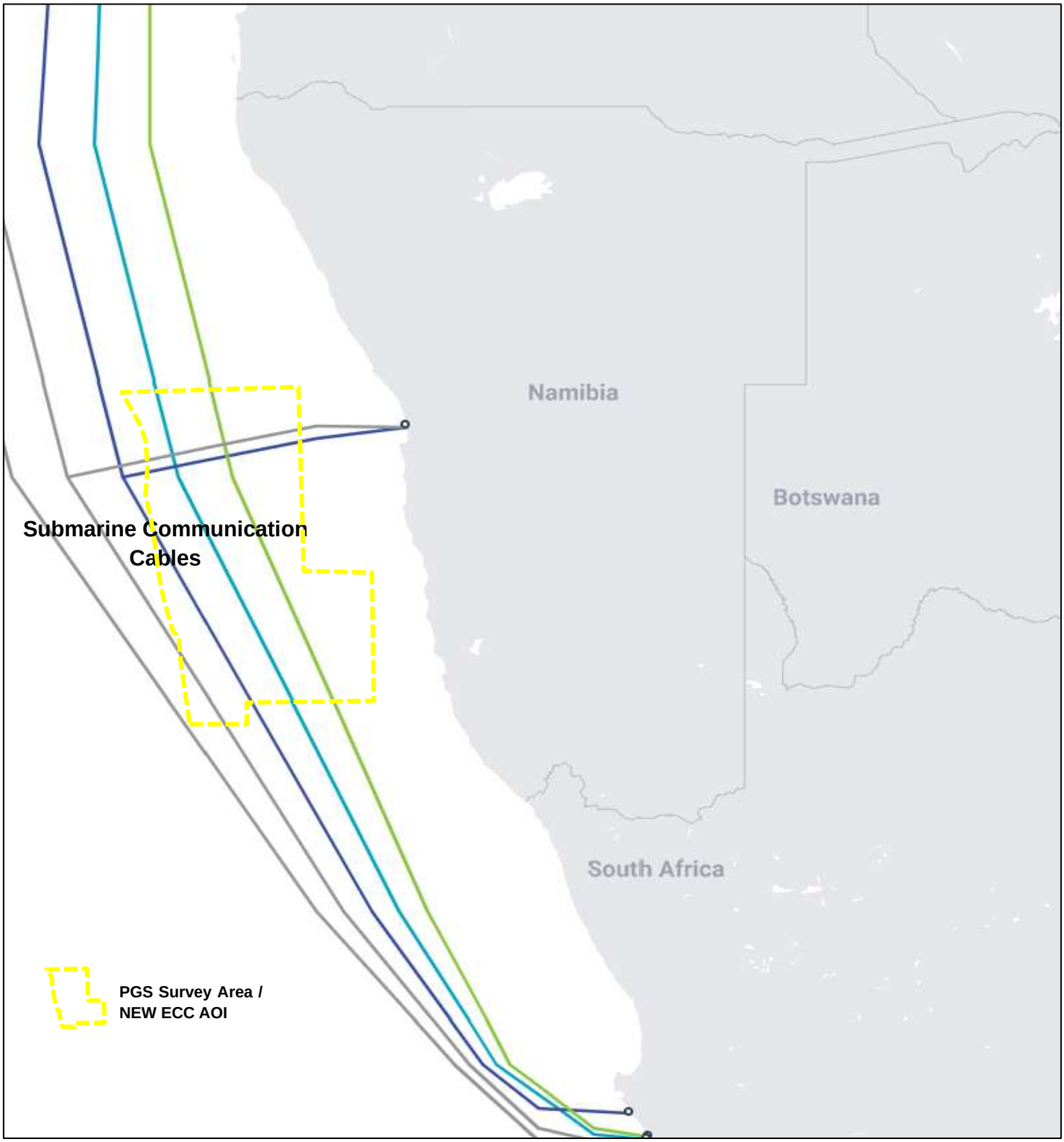


Figure 4.28: Map of Submarine Communication Cables with respect to proposed 2D / 3D seismic survey area (Source: www.submarinecablemap.com).

4.6.4 Archaeology

There are thousands of shipwrecks along the west coast of southern Africa. According to Namibian law, any wreck within Namibian territorial water that is older than 50 years is declared a national monument and therefore a protected historical artefact (Gribble, 1997).

Most known wrecks lie inshore in relatively shallow waters and their location is noted on charts drawn up by and available from the Hydrographic Office of the South African Navy (SAN Charts). The annual *Summary of South African Notices to Mariners No. 5* also describes the position and nature of submarine hazards along the southern African West Coast. No historical art fact or shipwrecks are known to exist in AOI.

4.7 Marine, Coastal and Onshore Protected Areas

4.7.1 Namibian Islands' Marine Protected Area (NIMPA)

The Ministry of Fisheries and Marine Resources has prepared draft regulations pertaining to the Namibian Islands' Marine Protected Area (NIMPA), indicating the position of the NIMPA, including the islands, and the positions of the line fish sanctuary and Rock Lobster sanctuary as per Government Gazette no. 4210 of 16 February 2009 (Tables 4.4 and 4.5).

The Namibian Islands' Marine Protected Area includes all islands, rocks, islets, marine resources, and marine area as follows:

(a) The northern border is constituted by a line drawn from a Point just north of Meob Bay at 24 ° 29' 10''S, 14 ° 30' 00"E, running due east to the high water mark.

(b) The southern border consists of a line drawn from a Point south-west of Chamais Bay at 27 ° 57' 34"S, 15 ° 28' 05" E, running due east to the high water mark.

(c) The western border is constituted by a line connecting the co-ordinates referred to in regulation 3 below.

(d) The eastern border runs along the high-water mark of Namibia's coast-line, between Meob Bay in the north and Chamais Bay in the south of the Marine Protected Area.

Tables 4.4 and 4.5 shows the islands, islets, rocks, line fish sanctuary and rock lobster sanctuary falling within the buffer zone of the Namibian Islands' Marine Protected Area.

The proposed 2D / 3D seismic survey area is far offshore from the Namibian Islands' Marine Protected Area (NIMPA) and coastal sensitive environments.

Table 4.4: PART III Coordinates of the Namibian Islands' Marine Protected Area.

All-encompassing buffer zone of the Namibian Islands' Marine Protected Area	**Latitude South**	**Longitude East**
North-West corner extends from this point straight east to the high-water mark on the coastline	24°29'10"	14°30'00"
Point west of Black Reef	24°33'19"	14°29'15"
Point west of Easter Point	25°17'34"	14°35'29"
Point west of Dolphin Head	25°44'24"	14°39'16"
Point south-west of Douglas Point	26°20'32"	14°44'25"
Point west of Elizabeth Point	26°55'28"	14°55'44"
Point north-west of Van Reenen Bay	27°21'13"	15°04'00"
South-West corner extends from this point straight east to the high-water mark on the coastline	27°57'34"	15°28'05"
The eastern border is the high-water mark on the coastline opposite the western border		

Table 4.5 Islands, islets, rocks, line fish sanctuary and rock lobster sanctuary falling within the buffer zone of the Namibian Islands' Marine Protected Area.

Islands	**Latitude S**	**Longitude E**
Hollamsbird Island	24°38'22"	14°31'51"
Mercury Island	25°43'10"	14°49'58"
Ichaboe Island	26°17'20"	14°56'11"
Seal Island	26°35'45"	15°09'22"
Penguin Island	26°37'00"	15°09'14"
Halifax Island	26°39'04"	15°04'47"
Possession Island	27°00'45"	15°11'37"
Pomona Island	27°11'37"	15°15'28"
Plumpudding Island	27°38'30"	15°30'49"
Sinclair Island	27°39'55"	15°31'13"
Islets and Rocks		
Neglectus Islet	26°08'11"	14°56'46"
Disused jetty in Hottentot Bay	26°08'30"	14°56'44"
Unnamed rock (near Danger Point)	26°14'45"	14°57'16"
Marshall Rocks	26°21'21"	14°57'31"
Staple Rocks	26°21'15"	14°58'46"
Boat Bay Rocks	26°25'16"	15°05'24"
Dumfudgeon Rocks	26°29'34"	15°07'01"
Ladies Rocks (N Rock)	26°51'26"	15°09'10"
Ladies Rocks (S Rock)	26°51'37"	15°09'11"
Long Island – North	26°49'10"	15°07'30"
Long Island – South	26°49'54"	15°07'41"
Albatross Rock	27°07'08"	15°14'17"
line fish sanctuary		
North-West corner of sanctuary (Northern border extends from this point straight east to the high-water mark on the coastline)	24°29'10"	14°30'00"
Point west of Black Reef	24°33'19"	14°29'15"
Point west of Black Rock	24°57'23"	14°42'25"
South-West corner of sanctuary (Southern border off Sylvia Hill extends from this point straight east to the high-water mark on the coastline_	25°09'57"	14°44'02"
rock lobster sanctuary		
North-West corner of sanctuary (Northern border extends from this point straight east to the high-water mark on the coastline)	27°03'43"	15°11'56"
Point west of Prinzenbucht	27°06'33"	15°12'44"
Point west of Pomona	27°12'02"	15°13'25"
Point west of Van Reenen Bay	27°24'42"	15°19'25"
Point west of Baker's Bay	27°40'17"	15°27'00"
SW corner of sanctuary (Southern border off Chamais Bay extends from this point straight east to the high-water mark on the coastline)	27°55'52"	15°38'15"

4.7.2 Ecologically or Biologically Significant Marine Area (EBSA).

The following is the summary of the Ecologically or Biologically Significant Areas (EBSAs) that have been delineated in Namibia (Fig. 4.29): Orange Seamount and Canyon Complex, Orange Cone, Namibian Islands, Namib Flyway, Walvis Ridge Namibia, Cape Fria, and Namibe.

There are two (2) biodiversity zones ('Conservation' and 'Impact Management') that have recently been defined within the EBSA as part of the ongoing Marine Spatial Planning (MSP) process being undertaken by the MFMR in Namibia (Fig. 4.29). MSP is being conducted in collaboration with South Africa and Angola within the marine border areas.

The following is the summary of the key management objectives of each demarcated biodiversity zones:

- ❖ Conservation Zone: Strict place-based biodiversity protection aimed at securing key biodiversity features in a natural or semi-natural state, or as near to this state as possible, and potentially destructive activities conditionally permissible through regulatory consent, and.

- ❖ Impact Management Zone: Is a multiple use area with management objectives focused on keeping key biodiversity features in at least a functional state.

Although EBSAs area have been delineated within the framework of the ongoing Marine Spatial Planning (MSP) process driven by the Ministry of Fisheries and Marine Resources, these areas are not formally proclaimed Marine Protected Areas (MPAs) or no-go areas. Various marine based activities including petroleum exploration activities are conditionally permissible through the current existing general regulatory consent frameworks such as the EIA Regulations 2012. An ECC shall be obtained from the Government before the Proponent start to acquire 2D/3D seismic survey data over the AOI (Fig. 4.29).

(i) Namibe (Kunene Tigres): There is no overlap with AOI.

(ii) Cape Fria: There is no overlap with AOI.

(iii) Walvis Ridge Namibia: There is an overlap with the AOI.

(iv) Namib Flyway: There is no overlap with the AOI.

(v) Namibian Islands: There is no overlap with the AOI.

(vi) Orange Seamount and Canyon Complex: There is an overlap with the AOI, and.

(vii) Orange Cone: There is no overlap with AOI.

4.7.3 Summary of the Onshore Environment and Protected Areas

The entire Namibian coastline is virtually protected in one way or another, north to south this includes, Dorob National Park, the Skeleton Coast National Park (SCNP), the West Coast Recreation Area (WCRA), Cape Cross Seal Reserve (CCSR), Walvis Bay Nature Reserve (WBNR), Walvis Bay Lagoon sites, the Namib-Naukluft National Park (NNNP) and the Tsau //Khaeb (Sperrgebiet) National Park (Figs. 4.29 and 4.30). The coastal belt is a very pristine and sensitive area and should be protected under one or another measure or control (Plates 4.1-4.3).

A number of ephemeral rivers mouths between the Orange and Kunene Rivers Mouths play a significant role and are key habitat areas of the coastal zone (Plates 4.1-4.3). The intertidal zone (i.e., the area between the low and high-water marks) provides foraging habitat to large numbers of shorebirds, including a number of migratory species, as well as two species of gulls. Foraging habitat for shorebirds includes both rocky and sandy substrates. stranded kelp and associated isopod, insect and polychaete communities may support high densities of shorebirds. Because these wetlands are widely spaced and relatively small in extent, they offer crucial foraging and roosting habitat to a large number of birds, including resident species and a range of shorebirds migrating along the western coast of Africa and may support tens of thousands of birds (Whitelaw et al. 1978, Williams 1993, Wearne and Underhill 2005).

The array of Walvis Bay wetlands, consisting of the Walvis Bay lagoon, mudflats, shoreline and salt works, is rated as the most important coastal wetland in southern Africa and one of the three top coastal wetlands in Africa for palaearctic birds (Wearne and Underhill 2005). These wetlands regularly support a minimum of 20 000 birds at any time, but may support up to 250 000 birds (Plates 4.1 and 4.2). They support up to 70% of the global population of Chestnut-banded Plovers, 40% of the African sub-species of Black-necked Grebe and 80% of the southern African population of Lesser Flamingo (Robertson et al. 2012, http:// www. nnf. org. na / CETN / ramsar.htm).

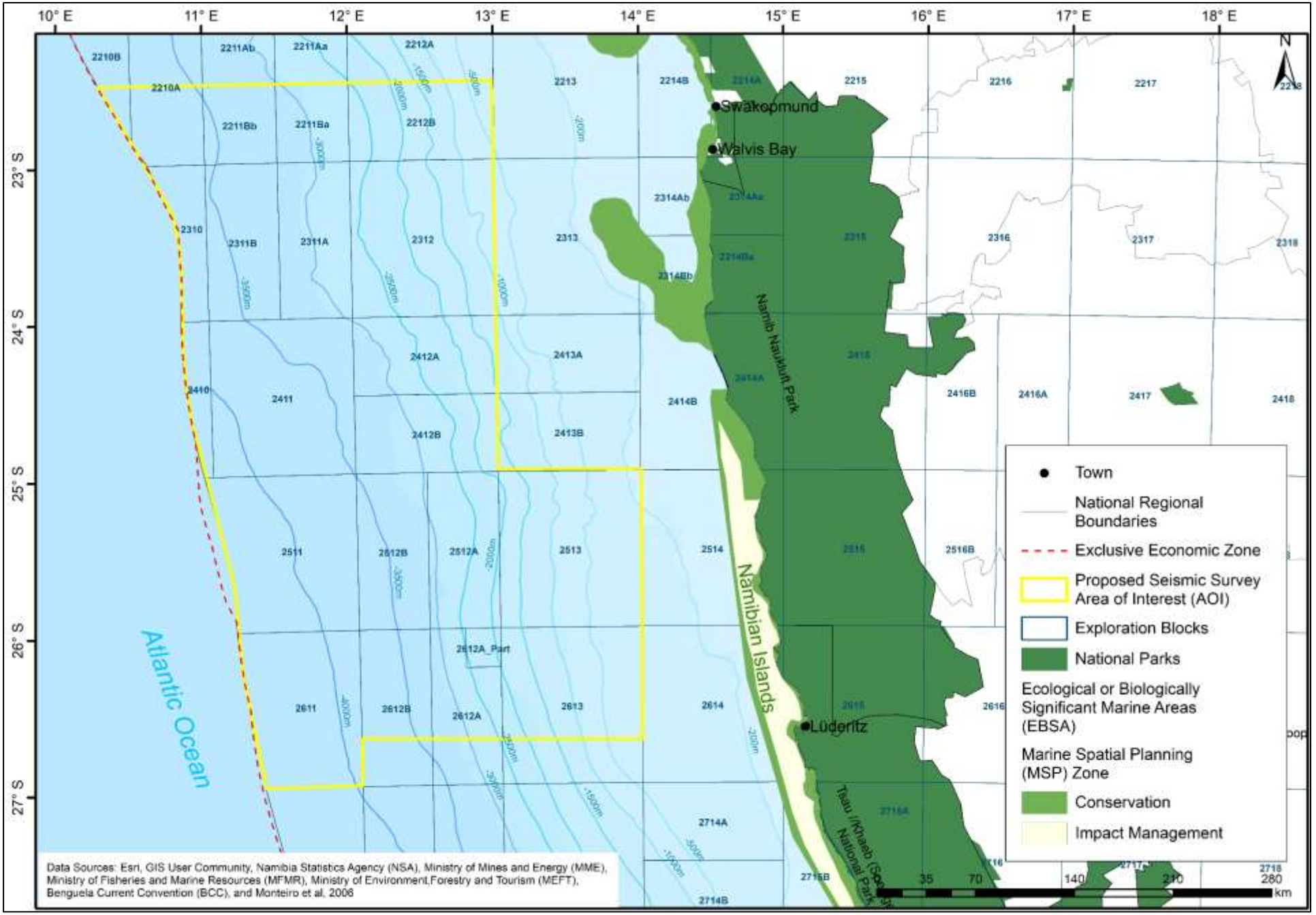


Figure 4.29: Ecologically or Biologically Significant Marine Area (EBSA) with respect to the proposed 2D / 3D seismic survey area of interest (Data Source: MFMR, https://geodata.benguelacc.org).

Figure 4.30: Sensitive protected areas along the Namibian coastline. The proposed survey area is situated far offshore and away from the coastline, onshore and Marine Protected Areas (Source: http://www.meft.gov.na).

Plate 4.1: Walvis Bay Lagoon (a) and (b), Ugab Ephemeral River Mouth (C) and Cape Cross Seal Colony at the Cape Cross Seal Reserve (d) (RBS Geotagged Images Series 2019).

Plate 4.2: Kunene River Mouth (a) – (c) and pristine coastline south of Kunene River Mouth, Skeleton Coast National Park (d) (RBS Geotagged Images Series 2022).

Plate 4.3: Orange River Mouth (RBS Geotagged Images Series 2023).

4.8 Public and Stakeholders Consultation Process

4.8.1 Objective of Undertaking Consultation Process

The overall objective of undertaking the public and stakeholder consultation process was to inform all the Interested and Affected Parties (I&APs) about the proposed project activities, disclose the Terms of Reference, the assessment and management reports and allow for inputs, comments or objections of the proposed Multiclient / Proprietary 2D/3D seismic survey operations.

4.8.2 Environmental Consultant and Proponent Roles and Responsibilities

Risk-Based Solutions (RBS) had the overall responsibilities for implementing the public and stakeholder consultation activities as part of the Scoping, EIA and EMP processes as required by the regulations as well as the Proponent corporate requirements. The RBS Consultants were responsible for the implementation of the consultation process including organising and conducting all the consultation events.

Direct contact and engagement of other marine users such as fisheries, fishing and other marine users in Walvis Bay, Swakopmund, Lüderitz, Oranjemund and Henties Bay were undertaken by Mr Percival Anthony Rinquest who is a qualified and experienced Marine Mammal Observer (MMO) and Fisheries Liaison Officers (FLO) based on Walvis Bay.

Stakeholder communications as well as the review and quality control of all technical reports, document and letters were managed by Dr Sindila Mwiya and Dr Vita Stankevica, the Project Directors and Quality Control Manager respectively. The Proponent provided all the applicable proposed project specific information such as the survey coordinates, boundary, maps, survey vessels/s to be used, timing and 2D/3D seismic survey technical specifications.

4.8.3 Consultation Approach and Implementation

The public and stakeholder consultation approach and implementation were undertaken in line with the provisions of the EIA Regulations, 2012. The public and stakeholder consultation process was undertaken during the months October and November 2023.

A Stakeholder Registered was opened on Tuesday, 31st October 2023 as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and EIA Regulations, 2012.

During the months of October and November 2023, public notices were published in the following local newspapers as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and EIA Regulations, 2012 (Figs. 4.31 - 4.34):

(i) New Era Daily English Newspaper dated Friday, 27th October 2023.

(ii) Market Watch Insert in Allgemeine Zeitung (Namibian German) Daily Newspaper dated Tuesday, 31st October 2023.

(iii) Market Watch Insert in Namibian Sun (Namibian English) Daily Newspaper dated Tuesday, 31st October 2023, and.

(iv) Market Watch Insert in Republikein (Afrikaans Newspaper) Daily Newspaper dated Tuesday, 31st October 2023.

The deadline for registration and submission of inputs, comments or objection was Friday, 17th November 2023 (Figs. 4.31 - 4.34 and Annex 2). Public notices were also placed at the following key multiple strategic locations in the town of Lüderitz (Plate 4.4 and Annex 2): //Karas Regional Council Office Notice Board, Lüderitz Town Council Office Notice Board, OK Shopping Center Notice Board), and Benguela Community Hall.

As part of the public and stakeholder consultation process, a public meeting was organised in Lüderitz on Tuesday 7th November 2023, at the Benguela Community Hall from 09hrs00-12hrs00 (Plate 4.5 and Annex 2). Minutes of the meeting and the stakeholder are provided in Annex 2. Table 4.6 provides detailed information on the timing and type of activities that have been undertaken as part of the environmental assessment process during the months of October and November 2023.

4.8.4 Interested and Affected Party Disclosures / Requirements

All the Interested and Affected Parties (I&APs) requesting for registration were asked to discloses their interest as provided for in the EIA Regulations, 2012, Regulation 23 (1), (b) which states as follows:

(1) A registered interested or affected party is entitled to comment in writing, on all written submissions made to the Environmental Commissioner by the applicant responsible for the application, and to bring to the attention of the Environmental Commissioner any issues which that party, believes may be of significance to the consideration of the application, as long as:

(a) the interested and affected party discloses any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the application.

Registered interested or affected parties were given the opportunity to comment in writing, on all written submissions made to the Environmental Commissioner by the applicant responsible for the application, and to bring to the attention of the Environmental Commissioner any issues which any party, believed may be of significance to the consideration of the application, subject to the comments being submitted within seven (7) days of notification of an application or receiving access to a scoping report or an assessment report; or the interested and affected party discloses any direct business, financial, personal or other interest which that party may have in the approval or refusal of the application.

4.8.5 Consultations Outcomes and Recommendations

Public and stakeholder engagements undertaken during the months of August and September 2023, were all aimed at informing and disclosing to the I&APs all the aspects of the proposed Multiclient/Proprietary 2D/3D seismic survey operations and the overall influence on the receiving marine environment.

The following topics were covered in the adverts, public notices, presentations at all the public meeting held in Lüderitz as well as in the distributed stakeholder consultations materials such as the BID and Scoping Reports:

- Oil and gas licensing regime.
- Evolution of sedimentary basin and how oil and gas is formed.
- Historical perspective on marine seismic survey in Namibia.
- PEL, Block, AOI, seismic survey, well drilling & oil /gas field.
- Key AOI for Proposed Offshore 2D/3D Seismic Survey.
- Offshore 2D/3D seismic survey and compliance requirements.
- Environmental assessment process, EMA, 2007 and EIA Regulations 2012.
- Overview of marine seismic survey.
- AOI and living marine resources receiving environment.
- AOI, commercial fishing grounds and MFMR stock assessment survey areas.

- ❖ AOI and tuna landings.
- ❖ Understanding constructive and destructive waves interferences with respect to marine seismic survey and the receiving marine biological environment.
- ❖ Underwater noise acoustic modelling.
- ❖ Likely sources of negative marine receiving environment.
- ❖ Potential positive impacts assessment.
- ❖ International best practices seismic survey mitigation measures.
- ❖ Illustration of offshore seismic survey mitigation measures using a video, and.
- ❖ Knowledge-Based System Model Methodology (KBSMM) opportunity for coexistence framework.

No written objections to the proposed seismic survey operations in the Walvis, Orange and Lüderitz Basins, offshore northcentral Namibia have been received during the consultation process undertaken during the months October-November 2023.

It is important that all the key identified stakeholders and especially all the other marine users including all the key fishing companies and associations, petroleum operators / PEL holders, other marine minerals exploration companies and key marine Government regulators (Ministry of Mines and Energy, Ministry of Environment, Forestry and Tourism, Ministry of Fisheries and Marine Resources and Ministry of Works and Transport) are notified before the start each of the proposed Multiclient / Proprietary 2D/3D seismic survey event operations by the Proponent.

Table 4.6: Detailed activities and timing of Interested and Affected Parties (I&APs) consultation process undertaken as part of the EIA process.

SCOPING, EIA AND EMP PROJECT CONSULTATION ACTIVITIES	SCOPING STAGE INFORMATION TO DISCLOSED	STAKEHOLDER TARGET GROUP	RESPONSIBILITY

ACTIVITIES	2023			2024
	Oct	Nov	Dec	Jan
1. Project screening				
2. Prepared Summarised Background Information Document (BID) and Scoping				
3. Prepared Public Advert				
4. Opened a Stakeholder Register and updated continuously				
5. Directly contacted and engaged the key Interested and Affected Parties, especially other marine users such as fisheries and fishing companies				
6. Registered the project with the Environmental Commissioner in the Ministry of Environment Forestry and Tourism (MEFT) via Ministry of Mines and Energy (MME)				
7. Twenty (21) days of public and stakeholder consultations from the date of 1st publication. Public notices will be published in the New Era Daily (English) Newspaper, Market Watch of the Namibian Sun (English), Republikein (Afrikaans Newspaper) and Allgemeine Zeitung (Namibian German Newspaper) during the months of October and November 2023. Public Notices placed at the key strategic locations in Oranjemund (Bank Windhoek Boarder Post Notice Board, First National Bank Notice Board and Spar Shopping Centre) and Lüderitz (//Karas Regional Council Office Notice Board, Lüderitz Town Council Offices Notice Board and OK Shopping Center Notice Board).				
8. Prepared Final Scoping / BID, Draft EIA and EMP Report				
9. Draft EIA and EMP Reports as may be applicable based on the inputs and comments obtained during the public and stakeholder consultation process				
10. Submit the Application for ECC to the Environmental Commissioner supported by the final EIA and EMP Reports				

1. Background Information Document (BID) summarising the proposed project
2. Draft Scoping Report with Terms of Reference (ToR) for EIA and EMP inclusive of specialist studies undertaken
3. Final EIA and EMP Reports Prepared

1. Namibia central government ministries.
2. Namibia regional government.
3. Namibia local government.
4. Other key government organs of State, and.
5. Namibia state owned enterprises

1. Fisheries / marine related associations / bodies.
2. Business (Private sector) organisation associations / bodies.
3. Project contractors and business partners

1. National Non-Governmental Organisations (NGOs) and Community Based Organisations (CBOs).
2. Regional/ local bodies / initiatives (such as Benguela Current Commission (BCC)
3. Interested and Affected Parties (I&AP) / Public

- ❖ Risk-Based Solutions (RBS) conducted the stakeholder consultation on behalf of the Proponent
- ❖ The Proponent provided all the applicable proposed project survey coordinates, boundary, maps, survey vessels/s to be used, and the proposed Multiclient / Proprietary 2D/3D seismic survey technical specifications

VACANCY ANNOUNCEMENT

DIGITAL FUNDRAISING OFFICER

This position will play a vital role in driving donor acquisition and managing fundraising campaigns for our organisation. If you have a passion for community engagement, strong skills in digital marketing, and graphic design, and a talent for creative content development, we want to hear from you! Minimum requirements: Bachelor's degree in Marketing and Communications or Graphic Design, with three years' experience. The full job description is available on www.sosnamibia.org.na

If you are interested, please email your detailed CVs and supporting documents to recruitment.hr@sos-namibia.org on or **before 03 November 2023.**

TELEMARKETING OFFICER

This position will be responsible for talking to potential customers on the phone to solicit donations. Duties include tracking customer contact lists, explaining the benefits of products and taking payment information. Keep detailed records of all calls and donor interactions, making notes of follow-up actions or future commitments from donors. Minimum requirements: Bachelor's degree in Marketing, Sales or Communications with three years' experience. The full job description is available on www.sosnamibia.org.na

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SOS CHILDREN'S VILLAGES

NCHE

EQUITABLE ACCESS TO QUALITY HIGHER EDUCATION

URGENT NOTICE:

Did you complete your studies in 2019, 2020 or 2021?

Pursuant to its mandates of promoting the establishment of a coordinated higher education system and quality assurance in higher education institutions, the National Council for Higher Education (NCHE) coordinates the undertaking of the National Graduate Surveys for graduates who completed their studies in Namibia.

The main objective of the National Graduate Survey is to evaluate the quality of higher education by assessing the general impact of the programmes on the graduates and their usefulness in the labour market.

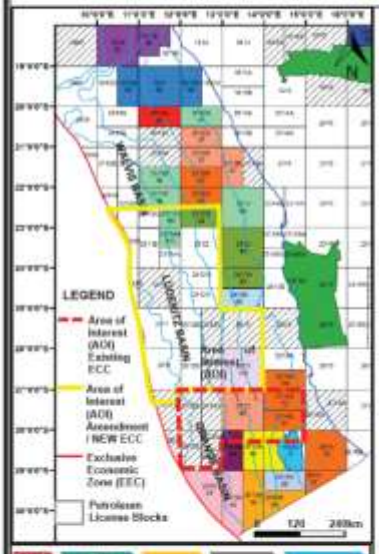
In preparation for the upcoming 2024 National Graduate Survey, NCHE is contacting graduates from the five (5) participating institutions namely, UNAM, NUST, IUM, IOL and NAMCOL to establish a sampling frame for the survey.

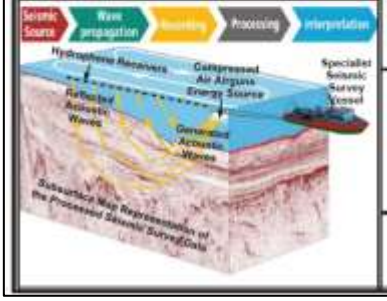
NCHE is, therefore, calling the graduates who completed their studies in 2019, 2020 and 2021 to update their contact details, and your cooperation in this regard would be appreciated.

For more information contact us at:
Email: hemis@nche.org.na
Telephone: 061-2871500

PUBLIC NOTICE FOR APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

PGS Exploration (UK) Limited (Proponent) Proposed Multiclient/Proprietary 2D / 3D Area of Interest (AOI), Orange, Lüderitz and Walvis Basins, Offshore Namibia





PGS EXPLORATION (UK) LIMITED (PROPONENT) intends to apply for an Amended and New Environmental Clearance Certificates (ECCs) over the outlined Area of Interest (AOI) with respect to the proposed potential Multiclient/Proprietary 2D / 3D seismic survey location specific projects that may be originated within the outlined AOI. The outlined AOI covers Blocks 2511, 2611, 2512B, 2512A, 2513, 2612B, 2612A, 2613, 2412B, 2411, 2410, 2310, 2311B, 2311Aa, 2311Ab, 2312, 2212B, 2211Ba, 2211Bb, 2210A and 2210B, falling in the Orange, Lüderitz and Walvis Basins, offshore deep-water, south-central Namibia. The Proposed AOI falls in water depths ranging from ca-200m to more than ca-4000m, from east to west, respectively. Although the outlined AOI represents a large area coverage, the actual likely location specific Multiclient/Proprietary 2D/3D seismic survey projects to be originated within the outlined AOI will be limited to the specific Petroleum Exploration Licenses (PELs) with potential high prospectivity opportunities. The likelihood of implementing specific projects within the proposed AOI will largely depend on the expression of interests by the PELs holders or the Government through NAMCOR wanting to acquire Multiclient/Proprietary 2D/3D seismic data sets for their respective AOIs.

The overall aim of undertaken Multiclient/Proprietary 2D/3D seismic survey seismic surveys is to map the subsurface of the key potential targeted areas within the outlined AOI. Although offshore seismic surveys operations in Namibia began as far back as 1968, a lot more still need to be done to have a full understanding of the subsurface geology, and petroleum systems of the deep-water offshore Namibia. The datasets from the potential Multiclient/Proprietary 2D/3D seismic surveys will provide critical insight into the regional and local subsurface geological evolution, deep-water offshore basin architecture, depositional, structural history and delineate potential drill-ready subsurface potential reservoirs likely to be situated kilometres below the seafloor. Seismic survey data sets generated can also be utilised in the search for natural suitable Carbon Capture and Storage (CCS) banking terrains as one of the possible options for Climate Change long-term global mitigation strategies. In oil and gas exploration, seismic survey data sets reduce the risk of drilling multiple dry wells, improve the chances for commercial discovery and reduces the environmental impacts of drilling more wells in the search for oil and gas resources.

The marine seismic survey is conducted using a specialist survey vessel towing an energy source in form of a compressed air source and hydrophone receivers. During the survey, compressed air is released to generate seismic acoustic signals/waves at regular intervals. The generated acoustic waves travel deep into the subsurface of the earth and get reflected by various rock formations of the subsurface at different depths below the seafloor. The returned signals get recorded and measured by receiving devices called hydrophones. Geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential subsurface geological structures called reservoirs that may contain potential commercial hydrocarbons resources. This is achieved by analysing the two-way travel times of the seismic waves through the various subsurface rock layers and the surface. 2D seismic survey is a regional mapping / imaging methodology aimed at de-risking an exploration project by establishing a validated Sedimentary Basin Scale Model of an exploration AOI. 3D seismic survey on the other hand, is a detailed local mapping / imaging methodology aimed at de-risking an exploration project by establishing a local validated Prospect/s or Lead/s Scale Models of an exploration AOI. 3D and 2D seismic surveys data sets are acquired on local to subregional dense and regional widely spaced survey grids / spacings, respectively.

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REGISTER BY EMAIL WITH: Ms Emerita Ashipala (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant),
Email: emerita.ashipala@gmail.com
For more technical clarifications on marine /offshore subsurface mapping using seismic survey operations, the receiving environment and oil and gas exploration and production, please contact Dr Sindila Mwiya EAP/Technical Permitting Advisor/ International Resources Consultant,
Email: frontdesk@rbs.com.na

A PUBLIC MEETINGS HAS BEEN ORGANISED IN LÜDERITZ AS FOLLOWS:
LÜDERITZ: Tuesday 7th NOVEMBER 2023, PLACE: Benguela Community Hall, Lüderitz Town, TIME: From 09hrs00-12hrs00

Risk-Based Solutions (RBS) CC (URL: www.rbs.com.na)
Your Technical Specialist Consultants, Permitting & De-Risking Advisors in Natural Resources covering Petroleum Exploration & Production/ Minerals Exploration & Mining / Energy / Water / Environmental Assessments & Management (ESIA, SEA, EIA, EMP, EMS)
Find Us @ 10 Schützen Street, ERF No. 7382, Swiedis House-Home of RBS, Tel: +264-61-306058 / 224780 | 236598

Figure 4.31: Copy of the Public Notice Advert No. 1 published in the New Era Daily English Newspaper dated Friday, 27 October 2023.

To soften blow of budget cuts

South Africa plans to raise borrowing

South Africa has about R4.3 trillion of debt and spends 18c of every tax rand collected on debt service costs.

CAROL PATON

South Africa's Finance Minister Enoch Godongwana says he will "bump up borrowing" to soften the blow of budget cuts when he tables the medium-term policy statement on Wednesday.

Speaking at the Kgalema Motlanthe Foundation Inclusive Growth Forum in the Drakensberg on Friday evening, Godongwana painted a dire picture of the state of public finances, and said that if nothing was done about public debt, South Africa would have no cash by the end of March next year.

South Africa has about R4.3 trillion of debt and spends 18c of every tax rand collected on debt service costs. Godongwana said SA had been hit by a triple whammy of falling revenue due to low growth, a rising cost of borrowing, and the dumping of South Africa government bonds by foreign investors.

Said Godongwana: "The problem with debt is not its size, it is the capacity of the economy to service it. In this environment, our capacity to service it is constrained. And what complicates things is that we have to redeem old debt. This year alone, the amount we are going to redeem is such that if we don't do anything, we won't have cash by the end of March. Am I scaring you too much? We have to cut expenditure and increase borrowing."

> *The problem with debt is not its size, it is the capacity of the economy to service it. In this environment, our capacity to service it is constrained.*
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> **Enoch Godongwana, Finance Minister: SA**

ELECTION

Godongwana's plan to make budget cuts in an election year has come under fire in the ANC.

"They call me Mr Austerity, I don't like it, but I can live with it," he said.

He said the proposed budget cuts would be smaller than the amount by which government typically underspends on its budget. In the last financial year, state departments underspent by R28 billion. In the previous year, underspending amounted to R31 billion.

Two of the biggest factors weighing down debt are load shedding and the deteriorating logistics capacity which is constraining mining exports.

The government had made the mistake in the past by focusing on fixing Eskom when what was needed was to fix the electricity supply system.

The same mistake should not be made with Transnet, said Godongwana.

Transnet's new turnaround plan involves a request for an R47-billion capital injection and R61 billion of debt relief. Rather than focusing on fixing Transnet, the government should focus on getting products to the ports, he said. -Fin24

South Africa's Finance Minister Enoch Godongwana. PHOTO REUTERS

Ministry to host consumer protection workshop

ELIJAH MUKUBONDA

The Ministry of Industrialisation and Trade is in the process of developing the Consumer Protection Legislation to protect consumers from unfair, deceptive, and fraudulent business practices.

In alliance with the United States Federal Trade Commission (USFTC), the Ministry is hosting a Consumer Protection workshop from 1-3 November 2023 at Hilton Hotel in Windhoek, within its mandate to facilitate and strengthen stakeholder engagements, dialogue and cooperation.

The seminar is expecting to host more than 50 participants and officials from neighbouring Botswana, Zambia and South Africa to promote cross-pollination of ideas from experts in the field.

The scheduled workshop is themed 'Consumer Protection and E-commerce' and seeks to demystify the development of the consumer protection legislation in relation to the current framework for consumer protection in Namibia and prospects for reform; emerging consumer protection trends in Southern Africa and the future of reform of consumer protection laws in Namibia.

Elijah Mukubonda. PHOTO FILE

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Figure 4.32: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Allgemeine Zeitung (Namibian German) Daily Newspaper dated Tuesday, 31st October 2023.

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South Africa plans to raise borrowing

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CAROL PATON

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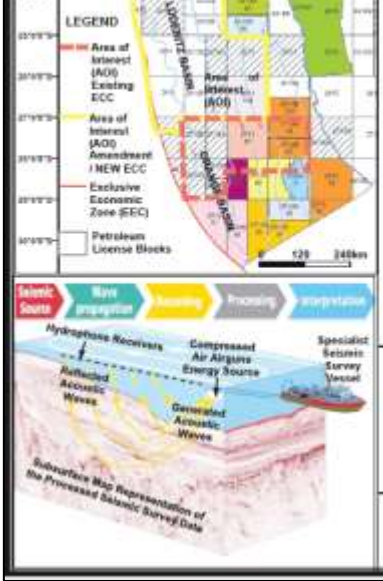

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The potential Multiclient/Proprietary 2D / 3D seismic survey location specific projects to be undertaken within the AOI, will be conducted using a MARPOL / Namibian Maritimes Laws compliant vessels and will adopt the well-established international best practices such as seasonality and survey implementation timing, establishment of buffer zones, use of Marine Mammal Observers (MMOs) & Fisheries Liaison Officers (FLOs), use of Passive Acoustic Monitoring (PAM) technology, soft starts' and 'pre-firing' observations, termination of firing in the 500m exclusion zone and use of turtle friendly tail buoys. The potential seismic survey activities within the proposed AOI cannot be undertaken without an Environmental Clearance Certificate (ECC) as provided for in the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. The Proponent is required to have undertaken environmental assessment process and the preparation of the EIA and Environmental Management Plan (EMP) Reports to support the application for ECC. In fulfilment of these environmental requirements, the Proponent has appointed Risk-Based Solutions (RBS) CC as the Environmental Consultant, led by Dr Sindila Mweya and supported by Ms Emerita Ashipala as the Environmental Assessment Practitioners (EAPs) to prepare the EIA and EMP Reports. All Interested and Affected Parties (I&APs) are hereby invited to register and submit written comments / objections / inputs with respect to the potential Multiclient/Proprietary 2D / 3D seismic survey to be undertaken within the proposed outlined AOI in Orange, Lüderitz and Walvis Basins, offshore Namibia. A Background Information Document (BID) and Project Reports are available for comments upon registration as a stakeholder / Interested and / Affected Party (I&AP). NOTE: In terms of the provisions of the EIA Regulation 23 (1), an I&AP is required to disclose, on registration any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the ECC application.

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Email: emerita.ashipala@gmail.com
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Email: frontdesk@rbs.com.na

A PUBLIC MEETINGS HAS BEEN ORGANISED IN LÜDERITZ AS FOLLOWS
LÜDERITZ: Tuesday 7th NOVEMBER 2023, PLACE: Benguela Community Hall, Lüderitz Town, TIME: From 09hrs00-12hrs00

Risk-Based Solutions (RBS) CC (URL: www.rbs.com.na)
Your Technical Specialist Consultants, Permitting & De-Risking Advisors in Natural Resources covering Petroleum Exploration & Production/ Minerals Exploration & Mining / Energy / Water / Environmental Assessments & Management (ESS, SEA, EIA, EMP, EMS)
Find Us @ 10 Schützen Street, Erf No. 7382, Swieda House-Home of RBS, Tel: +264-61-306058 / 224790 / 296598

Figure 4.33: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Namibian Sun (Namibian English) Daily Newspaper dated Tuesday, 31st October 2023.

To soften blow of budget cuts

South Africa plans to raise borrowing

South Africa has about R4.3 trillion of debt and spends 18c of every tax rand collected on debt service costs.

CAROL PATON

South Africa's Finance Minister Enoch Godongwana says he will "bump up borrowing" to soften the blow of budget cuts when he tables the medium-term policy statement on Wednesday.

Speaking at the Kgalema Motlanthe Foundation Inclusive Growth Forum in the Drakensberg on Friday evening, Godongwana painted a dire picture of the state of public finances, and said that if nothing was done about public debt, South Africa would have no cash by the end of March next year.

South Africa has about R4.3 trillion of debt and spends 18c of every tax rand collected on debt service costs. Godongwana said SA had been hit by a triple whammy of falling revenue due to low growth, a rising cost of borrowing, and the dumping of South Africa government bonds by foreign investors.

Said Godongwana: "The problem with debt is not its size, it is the capacity of the economy to service it. In this environment, our capacity to service it is constrained. And what complicates things is that we have to redeem old debt. This year alone, the amount we are going to redeem is such that if we don't do anything, we won't have cash by the end of March. Am I scaring you too much? We have to cut expenditure and increase borrowing."

> *The problem with debt is not its size, it is the capacity of the economy to service it. In this environment, our capacity to service it is constrained.*
>
> **Enoch Godongwana, Finance Minister: SA**

ELECTION

Godongwana's plan to make budget cuts in an election year has come under fire in the ANC.

"They call me Mr Austerity, I don't like it, but I can live with it," he said.

He said the proposed budget cuts would be smaller than the amount by which government typically underspends on its budget. In the last financial year, state departments underspent by R28 billion. In the previous year, underspending amounted to R31 billion.

Two of the biggest factors weighing down debt are load shedding and the deteriorating logistics capacity which is constraining mining exports.

The government had made the mistake in the past by focusing on fixing Eskom when what was needed was to fix the electricity supply system.

The same mistake should not be made with Transnet, said Godongwana.

Transnet's new turnaround plan involves a request for an R47-billion capital injection and R61 billion of debt relief. Rather than focusing on fixing Transnet, the government should focus on getting products to the ports, he said. -fin24

South Africa's Finance Minister Enoch Godongwana. PHOTO REUTERS

Ministry to host consumer protection workshop

ELIJAH MUKUBONDA

The Ministry of Industrialisation and Trade is in the process of developing the Consumer Protection Legislation to protect consumers from unfair, deceptive, and fraudulent business practices.

In alliance with the United States Federal Trade Commission (USFTC), the Ministry is hosting a Consumer Protection workshop from 1-3 November 2023 at Hilton Hotel in Windhoek, within its mandate to facilitate and strengthen stakeholder engagements, dialogue and cooperation.

The seminar is expecting to host more than 50 participants and officials from neighbouring Botswana, Zambia and South Africa to promote cross-pollination of ideas from experts in the field.

The scheduled workshop is themed 'Consumer Protection and E-commerce' and seeks to demystify the development of the consumer protection legislation in relation to the current framework for consumer protection in Namibia and prospects for reform; emerging consumer protection trends in Southern Africa and the future of reform of consumer protection laws in Namibia.

Elijah Mukubonda. PHOTO FILE

PUBLIC NOTICE FOR APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

PGS Exploration (UK) Limited (Proponent) Proposed Multiclient/Proprietary 2D / 3D Area of Interest (AOI), Orange, Lüderitz and Walvis Basins, Offshore Namibia

PGS EXPLORATION (UK) LIMITED (PROPONENT) intends to apply for an Amended and New Environmental Clearance Certificates (ECCs) over the outlined Area of Interest (AOI) with respect to the proposed potential Multiclient/Proprietary 2D / 3D seismic survey location specific projects that may be originated within the outlined AOI. The outlined AOI covers Blocks 2511, 2611, 2512B, 2512A, 2513, 2612B, 2612A, 2613, 2412B, 2411, 2410, 2310, 2311B, 2311Aa, 2311Ab, 2312, 2212B, 2211Ba, 2211Bb, 2210A and 2210B, falling in the Orange, Lüderitz and Walvis Basins, offshore deep-water, south-central Namibia. The Proposed AOI falls in water depths ranging from ca-200m to more than ca-4000m, from east to west, respectively. Although the outlined AOI represents a large area coverage, the actual likely location specific Multiclient/Proprietary 2D/3D seismic survey projects to be originated within the outlined AOI will be limited to the specific Petroleum Exploration Licenses (PELs) with potential high prospectivity opportunities. The likelihood of implementing specific projects within the proposed AOI will largely depend on the expression of interests by the PELs holders or the Government through NAMCOR wanting to acquire Multiclient/Proprietary 2D/3D seismic data sets for their respective AOIs.

The overall aim of undertaken Multiclient/Proprietary 2D/3D seismic survey seismic surveys is to map the subsurface of the key potential targeted areas within the outlined AOI. Although offshore seismic surveys operations in Namibia began as far back as 1968, a lot more still need to be done to have a full understanding of the subsurface geology, and petroleum systems of the deep-water offshore Namibia. The datasets from the potential Multiclient/Proprietary 2D/3D seismic surveys will provide critical insight into the regional and local subsurface geological evolution, deep-water offshore basin architecture, depositional, structural history and delineate potential drill-ready subsurface potential reservoirs likely to be situated kilometres below the seafloor. Seismic survey data sets generated can also be utilised in the search for natural suitable Carbon Capture and Storage (CCS) banking terrains as one of the possible options for Climate Change long-term global mitigation strategies. In oil and gas exploration, seismic survey data sets reduce the risk of drilling multiple dry wells, improve the chances for commercial discovery and reduces the environmental impacts of drilling more wells in the search for oil and gas resources.

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Figure 4.34: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Republikein (Afrikaans Newspaper) Daily Newspaper dated Tuesday, 31st October 2023.

Plate 4.4: Photos of the public notices that were placed at key public strategic localities covering the //Karas Regional Council Offices, Lüderitz Town Council, OK Foods and Benguela Community Hall.

Plate 4.5: Images from the public and stakeholder meeting that was held in the town of Lüderitz on Tuesday 7th November 2023, at the Benguela Community Hall from 09hrs00-12hrs00.

5. IMPACTS ASSESSMENT

5.1 Approach and Methods

Environmental assessment process in Namibia is governed by the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 gazetted under the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007). Principles of environmental management as detailed in the Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) were considered in the environmental assessment process for the proposed 2D / 3D seismic survey.

This Environmental Impact Assessment (EIA) has been prepared following the completion of the Environmental Scoping report with stakeholder consultations and Terms of Reference for the EIA. Assessment of both positive and negative likely impacts have been undertaken as detailed in this Chapter 5 with mitigation measures presented the EMP report.

Potential receiving environmental (physical, biological and socioeconomic) effects were assessed in relation to baseline conditions, i.e., the conditions that would prevail should the project not proceed. In this assessment report, receptors are defined as elements of the natural or human environment which may interact with, or be interacted by, the project. Baseline conditions are those that existed at the time of the assessment.

It is recognised that some receptors and resources may be more vulnerable to change or to have greater importance than others. Within the Project Area of Influence (Walvis, Lüderitz and Orange Basins, offshore Namibia), the importance and sensitivity of receptors (physical, biological and socioeconomic) were determined based on professional judgement and considering the following:

- Relevant legislative or policy standards or guidelines.
- Relative importance/value assigned to existing social or environmental features and receptors.
- Capacity of the receptor to absorb change, and.
- Capacity of the receptor to recover from change.

In evaluating the severity of potential environmental impacts, the following factors have been taken into consideration:

- Receptor/ Resource Characteristics: The nature, importance and sensitivity to change of the receptors / target or resources that could be affected.
- Impact Magnitude: The magnitude of the change that is induced.
- Impact Duration: The time period over which the impact is expected to last.
- Impact Extent: The geographical extent of the induced change, and.
- Probability of Occurrence: Chance of an impact occurring.
- Regulations, Standards and Guidelines: The status of the impact in relation to regulations (e.g., discharge limits), standards (e.g., environmental quality criteria) and guidelines.

5.2 Impact Characterisation

5.2.1 Impact Rating

The overall impact severity has been categorised using a semi-quantitative subjective scale as shown in Table 5.1 for sensitivity of receptors, Table 5.2 for magnitude, Table 5.3 for duration, Table 5.4 for extent and Table 5.5 probability.

Table 5.1: Definitions used for determining the sensitivity of receptors.

SENSITIVITY RATING		CRITERIA
1	**Negligible**	The receptor or resource is resistant to change or is of little environmental value.
2	**Low**	The receptor or resource is tolerant of change without detriment to its character, is of low environmental or social value, or is of local importance.
3	**Medium**	The receptor or resource has low capacity to absorb change without fundamentally altering its present character, is of high environmental or social value, or is of national importance
4	**High**	The receptor or resource has moderate capacity to absorb change without significantly altering its present character, has some environmental or social value, or is of district/regional importance.
5	**Very High**	The receptor or resource has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental or social value, or is of international importance.

Table 5.2: Scored on a scale from 0 to 5 for impact magnitude.

SCALE	DESCRIPTION
0	no observable effect
1	low effect
2	tolerable effect
3	medium high effect
4	high effect
5	very high effect (devastation)

Table 5.3: Scored time period (duration) over which the impact is expected to last.

SCALE	DESCRIPTION
T	Temporary
P	Permanent

Table 5.4: Scored geographical extent of the induced change.

SCALE	DESCRIPTION
L	limited impact on location
O	impact of importance for municipality.
R	impact of regional character
N	impact of national character
M	impact of cross-border character

The likelihood (probability) of the pre-identified events occurring has been ascribed using a qualitative scale of probability categories (in increasing order of likelihood) as shown in Table 5.5. Likelihood is estimated based on experience and/ or evidence that such an outcome has previously occurred. Impacts resulting from routine/planned events (normal operations) are classified under category (E).

Table 5.5: Summary of the qualitative scale of probability categories (in increasing order of likelihood).

SCALE	DESCRIPTION
A	Extremely unlikely (e.g. never heard of in the industry)
B	Unlikely (e.g. heard of in the industry but considered unlikely)
C	Low likelihood (egg such incidents/impacts have occurred but are uncommon)
D	Medium likelihood (e.g. such incidents/impacts occur several times per year within the industry)
E	High likelihood (e.g. such incidents/impacts occurs several times per year at each location where such works are undertaken)

5.2.2 Determination of Significant Impact

Appropriate methodologies to assess the identified impacts have been based on recognised good practice and guidelines specific to each subject area. In order to assess the overall level of an impact, the following was established:

- ❖ The sensitivity or importance of the receptor (Table 5.6), and.
- ❖ The magnitude of the effect occurring and the change to the existing baseline conditions as a result of the project (Tables 5.1 -5.5).

The assessment of the level of impacts has been based on a four-point scale, where adverse impacts identified as 'Major' or 'Moderate' are considered 'Significant' and 'Minor' adverse impacts are considered as 'Not Significant'. Positive impacts have been classified simply as 'beneficial', where applicable.

'None' is where a resource or receptor will not be affected in any way by an activity or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.

The framework for assessing the level of adverse impacts is outlined in Table 5.6. A combination of the magnitude of the impact under consideration and the sensitivity of the receiving environment determines the significance of the impact.

Table 5.6: Determination of significance impact.

IMPACT SEVERITY (Magnitude, Duration, Extent, Probability)	**RECEPTOR CHARACTERISTICS (SENSITIVITY)**				
	Very High (5)	**High (4)**	**Medium (3)**	**Low (2)**	**Negligible (1)**
Very High (5)	Major [5/5]	Major [4/5[	Moderate [3/5]	Moderate [2 /5]	Minor 1/5
High (4)	Major [5/4]	Major [4/4]	Moderate [3/4]	Moderate [2/4]	Minor [1/4]
Medium (3)	Major [5/3]	Moderate [4/3]	Moderate [3/3]	Minor [2/3]	None [1/3]
Low (2)	Moderate [5/2]	Moderate [4/2]	Minor [3/2]	None [2/2]	None [1/2]
Negligible (1)	Minor [5/1]	Minor [4/1]	None [3/1]	None [2/1]	None [1/1]

5.3 Assessment of Project Alternatives, Assumptions and Limitations

5.3.1 Assessment of Project Alternatives

The following project alternatives that have been considered in this environmental assessment:

(i) **Project Location:** Several potential geological horizons with potential hydrocarbons opportunities are known to exist in the offshore waters of Namibia covering the Walvis, Lüderitz and Orange Basins, offshore Namibia. The Proponent, however, is specifically targeting to map the petroleum systems in terms of potential source and reservoir rocks occurrences in the Walvis, Lüderitz and Orange Basins, offshore Namibia. The proposed survey is site-specific and related to the regional and local geology of the marine environment to which there are no alternatives sites to consider with respect to the targeted specific geological horizon. The only other alternative is the no-action option (no exploration activities are implemented in the proposed specific area covering the Walvis, Lüderitz and Orange Basins, offshore Namibia.

(ii) **The No-Action Alternative** - A comparative assessment of the environmental impacts of the 'no-action' alternative (a future in which the proposed 2D / 3D seismic survey activities do not take place) has been undertaken. An assessment of the environmental impacts of a future, in which the proposed survey and possible discovery of economic hydrocarbons resources do not take place, may be good for the receiving marine environment because there will be no negative environmental impacts due to the proposed operation that may take place within the targeted Walvis, Lüderitz and Orange Basins, offshore Namibia. The environmental benefits will include no seismic survey activities or potential future hydrocarbons discoveries / related exploration activities with potential negative environmental impacts on the receiving marine environment will take place.

However, it is important to understand that even if the proposed 2D / 3D seismic survey activities do not take place, to which the likely negative environmental impacts are likely to be temporary, low and localised, the other current and future marine users such as fisheries, and in particular trawlers and international shipping activities will still have some negative impacts on the receiving marine environment. The likely negative environmental impacts of the other current and future marine users that may still happen in the absence of the proposed 2D / 3D seismic survey activities includes:

- ❖ Overfishing.
- ❖ Natural fish stock decline due to global Climate change and other natural and oceanic phenomena.
- ❖ Destruction of the entire Namibian seafloor being trawled, and.
- ❖ Ever increasing killing of marine birds and related innocent species being affected by uncontrolled fisheries bycatch management.

Furthermore, it is also important to understand what benefits might be lost if the proposed activities do not take place. Key loses that may never be realised if the proposed project activities do not go-ahead include:

- ❖ Loss of potential added value to the unknown potential hydrocarbons resources that may be found within the Walvis, Lüderitz and Orange Basins, offshore Namibia, socioeconomic benefits derived from current and future hydrocarbons exploration, direct and indirect contracts and employment opportunities, export earnings, foreign direct investments, license rental fees, royalties, and various other taxes payable to the Government.

(iii) **Other Alternative Marine Users:** The project area falls within the greater BCLME and border the deep-sea fisheries to the east and the international shipping lines to the west. Due to the limited scope of the proposed 2D / 3D seismic survey activities and the implementation of the EMP, it is likely that the proposed activities can coexist with the current and potential future marine users within the general area.

(iv) **Potential User Conflicts:** Through the effective implementation of the EMP and continuous and effective communication with other marine users such as the deep-sea fisheries and international shipping operators / agents, the proposed 2D / 3D seismic survey activities can coexist without user's entitlement conflicts.

(v) **Ecosystem Function** (**What the Ecosystem Does**)**:** Ecosystem functions such as wildlife habitats, carbon cycling or the trapping of nutrients and characterised by the physical, chemical, and biological processes or attributes that contribute to the self-maintenance of an ecosystem of the marine environment are vital components of the receiving environment. However, the proposed 2D / 3D seismic survey activities will not affect the ecosystem function due to the limited scope and the ecosystem of the project area is part of the larger local and regional ecosystems which are all interlinked.

(vi) **Ecosystem Services:** Food chain, harvesting of animals or plants, and the provision of clean water or scenic views are some of the local ecosystem services associated with the marine environment. However, the proposed 2D / 3D seismic survey activities will not affect the ecosystem services due to the limited scope. The ecosystem of the project area is part of the larger local and regional ecosystems which are all interlinked.

(vii) **Use Values**: The project area has direct values such as fisheries, conservation, trade (shipping) and tourism as well as indirect values, which includes watching a television show about the general marine environment and its wildlife, food chain linkages that sustains the complex life within this area and bequest value for future generations to enjoy. The proposed 2D / 3D seismic survey activities will not destroy the current use values due to the limited scope and adherence to the provisions of the EMP, and.

(viii) **Non-Use or Passive Use**: The project area has an existence value that is not linked to the direct use / benefits to current or future generations. The proposed 2D / 3D seismic survey activities will not affect the ecosystem current or future none or passive uses due to the limited scope of the activities and the ecosystem of this area is part of the larger local and regional ecosystems which are all globally interlinked.

5.3.2 Impact Assessment Assumptions and Limitations

The peer-reviewed literature showed that there is limited data on the effect of high intensity sounds on the certain species in the marine environment. In addition, conclusions are variable as to the type and significance of impacts.

The assumptions and limitations associated with this environmental assessment study are listed as follows:

- The author assumes that all information relevant to the project description and instrumentation has been made available.
- The assessments are based to a large degree on generic 2D / 3D seismic survey information and detailed survey specifications are available on request from PGS.
- There will be no significant changes to the overall project description that will have some bearing on the impact assessments made in this report and affect the recommendations, mitigation and management programme.
- Assessments are based on extrapolation on existing baseline environment and previous studies results owing to a lack of site-specific information within the survey area.
- Assessments are limited to the conclusions drawn by studies on individual or small groups of animals as no conclusive evidence exists on a population scale, and.
- It is assumed that the mitigation measures presented in the EMP Report will be incorporated into the project plan and executed by the contractor.

These limitations are not considered to in any way negatively affect the results of impact assessment described in EIA Report or the environmental management framework that will be presented in the EMP Report. The development of any project will have both positive and negative implications and impacts.

The conservation of resources, safeguarding of ecosystems and general environmental health play important roles in the maintenance of a country's economy and social structure. The purpose of any EIA is to identify all areas on which the proposed project may potentially have a *negative* bearing and to assess the magnitude of such impacts.

The development of a sound environmental management plan is based on the classification and categorization of these aspects.

5.4 Description of Likely Impacts of the Proposed Surveys

5.4.1 Summary Positive Impacts

The implementation of the proposed 2D / 3D seismic survey activities will be undertaken to attract multinational oil and gas companies to undertaken exploration to ascertain whether the Walvis, Lüderitz and Orange Basins, offshore Namibia contains potential economically viable hydrocarbon reserves. The discovery of economic hydrocarbons reserves, and the development of a successful oil and gas industry will greatly and positively transform the economic landscape of Namibia and will have direct and indirect benefits to Namibia and its people. The following is summary of the key positive impacts that the proposed 2D / 3D seismic survey activities will have on socioeconomic landscape of Namibia:

- Increased earnings by the State through rights' rentals and payment of direct and indirect taxes.
- Increased understanding and knowledge of the deep-water petroleum systems of Namibia that could finally led to the discovery of economic oil or gas resources that will change the economic landscape of Namibia for benefits of its people.
- Contributions to the national geosciences' skills development and knowledge transfer through on job training and short-term job attachments of Namibians.
- Contributions to the short and long-term strategies of attracting investments in the petroleum exploration sector in Namibia through new data acquisition, research, monitoring and management.
- Contribution to the long-term strategy that will promote the coexistence of petroleum operations with other marine users in Namibia.
- Direct contributions to the training of young Namibians through increased contributions to the national PetroFund which is currently offering several scholarships to Namibians to be able to study at foreign universities.
- Contributions to economic growth through ongoing exploration investments and potential future oil and gas discovery.
- Creation of employment opportunities through short and long-term contracts, and.
- Contribution to the development of local infrastructures and new businesses to support the ongoing oil and gas exploration opportunities particularly around the Port of Walvis Bay.

5.4.2 Potential Negative Impacts of the Proposed Surveys

5.4.2.1 Underwater Acoustic Modelling

As part of the impact assessment process an underwater acoustic modelling specialist studies was commissioned by Risk-Based Solutions and the Contract was awarded to Seiche Ltd, an international specialist company based in the UK.

The primary purpose of undertaking the underwater acoustic modelling study was to predict the likely range of onset for potential injury (i.e., permanent threshold shifts in hearing) and behavioural effects on living marine resources such as marine mammals, and fish due to seismic survey operations. Baseline data on the living marine resources has been provided through a specialist study that has been conducted by Dr Amanda Rau.

Sound is readily transmitted underwater and there is potential for sound emissions from the survey to affect marine mammals. At long ranges the introduction of additional noise could potentially cause short-term behavioural changes, for example to the ability of cetaceans to communicate and to determine the presence of predators, food, underwater features and obstructions.

At close ranges and with high noise source levels, permanent or temporary hearing damage may occur, and while at very close range, gross physical trauma is possible. This report provides an overview of the potential effects due to underwater noise from the survey on the surrounding marine environment.

The frequency, or pitch, of the sound is the rate at which these oscillations occur and is measured in cycles per second, or Hertz (Hz). When sound is measured in a way which approximates to how a human would perceive it using an A-weighting filter on a sound level meter, the resulting level is described in values of dBA. However, the hearing faculty of marine mammals is not the same as humans, with marine mammals hearing over a wider range of frequencies and with a different sensitivity.

It is therefore important to understand how an animal's hearing varies over the entire frequency range in order to assess the effects of sound on marine mammals. Consequently, use can be made of frequency weighting scales to determine the level of the sound in comparison with the auditory response of the animal concerned. A comparison between the typical hearing response curves for fish, humans and marine mammals is shown in Fig. 5.1.

It is worth noting that hearing thresholds are sometimes shown as audiograms with sound level on the y axis rather than sensitivity, resulting in the graph shape being the inverse of the graph shown in Fig. 5.1.

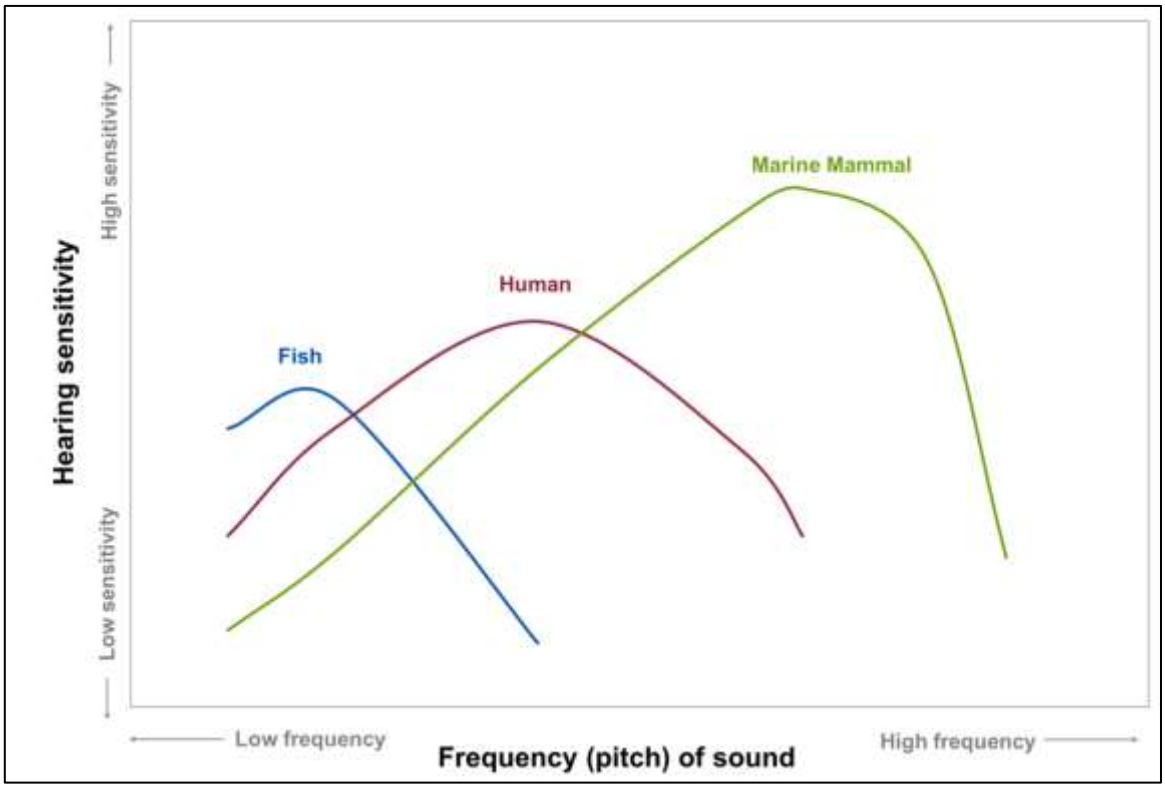

Figure 5.1: Comparison between hearing thresholds of different animals (Seiche Ltd, 2022).

Based on the results of acoustic modelling specialist assessment and without any mitigation measures in place, the following are summary of conclusions.

1. There is potential for significant disturbance to marine mammals within up to 2.9 km of the source array and mild disturbance within 9.4 km.

2. Before mitigation measures are applied, there is potential for injury to low frequency cetaceans within a radius of 280 m, 30 m for high frequency cetaceans and 833 m for very-high frequency cetaceans.

3. These injury zones will reduce to 57 m for low frequency cetaceans and 266 m for very-high frequency cetaceans once mitigation measures are applied, with high frequency cetacean injury thresholds no longer being exceeded.

4. These injury zones can effectively be monitored using MMOs. Based on the acoustic modelling results, a mitigation zone of 500 m is considered sufficient to effectively eliminate the risk of injury to marine mammals.

5. It is therefore concluded that it is unlikely that marine mammals will be injured as a result of the survey.

6. Recoverable injury could occur in some fish at a range of up to 369 m from the source array (for fish with swim bladders and eggs and larvae).

7. For fish without swim bladders, the potential range of effect reduces to a maximum of 201 m from the source array.

8. Temporary Threshold Shift (TTS) could occur to fish within 340 m of the source array, and.

9. Some sea turtles could be injured at ranges of up to 369 m from the source array.

The impact assessment is based on the direct impact of seismic activity (firing of the airgun) as well as potential impacts regarding the daily functions and operation of the survey vessel (vessel impacts) and any support parties.

The impacts arising directly from survey activities are related to noise emission (pressure, frequency and decibel range), whilst the indirect impacts include ship engine noise, deck maintenance, waste disposal, spillages, and other contaminants. There are numerous sources of anthropogenic-generated sound in the world's oceans today. Table 5.7 shows the general acoustic properties of a selection of anthropogenic sources of noise in the marine environment (OSPAR Commission, 2009).

Sound pressure levels (SPL) in water are measured in decibels (dB) relative to a reference pressure of 1 µPa. The commonly used pressure reference level for underwater acoustics is 1 micro-Pascal at 1 meter (1 µPa at 1 m or 1 µPa@1m). The reference level used for air (which matches human hearing sensitivity levels) is 20 µPa@1m.

The amount of acoustic energy that an animal experiences as a result of an underwater energy source discharge is expressed as the sound exposure level (SEL), which is a measure of the acoustic intensity as it takes into account the overall acoustic energy impinging on a receiver per unit area within 1 second (SEL = dB re 1 µPa2-s.). This measurement allows sounds of differing durations to be characterized in terms of energy (Woodside, 2008).

The response of and/or injury to a marine mammal to an anthropogenic sound will depend on numerous factors including the frequency, duration, temporal pattern and amplitude of the sound (peak-peak), the distance from the sound source and whether it is perceived as approaching or moving away (SOCAL-10). When an airgun is fired the release of pressure produces a bubble that rapidly pulsates to produce an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air discharged. Seismic airguns generate low frequency sound pulses below 250 Hertz (Hz) with the strongest energy in the range 10 -120 Hz, which is focused downwards, and peak energy between 30 to 50 Hz (Table 4.3).

Airguns also release low amplitude high frequency sound which are also radiated in horizontal directions. Airgun arrays have increased their power sources as greater depths are explored. The nominal source level of an airgun array can reach up to 260-262 dB (peak to peak) re 1 µPa @ 1m and

the acoustic energy has been measured up to about 100 kHz (AFTT, 2012. OSPAR, 2009, Woodside, 2007). Airgun arrays usually comprise a total of 12 - 70 airguns towed in parallel strings. Arrays typically produce sound in the region of 250 dB re 1 µPa @ 1 m. The majority of the energy produced is in the 0 - 120 Hz bandwidth, although some energy at much higher frequencies (100 kHz) is also produced.

The frequency spectra of various acoustic instruments used in marine exploration is shown in Fig. 5.2, while Fig. 5.2 shows the hearing ranges of marine animals relative to anthropogenic noise.

Table 5.7: Overview of the acoustic properties of anthropogenic sounds (Source: OSPAR 2009).

SOUND	SOURCE LEVEL (dB re 1µPa-m)	Bandwidth (Hz)	MAJOR AMPLITUDE (Hz)	DURATION (ms)	DIRECTIONALITY
SHIPPING					
Small boats and ships	160 – 180 rms	20 - >10 00	> 1000	Continuous	Omni-directional
Large Vessels	180 – 190 rms	6 - > 30 000	> 200	Continuous	Omni-directional
SONAR					
Echo-sounders	235 Peak	Variable	1 500 – 36 000	5 – 10	Vertically Focused
SEISMIC SURVEYS					
2-D Airgun Array	260 -262 P to P	<250	30 - 50	30 – 60	Vertically Focused
3-D Airgun Array	260 -262 P to P	10 – 100 000	10 - 120	30 – 60	Vertically Focused
OTHER ACTIVITIES					
Acoustic Determent or Harassment Devices	132 – 200 Peak	5000 – 30 000	5000 – 30 000	Variable 15 – 500	Omni-directional

5.4.2.2 Impacts of Noise on Marine Mammals

Marine noise spans a wide frequency range from 1 Hz to over 10 GHz depending on the activity. Marine life has developed special mechanisms both for emitting and detecting underwater sound. In marine mammals (cetaceans and pinnipeds), sound is used for communication, orientation, predator avoidance and foraging.

Marine mammals communicate and hear across a range of frequencies, with different species being sensitive to certain bandwidths. Sounds range from the 10 Hz low-frequency calls of Blue Whales to the ultrasonic clicks of more than 200 kHz in certain offshore dolphins and Harbour porpoises. California Sea Lions and Northern/Stellar Fur seals vocalize range of these mammals is 100 Hz – 20 kHz and 125 Hz – 34 kHz, whilst the hearing range is 150 Hz – 160 kHz and 200 Hz – 50 kHz respectively (Bailey et al, 2010. AFTT, 2012. Marine Mammal Commission, 2008). Table 5.8 shows that the hearing of marine mammals spans as wide a range of frequencies as the emitted sounds do (<1 kHz - 180 kHz).

Source levels of most mysticete cetacean sounds range from 137 to 190 dB re 1 µPa and those of most mid-frequency odonticete cetacean vocalisations range from 150 - 236 dB re 1 µPa @ 1 m. Source levels for California Sea Lions and Northern/Stellar Fur seals are in the order of 95 - 160 dB re 1 µPa @ 1 m. Communicative signals tend to be longer in duration, but at lower source levels.

The hearing threshold is the average sound pressure level (SPL) that is just audible to a subject under quiet conditions. For example, the Harbour porpoise's hearing threshold at 500 Hz is about 90 dB re 1 µPa, while its hearing threshold at 50 kHz is in the order of 35 dB re 1 µPa. This would mean that a sound with an SPL of 100 dB re 1 µPa and a frequency of 500 Hz would be barely audible to the porpoise, however, the same SPL at a frequency of 50 kHz would be perceived as relatively loud. It has been noted that seals' and sea lions' sensitivity to sound decreases rapidly with increasing frequency (Cunningham and Reichmuth, 2016). Species also differ markedly in their audiograms with respect to the frequency range they can hear, and with respect to their absolute sensitivity. Fig. 5.4 shows audiograms for common dolphin species (from Thomsen et al., 2009).

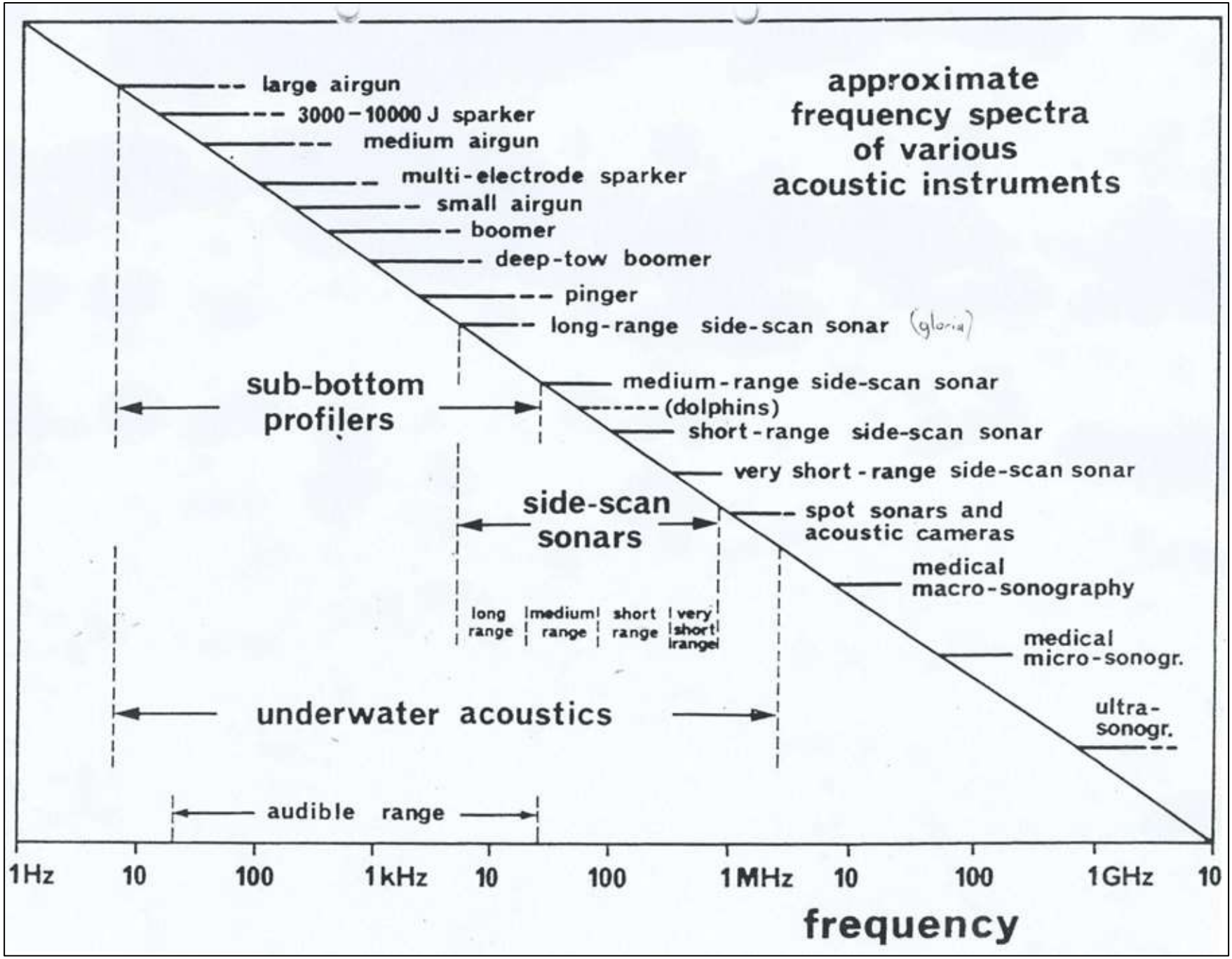

Figure 5.2: Approximate frequency of acoustic equipment used in underwater applications (Source: OSPAR, 2009).

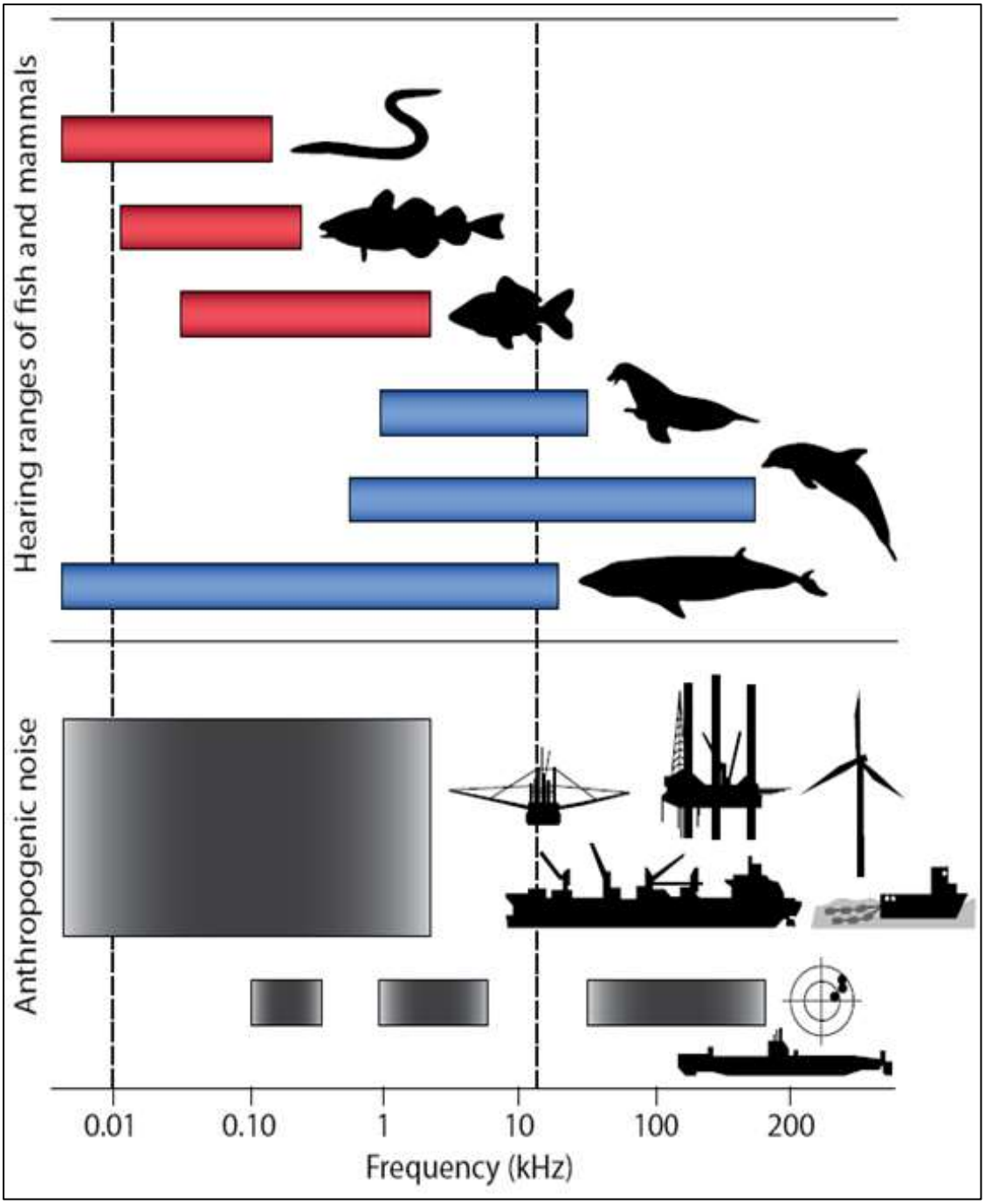

Figure 5.3: The hearing ranges of different kinds fish and mammals together with the overlap in frequency with different sources of human-generated noise (Sources: Slabbekoom *et al.,* 2010).

Table 5.8: Vocalisation and functional hearing frequency ranges for marine mammals (from AFTT, 2012, OSPAR, 2009, Thompson, 2000).

MAMMALS	VOCALISATION RANGE	HEARING RANGE	VOCALISATION SOURCE LEVEL
Low-frequency Cetaceans: Humpback, Southern Right Whales	10 Hz – 20 kHz	7 Hz – 22 kHz	150 - 192 dB re 1 µPa @ 1 m
Mid-frequency Cetaceans: Killer Whales, Bottlenose, Dusky, Long-beaked Common, Risso's, Rough-toothed Dolphins	100 Hz – >100 kHz	150 Hz – 160 kHz	137 - 236 dB re 1 µPa @ 1 m
High-frequency Cetaceans: Harbour Porpoise, Koiga species	100 Hz – 200 kHz	100 Hz – 200 kHz	120 - 205 dB re 1 µPa @ 1 m
Northern Fur Seals And California Sea Lions	125 Hz – 40 kHz	200 Hz – 50 kHz	95 - 160 dB re 1 µPa @ 1 m
Phocid Seals	100 Hz – 120 kHz	75 Hz – 75 kHz	103 - 180 dB re 1 µPa @ 1 m

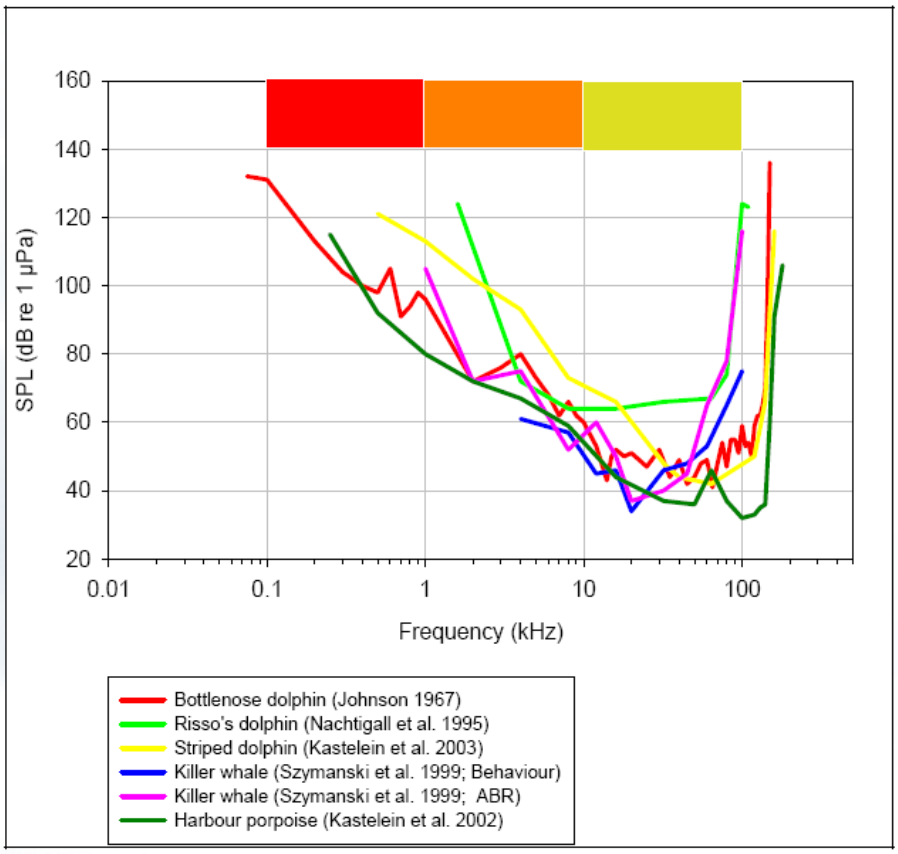

Figure 5.4: Representative audiograms of some common odontocetes. ABR = auditory brainstem response. The colours at the top represent the bandwidth and relative energy content of dredging noise: red = high orange = low gold = very low (After Thomsen at al., 2009).

The response of and/or injury to a marine mammal as a result of an anthropogenic sound will depend on numerous factors including the frequency, duration, temporal pattern and amplitude of the sound (peak-to-peak), the distance from the sound source, and whether it is perceived as approaching or moving away (SOCAL-10). A simplistic analysis the various scales of damage that can be affected on marine fauna, as provided by the Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Commission) is shown in Table 5.9.

In extreme cases, and at very high received SPLs close to the source, very intense sounds can result in internal injuries and might also lead to the death of the receiver. For example, underwater explosions used during construction or from the detonation of marine ammunition dumps, can cause not only hearing damage and injury, but death from the sound shock waves. The only known case where acute exposure to non-explosive sound has led to lethal effects involves atypical mass strandings of beaked whales during navy sonar exercises (AFTT, 2012).

Masking is the term used to describe a *temporary* reduction in ability to detect biologically relevant sounds as a result of a loud noise or strong SPL. The *zone of masking* is defined by the range at which sound levels from the noise source are received above hearing threshold levels.

It starts when the received sound level of the masking sound (e.g., a nearby ship engine) equals the ambient noise (e.g. wave or wind) in the frequency of the signal. Masking can shorten the range over which sounds can be detected, and across which conspecifics are able to communicate (e.g., mother and calf). However, most mammals communicate across a range of frequencies, so it is highly unlikely that the full range of frequencies used by one species will be completely masked for any significant time period.*Threshold shifts* refer to an animal's ability to hear at a frequency and occurs at two levels of severity: Temporary threshold shift (TTS) refers to the inability of an animal to hear a particular frequency for a period of hours to days. Permanent threshold shift (PTS) represents a permanent loss of hearing within a frequency range. Both TTS and PTS are triggered by the level and duration of the received signal. TTS have been induced in captive dolphin species at received levels higher than 190

dB. Finneran and Schlundt (2010) found that non-impulsive sounds with frequencies above 10 kHz are more hazardous than those at lower frequencies for Bottlenose dolphins.

Although no PTS have been recorded in cetaceans, it is argued that severe damage can occur in high-frequency cetaceans swimming within 265 m of powerful active acoustic sources such as hull-mounted sonar (AFTT, 2012). Table 5.10 summarises the threshold levels for TTS and PTS in marine mammals that function in different frequency ranges.

Behavioural disturbances are described as noticeable changes in activity and demeanour in direct response to a sound source. These effects are difficult to measure and quantify as they depend on a wide variety of factors, for example the characteristics of the signal, the individual perceiving the sound (age, sex, social status), the composition of the group (sex, calves present), the behavioural state prior to the sound disturbance (hunting, resting, socialising). Thus, the extent of behavioural disturbance for any given signal can vary both within a population as well as within the same individual. Table 5.11 summarises the threshold source levels for the onset of behavioural response in marine mammals.

Table 5.9: Damage affected on marine fauna by anthropogenic sounds (Source: OSPAR 2009).

Impact	Type of Effect
Physiological Non-Auditory	- Damage to body tissue: *e.g*. massive internal haemorrhages with secondary lesions, ossicular fractures or dysiocation, leakage of cerebro-spinal fluid into the middle ear, rupture of lung tissue. - Induction of gas embolism (Gas Embolic Syndrome, Decompression Sickness/DCS, 'the bends', Caisson syndrome) - Induction of fat embolism
Auditory Sound Induced Hearing Loss (SIHL)	- Gross damage to the auditory system – *e.g*. resulting in: rupture of the oval or round window or rupture of the eardrum - Vestibular trauma – *e.g.* resulting in: vertigo, dysfunction of co-ordination, and equilibrium - Permanent hearing ***threshold shift*** (PTS) – *e.g*., a permanent elevation of the level at which a sound can be detected - Temporary hearing threshold shift (TTS) – *e.g*., a temporary elevation of the level at which a sound can be detected
Perceptual	- ***Masking*** of communication with con-specifics - Masking of other biologically important sounds
Behavioural	- Stranding and beaching - Interruption of normal behaviour such as feeding, breeding, and nursing - Behaviour modified (less effective/efficient) - Adaptive shifting of vocalisation intensity and/or frequency - Displacement from area (short or long term)

Table 5.10: Acoustic criteria for predicting physiological effects on marine mammals (from AFTT, 2012).

Group	Species	Physiological	
		Onset TTS	Onset PTS
Low-Frequency Cetaceans	All mysticetes	178 dB re 1µPa^2-s (low-freq weighting)	198 dB re 1µPa^2-s (low-freq weighting)
Mid-Frequency Cetaceans	Dolphins, beaked whales, and medium and large toothed whales	178 dB re 1µPa^2-s (mid-freq weighting)	198 dB re 1µPa^2-s (mid-freq weighting)
High-Frequency Cetaceans	Harbor porpoise and *Kogia* spp.	152 dB re 1µPa^2-s (high-freq weighting)	172 dB re 1µPa^2-s (high-freq weighting)
Phocid Seals (In-Water)	Harbor, bearded, hooded common, spotted, ringed, harp, ribbon, & gray seals	183 dB re 1µPa^2-s (phocid weighting)	197 dB re 1µPa^2-s (phocid weighting)
Manatees	West Indian manatee		

Table 5.11: Behavioural Response sound source thresholds in marine mammals (after AFTT, 2012).

MARINE MAMMALS	BEHAVIOURAL RESPONSE THRESHOLD
Low-frequency Cetaceans: Humpback, Southern Right Whales	<= 160 dB re 1 µPa
Mid-frequency Cetaceans: Killer Whales, Bottlenose, Dusky, Long-beaked Common, Risso's, Rough-toothed Dolphins	167 - >170 dB re 1 µPa
High-frequency Cetaceans: Harbour Porpoise, Koiga species	90 - 140 dB re 1 µPa
California Sea Lions	165-170 dB re 1 µPa
Phocid Seals	<= 190 dB re 1 µPa

Table 5.12 shows the results of 11 studies indicating the impacts of impulsive sounds, including airgun surveys (NOAA, 2015). In only 2 out of 11 studies of impulsive sounds did measurable TTS occur. This may indicate that marine mammals are more tolerant of human activity than previously supposed. Seismic airguns generate low frequency sound pulses below 250 Hz with the strongest energy (which is focused downwards) in the range 10-120 Hz and peak energy between 30 to 50 Hz. Airguns also release low amplitude high frequency sound which radiate horizontally. The nominal source level of an airgun array typically produce sound in the region of 250 dB re 1 µPa @ 1 m but can reach up to 260-262 dB (p-p) re 1 µPa @ 1m. Most of the energy produced is in the 0 - 120 Hz bandwidth, although acoustic energy has been measured as up to 100 kHz (AFTT, 2012. OSPAR, 2009, Woodside, 2007).

Table 5.12: Summary of TTS studies on marine mammals using impulsive sounds (from NOAA, 2015).

Source	Species (n)	Measured TTS Frequencies‡	Peak Pressure	Pulse Duration	Ratio* (Pa/s)	Reference
Explosion simulator (500 kg charge)	Beluga (1). Bottlenose dolphin (2)	1.2, 1.8, and 2.4 kHz	69183 Pa (216.8 dB)	0.0095 s	7,282,421	Finneran et al. 2000
Water gun (80 in3)	Beluga (1)	**0.4**, 4, and **30** kHz	158489 Pa (224 dB)	0.0063 s	**25,156,984**	Finneran et al. 2002
Water gun (80 in3)	Bottlenose dolphin (1)	0.4, 4, and 30 kHz	218776 Pa (226.8 dB)	0.01 s	21,877,600	Finneran et al. 2002
Arc-gap transducer	California sea lion (2)	1 and 10 kHz	13963 Pa (202.9 dB)	0.0142	983,310	Finneran et al. 2003
Airgun (20 in3)	Harbour porpoise	**4**, 32, and 100 kHz	5623 Pa (195 dB)	0.05 s+	**112,460**	Lucke et al. 2009
Impact pile driver (4.2 m pile at 800 m)	Harbour porpoise	0.5, 1, 2, 4, 8, 16, 32, 63, and 125 kHz	1000 Pa (180 dB)	0.124 s	1452	Kastelein et al. 2015a
Airgun (40-150 in3)	Bottlenose dolphin (3)	0.25, 0.5, 1, 2, 4, 8, 16, 32, 40, 45, 50, and 64 kHz	31622 Pa (210 dB)	0.3 s	105,407	Finneran et al. 2015

‡ Frequencies in **bold** indicate those where measurable **TTS occurred**.
* Ratios in bold text indicate exposure scenarios where measurable TTS occurred.
+ Lucke et al. 2009 did not provide the exact pulse duration in their experiment and only indicated it was less than 0.05 s. NOAA conservatively chose to use 0.05 s for calculating the ratio (i.e., the use of a shorter duration would only result in a higher ratio).

5.4.3 Overall Summary of Negative Impacts Assessment Results

5.4.3.1 Atmospheric Emissions and Climate Change

As with most deep-sea going vessels, this seismic survey vessel will make use of heavy marine fuel to power generators and motors. Like all combustion engines, these machines generate exhaust fumes containing several toxic gases including carbon mono- and dioxide (CO, CO_2), nitrogen oxides (NO_x) and sulphur oxides (SO_x). Diesel combustion can produce hydrocarbons (THC, VOC) and general smoke and soot. Moreover, incineration of certain onboard wastes will, depending on the chemical composition, discharge CO, $C0_2$ and dioxins. For those wastes not incinerated onboard, appropriate storage containers should be provided until the waste can be disposed of onshore.

The atmospheric emissions and the influence on Climate Change of the proposed survey and support vessels will be like any other diesel-powered vessels of comparable tonnages operating within the region, together with the emissions from the seismic source compressors.

The overall potential impacts of the proposed 2D / 3D seismic survey on the atmospheric emissions and Climate Change and without mitigations will be low due to high dilution and if the MARPOL standards are implemented, the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and not significant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey.

5.4.3.2 Seawater Quality

In contrast there is a possible risk of disturbance to or contamination of the seawater as a result accidental discharge of waste into the ocean from both the main seismic vessels and any support vessels associated with the project. Potential discharge includes galley waste, sewage, machine oil leakage and deck drainage.

Raw sewage released into the marine environment can result in a temporary increase in biological oxygen demand due to increased organic and bacterial activity involved in the decomposition process. Excessive disposal could trigger anaerobic conditions in the immediate surroundings. However, treated sewage does not place a bacterial load on the water state. Galley waste consists primarily of food (peelings, leftovers). As with sewage, biodegradable components require organic and bacterial decomposition and would thus place a small, temporary oxygen load on the marine environment. The volume would be comparable to any other similarly sized vessels in the area.

The disposal of solid waste (non-biodegradable domestic waste, packaging, industrial waste) into the sea could pose a hazard to the marine environment in the form of chemical contamination or physical danger (i.e., can be eaten or entangle) to marine mammals, turtles and birds. These can also be transported away from the disposal area and land up on the shore or on the seabed. Solid waste should either be incinerated on board in accordance with MARPOL 73/78 regulations or stored in containers for disposal at port, so there is NO impact on the marine environment if protocols are followed. The only impact would be if some packaging accidentally blew overboard. Efforts should be made to retrieve any plastics or material hazardous to marine mammals.

Cleaning liquids, solvents and machine oils can be washed overboard during deck swabbing and general ship upkeep. However, the volumes of these substances are relatively small in comparison with the surrounding environment and get quickly diluted. The potential impact will be of low intensity because it will be diluted both with cleaning waters onboard and across the extent of the survey area.

The overall potential impact of the proposed 2D / 3D seismic survey on the seawater quality of the receiving environment sensitivity and without mitigations will be low and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and insignificant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey.

The potential of a major oil spill is equal to that of any other vessels operating within or travelling through the BCLME and would be an accidental occurrence. Any oil spill would be attended to immediately and

treated in accordance with the company's Emergency Response Plan (ERP) and National Marine Pollution Response Plan for Namibia. Based on the various oil spill modelling studies conducted by RBS since 2008 for various oil and gas 2D / 3D seismic survey and drilling operations in the region, in an event of an accidental oil spill occurring, the oil slicks are likely to go in north-northwest direction away from the sensitive shallow water and coastal environments.

5.4.3.3 Seafloor Topography and Sediment Quality

Due to the non-destructive nature of the exploration tool, the direct impact of the seismic process itself (activating of the seismic source) on the seafloor is considered nil as there is no tangible physical disturbance of the seafloor, since only sound waves and energy penetrate the substrate. Direct impacts of the seismic sound pulses on these elements are inconsequential as the very nature of the system is to travel through water with minimal disturbance and to penetrate the sediments. The non-intrusive measurement of sub-seafloor material means that there is no physical disturbance or bearing on the physical or chemical properties of the seafloor or the water. As the survey will be undertaken while the ship is moving, there will also be no anchorage or drag on the seafloor associated with the seismic survey.

The overall potential impact of the proposed 2D / 3D seismic survey on the seafloor topography and sediment quality receiving environment sensitivity and without mitigations will be low and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), extremely low likelihood of occurrence (A) and not significant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey.

5.4.3.4 Benthic Organisms Including Deep Sea Red Crab

Although most marine benthic invertebrates are not sensitive to sound pressure, some have statocyst organs that are sensitive to changes in hydroacoustic patterns. Research indicates that the potential of seismic pulses to cause pathological injury or masking of environmental sounds in benthic invertebrates is highly unlikely. Any potential damaging effects only occur at close range (within 15 m of the sound source). Seismic sources with source levels of 220–240 dB re 1 µPa @ 1m, deployed at 3-6m depth have no physical effect on macrobenthos further than 1 m from the source (Bendell, 2011). Pearon *et al*. (1994) found no statistically significant changes in mortality or development rates of crab larvae exposed to a 7-element seismic source, even those exposed as close as 1 m from the source.

Some benthic organisms may exhibit avoidance behaviour, but there is little scientific documentation in this regard. Research indicates no reduction in catch of commercially exploited benthic species during or after seismic survey (Bendell, 2011), suggesting no attempt at avoidance.

As most of this survey will be conducted in water depths greater than 200 m, the perceived impact on benthic fauna falls far outside the range at which pathological injury would occur.

The overall potential impact of the proposed 2D / 3D seismic survey on benthic organisms including Deep Sea Red Crab and without mitigations will be low and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (C) and not significant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey.

5.4.3.5 Fish

While high energy seismic survey can result in mortality in early fish life stages, the impacts are more likely to induce changes in fish behaviour and temporarily alter distributions of adult populations (ESLO, 2011). The magnitude of any effects is inversely proportional to the distance from the sound source.

There is a higher risk of pathological injury or mortality from seismic sound in shallow water reef species and in large demersal species with swim-bladders. These fish may suffer severe damage to their hearing ability that could last for some time post-survey (OSPAR, 2009). The proposed survey would be primarily conducted in water depths greater between -100 m and -4000m. Thus, the impact on demersal fish (or fish who flee to the sea floor rather than horizontally away from the sound source will

receive the noise at Sound Exposure Level (SEL) outside of the ranges at which physiological injury or mortality occur (Woodside, 2008).

Experiments conducted off California show that non-explosive seismic survey (e.g., compressed air) are by-and-large not lethal to fish. Significant physiological impacts are only seen in fish swimming within a few meters of the activating seismic source (ESLO, 2011). The potential for physiological damage and/or mortality depends strongly on the size of the fish. Adult fish normally exhibit avoidance behaviour in response to seismic survey and thus are unlikely to experience physiological damage (Bendell, 2011). However, juveniles and fish smaller than 50 mm in length, swimming in the water column within 5 m of an operational seismic source can be severely impacted or killed (Bendell, 2011). It is argued that fish without swim bladders (e.g., mackerel) are not sensitive to sound pressures and will thus have no adverse effects from seismic survey (Dragsund, 2013).

Key studies conducted in the North Atlantic and Barents Sea between 1973 and 1996 (review by (Bendell, 2011) indicated that threshold levels exceeding 220 dB were required to cause pathological injury, while auditory damage was indicated at 180 dB. No mortality was recorded for any fish beyond 0.5 -1 m from the source. A healthy adult fish will detect a sound source at long distance and will move out of damage range (Woodside, 2008).

The ability of fish to avoid seismic noise is largely dependent on their size and based on their swimming abilities (Bendell, 2011). Fish larger than 50 mm are expected to swim out of harm's range. Studies conducted by Det Norske Veritas (DNV) concluded that seismic activities on the Norwegian continental shelf have little effect on fish. The results show negligible physical impact. Mortality required peak pressures in excess of 229 dB with a rise time of 1msec – the equivalent of a chemical explosion. The much lower rise time from seismic sources as well as lower peak pressure are unlikely to be lethal.

Experimental results off northwest Australia indicated minimal effect from a 50-day 2D / 3D seismic survey with source SEL of 220 – 240 dB re 1μPa^2-s and a frequency range of 10 – 110 Hz. Behavioural responses such as changes in feeding habits and erratic swimming (indicating an avoidance response) were documented in captive reef fish at received SEL of about 160 dB re 1 μPa. Behavioural changes were short-term and biologically insignificant (Woodside, 2007). Individual fish and schools of fish were noted to move between 400 m and 200 m away from the survey line for an hour after the seismic source passed (Woodside, 2008).

Natural mortality rates for juvenile fish are high and any mortality resulting directly from the seismic survey is statistically insignificant within the broader population. Juvenilles of most fish species are generally concentrated in shallow shelf waters. As most of the proposed survey lines will be run in deeper waters, the impacts on fish recruitment at the population level are of low impacts*.*

The impact on larvae close to the surface in the vicinity of the seismic source will be of high intensity in the short term, but in overall comparison with natural mortality, the impact of the seismic survey is considered to be of low significance to larval stages, particularly if timing and spatial mitigating measures are employed. Seismic noise disturbance may impact the spawning activities of certain fish species. However, most of the commercially important species spawn inshore in shallow waters and south of the proposed survey area. In view of the relatively short duration of the disruption to species and the wide distribution and migrations ranges of potentially impacted species the impact of the survey on recruitment is considered to be of low significance, because the survey will be covering more of the deeper water expected to less vulnerable fish species.

The potential impact of physical damage to pelagic species near the noise source would be of high intensity. The potential impact would be limited to the short-term period of surveying activities in the population locale. However, the potential impact on demersal and species in shallow and inshore water would be insignificant as they are expected to be well out of the range of damage. Also, large pelagic species have under-developed or no absent swim bladders, and the risk of injury in these species is negligible. The overall impact of damage to pelagic fish species is of low significance dependant on the mitigation measures employed.

The fish of the BCLME are generally highly mobile and exhibit large migration patterns and ranges, so while the potential impact on fish behaviour could be of high intensity, this would be limited to shallow

waters and /or close proximity to the seismic source, and restricted to the short-term duration of the survey operating in the area., but limited to the survey area. The impact of fish behaviour is thus considered to be of low significance both with and without mitigation measures.

The overall potential impact of the proposed 2D / 3D seismic survey on fish and without mitigations will be medium and the impact will be of medium magnitude (2), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and low significance (4/1). With mitigations the overall impacts will be low and temporary for the duration of the survey.

5.4.3.6 Sea Turtles

The occurrence of sea turtles within the BCLME, Leatherback, is thought to be on the increase as a result of the availability of their preferred food, jelly fish, which have dramatically increased since the collapse of sardine and anchovy populations. Leatherback Turtles are listed as Critically Endangered worldwide by the IUCN and fall into the highest need for conservation categories as defined by the Convention on Migratory Species (CMS) and the Convention on International Trade in Endangered Species (CITES) (Nacoma, 2013). Nonetheless, as many as 700 sea turtles are caught by the Namibian pelagic longline fishery targeting tuna, swordfish and sharks each year. Catches are likely to be the highest in the northern Benguela, where sea turtle abundance and fishing (longline and artisanal) activity is the highest additionally sea turtles are caught by artisanal fisheries for consumption in Angola.

The effect of the impacts of seismic survey on turtles is poorly studied in comparison to studies on cetaceans, but those that have been conducted suggest that there are unlikely to be any physical effects or shifts in hearing threshold, if the turtle is not within the immediate vicinity of the sound source. Basking turtles may not move away sufficiently quickly from a sound source and if it is initiated at full power within close range (<15 m), pathological injury can be expected. Bartoli *et. al*., (1999) concluded that the hearing sensitivity range for sea turtles is between 250 and 700 Hz. This is outside of the range of most seismic and considerably higher than the focal frequency ranges from this proposed survey.

Recent research indicates that masking is unlikely to be a significant impact from seismic survey. This mainly because it has been shown that magnetic signals are turtles' main navigational tools rather than sound signals (Lohmann *et al.*, 2001).

Anthropogenic pollution of the oceans has possibly the highest impact on turtle mortality. Leatherback turtles feed on jellyfish and are known to have mistaken plastic bags, polystyrene, tar balls, balloons and the like, for food. Such substances obstruct the digestive tract resulting in starvation. Absorption of foreign chemicals can reduce the natural absorption of beneficial nutrients from actual food.

Dead turtles have been found entangled in ropes, nets and fishing gear. Being air-breathing creatures, entanglement weighs the turtles down and restricts their ability swim, leading to eventual drowning.

Trials conducted on caged Loggerhead and Green Turtles (McCauley et al., 2000) revealed behavioural changes at levels in excess of 175 dB re 1 µPa @ 1m. Several experimental results indicate that behavioural responses (rising to the surface, altered swimming patterns) occur at about 2 km from the seismic source at sound exposure levels of 166 dB re 1 µPa @ 1m and avoidance behaviour (i.e. moving away and not returning to the depths at which they usually rest) at 1 km from the source and sound exposure levels of 175 dB re 1 µPa @ 1m (McCauley et al., 2000. Lendhart, 1994).

Although Leatherback turtles are frequenting the BCLME waters more in recent years, they are still only occasional visitors and sightings are rare as Leatherback turtles breed in Gabon and the Republic of Congo, some 2500 km to the north. The likelihood of encountering one during the survey is low. None-the-less, should a turtle be in close range, the potential impact on turtle behaviour and feeding is of high intensity in the short-term, but of low probability.

The impact of the seismic survey on turtle mortality due to entanglement or garbage consumption is of low significance, as long as MARPOL 73/78 solid waste disposal procedures are to be followed.

The impact of seismic noise on turtle migration is of low significance since turtles make use of magnetic cues rather than acoustics for navigation (Lohmann et al., 2001).

The overall potential impact of the proposed 2D / 3D seismic survey on sea turtles and without mitigations will be medium and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and low significant (2/1). With mitigations the overall impacts will be low and temporary for the duration of the survey.

5.4.3.7 Seabirds

There are many birds migratory bird species found in Namibia. The potential impacts from this survey are likely to be on sea-going birds that forage offshore and rest on the water and those that plunge-dive for food. There is little experimental data on the impact of underwater noise from seismic survey on birds. Apart from a study that shows that frequency range of the call of the Thick-billed Murrre is 1 – 4 Hz (Gaston and Jones, 1998), there is virtually no data on the vocal range or underwater hearing capacity of diving birds such as cormorants, black- and red-throated divers, guillemots, razorbills, puffins, albatrosses and petrels.

Significant numbers (~30850) of seabirds are drowned in Namibian waters each year by long-line vessels fishing for hake, tuna, billfish and sharks (Petersen et al., 2007). The birds dive onto baited hooks, are caught and dragged underwater. In comparison, the impact of this seismic survey on bird populations is considered negligible. Seabirds are only likely to be at risk from the proposed survey in the event of an oil spill or other major water-borne pollution which are every rare event and considering the fact the proposed seismic survey will be taking place in deep-water.

The potential pathological impact of seismic pulses on non-diving birds is insignificance as bids would be expected to fly away from the noise source. The potential of pathological impact is of low significance on diving sea birds without “warning” and of low significance if warning “ramp-up” measures are employed.

Avoidance behaviour would be limited to the immediate vicinity of the seismic source and only for the duration of the actual activation and vessel passage. The impact on behaviour is thus considered to be of medium intensity for a short duration, but of low significance. The impact of the seismic on non-diving bird behaviour is insignificant.

The impact of the survey on the foraging of diving and non-diving birds is of moderate intensity in the medium term in the immediate vicinity and of low significance.

The overall potential impact of the proposed 2D / 3D seismic survey on seabirds and without mitigations will be medium to low and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and minor significance (3/2). With mitigations the overall impacts will be low and temporary for the duration of the survey.

5.4.3.8 Seals

The only seal species found in Namibia is the Cape Fur Seal and the nearest breading colony is at Cape Cross located along the central coastline of the proposed survey area in the Walvis, Lüderitz and Orange Basins, offshore Namibia. Although Cape fur seals generally forage in shallow, shelf waters, they have been seen 150 km from the coast and there is a very high likelihood that Cape Fur Seal will be encountered within the survey area. Cape Fur Seal typically dive to depths less than 100 m. In deeper water sound can become concentrated and can be received at higher sound energy levels (SEL) than near the source.

Although there are a few reports of Cape Fur seals approaching operational survey vessels (possibly out of curiosity), seals generally move away from any source of discomfort. Controlled exposure experiments with small seismic source elements (source level: 215 – 224 dB re 1 µPa (p-p) were carried on harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*). While two harbour seals showed immediate, but short-term, startle responses to the initial seismic source pulses, the behaviour of all harbour seals returned to normal soon after the end of each trial, even in areas where disturbance

occurred on several consecutive days (Thomsen, 2000). Thus, it is expected that the seismic survey will have little impact on the very mobile and less sensitive cape fur seals.

Because they have lungs and air passages adapted for changing pressures encountered while diving, as well as the ability to equalise air pressure in their heads, seals are unlikely to experience physiological damage from seismic pulses (Bendell, 2011). In addition, seals exhibit avoidance behaviour, moving away from seismic noise. So, the likely physiological impact from the seismic source survey is of low significance.

The impact of a seal colony's startle response to support helicopters flying overhead can be of high intensity in the medium and long term, owing to injury and death caused by stampeding, and is thus considered significant without the mitigation of changing flight paths which must be implemented by support helicopters throughout the survey.

Seals observed tolerance of marine operations suggests that the impact of the seismic survey on their behaviour is of low significance.

The extensive range over which Cape Fur Seals are known to forage indicates that the impact of the survey on their prey availability is insignificant.

The overall potential impact of the proposed 2D / 3D seismic survey on seals and without mitigations will be low and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and low significant (2/1). With mitigations the overall impacts will be low and temporary for the duration of the survey.

5.4.3.9 Cetaceans

Namibian waters of the BCLME are host to a range cetacean species that are either migrating through the area, have come to the area to breed (temporary residents) or are endemic. There are two main groups of cetaceans: mysticete (baleen whales) and odontocete (toothed whales and dolphins). The mysticete group comprises predominantly migratory species, whilst the odontocete are both resident and migratory.

Based on available research, it is highly likely that mysticetes will avoid areas of seismic noise, particularly if warning mitigation measures are applied as detailed in the EMP Report. Changes in migration patterns due to such avoidance behaviour are likely to have only minimal impact relative to the great distances covered by these migrating animals. The expected impact of seismic noise on the general baleen whale population is of low significance. The low likelihood of encountering many mysticetes will further lessen any potential impacts from this survey.

The area covered by migrating and resident cetaceans is large and they have a wide range of available food sources, particularly within the high productivity waters of the BCLME. Various studies have indicated that baleen whales exposed to moderate low-frequency signals demonstrated no variation in foraging activity (AFTT, 2012). While the prey of resident odontocetes (fish and cephalopods) may be temporarily displaced through stress and avoidance reactions to the seismic noise, this would be of limited duration in time and extent. Odontocetes have a varied diet and a temporary spatial shift of one species should not cause any feeding stress. It is believed that mysticetes do not feed regularly during breeding. They rely on blubber reserves rather than moving after food sources. Thus, the impact of the seismic survey on food source and availability is deemed to be insignificant.

All known marine mammal mortalities proved or assumed to be caused by anthropogenic sound involve a limited number of species and are at least an order of magnitude less than the number of cetaceans killed annually in direct fisheries bycatch (Ketten and Todd, 1993). Injury from commercial vessel ship strikes and impacts from urban pollution have greater reported impact on marine mammals than any known seismic survey (OSPAR, 2009).

The proposed 2D / 3D seismic survey in the Walvis, Lüderitz and Orange Basins, offshore Namibia will have no impact on Southern Right whales, Dusky dolphins or Benguela dolphins as their preferred habitat is well inshore. Potential impact is considered insignificant for Grey's beaked whale and very

low for Southern Right-whale dolphins as they are likely to be encountered only inshore. The overall impact on cetaceans within the BCLME is of low significance.

The overall potential impact of the proposed 2D / 3D seismic survey on cetaceans and without mitigations will be medium and the impact will be of low magnitude (1), temporary duration (T), limited impact on location (L), low likelihood of occurrence (B) and minor significance (4/1). With mitigations the overall impacts will be low and temporary for the duration of the survey.

5.4.3.10 Fishing Industry (Socioeconomic)

The fishing industry in Namibia is undoubtedly the most socioeconomically sensitive of all the industries operating within Namibian offshore waters. Major commercial fishing grounds such as the Deep-Sea Crabs, Hake and Monkfish trawl grounds do overlap with the proposed 2D / 3D seismic survey area in Walvis, Lüderitz and Orange Basins, offshore Namibia. During the survey, there will be an operational, a temporary 500 m statutory activity exclusion (safety) zone around the survey vessel and equipment that will be in force. These exclusion zones will temporarily prohibit trawling within proximity of the survey vessel.

The overall potential impact of the proposed 2D / 3D seismic survey on the commercial fishing ground and subsequently the socioeconomic contributions of the fishing industry to the Namibian Economy and without mitigations will be of medium to high impact and magnitude (3), temporary duration (T), limited impact on location (L), medium likelihood of occurrence (B) and medium significance (4/3). With mitigations the overall impacts will be low to medium and temporary for the duration of the survey.

5.4.3.11 Other Socioeconomic Activities

Other socioeconomic activities known to occur in the general area include the following:

(i) Tourism and recreation concentrated only along the coastal zone.

(ii) Minerals exploration and mining covering the shallow waters, coastal and onshore environments.

(iii) Other petroleum exploration licence holders bordering the proposed survey area within the Walvis, Lüderitz and Orange Basins, offshore Namibia.

(iv) International shipping covering the offshore environment and overlapping with the survey area, and.

(v) International communication lines / cables covering the offshore environment overlapping with the survey area.

The proposed 2D / 3D seismic survey will not affect the tourism and recreation and minerals exploration and mining because these they are falling completely outside the targeted survey area. The proposed 3D and 3D seismic lines may extend into other petroleum exploration license areas. The impacts of the proposed seismic survey concurrent with other exploration activities will result in cumulative environmental impacts in the immediate surrounds for the short term.

The proposed 2D / 3D seismic survey activities have implications on the passage of other vessels. The survey vessel may well be considered a fixed marine feature that is to be avoided by other vessels because the vessels is towing an array and by the nature of the precision positioning required for accurate data collection, the operation has little room for manoeuvrability during seismic operations.

The Petroleum (Exploration and Production) Act, 1991 designates a seismic vessel as an “offshore installation” and affords it a 500 m safe zone which no other vessel may legally enter without appropriate authorisation. Correspondingly, the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10) recognizes seismic vessels as having “restricted

ability to manoeuvre" and assigns responsibility to all other boats to give way to such vessels. Seismic contractors generally commission the support vessels to be 'chase'boats and to ensure that other vessels are aware of their status and adhere to the safe exclusion limits.

All vessels will be required to avoid the seismic vessel by the margin of its set safe exclusion limits. The adjustment of shipping routes would be limited to the extreme near vicinity of the seismic vessel and would be no greater than any repositioning associated with any other vessels restricted in their manoeuvrability. The potential impact of interference with shipping routes would be of low intensity and limited to the survey area. The significance of the impact is deemed negligible, with or without mitigation measures.

As shown in Fig. 4.28, the seafloor Submarine Communication Cables overlaps with the area of the proposed 2D / 3D seismic survey area. However, the proposed survey operations will not disrupt or destroy the seafloor cables in anyway because the survey operations will be undertaken on water surface and will not touch the seafloor areas.

The overall potential impact of the proposed 2D / 3D seismic survey on the other socioeconomic activities such as tourism and recreation, minerals exploration and mining, other petroleum exploration licenses holders, international shipping lines and international subsea communication cables and without mitigations will be low and the impact will be negligible to low magnitude (1), temporary duration (T), limited impact on location (L), unlikely to low likelihood of occurrence (A /B) and insignificant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey

5.4.3.12 Cumulative Impacts

Cumulative impacts are those impacts which result from the incremental impact of the proposed activities (2D / 3D seismic survey) when added to other past, present, and reasonably near future activities such as shipping and fishing vessels and other oil and gas survey vessels and drilling rigs.

The cumulative impacts on the marine habitats, fauna, and flora species, ecosystem functions, services, use values and non-use or passive use, physiography and geological resources, within the proposed survey area are considered insignificant. Each event of the proposed survey will be conducted over a shot period lasting for about seventy (70) days.

All other operational related impacts such as increased noise, waste management, security, public safety, occupational health and safety and accidental events will be short-term and site-specific and with less additional influence by the other past, present, and reasonably near future activities.

The scale of fugitive particulate material generation and their impacts on the surrounding marine environment is generally negligible, particularly because the naturally strong winds have a much greater impact in this regard. Adequate mitigation measures are, however, available during the operational phase.

The overall potential impact of the proposed 2D / 3D seismic survey on the other socioeconomic activities such as tourism and recreation, minerals exploration and mining, other petroleum exploration licenses holders, international shipping lines and international subsea communication cables and without mitigations will be low and the impact will be negligible to low magnitude (1), temporary duration (T), limited impact on location (L), unlikely to low likelihood of occurrence (A /B) and insignificant (2/1). With mitigations the overall impacts will be negligible and temporary for the duration of the survey.

5.4.3.13 Climate Change

According to the 2020 fourth National Communication to the United Nations Framework Convention on Climate Change published by the Ministry of Environment, Forestry and Tourism, Namibia's already low climate resilience and adaptive capacities continue to be threatened by changes in temperature and precipitation, periodic droughts, and floods. Namibia's future vulnerability to climate change will be

determined by the nature of the biophysical changes to which its population, economy and livelihoods are exposed, and by national and individual capacities to manage, recover from, and adapt to these changes (Republic of Namibia, 2020).

The Paris Climate Accords, adopted in 2015 and 26th UN Climate Change Conference of the Parties (COP26) that took place in Glasgow from 31st October – 13th November 2021 both have global commitment goals of limiting global warming to below 2°C (and ideally below 1.5°C) above pre-industrial levels. Namibia is one of the highly vulnerable nations, such that even a 1.5°C increase in global temperature will have severe local impacts, negatively affecting the agriculture, water, health, and biodiversity sectors (Republic of Namibia, 2020).

According to the 2021 Namibia's Updated Nationally Determined Contribution published by the Ministry of Environment, Forestry and Tourism, Namibia's mitigation commitment is in the form of a decrease in Greenhouse gasses (GHG) emissions compared to the Business as Usual (BAU) baseline over the 2015-2030 period. The 2021 updated national document presents an improvement in the commitment of the devotion of Namibia to meeting the Paris Agreement goal and following the road to net zero emissions by 2050. Namibia has committed to reducing its GHG emissions conditionally by at least 91% of its BAU scenario by reducing emissions by 21.996 MtCo2e (14%) unconditional part and 77% conditional part) in 2030 compared to BAU (24.167 MtCo2e) (Republic of Namibia, 2021).

Adaption is still a relevant feature in Namibia and the country is considered one of the most vulnerable countries to the impacts of climate change (Republic of Namibia, 2021). The country is particularly vulnerable to flooding and droughts. According to the Republic of Namibia, (2021), Ministries with adaptation relevance proposed a total of 49 priority actions with agriculture, tourism and fisheries sectors being critical for adaptation. Several ministries have set goals for both youth and women's participation because gender-balanced training and the promotion of the youth and women are seen as relevant to the adaptation drive (Republic of Namibia, 2021).

Namibia is working towards reducing the effects of global warming on communities and sectors through short and long-term resilience and adaption strategies. In the energy sector, the national sustainable energy strategy of Namibia looks to introduce new emissions-reducing technologies and encourage healthier practices that are more energy efficient. According to the 2021 Namibia's Updated Nationally Determined Contribution published by the Ministry of Environment, Forestry and Tourism, the projected net cost of the Updated Nationally Determined Contribution (NDC) mitigation measures to be implemented in Namibia is expected to be approximately USD 3.61 billion by 2030 and more than USD 1.72 billion for adaptation targets, representing a total funding need of approximately USD 5.33 billion (or N$ 77 billion). To put this figure of N$ 77 billion into the current and as at February 2021 Namibian fiscal context as published by the Ministry of Finance, the total estimated revenue collected for the year amounted to N$ 52.9 billion against a budget of N$ 55.5 billion while the total estimated expenditure for the year amounted to N$ 72.1 billion. The budget deficit is estimated at about 9.7 percent of Gross Domestic Product (GDP) with total debt standing at 68.8% and debt servicing estimated at N$ 7.7 billion or 14% of revenue.

Based on the current fiscal standing of Namibia for 2021-2022 and beyond, it will be extremely challenging and impossible for the country to be able to finance the N$ 77 billion NDC mitigation budget measures by 2030 without heavily relying on drying-up and scarce handouts, donations, loans, and grants from developed countries. The current and envisaged green environmental financing models that are dependent on handouts, donations, loans, and grants from developed countries coupled with massive socioeconomic challenges and rural inherited generational poverty, will see Namibia struggle to achieve its NetZero by 2050. As such Namibia cannot afford to abruptly stop all greenhouse emitting industries such as oil and gas exploration and switch to green energy overnight. Even the developed and industrialised countries responsible for all the historical, current and the next thirty (30) years of greenhouse gases emissions have adopted long-term strategies of transforming to greener economies and hope to achieve NetZero by 2050.

Namibia is a developing country struggling economically with high levels of debt, high unemployment, high poverty levels, challenging social economic issues, riddled with unequal distribution of prosperity and majority of the indigenous Namibians swimming in inherited generational poverty. The adoption of coexistence developmental approaches in the diversification of the national resources base will greatly

help the country to widen its income base and financial independence to be able to fund both the short- and long-term climate change resilience and adaption strategies for the benefit of all Namibians.

The proposed 2D / 3D seismic survey can be classified as a small, short-term, local project aimed at supporting the development of fossil fuel opportunities in the Walvis, Lüderitz and Orange Basins, offshore Namibia while at the same time will provide datasets that could support the development of other sectors such as the search for offshore wind energy, and minerals resources as well as Carbon Capture Storage (CCS) geological system. The proposed 2D / 3D seismic survey inclusive of all the supporting activities are likely to be associated with the releases of localised and site-specific emissions that may have some localised influence on the local climate with negligible, national, regional or global significance.

The survey vessels will emit greenhouse gases and various air contaminants, including sulphur oxides, nitrogen oxides, carbon monoxide and particulate matter. Within the proposed 2D / 3D seismic survey area climate change threats have direct impact on fisheries and food security. The release of airborne particulate matter can result from various natural activities including from shipping and fishing vessels. It is important to note that all the equipment to be used for the proposed survey will be serviced and maintained regularly. The proposed survey shall be overseen by experienced personnel and the operation must adhere to the provisions of the national and international best practices, regulations of EnerGeo Alliance, formerly known as the International Association of Geophysical Contractors (IAGC), International Convention for the Prevention of Pollution from Ships (MARPOL) and the applicable national legislation and regulations.

The short-term duration of the proposed 2D / 3D seismic survey activities will result in negligible cumulative impacts for the marine environmental and social factors, with no long-term cumulative impacts following cessation of the proposed activities.

5.4.4 Overall Summary of Negative Impacts Assessment Results

5.4.4.1 Overall Impact Assessment Framework

The overall impact assessment framework adopted the Leopold matrix which is one of the best known internationally matrix methodology available for predicting the impact of a project on the environment. The Leopold matrix is a two-dimensional matrix cross-referencing the following:

- The activities linked to the project stages covering mobilisation and pre-survey preparations, actual survey operations, post survey operations, and non-routine or accidental events that are likely to have an impact on the receiving environment (physical, biological and socioeconomic), and.

- The existing environments (physical, biological and socioeconomic) that could possibly be affected by the project.

The activities linked to the proposed 2D / 3D seismic survey are listed on one axis, while the receiving environments (physical, biological and socioeconomic) are listed on the other axis, and divided in following three (3) major groups:

- Physical conditions: marine and coastal air quality, change climate, seawater quality, seabed topography and sediment quality.

- Biological conditions: marine and coastal benthic ecology, fishes, turtles, seabird, seals, cetaceans, and.

- Socioeconomic conditions and other users: marine and coastal fishing industry, tourism and recreation, minerals exploration and mining, other petroleum exploration licence holders, international shipping line and international communication lines / cables routes.

The proposed 2D / 3D seismic survey activities have the potential to affect the receiving environments in many ways. The first step in impact identification has been to identify the various types of activities associated with the mobilisation and pre-survey preparations, actual survey operations, post survey

operations stages of the proposed survey, together with their associated emissions and discharges where appropriate. At a high level, the main sources of impact that the proposed 2D / 3D seismic survey will have on the receiving environment are:

- Planned or routine events: where an aspect (i.e., impact producing factor) is a result of routine Project activities. For example, the generation of atmospheric emissions from the survey and support vessels can be considered a planned event, and.

- Unplanned or non-routine (accidental) events: where an aspect is a result of mishaps or failures, including failure of equipment, procedures not being followed, human error, unforeseen events, or process equipment not performing as per design parameters. Typical examples are spills, leaks, emergency emissions, collisions, and explosions.

Overall, the following is the summary of the project related activities linked to planned/ routine and unplanned / accidental events of the mobilisation and pre-survey preparations, actual survey operations, post survey operations stages of the proposed survey:

1. Port of Walvis Bay including onshore support operations and waste management.

2. Physical presence of survey and support vessels.

3. Physical disturbance of the survey operations.

4. Sound generation from proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels.

5. Increased light levels from routine vessels operations.

6. Atmospheric emissions from routine operations of the survey and support vessels.

7. Planned marine discharges.

8. Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils.

9. Accidental event: Loss of vessel, equipment or material.

10. Accidental event: Collision with marine wildlife during vessel operations, and.

11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.

Accidental events can potentially lead to significant impacts, for example in the event of an oil spill. However, they are clearly not a part of the intended activity and their potential occurrence has a low probability of occurrence associated with it. Such impacts have therefore been treated differently. The activities / sources of potential impact due to the project and the receiving environment that could potentially be affected has been assessed in this EIA report and presented in form of a two-dimensional cross-referencing Leopold matrix covering the following:

- Sensitivity of receptors (Table 5.13).

- Impact magnitude (Table 5.14).

- Duration / time period of exposure (Table 5.15).

- Geographical extent (Table 5.16).

- Probability, likelihood of occurrence (Table 5.17), and.

- Overall significant impacts (Table 5.18).

Table 5.13: Sensitivity of receptors (Physical, biological and socioeconomic receiving environment).

RECEIVING ENVIRONMENT SENSITIVITY

SENSITIVITY RATING		CRITERIA
1	Negligible	The receptor or resource is resistant to change or is of little environmental value.
2	Low	The receptor or resource is tolerant of change without detriment to its character, is of low environmental or social value, or is of local importance.
3	Medium	The receptor or resource has low capacity to absorb change without fundamentally altering its present character, is of high environmental or social value, or is of national importance
4	High	The receptor or resource has moderate capacity to absorb change without significantly altering its present character, has some environmental or social value, or is of district/regional importance.
5	Very High	The receptor or resource has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental or social value, or is of international importance.

SOURCES OF POTENTIAL IMPACT				RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
				PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT						
				Air Quality	Change Climate	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
			ONSHORE / COASTAL																		
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1.	Port of Walvis Bay including Onshore support operations and waste management	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
			OFFSHORE																		
		2.	Physical presence of survey and support vessels	1	1	2	1	1	1	2	4	2	2	4	4	1	1	1	1	1	1
		3.	Physical disturbance of the survey operations	1	1	1	1	1	1	2	4	2	2	4	4	1	1	1	1	1	1
		4.	Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	1	1	1	1	1	1	4	4	4	2	4	4	1	1	1	1	1	1
		5.	Increased light levels from routine vessels operations	1	1	1	1	1	1	2	2	4	2	4	2	1	1	1	1	1	1
		6.	Atmospheric emissions from routine operations of the survey and support vessels	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		7.	Planned marine discharges	1	1	2	1	1	1	2	2	2	2	3	2	1	1	1	1	1	1
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	1	1	2	1	1	1	2	2	2	2	3	2	1	1	1	1	1	1
		9.	Accidental event: Loss of vessel, equipment or material	1	1	1	1	1	1	2	2	2	2	3	2	1	1	1	1	1	1
		10.	Accidental event: Collision with marine wildlife during vessel operations	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
		11.	Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	1	1	4	1	1	1	4	4	4	4	4	4	1	1	1	1	1	1

Table 5.14: Likely impact magnitude.

MAGNITUDE

SCALE	DESCRIPTION
0	no observable effect
1	low effect
2	tolerable effect
3	medium high effect
4	high effect
5	very high effect (devastation)

				RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																
				PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT					
				Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
SOURCES OF POTENTIAL IMPACT																				
			ONSHORE / COASTAL																	
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1.	Port of Walvis Bay including Onshore support operations and waste management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			OFFSHORE																	
		2.	Physical presence of survey and support vessels	0	0	3	0	0	0	3	3	3	3	3	2	1	0	1	1	0
		3.	Physical disturbance of the survey operations	0	0	0	0	0	0	3	3	3	3	3	2	1	0	1	1	0
		4.	Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	0	0	0	0	0	0	3	1	1	1	3	2	1	0	1	1	0
		5.	Increased light levels from routine vessels operations	0	0	0	0	0	0	1	1	3	1	3	0	1	0	1	1	0
		6.	Atmospheric emissions from routine operations of the survey and support vessels	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		7.	Planned marine discharges	0	0	3	0	0	0	1	3	3	3	3	0	1	0	1	1	0
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	0	0	1	0	0	0	3	3	3	3	3	4	1	0	1	1	0
		9.	Accidental event: Loss of vessel, equipment or material	0	0	1	0	0	0	1	1	1	1	3	3	1	0	1	1	0
		10.	Accidental event: Collision with marine wildlife during vessel operations.	0	0	0	0	0	0	0	0	0	0	3	0	1	0	1	1	0
		11.	Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	0	0	1	0	0	0	4	4	4	4	4	4	1	0	1	1	0

Table 5.15: Likely impact duration / time period of exposure.

DURATION OF IMPACT EXPOSURE

SCALE	DESCRIPTION
T	Temporary
P	Permanent

SOURCES OF POTENTIAL IMPACT			RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
			PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT						
			Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
			ONSHORE / COASTAL																	
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1. Port of Walvis Bay including Onshore support operations and waste management	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
			OFFSHORE																	
		2. Physical presence of survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		3. Physical disturbance of the survey operations	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		4. Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		5. Increased light levels from routine vessels operations	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		6. Atmospheric emissions from routine operations of the survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		7. Planned marine discharges	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	ACCIDENTAL	8. Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		9. Accidental event: Loss of vessel, equipment or material	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		10. Accidental event: Collision with marine wildlife during vessel operations.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T

Table 5.16: Likely impact geographical coverage / extent.

GEOGRAPHICAL COVERAGE

SCALE	DESCRIPTION
L	limited impact on location
O	impact of importance for municipality;
R	impact of regional character
N	impact of national character
M	impact of cross-border character

SOURCES OF POTENTIAL IMPACT			RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
			PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT						
			Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
		ONSHORE / COASTAL																		
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1. Port of Walvis Bay including Onshore support operations and waste management	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		OFFSHORE																		
		2. Physical presence of survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		3. Physical disturbance of the survey operations	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		4. Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		5. Increased light levels from routine vessels operations	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		6. Atmospheric emissions from routine operations of the survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		7. Planned marine discharges	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	ACCIDENTAL	8. Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		9. Accidental event: Loss of vessel, equipment or material	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		10. Accidental event: Collision with marine wildlife during vessel operations.	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.	L	L	O	L	L	L	O	O	O	O	O	O	L	L	L	L	L	L

Table 5.17: Likely impact probability, likelihood of occurrence.

PROBABILITY, LIKELIHOOD

SCALE	DESCRIPTION
A	Extremely unlikely (e.g. never heard of in the industry)
B	Unlikely (e.g. heard of in the industry but considered unlikely)
C	Low likelihood (egg such incidents/impacts have occurred but are uncommon)
D	Medium likelihood (e.g. such incidents/impacts occur several times per year within the industry)
E	High likelihood (e.g. such incidents/impacts occurs several times per year at each location where such works are undertaken)

SOURCES OF POTENTIAL IMPACT			RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
			PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT						
			Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
			ONSHORE / COASTAL																	
ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES		1. Port of Walvis Bay including Onshore support operations and waste management	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
			OFFSHORE																	
		2. Physical presence of survey and support vessels	A	A	C	A	A	A	C	C	C	C	C	C	A	A	A	A	A	A
		3. Physical disturbance of the survey operations	A	A	A	A	A	A	C	C	C	C	C	C	A	A	A	A	A	A
		4. Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	A	A	A	A	A	A	C	C	C	C	C	C	A	A	A	A	A	A
		5. Increased light levels from routine vessels operations	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A
		6. Atmospheric emissions from routine operations of the survey and support vessels	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		7. Planned marine discharges	A	A	B	A	A	A	B	B	B	A	A	A	A	A	A	A	A	A
	ACCIDENTAL	8. Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	A	A	B	A	A	A	B	B	B	B	B	B	B	A	A	A	A	A
		9. Accidental event: Loss of vessel, equipment or material	A	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A
		10. Accidental event: Collision with marine wildlife during vessel operations.	A	A	B	A	A	A	B	B	B	B	B	B	A	A	A	A	A	A
		11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	A	A	B	A	A	A	B	B	B	B	B	B	A	A	A	A	A	A

Table 5.18: Likely impact significant of impacts.

IMPACT SIGNIFICANT

IMPACT SEVERITY (Magnitude, Duration, Extent, Probability)	RECEPTOR CHARACTERISTICS (SENSITIVITY)				
	Very High (5)	High(4)	Medium (3)	Low (2)	Negligible (1)
Very High (5)	Major [5/5]	Major [4/5[	Moderate [3/5]	Moderate [2 /5]	Minor 1/5
High (4)	Major [5/4]	Major [4/4]	Moderate [3/4]	Moderate [2/4]	Minor[1/4]
Medium (3)	Major [5/3]	Moderate[4/3]	Moderate[3/3]	Minor[2/3]	None[1/3]
Low (2)	Moderate [5/2]	Moderate[4/2]	Minor[3/2]	None[2/2]	None[1/2]
Negligible (1)	Minor [5/1]	Minor [4/1]	None [3/1]	None [2/1]	None [1/1]

SOURCES OF POTENTIAL IMPACT			RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
			PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT						SOCIOECONOMIC ENVIRONMENT						
			Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
		ONSHORE / COASTAL																		
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1. Port of Walvis Bay including Onshore support operations and waste management	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
		OFFSHORE																		
		2. Physical presence of survey and support vessels	2/1	1/1	2/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1	4/1	1/1	1/1	1/1	1/1	1/1
		3. Physical disturbance of the survey operations	2/1	2/1	2/1	2/1	2/1	2/1	4/1	3/2	3/2	3/2	3/2	4/1	1/1	1/1	1/1	1/1	1/1
		4. Sound generation from the proposed 2D or 3D seismic survey seismic sources including sound of the survey and support vessels	1/1	1/1	1/1	1/1	1/1	1/1	4/2	4/2	2/1	2/1	4/2	4/2	1/1	1/1	1/1	1/1	1/1
		5. Increased light levels from routine vessels operations	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
		6. Atmospheric emissions from routine operations of the survey and support vessels	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
		7. Planned marine discharges	1/1	1/1	3/2	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	2/1	1/1	1/1	1/1	1/1	1/1
	ACCIDENTAL	8. Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	1/1	1/1	3/2	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	3/2	1/1	1/1	1/1	1/1	1/1
		9. Accidental event: Loss of vessel, equipment or material	1/1	1/1	1/1	1/1	1/1	1/1	1/1	3/2	3/2	3/2	3/2	4/1	1/1	1/1	1/1	1/1	1/1
		10. Accidental event: Collision with marine wildlife during vessel operations.	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	4/1	1/1	1/1	1/1	1/1	1/1
		11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	1/1	1/1	4/1	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	3/2	3/2	1/1	1/1	1/1	1/1

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Conclusions

The Proponent (PGS Exploration (UK) Limited, intend to acquire Multiclient/Proprietary 2D/3D seismic survey activities over the AOI covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, falling within the Walvis, Orange, and Lüderitz Basins Offshore Namibia Walvis, Orange, and Lüderitz Basins Offshore Namibia.

The Proposed AOI falls in water depths ranging from ca-200 m to more than ca-4000m, from east to west, respectively. respectively. The proposed Multiclient/Proprietary 2D / 3D seismic survey is planned to be implemented from January 2024. The likely negative impacts of the activities on the receiving marine environment will be localised and limited to a specific survey area within the greater AOI (Table 6.1).

The proposed 2D / 3D seismic survey operational area / AOI will not be conducted concurrently and will not cover entire outlined area of interest due to logistical and equipment requirements as well as licenses holders\ blocks\clients demand-driven nature of the key areas \ blocks to be survey. The proposed 2D / 3D seismic survey in the Walvis, Lüderitz and Orange Basins, offshore Namibia can coexist with other proposed and ongoing marine related activities in the area (Table 6.2).

November to March is generally the most favourable weather window to undertake the proposed 2D / 3D seismic survey operations (Table 6.2). Within the deep-water portion of the proposed survey area, operations may be undertaken without major influences from the other marine users except for the poor winter weather between June-October as well as the primary and secondary whales peak migration periods from May-July and October–November, respectively.

As shown in Table 6.1, the likely negative impacts of the proposed Multiclient/Proprietary 2D / 3D seismic survey activities have all been assessed against the receiving marine environment without the application of any mitigation measures. Based on the acoustic modelling results, a mitigation zone of 500 m is considered sufficient to effectively eliminate the risk of injury to marine mammals.

The overall likely negative impacts that the proposed Multiclient/Proprietary 2D / 3D seismic survey operations will have on the physical, biological and socioeconomic receiving environment is regarded to be of moderate significance in the short-term and low significance in the long-term, assuming mitigation measures as detailed in the EMP Report are implemented and monitored.

The proposed 2D / 3D seismic survey operations can coexist with other proposed and ongoing marine related activities in the area if mitigation measures and precautionary principles linked to international best practices as recommended by the Joint Nature Conservation Committee (JNCC) of the EnerGeo Alliance are implemented and monitored during each survey event.

Table 6.1: Summary of the impact assessment results without the implementation of the mitigation measures.

Potential Impacting Factors	Impacted Sectors – WITHOUT mitigation measures applied – Survey Activities									
	Air quality	Water quality	Cape Fur Seal	Cetaceans	Sea Turtles	Sea Birds	Shore Birds	Fish	Fisheries	Tuna Fishery
Seismic Noise – short term	No impact	No impact	Insignificant impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	No impact	Low-Moderate impact	Low-Moderate impact	Moderate - High impact
Seismic Noise – long term	No impact	No impact	Insignificant impact	Low impact	Insignificant impact	Insignificant impact	No impact	Low impact	Low impact	Low-Moderate impact
Light disturbance	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	No impact	No impact	No impact	No impact
Aircraft Noise –short term	No impact	No impact	Moderate - High impact	Low impact	No impact	Low impact	Moderate - High impact	No impact	No impact	No impact
Aircraft Noise –long term	No impact	No impact	Low impact	No impact	No impact	No impact	Low impact	No impact	No impact	No impact
Vessel exclusion zone – short term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Moderate impact	Moderate impact
Vessel exclusion zone – long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Low impact	Low impact
Waste generation	No impact	Moderate impact	Moderate impact	Low impact	Moderate - High impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	Low impact	Low impact
Air Emissions	Moderate impact	No impact	No impact	No impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact	No impact
Major accidental spill of diesel/oil	Insignificant impact	High impact	Moderate impact	Moderate impact	Moderate impact	Low-Moderate impact	High impact	Moderate impact	Moderate - High impact	Moderate - High impact
Small accidental spills	No impact	Low impact	Insignificant impact	Insignificant impact	Insignificant impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact
Ballast water	No impact	Moderate - High impact	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	Low impact	No impact

Table 6.2: RBS developed coexistence Knowledge-Based System Model Methodology (KBSMM) log framework fully validated and populated during the process of updating the EIA Report and identifying suitable window/s of opportunities for undertaking the proposed Multiclient/Proprietary 2D/3D seismic survey activities with respect to the receiving environment in the Walvis, Lüderitz and Orange Basins, offshore Namibia.

MONTH	KEY FISHING SEASON (KEY SPECIES)	MAIN SPAWNING ACTIVITIES (KEY SPECIES)			MINISTRY OF FISHERIES AND MARINE RESOURCES STOCK SURVEYS		KEY CETACEOUS PRESENCES / MIGRATORY TIMES		OTHER KEY USERS	WEATHER WINDOW	COMMENTS ON OFFSHORE SEISMIC SURVEY OPPORTUNITY WINDOW
January	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster		Hake spawning occurs throughout the year with main spawning period between July -October	Cape Monk spawn throughout the years, with peaks in Jul & Sep for females & Aug for males	Hake Stock Survey	Rock Lobster Monthly Stock Survey		Cetacean including Whales may be found in the Namibian waters	❖ Marine Diamond Exploration and Mining in shallow water less than -200m. ❖ The Survey area covers an area which is a busy international shipping lane	Good	Impact – Hake Stock Survey (less than-1000m), Tuna migrating (Trip Seamount) SURVEY PLANNED TO START 2024
February	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Hake Stock Survey (less than-1000m), Tuna migrating (Trip Seamount)
March	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Tuna migrating (Trip Seamount)
April	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster									Moderate Mixed	Impact – Tuna migrating (Trip Seamount)
May	Hake Trawl, Monk						Whales Migration Primary Peak Period				No Impacts but unfavorable weather
June	Snoek, Hake Trawl, Monk	Snoek, and Orange Roughy								Very Poor	No Impacts but unfavorable weather
July	Hake Trawl, Monk										Impact – Orange Roughy spawning (shallow waters), Snoek migrating in deepwater
August	Hake Trawl, Monk										Impact – Orange Roughy aggregated spawning, Snoek migrating in deepwater
September	Surface Longline, Hake Trawl, Monk									Poor	Impact – Snoek migrating in deepwater
October	Pole and line Tuna, Surface Longline, Monk	Rock Lobster			Rock Lobster Stock Survey		Whales Migration Secondary Peak Period			Moderate Mixed	Impact – Shallow water rock Lobster Stock Survey, Tuna migrating (Trip Seamount)
November	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster				Monk Stock Survey					Good	Impact – Monk Stock Survey (less than-1000m), Tuna migrating (Trip Seamount)
December	Pole and line Tuna, Hake Longline, Hake Trawl, Surface Longline, Monk, Rock Lobster										Impact – Tuna migrating (Trip Seamount)

6.2 Recommendations

The following are the key recommendations:

(i) The proposed 2D / 3D seismic survey by PGS covering Blocks 2310, 2311B, 2311A, 2312, 2410, 2411, 2412A, 2412B, 2511, 2512B, 2512A, 2513, 2611, and Portions of Blocks, 2210B, 2210A, 2211Bb, 2211Ba, 2212B, 2612B, 2612A, and 2613, in the Walvis, Orange, and Lüderitz Basins Offshore Namibia, Walvis, Orange, and Lüderitz Basins Offshore Namibia shall be issued with a new ECC and allowed to go-ahead.

(ii) The Proponent shall prepare, implement, monitored and report on the performance of the Environmental Management Plan (EMP) detailing all the key mitigation measures. The mitigation measures to be presented in the EMP Report shall be modelled around two main concepts: Industry best practice and local phenomena unique to the area of exploration (Walvis, Lüderitz and Orange Basins, offshore Namibia). Furthermore, International standards of protection have been developed through the Joint Nature Conservation Committee (JNCC) "guidelines for minimising the risk of injury and disturbance to marine mammals from seismic survey", in addition to the EnerGeo Alliance's "recommended mitigation measures for cetaceans during geophysical operations". Best industry practices which are based on the Best Practicable Environmental Option (BPEO) has proved to be effective in several different countries like Canada, Australia, Norway, and the United States. These guidelines have been developed based on noise attenuation modelling, international experiences during seismic acquisition and a precautionary approach to the disturbance of marine mammals from seismic survey. The following are the example summary of some of key mitigation measures that included in the EMP Report:

- ❖ Seasonality and timing.
- ❖ Establishment of an operational buffer zones.
- ❖ Use of Marine Mammal Observers (MMOs) and Fisheries Liaison Officers (FLOs).
- ❖ Use of Passive Acoustic Monitoring (PAM) Technology.
- ❖ Soft starts' and 'pre-activation' observations.
- ❖ Termination of activation in the 500m exclusion zone.
- ❖ Marine animal monitoring and mitigation plan aboard the survey vessel.
- ❖ The use of Turtle friendly tail buoys, and.
- ❖ Compliance to all MARPOL Regulations and waste disposal procedures.

(iii) In the absence of any specific mitigation measures being provide in the EMP, the Proponent shall always adopt the precautionary approach, and.

(iv) The MME, MFMR, MWT, MEFT, other PEL holders, minerals licenses holder, all fishing companies operating in the Walvis, Lüderitz and Orange Basins, offshore Namibia and especially overlapping with the proposed survey area shall be notified on the implementation of each survey event. The communication shall be done directly to each key stakeholder group / organisation as well as through the Office of the Petroleum Commissioner in the Ministry of Mines and Energy (MME) who in turn will notify the other institutional stakeholder.

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8. ANNEXES

Annex 1 – BID and Final Environmental Scoping Report

Annex 2 – Proof of Public and Stakeholder Consultation Materials