TGS Geophysical Company (UK) Limited

Final Environmental Impact Assessment (EIA) Report to Support the Application for Environmental Clearance Certificate (ECC) for Proposed Multiclient or Proprietary 2D / 3D Seismic Survey covering Blocks 2010A, 2011A, 2010B, 2011B, 2111A, 2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A,
Walvis and Lüderitz Basins, Offshore South-Central Namibia

November 2022

Dukes Court, Duke Street,
Woking, GU21 5BH,
UNITED KINGDOM

SUMMARY INFORMATION

Proponent
TGS Geophysical Company (UK) Limited

MEFT ECC Application Reference No.
221114000321

Project Title / Subject on the ECC
Environmental Clearance Certificate for the
Proposed Multiclient or Proprietary 2D / 3D Seismic Survey covering
Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba,
2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B,
2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B,
2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A
Lüderitz and Walvis Basins, Offshore Namibia

Petroleum Exploration Activities
Proposed Multiclient or Proprietary 2D / 3D Seismic Survey
Offshore / Marine Environment, Namibia

Location Survey Area of Interest
Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb,
2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba,
2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B,
2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A
Lüderitz and Walvis 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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NON-TECHNICAL SUMMARY

1. Background

TGS Geophysical Company (UK) Limited here in referred as ("**TGS**") (the "**Proponent**") is proposing to conduct a regional Multiclient (MC) or Proprietary / Exclusive 2D/3D seismic survey over a 199,000 km^2 Area of Interest (AOI) situated in the Lüderitz and Walvis Basins Namibia. The proposed AOI covers Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A. The Proposed survey area falls in water depths ranging from ca-1000m to ca-4000m from east to west, respectively. The proposed 2D / 3D seismic survey is planned to be implemented from January / February 2023. The proposed survey will be undertaken over multiple survey events and seasons using one (1) or two (2) third-party chartered survey surveys compliant to the International Convention for the Prevention of Pollution from Ships (MARPOL) and Namibian Maritimes legal requirements.

The proposed 2D / 3D seismic survey is 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 an Environmental Clearance Certificate ("ECC"). TGS Geophysical Company (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, TGS Geophysical Company (UK) Limited appointed Risk-Based Solutions (RBS) CC as the Environmental Consultant to prepare all the required reports and apply for the ECC with respect to the proposed 2D / 3D seismic survey in the Lüderitz and Walvis Basins, offshore Namibia.

This Environmental Impact Assessment (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 October 2022.

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 a number of 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. Owing to the fact that 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 Lüderitz and Walvis 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 airgun noise range from imperceptible to distress-induced altered patterns, which will include changes in diving time, swimming directions and resting periods.

The 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. The overall ecological significance impact is expected to be low. The following is the summary of the impact assessment results:

- **Cetaceans:** Based on the results of the living marine resources studies and acoustic modelling undertaken for this project, it is highly likely that mysticetes will avoid areas of seismic noise, particularly if warning mitigation measures are applied. 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 considered to be of low significance. The low likelihood of encountering many mysticetes will further lessen any potential impacts from this survey. To mitigate impacts on migratory cetaceans, particularly mysticetes, it is recommended that seismic surveying along the shelf break not be undertaken in migration months (May - July and October – November).

  Air gun noise is only expected to impact low-frequency cetaceans within close range of the operating airgun. As there are no known resident low-frequency cetaceans, the impact will be on migrating mammals. The number of mammals migrating through the BCLME is relatively low and wide-spread. 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. Overall, the expected impacts at population level are considered low in the long term. Noise from support vessels will have an insignificant impact, because whales and dolphins are likely to display avoidance reactions at a distance of about 1 km. The communication and navigation sounds emitted by whales and dolphins should not be masked by noise emitted by supply vessels and

therefore, it is considered to be of insignificant impact. The impact of prey displacement as a result of seismic activities is considered to be of very low significance overall, as marine mammals have an adaptable diet and prey on more than one fish species. In addition, these creatures are highly mobile and able to follow prey in different directions. The impact of the seismic survey on feeding would be of very low significance.

- **Seabirds:** 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. However, research indicates that acoustic damage will only occur in birds diving within 5 m of the firing source. This is considered highly unlikely as the array is towed behind the vessel and there is effectively a bird-free corridor associated with operational vessels. Impacts on sea birds are likely to be minimal and related primarily to lighting of vessels at night. Birds will be attracted to the vessel as a potential resting place. However, they can become disoriented by lights and collide with cables and vessel bulkheads.

- **Sea turtle:** Sea turtles are known to occur in the Namibian marine environment. However, seismic noise is unlikely to negatively affect them in any way. The impact on sea turtles from seismic noise as well as the possibility for entanglement in seismic survey gear is insignificant.

- **Fish Species:** The impact on larvae close to the surface in the vicinity of the airgun 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 *very 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 of the proposed survey area, and in view of the relatively short duration of the disruption to species and the wide distribution of fish, the impacts of the survey on fish recruitment at the population level are considered to be of *low* significance. The potential impact of physiological damage to pelagic species in close proximity to 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. The overall impact of physiological damage to pelagic fish species is considered to be of *low to very low* significance dependant on the mitigation measures employed. However, the potential impact on demersal species and on species in shallow and inshore water would be insignificant as they are expected to be well out of the range of damage. Also, certain species of commercial importance (herring, mackerel, gobi, sharks) have under-developed or no swim bladders and there is little risk of injury from seismic noise. The physiological impact on large pelagic species is considered to be *negligible*. 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 airgun, 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.

- **Fisheries:** Research indicates that catch rates should be resumed within a few days, as CPUE returns to normal within a week of seismic operations ceasing. Thus, the expected impact on commercial catch and effort is considered to be of moderate to low significance depending on timing and location. Most of the fishing grounds lie inshore of the proposed survey area and will as such experience little or no disruption as a result of survey activities. The tuna fishery could be affected along the shelf edge in the southern portion of the AOI. While the seismic survey will not impact the fish themselves or the species as a whole, it may interfere with and obstruct the fishing vessels. In addition, seismic noise may cause the fish to alter their migration route and avoid the areas of seismic operations. This can have a direct impact on the fishing industry, which targets tuna species in known locations. The pole-and-line fishery in particular, is a very small and seasonal fishery, operating only a couple of months in the year. The effort is variable dependent on fish availability. The fishery operates on windows of opportunity. When a shoal is located, many vessels will congregate at one location for a number of days. Albacore tuna congregate at Tripp Seamount which is well south of the AOI. Although boats preferentially frequent this area catches vary from year to year, as the movement of albacore between South

Africa and Namibia is poorly understood and there is no clear pattern. Due consideration must be given to this fishery and negotiations regarding the timing of the seismic survey could lessen any potentially negative associated impacts. Flexibility is paramount in limiting impacts on this fishery, which could be moderate if no mitigation or consultation is undertaken, but low to no impact depending on the timing of the survey and fish stock availability, and.

- **Normal survey vessels operations:** The seismic survey and support vessels all produce waste which needs to be monitored and disposed of in an environmentally sustainable manner that meets international standards. Some of these wastes, such as galley waste and sewage, are discharged into the ocean in accordance with MARPOL provisions. These wastes can impact water quality, marine mammals, birds, turtles, fish and fisheries and can be harmful to the ecosystem if not correctly managed. The biggest threat to the environment would be an accidental oil spill. The potential of a major oil spill as a result of these survey activities is equal to that of any other vessels operating within or travelling through the BCLME and would be an accidental occurrence. Any oil spill should be reported immediately and treated in accordance with the major disaster plan of the country and/or region.

4. Conclusions

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 (short term), seismic noise (long term, light disturbance, aircraft noise (short term), aircraft noise (long term), vessel exclusion zone (short term), vessel exclusion zone (long term), 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. 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 are applied.

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. Based on the results of acoustic modelling specialist assessment undertake and without any mitigation measures in place, seismic survey activities have been identified as having the potential to cause injury to low frequency cetaceans at a range of up to 291 m from the source array and 798 m for very-high frequency cetaceans. However, the injury radius is only 25 m for high-frequency cetaceans. Given the potential for injury (and disturbance) from the survey, it is recommended that further mitigation measures should be adopted. These injury zones can effectively be monitored using Marine Mammals Observers (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. It is therefore concluded that it is unlikely that marine mammals will be injured as a result of the survey. Recoverable injury could occur in some fish at a range of up to 363 m from the source array (for fish with swim bladders and eggs and larvae). For fish without swim bladders, the potential range of effect reduces to a maximum of 194 m from the source array. Some sea turtles could be injured at ranges of up to 363 m from the source array.

The overall likely negative impacts on all the fisheries sectors of the affected environment are considered to be low to insignificant in the long-term, if the recommended mitigation measures provided in the EMP Report are implemented and monitored throughout the proposed survey duration and for each survey event. The overall ecological significance impact is expected to be low in the long-term. It is hereby recommended that the proposed 2D / 3D seismic survey activities covering the Lüderitz and Walvis Basins, offshore Namibia, shall go-ahead and be granted with an ECC. The proposed 2D / 3D seismic survey in the Lüderitz and Walvis Basins, offshore Namibia can coexist with other proposed and ongoing marine related activities in the area and precautionary principles and actions shall be exercised at all times.

Table 1: Summary of Impact Assessments with no mitigation applied.

Potential Impacting Factors		Impacted Sectors – WITHOUT mitigation measures applied								
	Air quality	Water quality	Marine Mammals		Marine Turtles	Sea Birds	Shore Birds	Fish	Fisheries	Tuna Fishery
			Cape Fur Seals	Cetaceans						
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 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

5. Recommendations

The proposed 2D / 3D seismic survey is planned to be implemented from January / February 2023 if the ECC is granted. As shown in Table 2, October to April is the most favourable weather window to undertake the proposed 2D / 3D seismic survey operation especially in the deeper waters where there are lesser likely negative influences / overlaps of the proposed survey activities / area with the receiving sensitivity marine environments such as the fish, fisheries, and cetacean migratory areas. During the seismic survey operations effective communication with other marine users such as the MFMR and the fishing companies operating in the area shall be key to the successful implementation of the proposed 2D / 3D seismic survey especially when operating in the southern and shallow eastern portions of the proposed survey area. Within the deep-water portion of survey area, operations may be undertaken without major influences on the other marine users except the for the poor winter weather between June-October and the overlap with international shipping routes used for global trades.

Table 2: Log frame for evaluating the window of opportunity for undertaking the proposed 2D / 3D seismic survey activities with respect to other marine activities around AOI.

<table>
<tr><th>Month of Year</th><th colspan="2">Key Fishing Season (Key Species)</th><th>Main Spawning Activities (Key Species)</th><th>Key Cetaceous Presences / Migratory Times</th><th>Other Key Users Such as Minerals and Petroleum Operations</th><th>Weather Window</th><th>Marine seismic Survey Opportunity Window</th></tr>
<tr><td>January</td><td rowspan="9">Hake, Monkfish trawl, Deep-Sea Crabs and Orange Rough especially in the Shallow waters (-100 to -600 m) not covered by the proposed survey area.</td><td rowspan="3">Tuna Fishery (Southern Portions of the AOI)</td><td></td><td></td><td rowspan="12">International Shipping Lanes throughout the year</td><td rowspan="3">Good</td><td rowspan="4"></td></tr>
<tr><td>February</td><td></td><td>Leatherback</td></tr>
<tr><td>March</td><td></td><td>Turtles</td></tr>
<tr><td>April</td><td></td><td rowspan="3">Blue Whales Moving North</td><td>Moderate Mixed</td></tr>
<tr><td>May</td><td rowspan="4"></td><td></td><td rowspan="6">Poor</td></tr>
<tr><td>June</td><td></td><td></td><td></td></tr>
<tr><td>July</td><td></td><td></td><td></td></tr>
<tr><td>August</td><td></td><td></td><td></td></tr>
<tr><td>September</td><td rowspan="3">Coby (Inshore)</td><td></td><td></td></tr>
<tr><td>October</td><td>Ministry of Fisheries and Marine Resources (MFMR) Stock Assessments undertaken in less than -1000 m water depth</td><td>Tuna Fishery (Southern Portions of the AOI)</td><td></td><td></td><td>Moderate Mixed</td><td rowspan="3"></td></tr>
<tr><td>November</td><td></td><td></td><td rowspan="2">Good</td></tr>
<tr><td>December</td><td></td><td></td><td></td></tr>
</table>

The Proponent has prepared the Environmental Management Plan (EMP) detailing all the key mitigation measures. TGS Geophysical Company (UK) Limited is committed to complying with all applicable national, regional (Southern African Development Community-SADC) and international regulations, protocols, obligations, international best industry practice and the precautionary principles in offshore seismic survey operations. As an international operator, TGS Geophysical Company (UK) Limited' s mitigation measures have been modelled around two main concepts namely: Industry best practice and local Namibian requirements unique to the area of exploration. In addition to national requirements, TGS Geophysical Company (UK) Limited will conform to the international best industry practice and guidelines for minimising the risk of injury and disturbance to marine mammals from seismic survey

developed by the Joint Nature Conservation Committee (JNCC) and key mitigation measures for cetaceans during geophysical operations recommended by the International Association of Geophysical Contractors (IAGC). Best industry practice has proved to be effective in several different countries like Canada, Australia, United Kingdom, 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 proposed mitigation measures as detailed in the EMP Report includes the following:

(i) The proposed 2D / 3D seismic survey is planned to be implemented from January / February 2023.

(ii) Use of a Passive Acoustic Monitoring (PAM) system to detect marine mammal calls in low visibility conditions.

(iii) Use of Marine Mammal Observers (MMOs) on seismic vessel.

(iv) Delay of ramp up for marine mammals seen or heard inside safety zone of 500 m.

(v) Shutdown of airguns for marine mammals seen inside of safety zone or during line changes.

(vi) The use of the lowest practicable airgun volume as defined by the operator.

(vii) Continuous liaising with the national coordinating seismic Task Force comprising the Ministry of Fisheries and Marine Resources, Ministry of Mines and Energy and Ministry of Environment, Forestry, and Tourism, and.

(viii) Continuous liaising with the Benguela Current Commission (BCC) in terms of transboundary coordinating framework with respect to seismic activities between Namibia and South Africa.

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

All the key stakeholders shall be notified before the implementation of each survey event. 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 Overview

TGS Geophysical Company (UK) Limited here in referred as ("**TGS**") (the "**Proponent**") is proposing to conduct a regional Multiclient (MC) or Proprietary / Exclusive 2D/3D seismic survey over a 199,000 km^2 Area of Interest (AOI) situated in the Lüderitz and Walvis Basins Namibia (Figs. 1.1-1.3). The proposed survey area covers Blocks 2010A, 2011A, 2010B, 2011B, 2111A, 2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A, Walvis and Lüderitz Basins Offshore Namibia (Figs. 1.2 and 1.3). The water depths of the survey area range from ca-1000m to ca-4000m from east to west, respectively.

The proposed 2D / 3D seismic survey is planned to start from January / February 2023 if the Proponent is granted the 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 airguns 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 and pre-survey preparations.

(ii) Actual survey operations.

(iii) 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. There will be no requirement for any additional port infrastructure to be constructed or modified to support the proposed survey. No helicopter crew transfer support is anticipated except in event of an emergency.

1.2 TGS Geophysical Company (UK) Limited (Proponent)

TGS is a leading energy data and intelligence company, known for its asset-light, multi-client business model and global data collection (www.tgs.com/about-us/this-is-tgs). TGS employs approximately 480 employees with its corporate headquarters in Oslo, Norway and its operational headquarters in Houston, Texas, U.S.A. The company's other main offices are located in the UK, Brazil and Perth, with further employees located in other cities around the globe. The company's stock is traded on the Oslo Stock Exchange, is part of the OBX Index (25 most liquid shares at the OSE). TGS offers extensive global data libraries that include seismic data, magnetic and gravity data, multi-beam and coring data, digital well logs and production data, and new energy solutions data. TGS also offers specialised services such as advanced processing and analytics and cloud-based data applications and solutions.

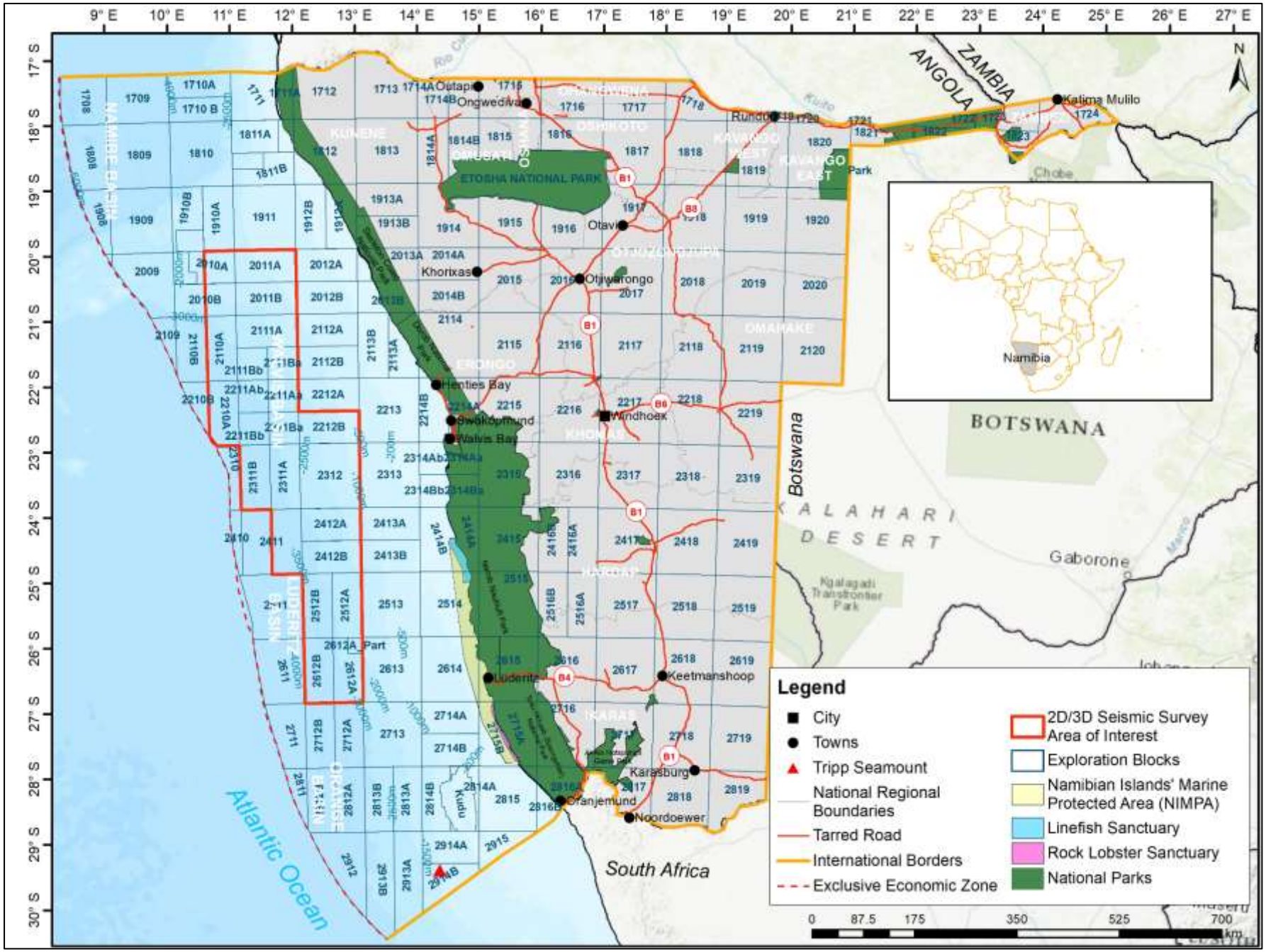


Figure 1.1: Regional location of the proposed 2D / 3D seismic survey coverage areas in the Lüderitz and Walvis Basins, offshore central Namibia.

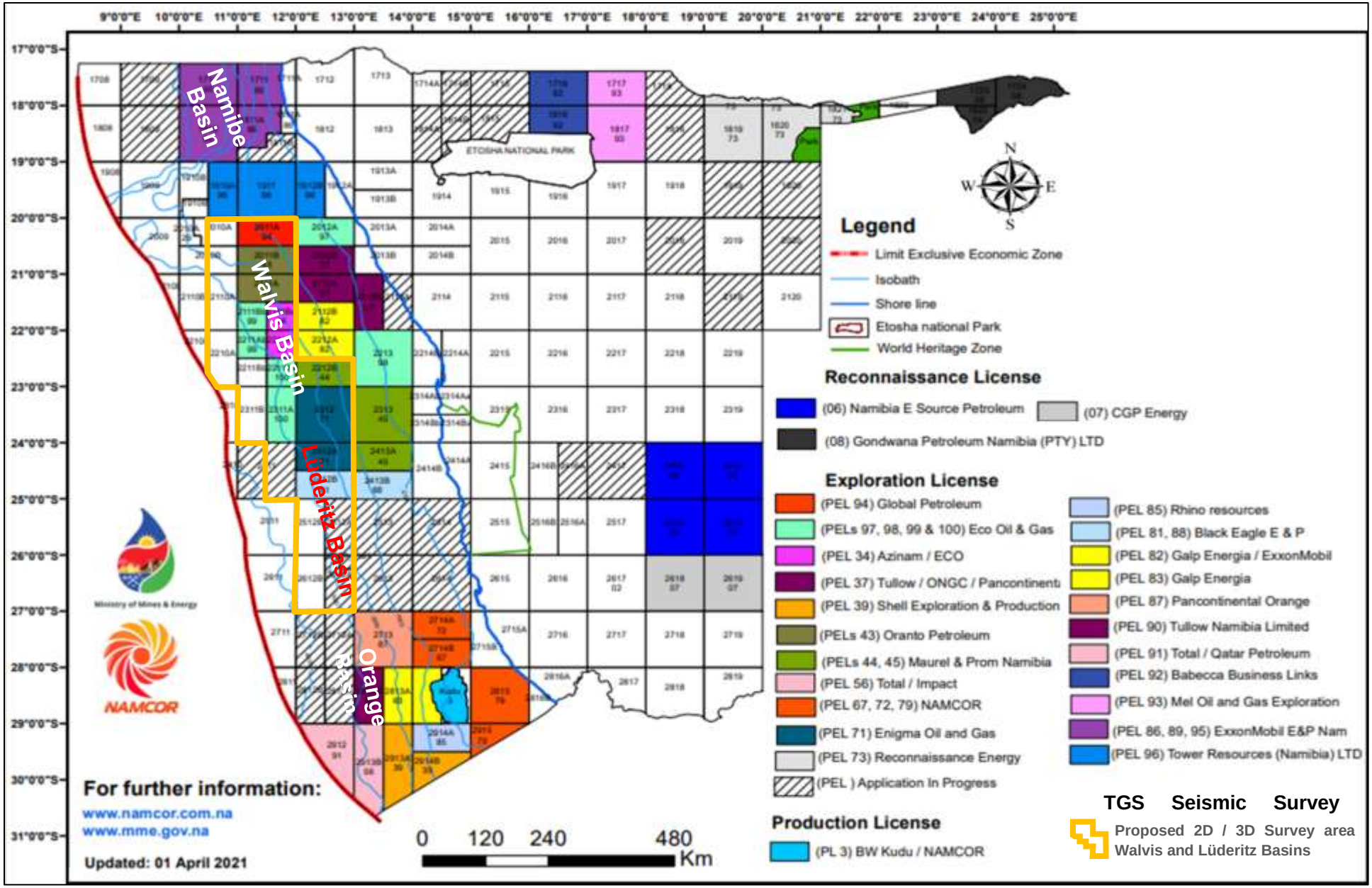


Figure 1.2: Hydrocarbon map of Namibia showing the proposed 2D / 3D seismic survey area covering Blocks 2010A, 2011A, 2010B, 2011B, 2111A, 2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A, Walvis and Lüderitz Basins Offshore Namibia with water depths ranging from ca-1000m to -4000m from east to west, respectively (Modified Source: www.mme.gov.na).

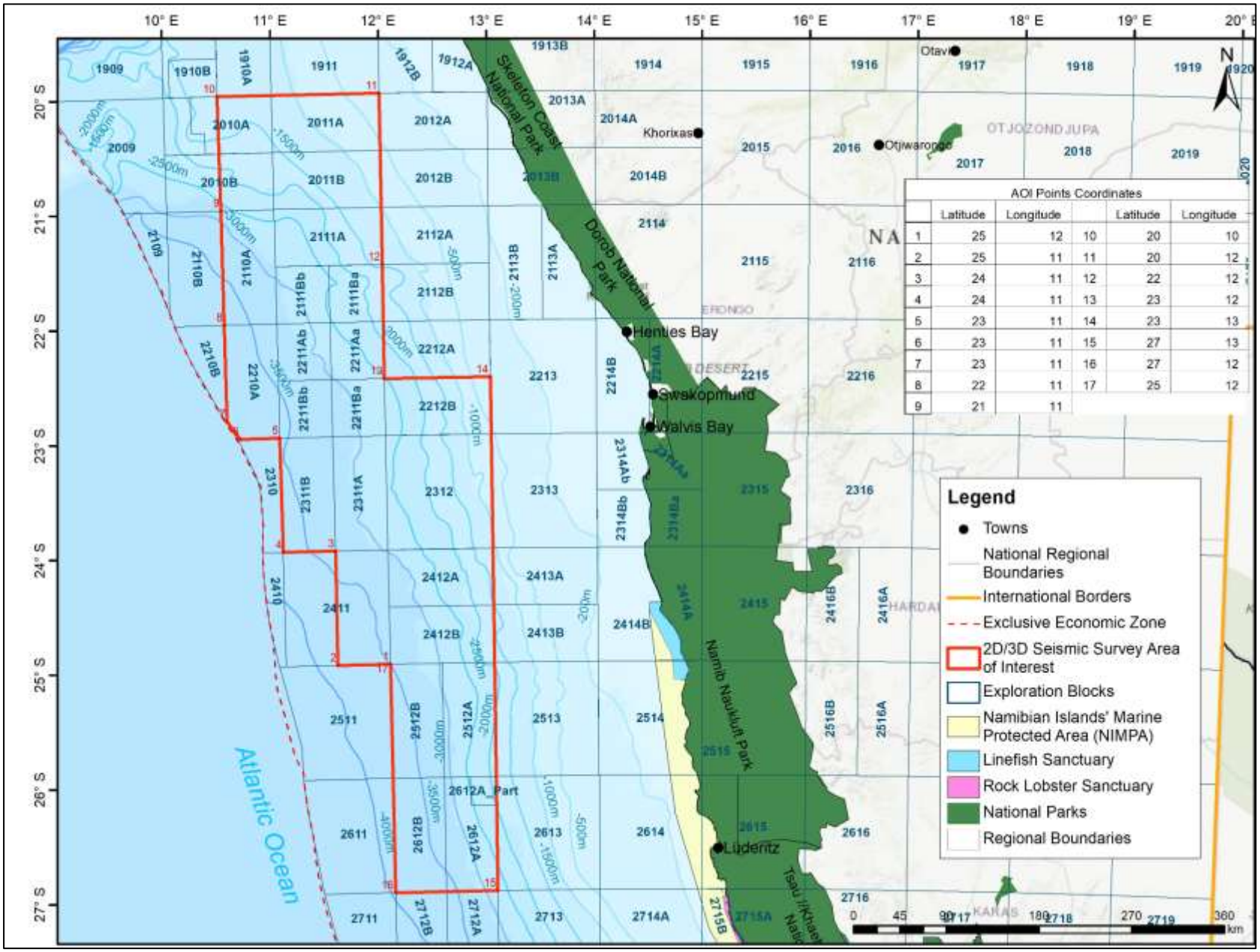


Figure 1.3: TGS proposed 2D/3D seismic survey area covering Blocks 2010A, 2011A, 2010B, 2011B, 2111A, 2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A, Walvis and Lüderitz Basins Offshore Namibia with water depths ranging from ca-1000m to -4000m from east to west, respectively.

1.3 Project Motivation, Permitting and Regulatory Requirements

1.3.1 Project Motivation

Although offshore seismic survey operations in Namibia began as far back as 1968, a lot more still need to be done to have a full understanding of the petroleum systems of the deep-water offshore Namibia (Figs. 1.4 and 1.5).

The datasets from the proposed 2D / 3D seismic survey by TGS will provide critical insight into the subsurface geological evolution, offshore basin architecture, depositional, structural history and delineate potential drill-ready 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 small, short-term, local project 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, minerals resources and large-scale CCS facilities terrains. Namibia and indeed the global offshore continental shelves broadly represent the largest potential storage for Gigaton-scale Carbon Capture and Storage (CCS).

CCS is a promising and great potential emission reductions strategy towards meeting globally commitments targets, national regulatory compliances, meeting corporate performance targets, participating in potential new CO_2 banking and markets systems and meeting overall Environment, Social and Governance (ESG) national and corporate pillars.

Extensive researches and monitoring continue to be undertaken on various aspects of CCS globally (Pernin, et., al., 2022, Rosa, L and Mazzotti, 2021, Page, *et, al*., 2020, Martin-Roberts, *et al*, 2020, Tomić,, *et, al.,* 2018, and Capros, *et, al*., 2018). According to Pernin, *et., al*., 2022, at present there are less than 30 sites worldwide storing around 40 Mt of CO_2/year and additional Carbon Capture storage (CCS) sites are needed to achieve ambitious net carbon dioxide (CO_2) emissions goals. As illustrated in Fig. 1.7, seismic data to be collected offshore Namibia can also be used in the search for future CO_2 subsurface storage sites container and containment facilities that may prove viable as potential future CO_2 subsurface business banking system aligned to global Climate Change NetZero CO_2 Emissions Goals by 2025 and beyond.

CCS will not prevent CO_2 from being emitted but it will remove low-cost CO_2 being generated by heavy industries such as gas processing, steel and cement plants where separation and transportation system already exists. The existing infrastructure involved in heavy industries separation process generates very concentrated streams of CO_2 which is easy to capture, transport and store, thereby making the industrialised CCS systems achievable provided that the storage facilities exist within the local industrialised area. Seismic survey methods can greatly support the search for suitable onshore and offshore industrial zones / sites with suitable geology for storing industrial CO_2 (Pernin, *et., al*., 2022 and Fig. 1.7). Geophysics and indeed seismic survey can provide all the key geological information needed in CCS site selection, monitoring and verification of stored CO_2 in the reservoir and its capability of storing CO_2 (Fig. 1.7). Therefore, the expansion of the national marine seismic data coverage in Namibia, may open up future opportunities and create potential future industry and jobs opportunities within the area of CCS and international CO_2 trade.

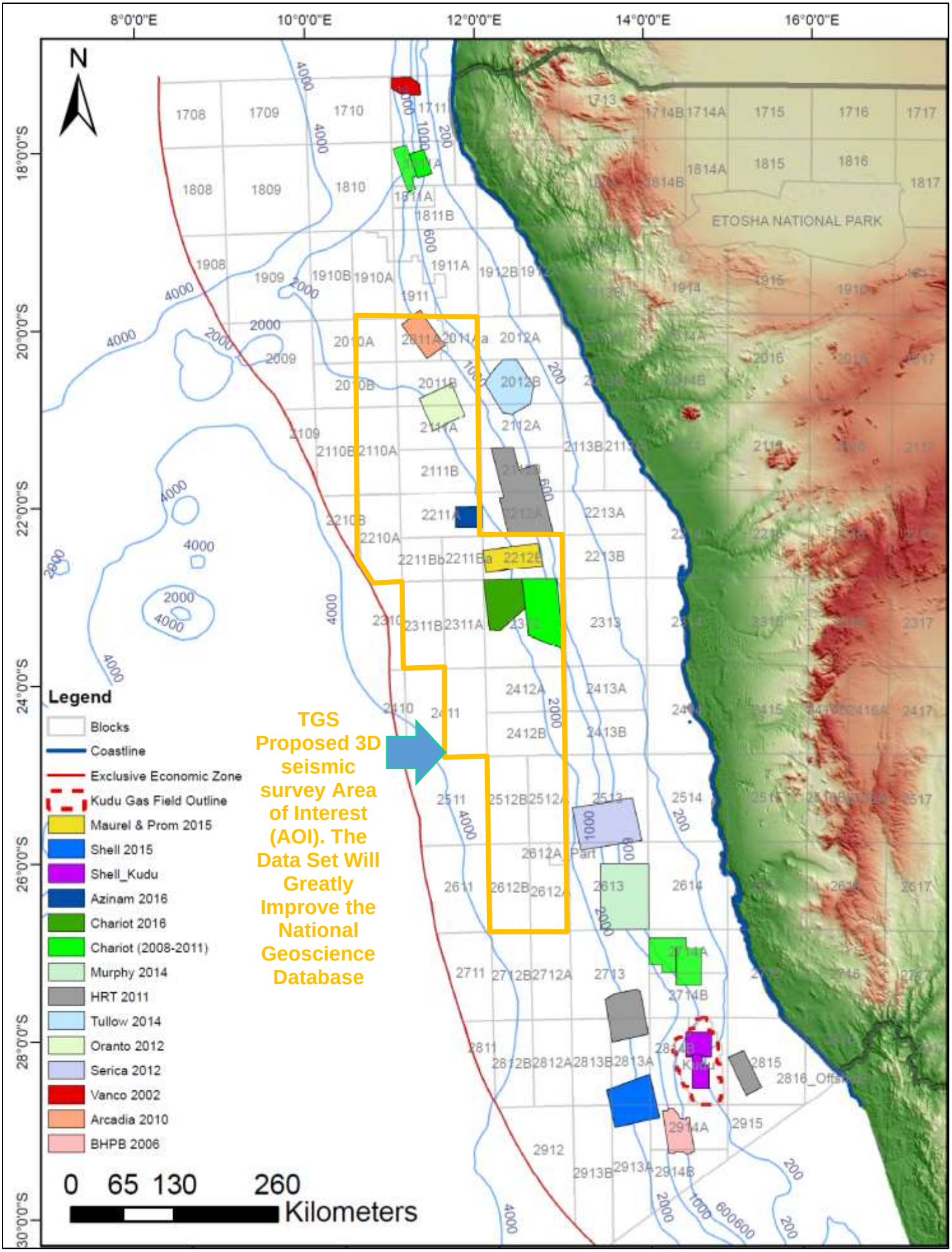


Figure 1.4: Overview of the 3D seismic survey database coverage of Namibia as of 2016 with respect to the proposed survey (Source: www.namcor.com.na).

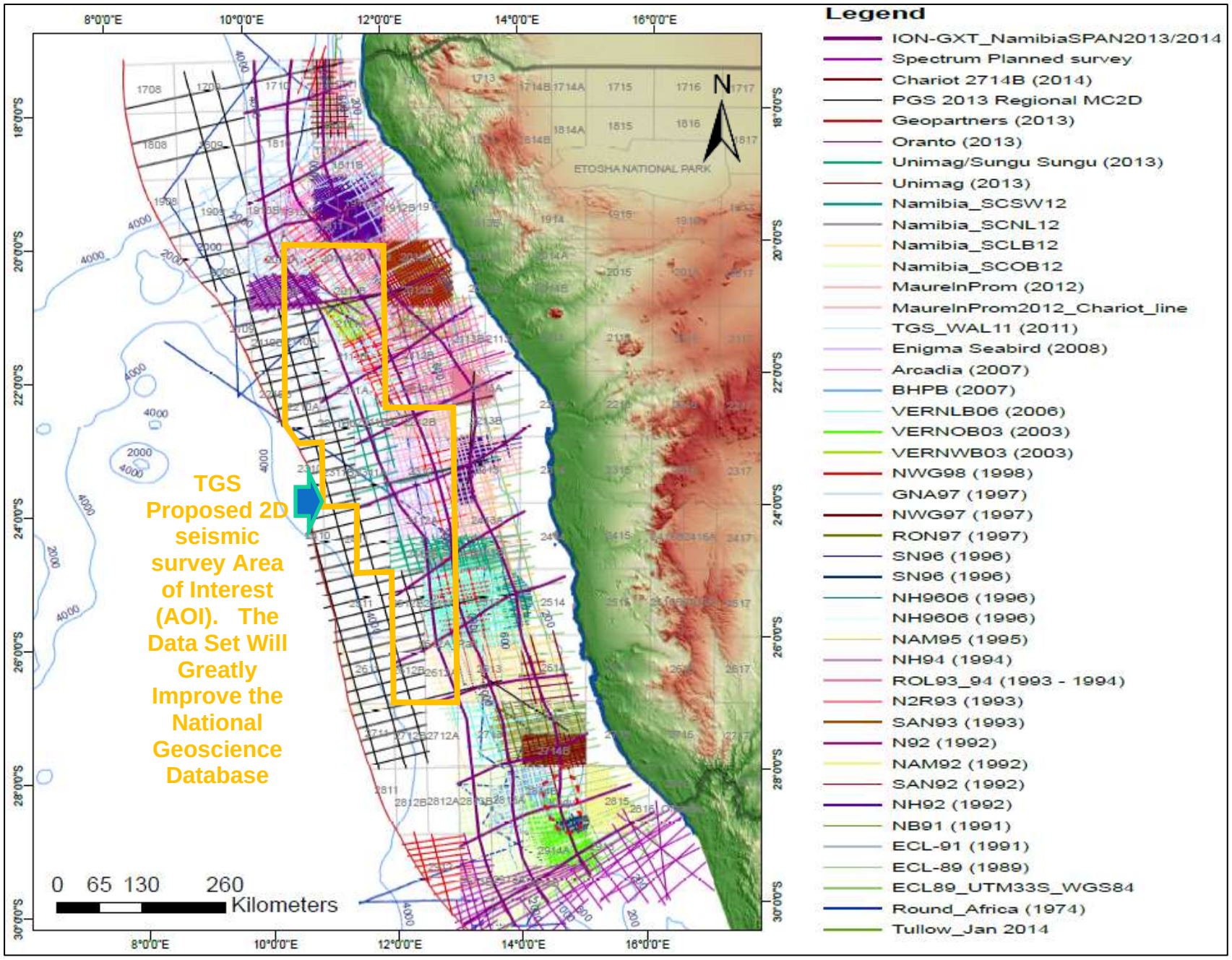


Figure 1.5: Overview of the 2D seismic survey database coverage of Namibia as of 2016 with respect to the proposed survey (Source: www.namcor.com.na).

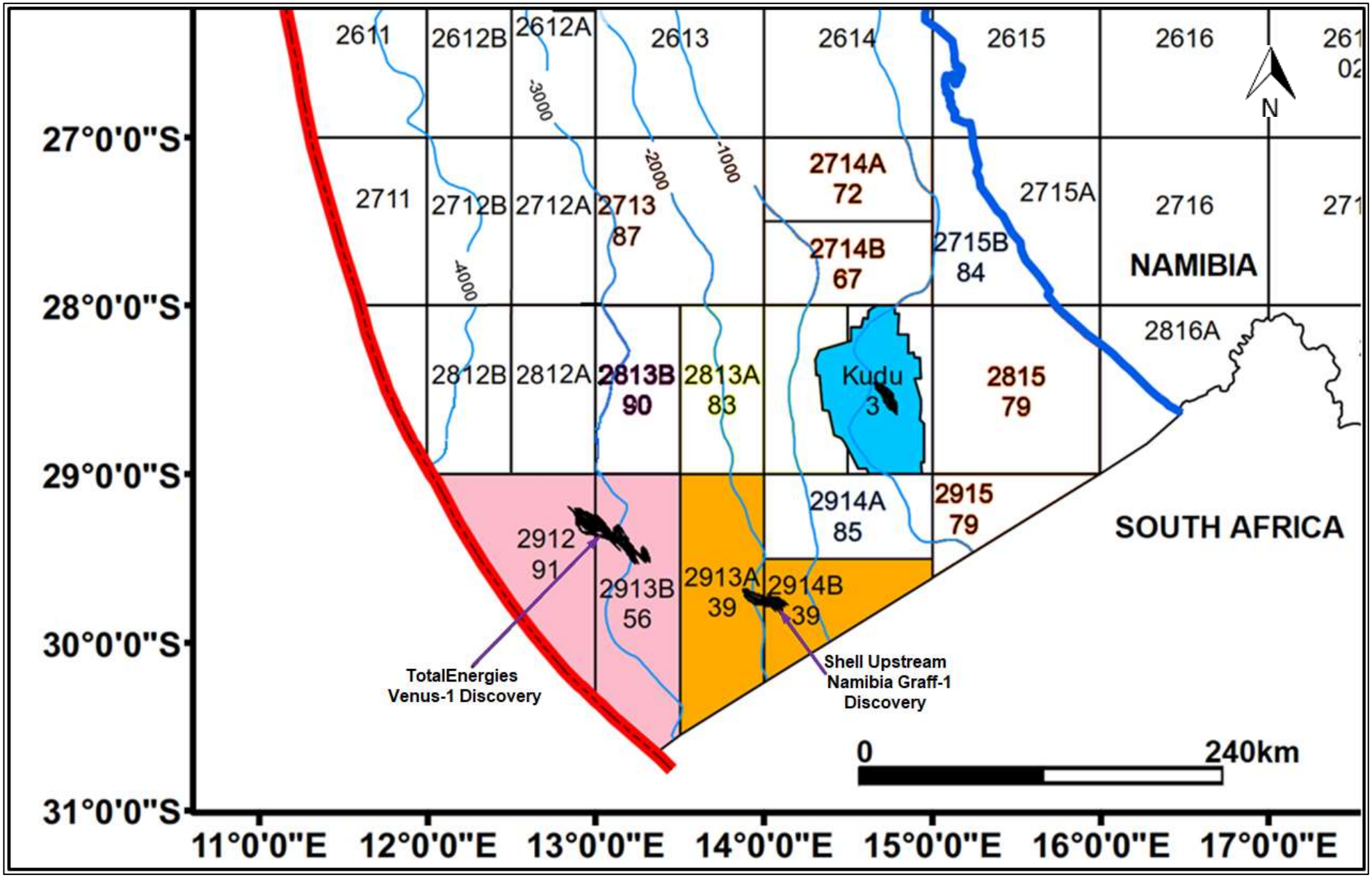


Figure 1.6: Locations of the known oil and gas discoveries offshore Namibia showing the Kudu Gas Field, the TotalEnergies Venus-1 discovery in Petroleum Exploration License (PEL) 56 covering Blocks 2912 and 2913B and the Shell Upstream Namibia BV Graff-1 discovery in PEL 39 covering Blocks 2913A and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

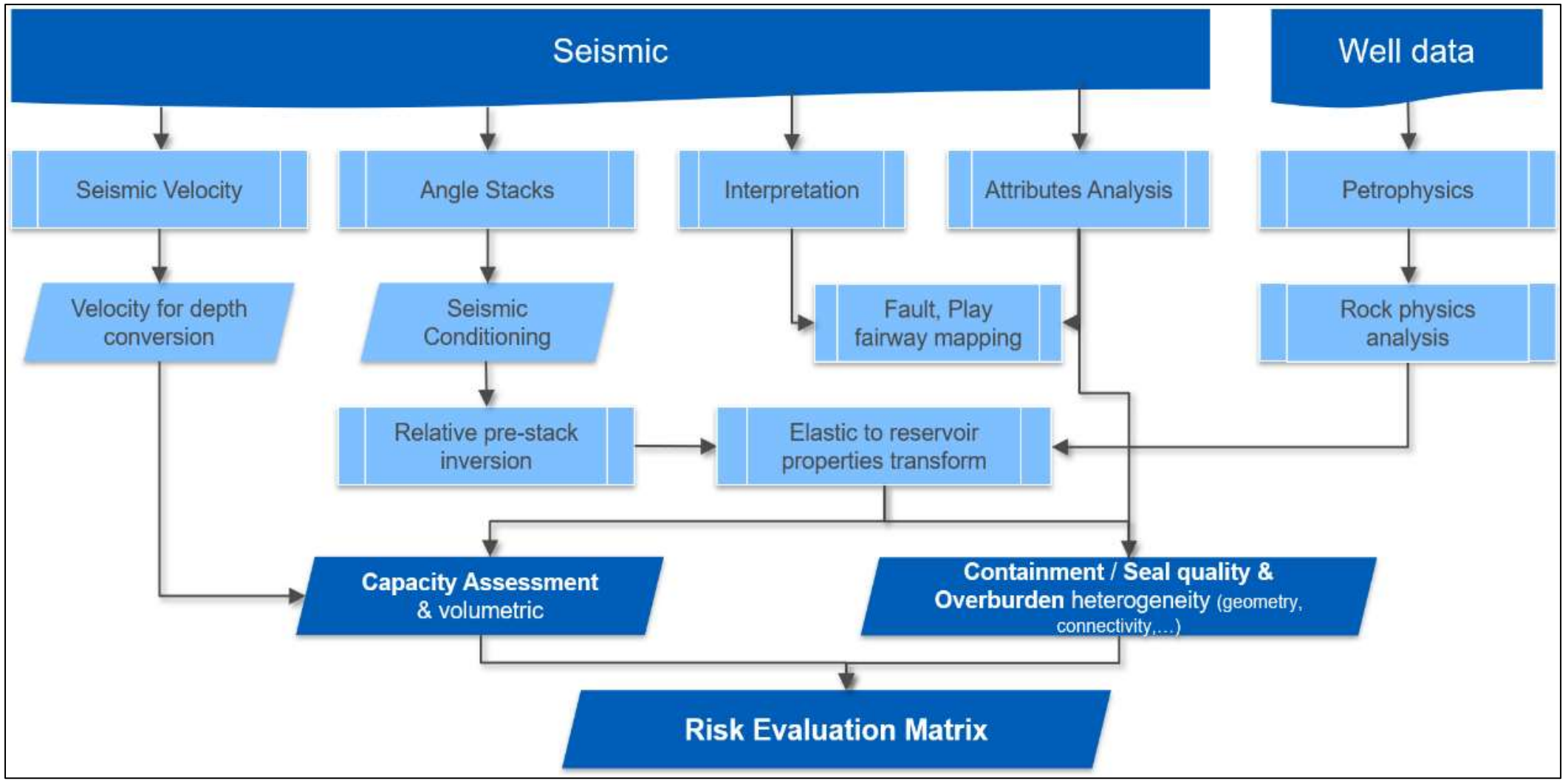


Figure 1.7: General overview of the seismic data analysis workflow implemented for the CO_2 subsurface storage sites container and containment analysis (Source: Pernin, *et., al*., 2022).

1.3.2 Permitting Regulatory Requirements

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 2D / 3D seismic survey requires the Proponent to adhere to environmental laws and regulations of the country.

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 (TGS) 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 and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare this EIA and a separate Environmental Management Plan (EMP) Reports to support the application for ECC. This 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) (Fig. 1.8).

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

1.3.3.1 Overview

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

1.3.3.2 Multiclient (MC) Surveys

Under a MC system, 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 sold / 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. Contractually, the partnership decides how they split the cost and decide upon how the data will be managed and proceeds shared.

1.3.3.3 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.

1.3.3.4 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.

1.4 Environmental Assessment Process

1.4.1 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. 1.8):

- Current outlined initial survey area covering and any future survey extension falling within the Lüderitz and Walvis 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.

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. 1.8. 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. The general framework of the baseline data collection was as follows:

- 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 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).

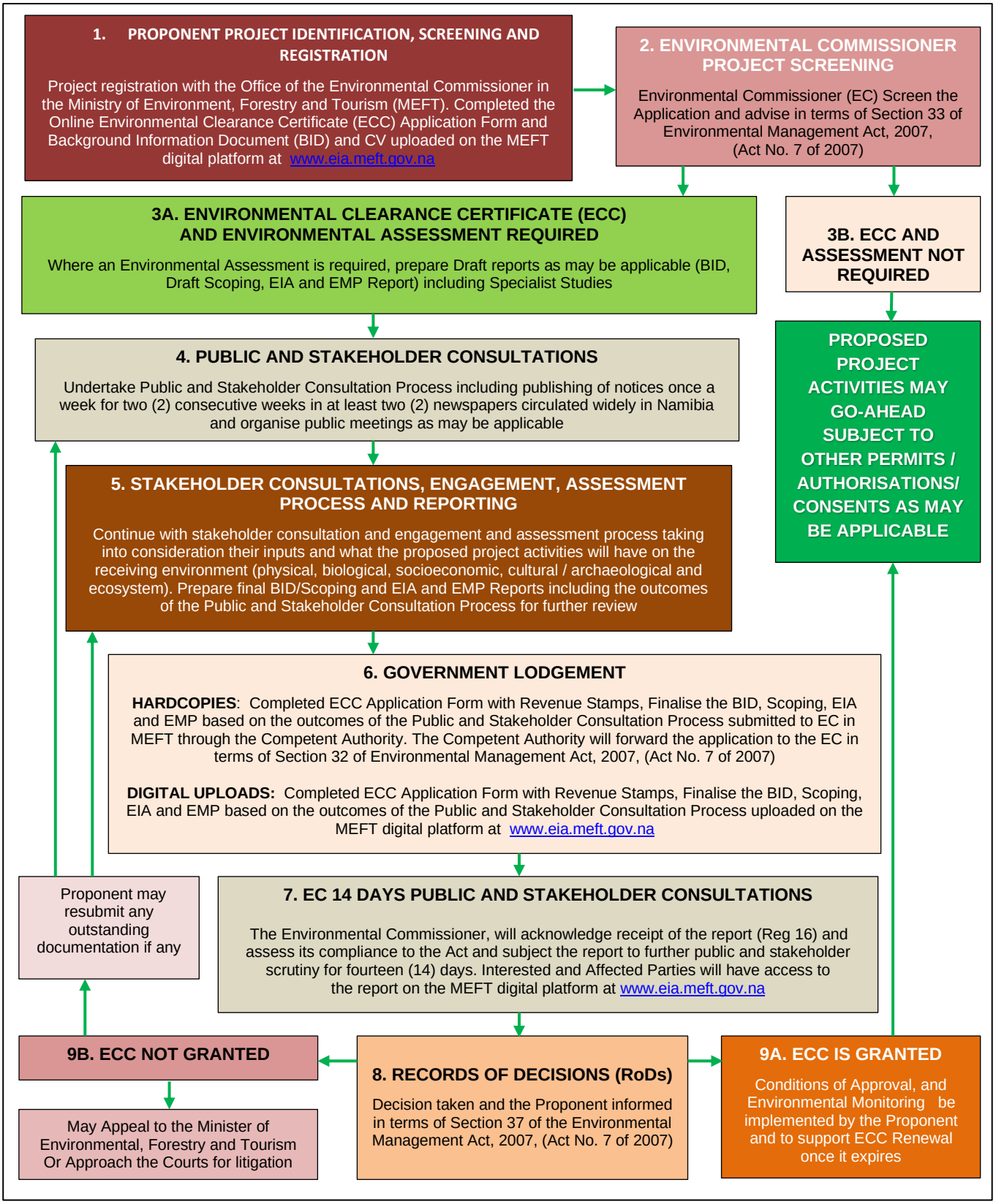


Figure 1.8: RBS schematic presentation of Namibia's Environmental Assessment procedure.

1.4.4 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 (Annex 1), the following specialist assessments / studies have been undertaken as part of the EIA process.

1. Living marine resources covering fish, fishing seasons, birds, mammals and related ecosystem variability (Annex 2), and.

2. 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 (Annex 3).

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 International Association of Geophysical Contractors (IAGC) 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-firing' observations.
- Termination of firing 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.

1.4.5 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 month October 2022. The key consultation approach will focus on the following activities (Annex 4):

1. Preparation of the appropriate materials such public notice, BID, posters, presentation, and leaflets.

2. Directly contacting and engaging with the key stakeholders such as fishing companies and other affected parties.

3. Use of newspaper publications notices / adverts. 1st advert published in the Confidente Newspaper dated Friday 7th – Thursday 13th October 2022 and the 2nd adverts were published in the Market Watch of the Namibian Sun (English), Republikein (Afrikaans Newspaper) and Allgemeine Zeitung (Namibian German Newspaper) of Thursday, dated 13th October 2022 and third advert was published in the New Era Newspaper, dated Monday 17th October 2022 (Fig. 1.96 and Annex 4).

4. Placement of public notices at strategic places in Lüderitz, Walvis Bay, Swakopmund and Henties Bay (Fig. 1.10), and.

5. Organising public meetings in Swakopmund (Fig. 1.10).

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, was key step 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.

1.4.6 Summary of the Assessment Steps

The environmental assessment process used for this project took into considerations the provisions of the Environmental Impact Assessment (EIA) Regulations, 2012 and the Environmental Management Act (EMA), 2007, (Act No. 7 of 2007) as outlined in Fig. 1.8. The following is the summary of the key steps:

(i) Project screening process was undertaken in September 2022.

(ii) Draft BID and Public notice were prepared in September 2022.

(iii) A Draft Scoping Report was prepared in September / October 2022.

(iv) Public and stakeholder consultations process including publishing of notices once a week for two (2) consecutive weeks in at least two (2) newspapers circulated widely in Namibia undertaken in October 2022.

(v) Closing date for submission of comments/ inputs to the environmental assessment process- Friday 28th October 2022

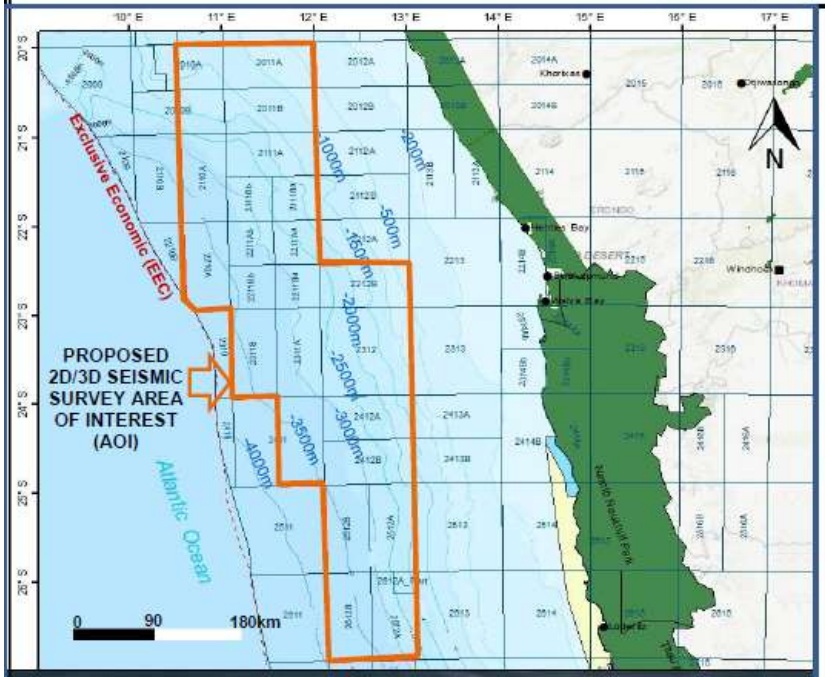
(vi) Prepared Draft EIA and EMP Reports including specialist assessments reports such as Marine Mammals, Birds, Fish, Fisheries and Acoustic Modelling –September and October 2022.

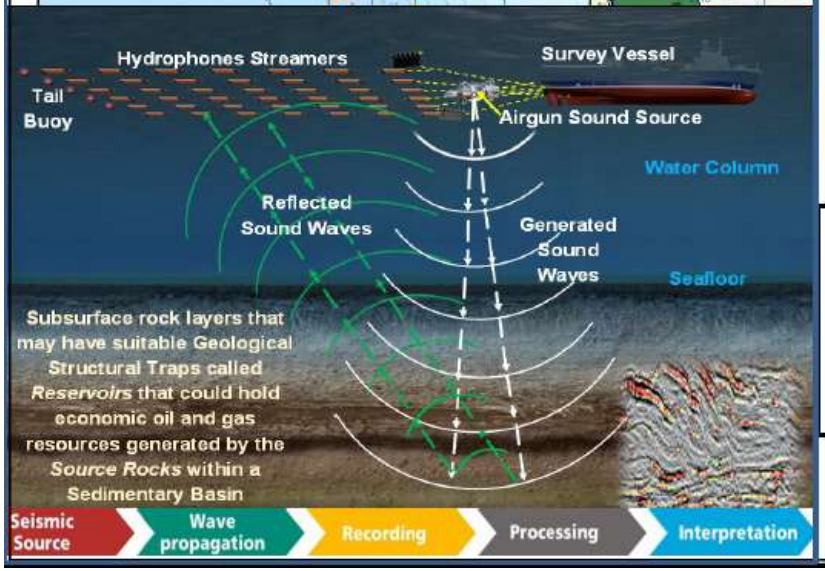
(vii) Comments and inputs from the public and stakeholder consultations used to finalise the Draft Scoping, EIA and EMP Reports – October / November 2022, and.

(viii) The final EIA and EMP report used to support the application for Environmental Clearance Certificate (ECC) for the proposed multiclient 2D/3D Seismic Survey. The ECC application to be submitted to the Office Environmental Commissioner in the Ministry of Environment, Tourism and Forestry (MEFT) through the Ministry of Mines and Energy (Competent Authority) – November 2022.

PUBLIC NOTICE FOR APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

TGS Geophysical Company (UK) Limited (the Proponent) Proposed Multiclient 2/3D Seismic Survey Aera of Interest (AOI) Over Blocks, 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A Walvis and Lüderitz Basins Offshore Namibia





TGS Geophysical Company (UK) Limited (PROPONENT) is proposing to conduct Multiclient (MC) 2D/3D Seismic Survey over the Area of Interest (AOI) covering Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A falling within the Walvis and Lüderitz Basins, Offshore Namibia with water depth of -1000m to 4000m. The overall aim of the proposed MC 2D/3D seismic surveys is to map the subsurface of the key selected 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 and petroleum systems of the deep-water offshore Namibia. The datasets from the proposed MC 3D/2D 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 to be generated is not only used for petroleum exploration but also highly useful for other marine / seafloor related studies and researches such as Deep-Sea Minerals (DSM) exploration and production and the search for natural suitable Carbon Capture and Storage (CCS) terrains as one of the possible options for Climate Change long-term global mitigation strategies.

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. In offshore environment, the vessel towed airguns (energy source) release compressed air to generate seismic acoustic signals / waves at regular intervals. The controlled generated acoustic waves that travel deep into the earth is reflected by various rock formations of the subsurface below the seafloor, and returns to the surface where it is recorded and measured by receiving devices called hydrophones. By analysing the travel times of seismic waves through the various subsurface rock layers 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 potential commercial hydrocarbons resources. 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 Area of Interest. 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 Area of Interest within a Sedimentary Basin. 3D and 2D Seismic Surveys are acquired on local to subregional dense and regional widely spaced survey grids / spacings, respectively.

The proposed multiclient 3D/2D seismic survey will be conducted using a MARPOL / Namibian Maritimes Laws compliant vessels and will adopt 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 proposed 3D/2D seismic survey activities cannot be undertaken without an Environmental Clearance Certificate (ECC) as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. In fulfilment of the 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 and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare EIA and Environmental Management Plan (EMP) Reports to support the application for ECC. All Interested and Affected Parties (I&APs) are hereby invited to register and submit written comments / objections / inputs with respect to the proposed multiclient 3D/2D seismic surveys covering the deep-water Walvis and Lüderitz 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), interested and / or affected party is required to disclose any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the application.

REGISTER BY EMAIL WITH: Ms Emerita Ashipala (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email**: emerita.ashipala@gmail.com or Mr Samison Mulonga (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email:** mulongas@gmail.com. For more technical clarifications on marine seismic survey and oil and gas exploration please contact Dr Sindila Mwiya EAP/Technical Permitting Advisor / International Resources Consultant, **Email:** frontdesk@rbs.com.na

REGISTRATION & WRITTEN SUBMISSIONS DEADLINE IS: FRIDAY, 28th OCTOBER 2022
A PUBLIC MEETING HAS BEEN ORGANISED IN SWAKOPMUND AS FOLLOWS:
DATE: Thursday 20th October 2022, PLACE: Namib Primary School Hall, TIME: From 14hrs00-17hrs00

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 1.9: Copy of the Public Notice published in three (3) local Newspapers for three (3) consecutive weeks starting the 7th October 2022.

Figure 1.10: Public notices that were placed at multiple strategic places in Lüderitz, Walvis Bay, Swakopmund and Henties Bay and public meeting held on the 20th October 2022 at the Namib Primary School Hall, Erongo Region, Swakopmund.

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 (2D / 3D seismic) 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 the proposed 2D / 3D seismic survey activities.

- A precautionary approach has been adopted 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, TGS geophysical company (UK) limited (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).

- **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**

- **Section 8: ANNEXES**:
  Annex 1 – BID and Final Environmental Scoping Report.

  Annex 2 – Marine Mammals, Birds, Fish and Fisheries Specialist Report.

  Annex 3 – Underwater Acoustic Modelling Specialist Report.

  Annex 4 – Proof of Public and Stakeholder Consultation Materials, and.

  Annex 5 – Proposed Survey, Vessel and Associated Specifications.

2. PROJECT DESCRIPTION

2.1 Summary of the Proposed Survey

The following is the general summary specifications of the proposed 2D / 3D seismic survey activities by TGS (Figs. 2.1-2.5):

- **Proposed activities** – 2D / 3D seismic survey**.**
- **Location** – Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A Walvis and Lüderitz Basins, offshore southcentral, Namibia.
- **Summary of the 3D seismic survey layout (Fig. 2.1 and Annex 5):**
    - Streamer Spread: 10 x 150 m x 8100 m
    - Streamer Depth: 15 m flat tow
    - Number of Channels: 648 per streamer
    - Fan Mode: 25% max.
    - Source Volume: ~ 3000 cu.in.
    - Source Depth: 8 m
    - Shot Point Interval: 12.5 m triple source fired sequentially
    - Sail Line Interval: 750 m
    - Record Length: 14 s cont. rec. (extracted and deblended)
    - Fold: 122, and.
    - Bin Size: 6.25 m x 25 m.
- **Summary of the 2D seismic survey specifications (Fig. 2.2 and Annex 5):**
    - 2D grid: Either 5x5 km or 10x10 km
    - SP spacing: 25 m
    - Streamer length: 8-12 km, and.
    - Vessel: specs for provisional vessel attached (Annex 5).
- **Seismic survey Water Depth of the main key target area** – Ranges from ca-1000m to ca-4000 m from east to west.
- **Nearest Namibian Port** –Port of Lüderitz or Walvis Bay.
- **Nearest fishing ground**-Tuna fishing grounds overlapping with the southern portions of the proposed survey area (October – April fishing season).
- **Operating company** – TGS (Proponent).
- **Survey vessel (s)** – To be confirmed and multiple vessels (2) may be used (Annex 5).
- **Type of Survey** – 2D / 3D Streamers (Annex 5).
- **Desired acquisition time** – From January 2023 if ECC is granted, and.
- **Estimated survey duration** –Seventy (70) days per survey event.

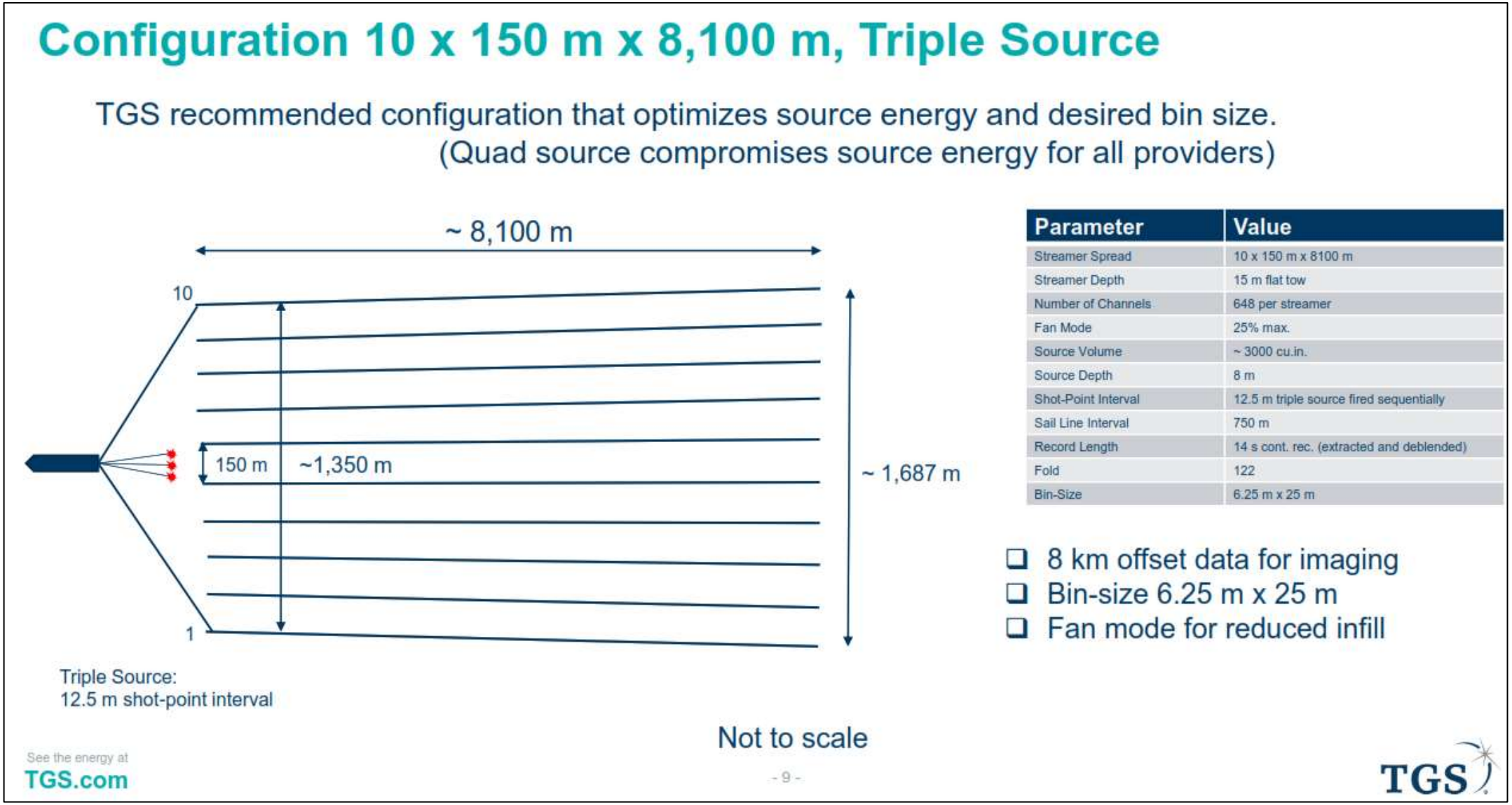


Figure 2.1: Example illustration of marine seismic survey layout and configurations, (Source: TGS, 2022).

Figure 2.2: Regional 2D seismic survey Area of Interest (AOI) ~199000km^2 and the prime lines measuring ~6400km^2 (Source: TGS, 2022).

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). 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. 2.3 and 2.4).

Airguns are the most common sound source used in modern offshore seismic survey (Plate 2.1 and Figs. 2.3 and 2.4). 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. 2.3 and 2.4). 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. The proposed 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. 2.3-2.5. 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 (Fig. 2.5).

2.3 Envisaged Logistical Arrangements Support

The vessel/s, helicopter and all other supporting equipment will to be used for the proposed 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 (MFMR) (Tables 2.1-2.4, Plate 2.2 and Annex 5).

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.

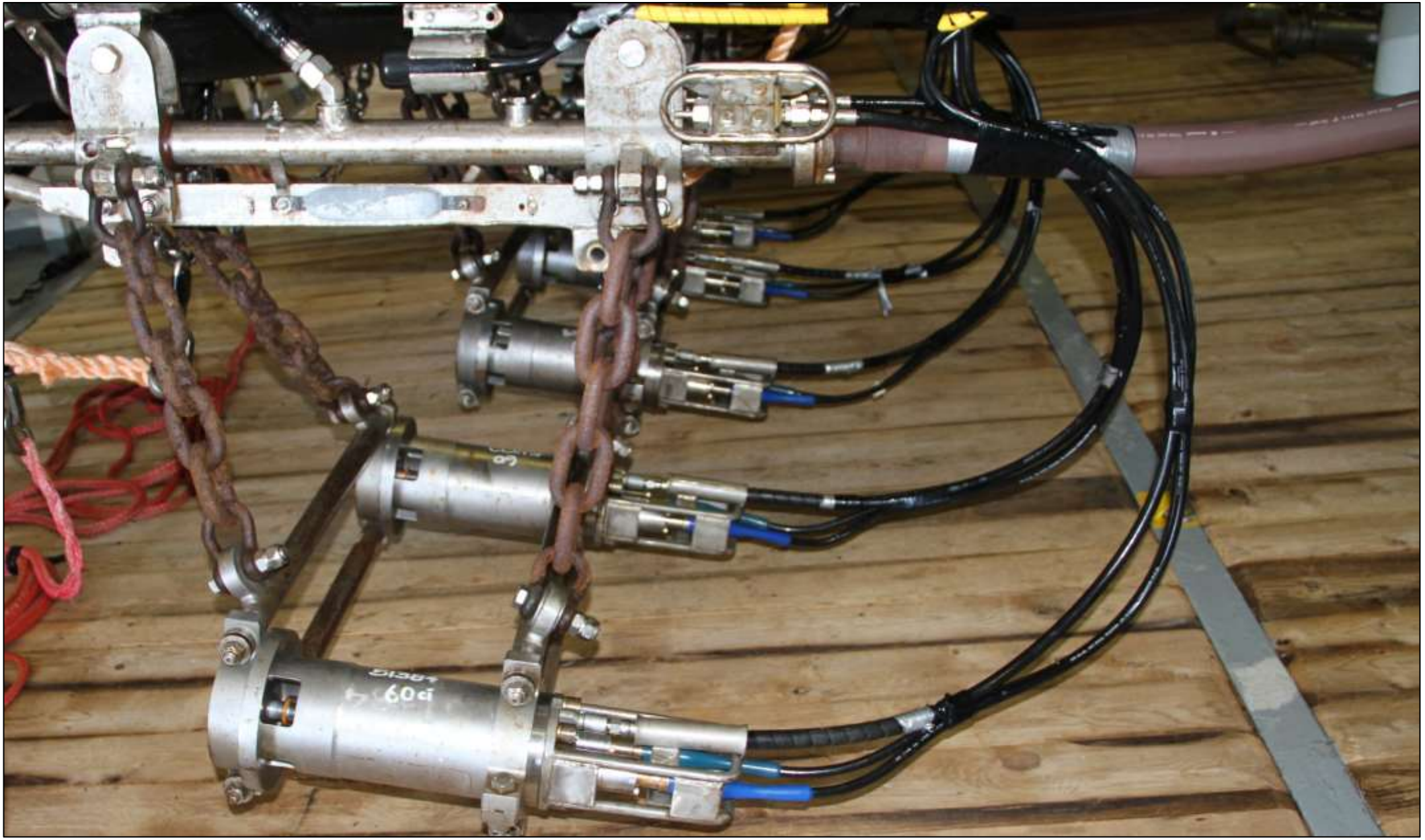


Plate 2.1: Example of the air guns used in marine seismic survey operations.

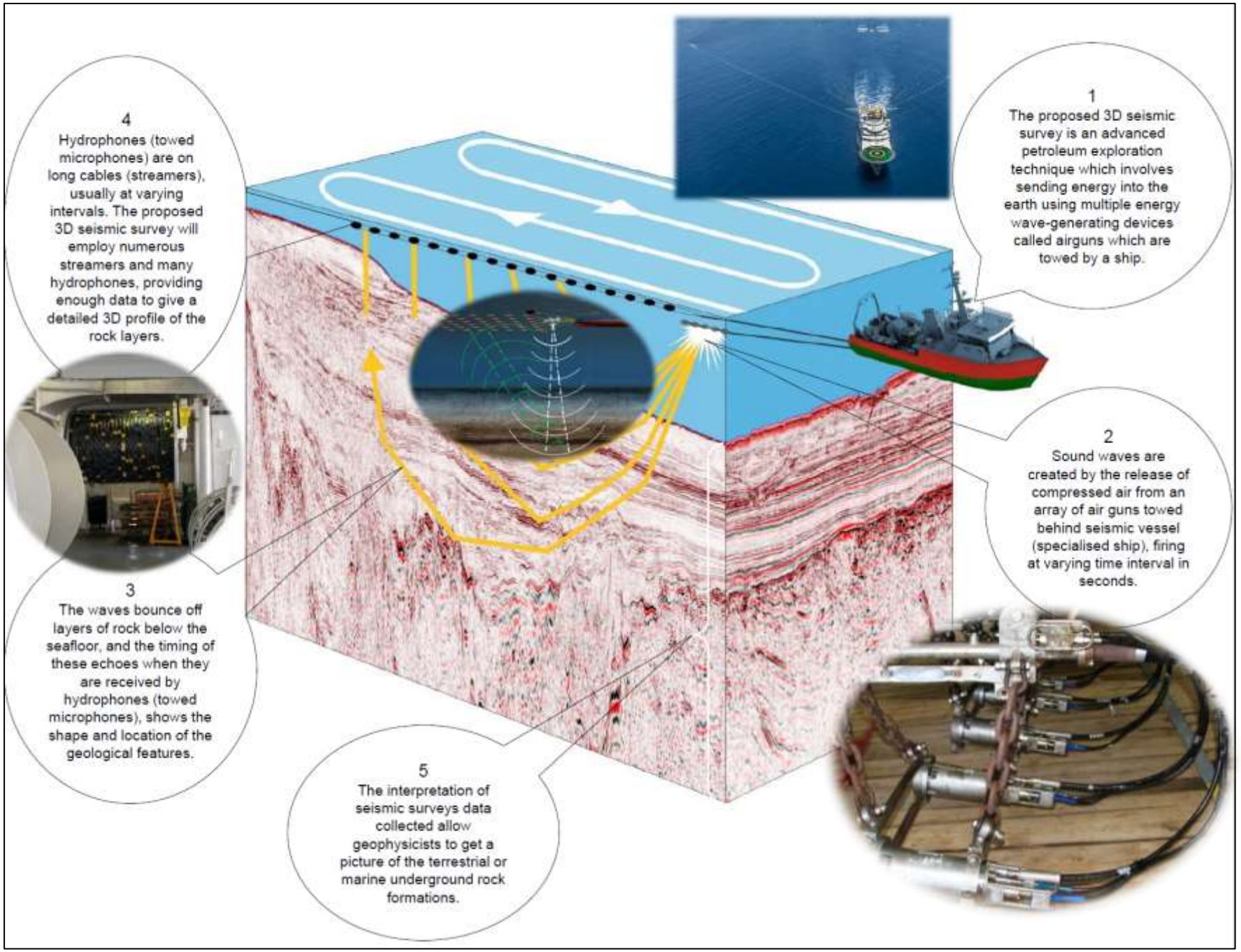


Figure 2.3: Illustration of the of the principles of marine / offshore seismic survey method.

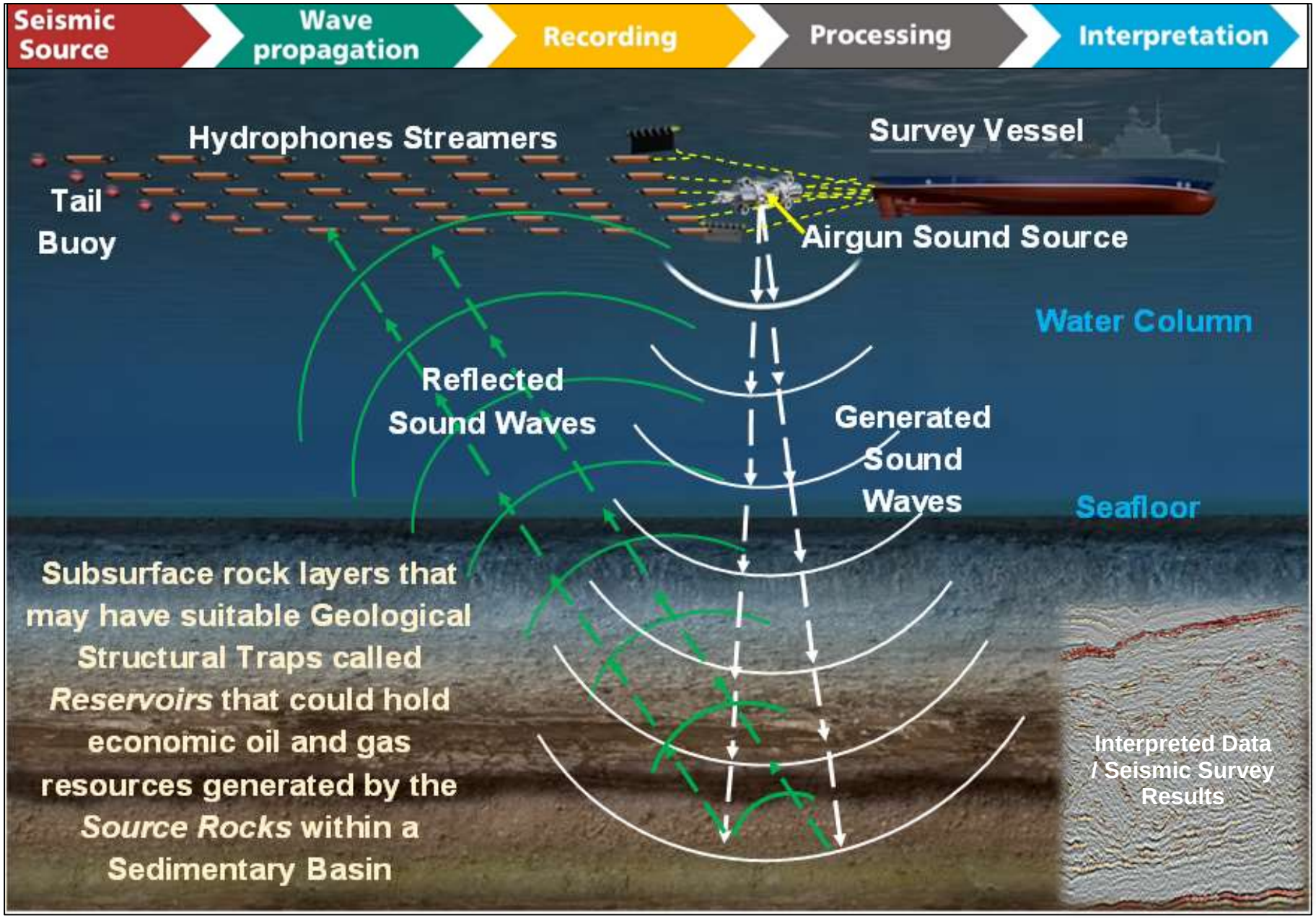


Figure 2.4: Illustration of the application of marine seismic survey method involving data collection and analyses of the times for seismic waves to travel between the various subsurface rock formations. Geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential drill-ready subsurface geological structures called reservoirs that may contain commercial hydrocarbons as shown in Fig. 2.4 (Image Source: www.youtube.com/watch?v=FN8IAb0rG9A).

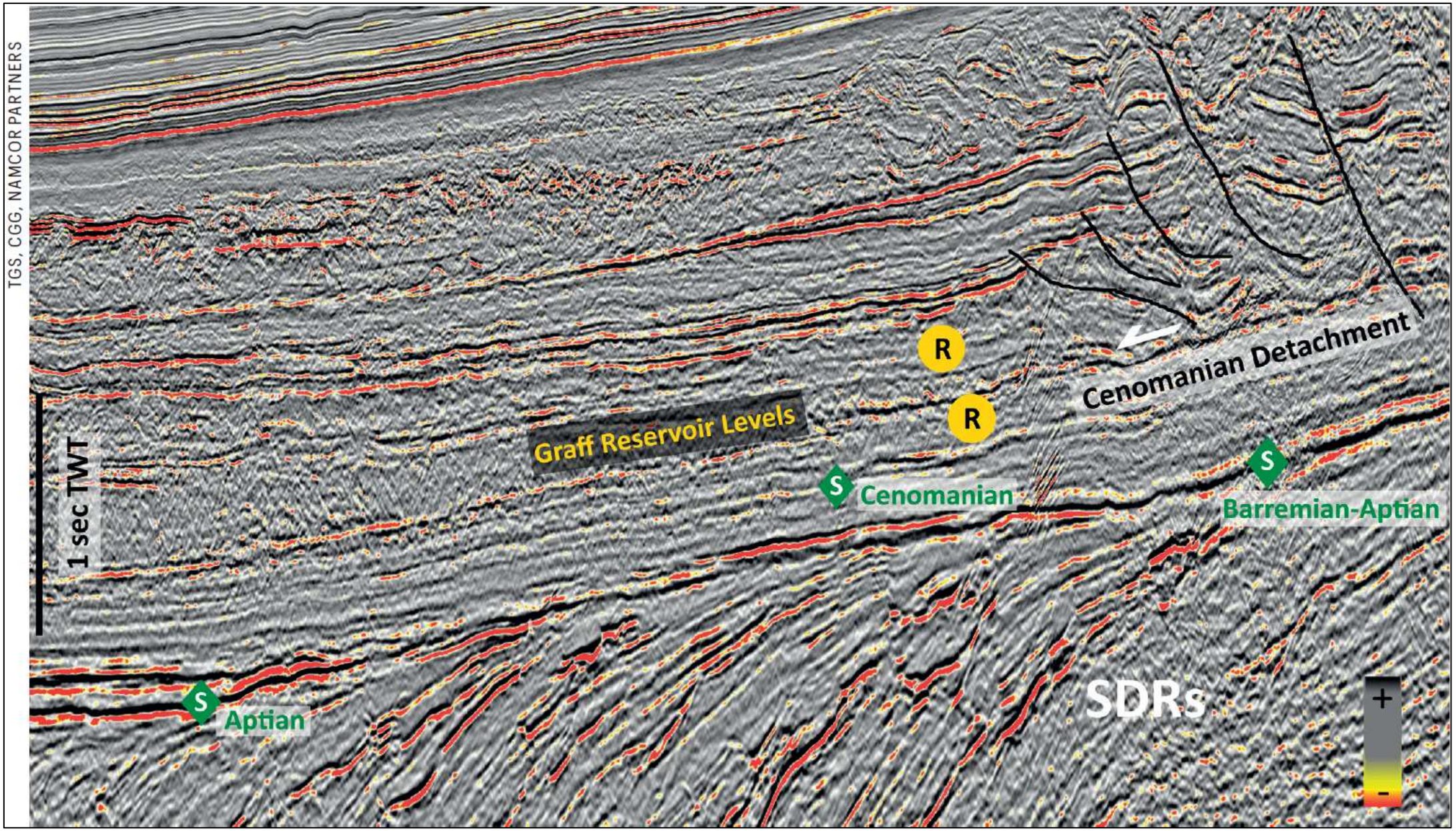


Figure 2.5: An example of the results of seismic survey data interpretation from the Orange Basin, offshore Namibia showing the SW–NE dip line through the Graff light oil discovery trend at the western end of the toe-thrust system and the base of the collapse structures. The Santonian–Campanian turbidites have been trapped above the outer high, which likely acts as a backstop for the reservoir influx from the east. Light oil in two different reservoir levels has been discovered by Shell in 2022 (Source: Winter, *et, al*., 2022).

Table 2.1: Summary of the specifications of the proposed 3D seismic survey by TGS in the Lüderitz and Walvis Basins, offshore Namibia (Source:TGS, 2022).

Item No	Information required	Applicant Response
1.	Spread width *E.g. Min spread: 700 m* *Max spread: 1650 m*	**Min: ~1,350 m** **Max: ~1,687 m (25% fan)**
2.	Streamer length (m)	**8,100 m**
3.	Number of prime lines	**tbc**
4.	Overall spread length (back deck to tail buoy) *E.g. Min spread: 8750 m* *Max spread: 12750 m*	**~8,800 m**
5.	Streamer depths *E.g. Min: 10 m* *Max: 20 m*	**Nominal 15 m flat tow**
6.	Number of streamers *E.g. Min spread: 8* *Max spread: 12*	**10**
7.	Streamer interval / receiver group spacing *E.g. Min spread:* *Max spread:*	12.5 m
8.	Type of streamers (Solid/Gel – 1C/2C/3C)	**Solid streamer – 1C**
9.	Streamer steering device and length between devices	
10.	Streamer diameter	**~60 mm**
11.	Channels per streamer *E.g. 648 - 960*	**648**
12.	**Spread visibility**	
	Tail buoys with light and radar reflector (Y/N)	Yes
	Outer Tail buoys with AIS (Y/N)	No, but GPS navigation
	Head buoys with light (Y/N)	Yes
	Deflectors with light and radar reflector(Y/N)	Yes
	Number and length of streamers sections	67 x 150 m
	Number of traces /geophones per section	12
	Number of depth control unit per streamer	~30
	Number of Acoustic positioning unit per streamer	~30
13.	Gun type	GII-Gun
	Airgun total number, single gun/cluster of guns	
	Source Volume	**~3,000 cu. in**
	Source nominal operating Pressure	
	Source operating Depth	**Nominal 8 m**

Table 2.2: Example of the survey vessel specifications.

Item No	Information required	Applicant Response
1.	Number of source vessels	**1**
2.	Specifications	**See spec sheet for COSL HYSY 721**
3.	Mob / demob port + schedule	
4.	Typical Person on Board (POB) during surveying: • Party chief • Processors (geophysicists) • Observers (MMO/PAM/FLO) • Navigators Gun technicians *E.g. 1 Party Chief* *1 Assistant Party Chief* *1 Chief On board processor* *2 On board processors* *1 Chief Observer* *2 Senior Observers* *2 Observers* *1 Chief Navigator* *2 Senior Navigators* *2 Navigators* *1 Chief Mechanic* *4 Mechanics* *2 MMO* *1 PAM operator* *1 FLO*	
5.	Typical speed (eco, max, acquisition) *E.g. 4-5 knots during acquisition* *20 knot max and 12-15 knot cruising*	**~4.5 knots during acquisition** **16 knots cruising**
6.	Fuel consumption (per day)	**45 m^3/day**
7.	Combustible to be used – Sulphur % *E.g. MARPOL 0.5% max compliance*	**0.5% low-sulphur fuel to be used if available locally**
8.	Sewage treatment onboard (yes/no)	**Yes**
9.	Incinerator onboard (yes/no)	**Yes**
10.	Minimum safety clearance required between survey vessel and other vessels (distance in km or nm)	**For 3rd party vessels:** **4 nm ahead of survey vessel** **2 nm either side of survey vessel** **3 nm aft of survey vessel**

Table 2.3: Example of the support vessel and helicopters specifications.

Item No	Information required	Applicant Response
1.	Number of permanent Escort vessel(s) / Chase boat(s)	**1-2**
2.	Number of Support / chase vessel(s)	**1**
3.	Type / typical size	**~50-60 m length, ~10-15 m width**
4.	Typical Person on Board (POB) during surveying	**~20**
5.	Typical speed (eco, max, acquisition)	**Max speed ~15 knots**
6.	Fuel consumption (per day)	**~1.4 m^3/day**
7.	Combustible to be used – Sulphur %	**0.5% low-sulphur fuel to be used if available locally**
8.	Sewage treatment onboard (yes/no)	**Yes**
9.	Incinerator onboard (yes/no)	**No**
10.	Number of Helicopter rotations per week	N/A – crew changes will be done either in-port or boat-to-boat

Plate 2.2: Example of the survey vessel that will be used for the proposed 2D/3D seismic survey in the Lüderitz and Walvis Basins (Source: TGS, 2022).

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 fall 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 Lüderitz and Walvis Basins, offshore Namibia.

3.4 Regulatory Agencies

Regulatory authorities relevant to the proposed activities, proposed 2D / 3D seismic survey in the Lüderitz and Walvis 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	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	The competent authority for petroleum exploration and production activities in Namibia.
Ministry of Works, and Transport	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	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. Water Act 54 of 1956 (as amended).

6. Sea Shore Ordinance 37 of 1958.

7. 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).

8. 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).

9. Hazardous Substance Ordinance 14 of 1974.

10. Atmospheric Pollution Prevention Ordinance 11 of 1976.

11. Dumping at Sea Control Act 73 of 1980.

12. 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).

13. 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).

14. 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).

15. 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.

16. Foreign Investment Act 27 of 1990.

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

18. Nature Conservation Amendment Act 5 of 1996.

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

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

21. Wreck and Salvage Act 5 of 2004.

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

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

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

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

26. Disaster Risk Management Act 10 of 2012.

27. 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.

28. 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 (Annex 2).

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).

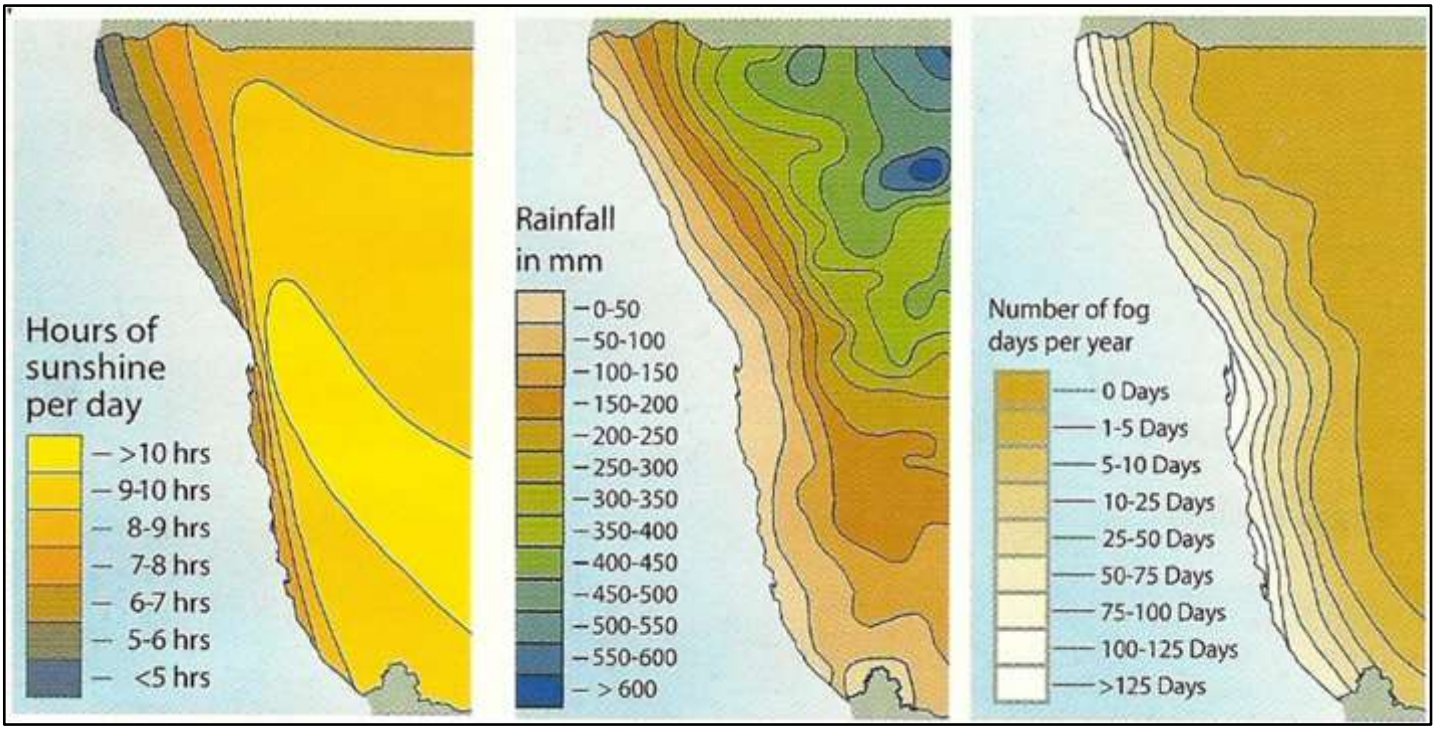


Figure 4.1: Map showing hours of sunshine per day, rainfall in mm, and number of fog days per year (Molloy and Reinikainen, 2003).

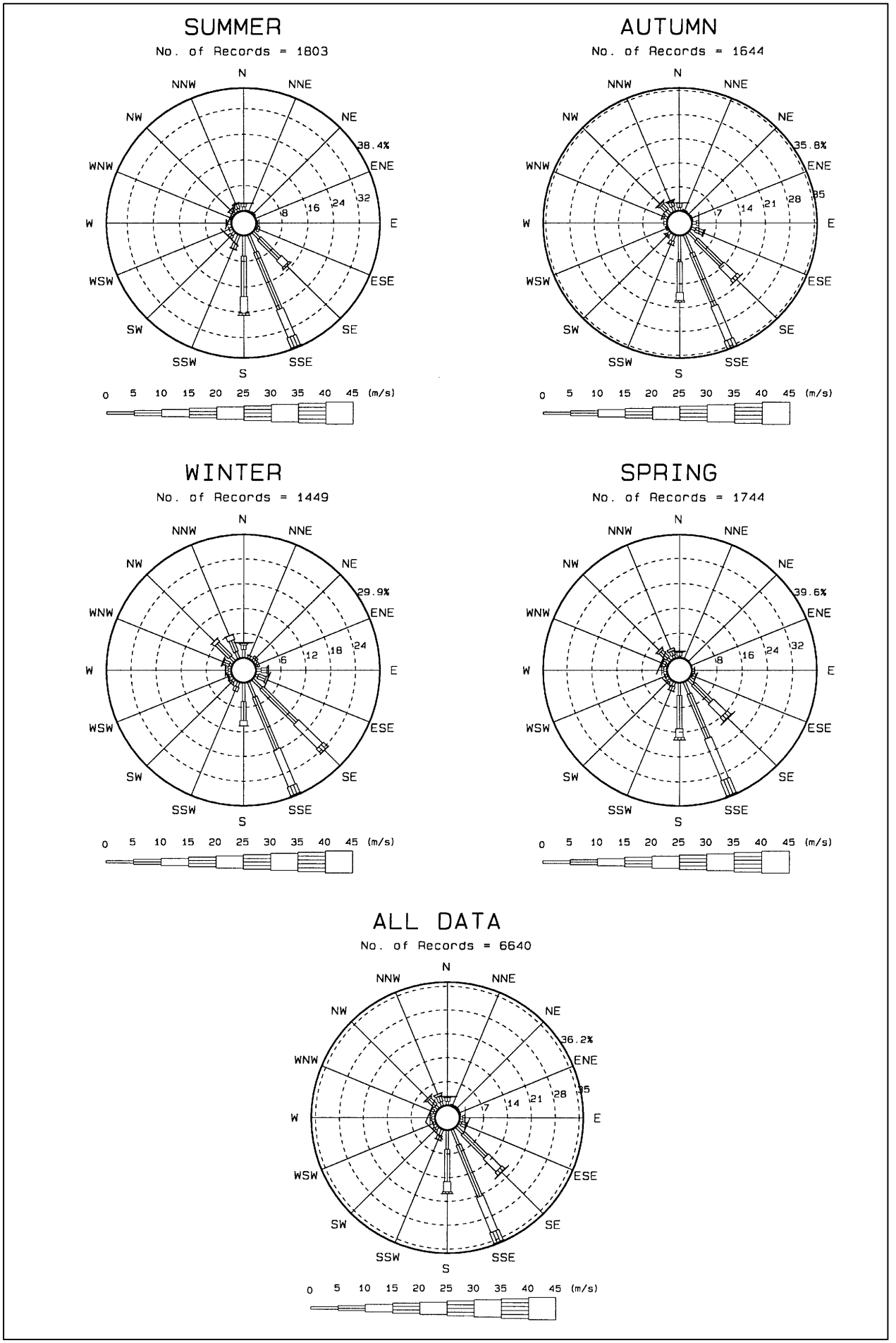


Figure 4.2: Seasonal wind roses for the offshore area 28°- 29°S. 15°-16°E (Oranjemund) (Source: Voluntary Observing Ship (VOS) data from the Southern Africa Data Centre for Oceanography (SADCO)).

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.

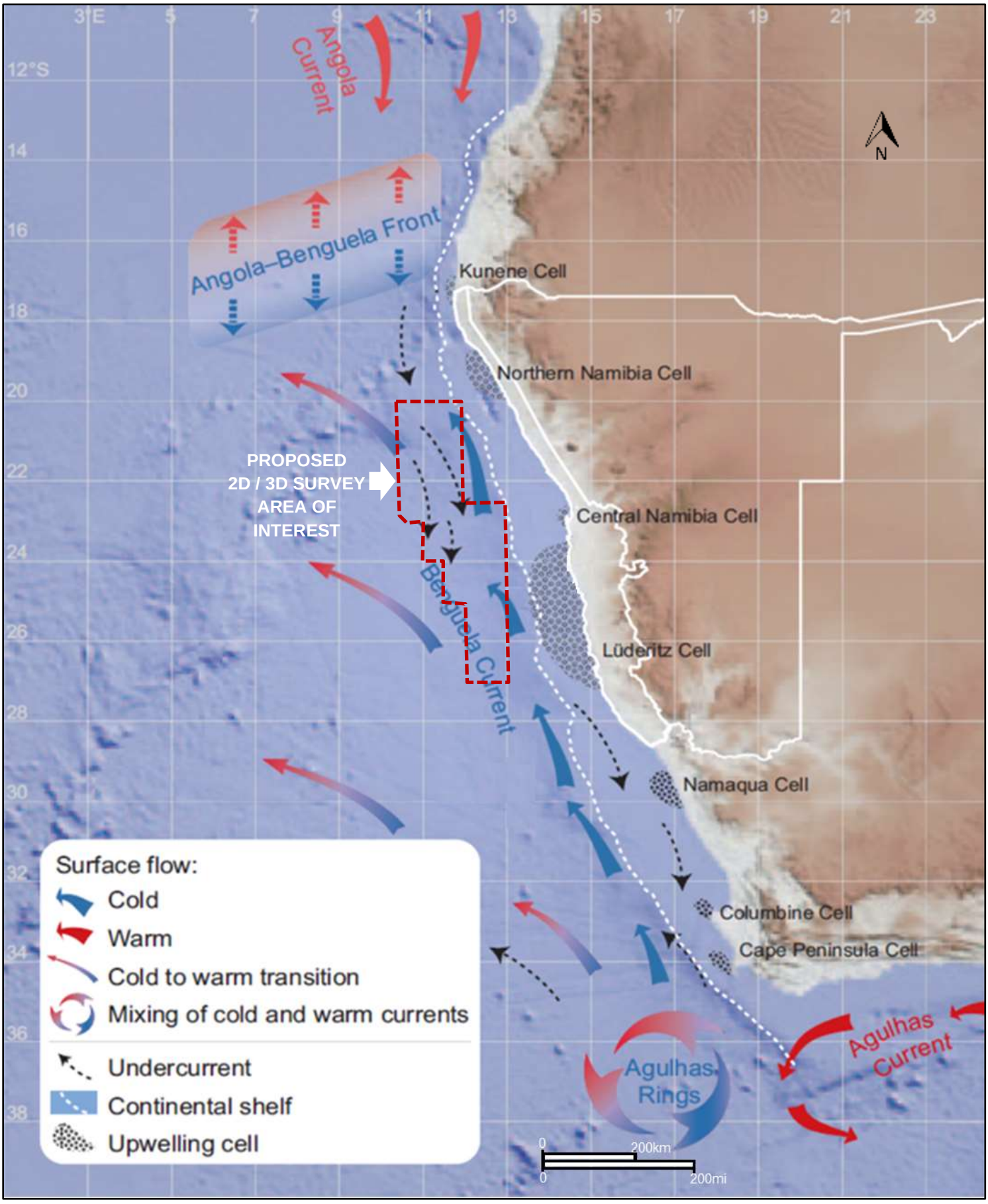


Figure 4.3: Main features of the Benguela System showing the location of the proposed survey area within the BCLME (Source: Ministry of Environment, Forestry, and Tourism, 2012).

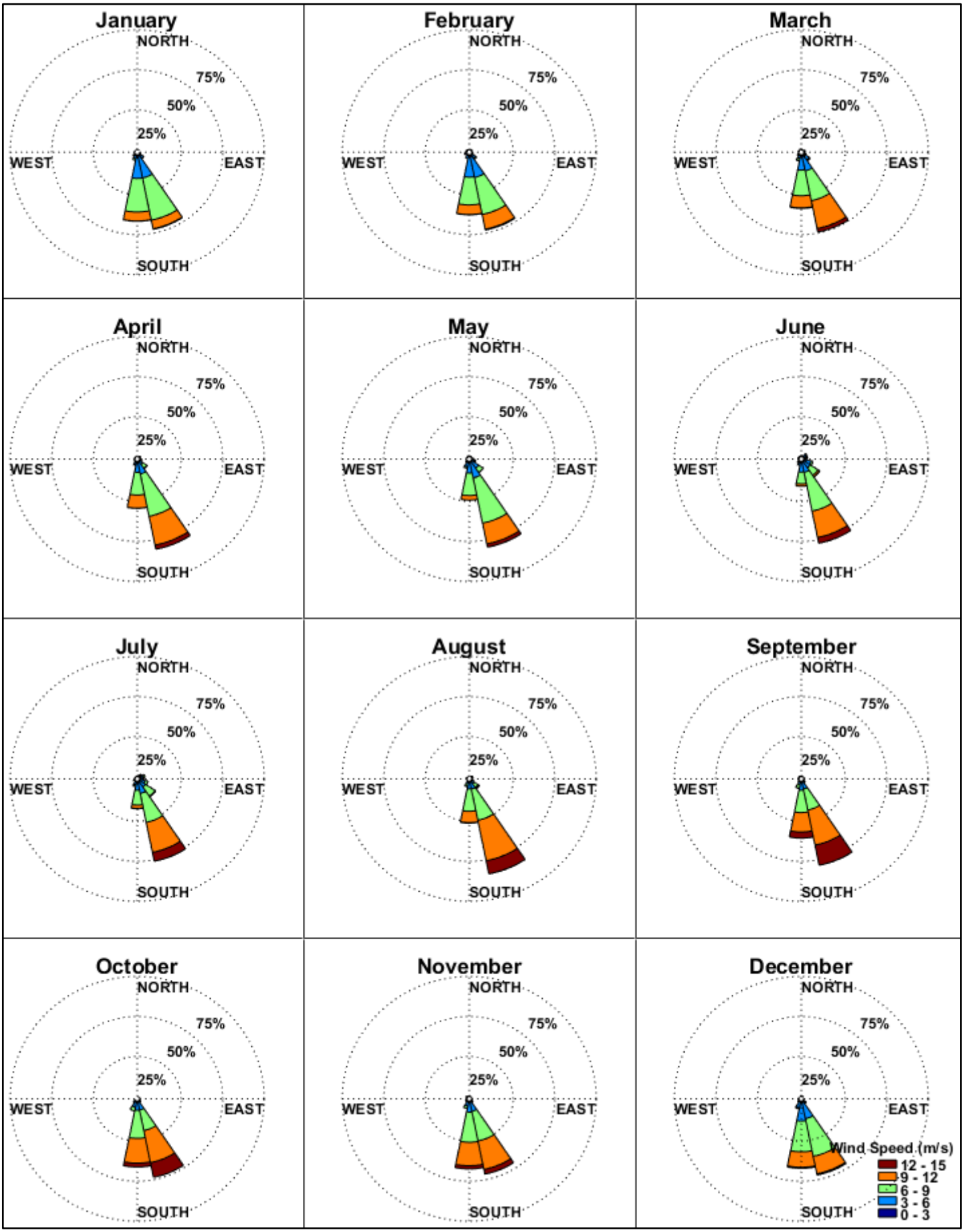


Figure 4.4: Monthly CFSR wind roses near PEL 44. Wind speeds in m/s, using meteorological convention (i.e., direction wind is coming from) (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

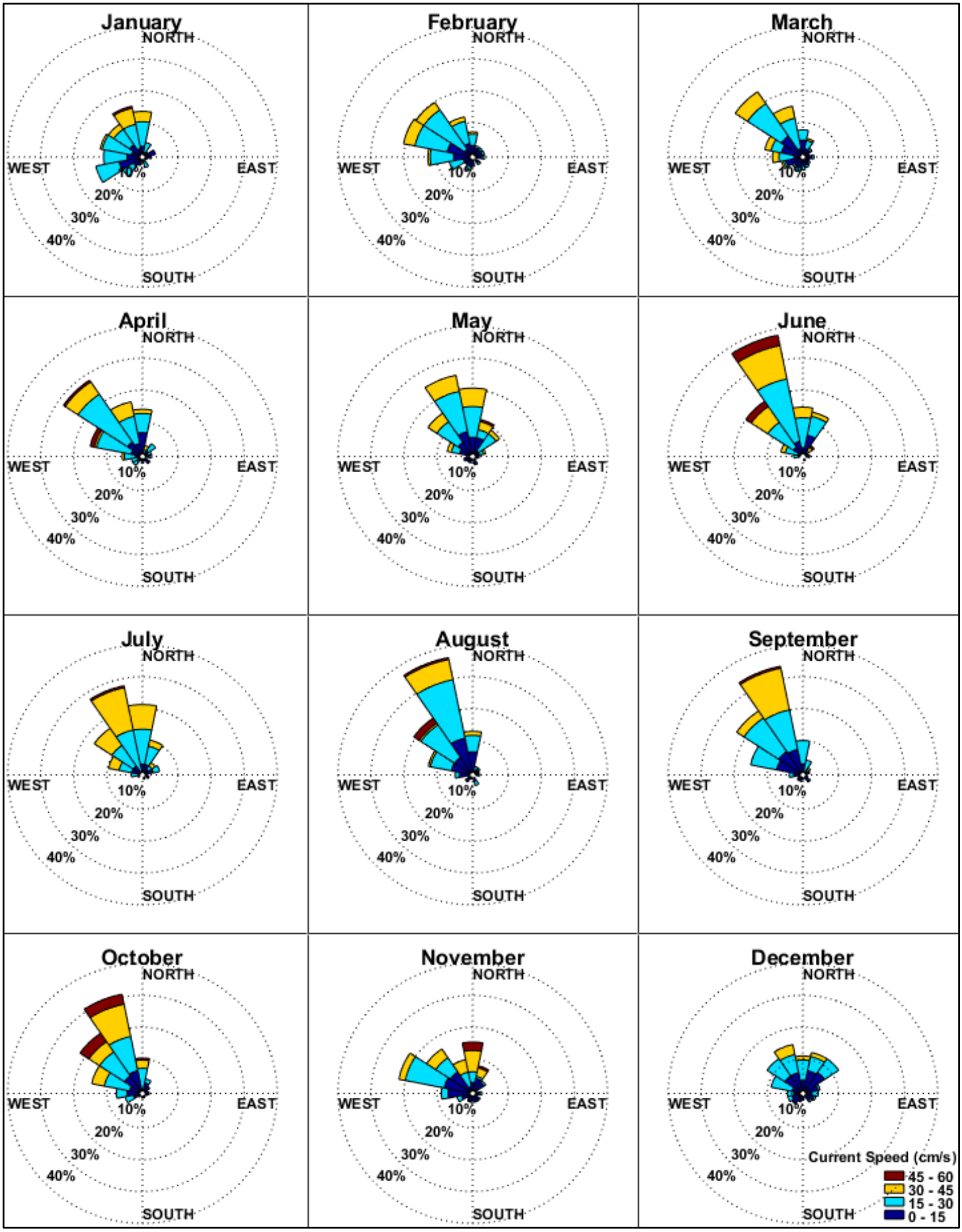


Figure 4.5: Monthly HYCOM surface current roses, offshore Namibia (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

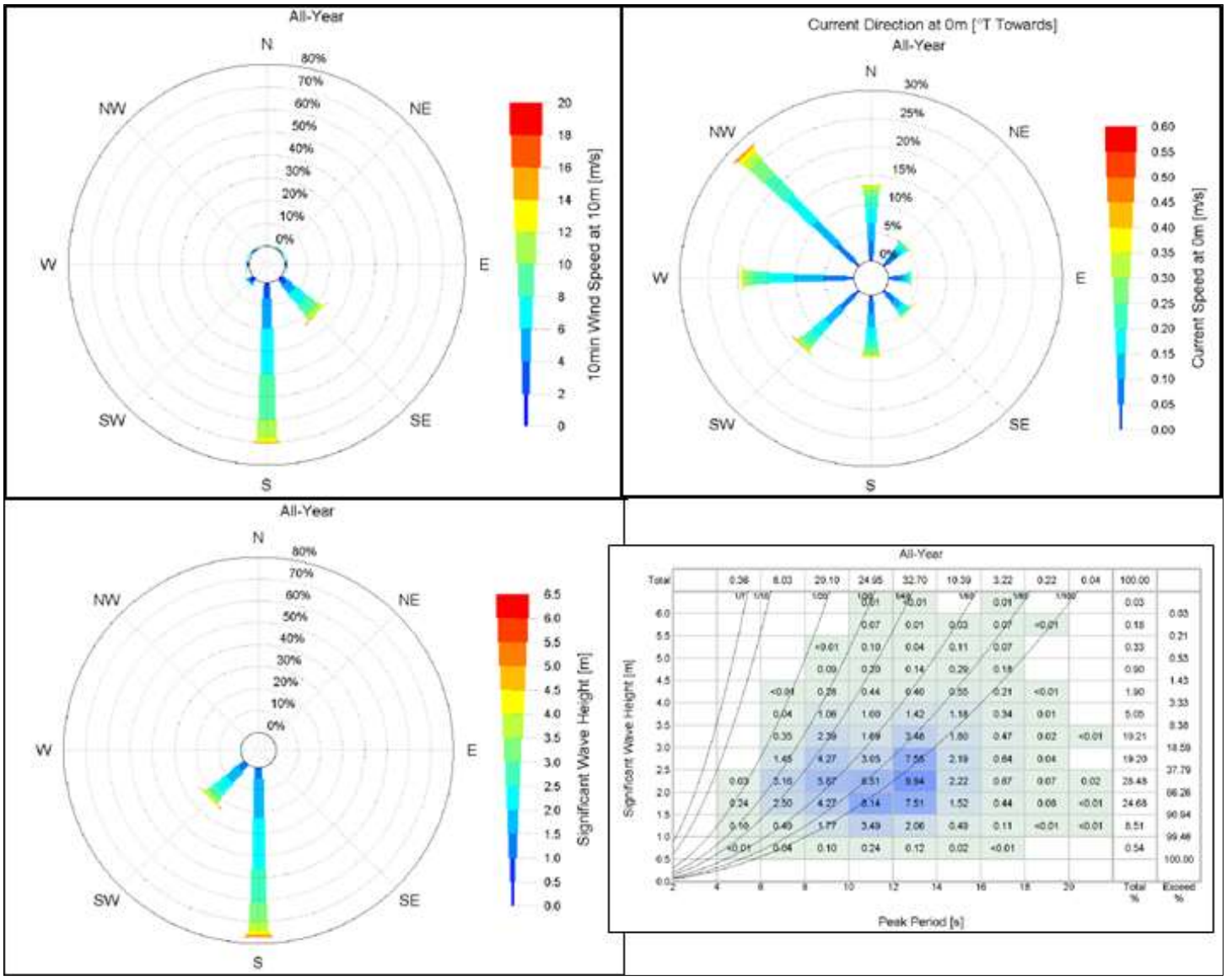


Figure 4.6: Comparative analysis of the all-year operational wind, current and wave criteria expected around the proposed survey area (Source: Risk-Based Solution Oil Spill Modelling Specialist Study for PEL 44 by RPS, 2019).

	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 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.

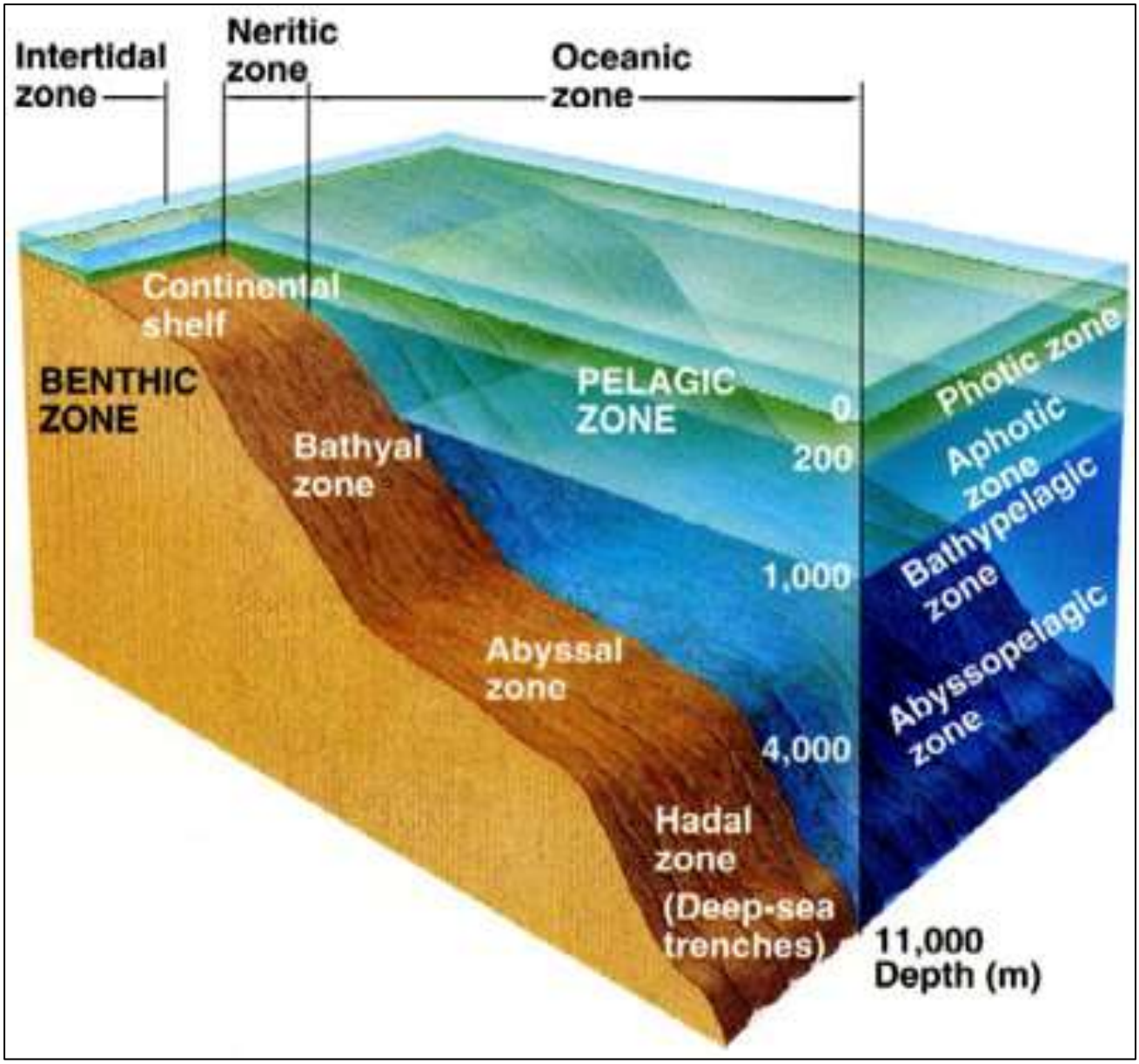


Figure 4.8: Overview of the ocean zones. The proposed survey area falls within the Photic (ca-100 m) and Abyssal Zones (ca-4000) with steep to very steep seafloor profile (Source: www.marinebio.org).

4.3.3 Seabed Sediments

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.

4.3.4 Seafloor Sediments and Habitats Characteristics

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 pelagic environment is home to diverse living marine resources inclusive of the area covered and surrounded by the proposed 2D / 3D seismic survey (Fig. 4.9). The distribution of fishing and spawning areas, marine mammals, and seabirds habitats relative to the proposed 2D / 3D seismic survey is shown in Fig. 4.6. Through careful fisheries management, the Namibian commercial fisheries sector which inherited a heavily overfished resource at Independence, now has growing fish stocks which are fished throughout Namibia's 200-mile Exclusive Economic Zone (EEZ).

Annual seafood export revenue is now over Namibia $5 billion, the industry being worth around 4% of Namibia's Gross Domestic Product, and it employs over 13,000 people. 9,000 of these employees are in the hake sector, mostly working in onshore processing factories. 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. These large numbers maintain an important and lucrative commercial fishery within the Namibian Exclusive Economic Zone (EEZ) including the southern part of Namibia.

4.4.2 Fish Stocks

4.4.2.1 Overview

The fish fauna of the cold-temperate BCLME region is characterised by a relatively low diversity of species compared with warmer oceans (Annex 2). 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 (Hutchings et al., 2009). There is a socioeconomically important commercial fishery within the Namibian EEZ. Marine fish species can generally be divided in three categories (Annex 2):

- 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.

4.4.2.2 Demersal Fish

Demersal fish distributions vary with latitude and depth, with the major boundary along the shelf edge at -300 m to -350 m (Annex 2). Shelf assemblages are distributed latitudinally. Namibian demersal fish species include Deep-water and Cape hake, Silver scabbardfish, Cape bonnetmouth, Cape John Dory, Cape gunnard, Kingklip, Snoek and Cape monkfish. Upper slope assemblages include deep-water hake, blackbelly rosefish, lanternfish, African catshark, Orange roughy. Commercially exploited demersal species include both Shallow- and Deep-water Cape hake (Merluccuis capensis and Merluccius paradoxus), Monkfish (Lophius vomerinus) and Kingklip (Genypterus capensis).

Orange Roughy (Hoplostethus atlanticus) was fished commercially until 2009 when a moratorium was imposed due to declining numbers. This species is found mostly on the continental shelf, where the distribution varies seasonally, but usually at depths greater than -500 m. Apart from the target species described above, many demersal species are caught as "bycatch". These include Jacopever (Helicolenus dactylopterus), Angelfish/Pomfret (Brama brama), Gurnard (Chelidonichtyes sp), several cephalopod species (such as squid and cuttlefishes) and many elasmobranch species (sharks and rays) (MFMR, 2012).

4.2.2.3 Meso-Pelagic Fish

Meso-pelagic fish characteristically display extensive diurnal vertical movements, being bottomdwellers during the day and rising into the epipelagic zone at night (Annex 2). Some meso-pelagic species, such as horse mackerel, also display different habitat preferences at different life stages, with juvenile horse mackerels being pelagic, whilst adults are meso-pelagic.

4.2.2.4 Pelagic Fish

Pelagic fish species are divided into two main groups as defined by their diet (Annex 2):

- Relatively small planktivorous fish that eat plankton, and.
- Relatively larger piscivorous predatory fish that eat other fish.

Small planktivorous shoaling fish are what upholds the Benguela ecosystem. They are the main food source for a range of predatory species such as piscivorous fish, squid, seabirds, seals and cetaceans. When pelagic fish populations are small, the predators suffer, but when numbers are large, the predators thrive. However, there is a negative feed-back, as an over-abundance of pelagic fish can

depress the standing stocks of their own food supply, primarily microscopic zooplankton (Maloney and Shannon, 2009. SASSI, 2014). Historically the most commercially important small shoaling fish species within the Namibian waters of the BCLME were the anchovy (Engraulis japonicus), southern African anchovy (Engraulis capensis) and the South African pilchard (Sardinops ocellatus) and sardine (Sardinops sagax). However, Redeye Round herring (Etrumeus whiteheadi) is also abundant off South Africa, and in the last decades Pelagic goby (Sufflogobius bibarbatus) and horse mackerel have become important off Namibia.

4.2.2.5 Habitat and Fish Spawning Area

The seafloor habitats are likely to comprise channels dominated by sandy mud to muddy sand texture (Bremner, 1983. Bremner, *et., al*., 1988 and Geological Survey of Namibia, 2003). As shown in Fig. 4.9 all the key fish spawning areas are situated to the east and outside the proposed survey area. Most of the proposed survey area 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 area around the proposed survey area has the following unfavourable characteristics for fish spawning habitat (Fig. 4.9):

- Water depth of up to -4000m.
- The absence of any granular material with gravel less 10%.
- Likely to be dominated by poorly sorted, sandy mud to muddy sand texture, and.
- The presence of >75% fine materials (sand, silts, and clays).

4.2.2.6 General Threats to Fish Stocks

There are numerous factors that threaten the sustainability of fish populations including (Annex 2):

- Overfishing and overharvesting.
- Introduction of invasive alien species through mariculture development.
- Disruption of habitat by human activity (seaside development. bottom trawls. exploration and mining).
- Marine pollution from increased marine vessel traffic, harbour activities and seaside development.
- Periodic climatic and environmental variability (e.g., Benguela niños).
- Natural ecological events (Harmful algal blooms, H_2S eruptions).
- Imbalances in the ecosystem leading to over-/under-predation due to changes in population sizes within the food chain, and.
- Improper /irregular monitoring and adjustment of harvesting legislation at times of natural environmental stress.

Most of the fish species occur on the onshore fringes of the AOI, with exception of tuna which is found in large numbers near Tripp Sea Mount (Annex 2). The impact on the populations and most of the fisheries are likely to be low and of short duration. Discussion with the tuna industry is required regarding the timing of the survey southern portions of the proposed survey area.

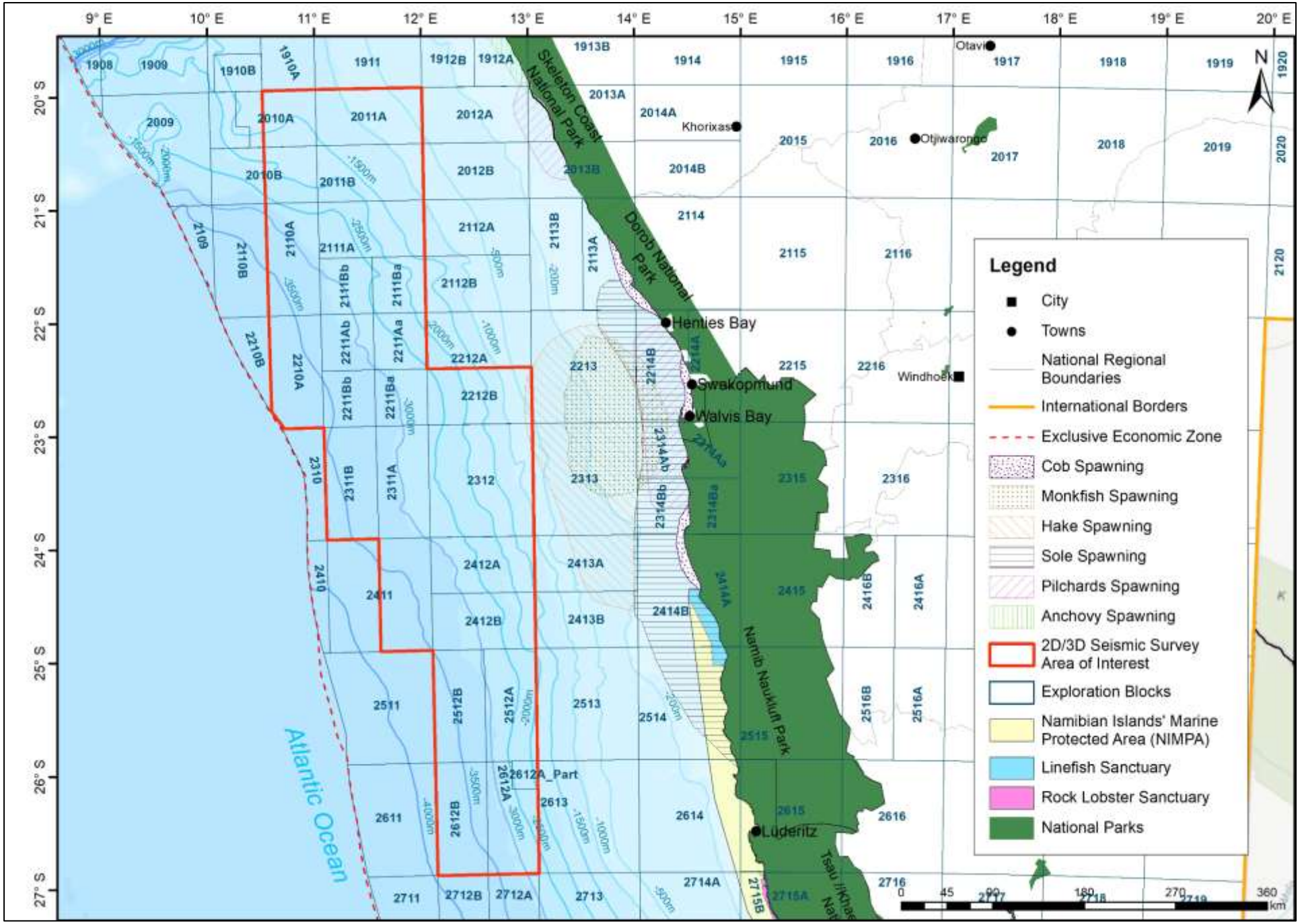


Figure 4.7: Known fish spawning areas relative to the proposed 2D / 3D seismic survey.

4.4.3 Commercial Fishing Grounds and Catches

4.4.3.1 Commercial Fisheries

The fishing industry in Namibia is undoubtedly the most socio-economically sensitive of all the marine activities currently being undertaken in Namibian waters (Annex 2). The commercial fishing industry is a major employer and contributes significantly to Namibia's GDP and foreign exchange earner, second most important after mining (MFMR 2017). In 2021, Namibia auctioned 87,500 metric tons (MT) of horse mackerel quotas, earning the government NAD 214 million (USD 14.5 million, EUR 13.2 million) in revenue. Over 16, 500 people are directly employed by the commercial fisheries, with triple that number working in related and support services e.g., logistic, dock workers, general services and supplies.

Commercial catches are landed at the ports of Walvis Bay and Lüderitz and target include hake (Merluccius capensis and M. paradoxus), monkfish (Lophius vomerinus and L. vaillanti), Cape horse mackerel (Trachurus capensis), sardine (Sardinops sagax), Deep-sea red-crab (Chaceon maritae), rock lobster (Jasus lalandii), snoek (Thyrsites atun), kob (Argyrosomus inodorus and A. coronus), West Coast Steenbras (Lithognathus aureti), Albacore tuna (Thunnus alalunga), Yellowfin tuna (T. albacares), Bigeye tuna (T. obesus), Swordfish (Xiphias gladius), as well as species of sharks (MFMR 2019).

Horse mackerel and hake stocks constitute about 94% of the annual fish landings (Esau, 2019). The rights to species exploitation are granted by the Ministry of Fisheries and Marine Resources (MFMR), who attempt to control the industry in the interests of economic viability without overexploitation. Dramatic stock losses have huge impacts on the fishing industry which requires a steady income and profit in the short term. However, quotas are adjusted, and cut, if necessary, to allow populations to recover to sustainable sizes (Esau, 2019. SASSI, 2014). There are currently 116 Namibian-registered commercial fishing vessels, comprising demersal trawlers that include both large freezer vessels (up to 70 m in length), as well as a smaller fleet of monk trawlers. These vessels fish year-round, except for in October which is a closed annually. Six fisheries are controlled by an annual Total Allowable Catch (TAC) determined by MFMR. The TACs for 2019 to 2021, as shown in Table 4.2. The fishing methods used are shown in Table 4.3.

Table 4.2: Total Allowable Catch for 2021 (ESAU, 2019. MFMR, 2020).

TARGET SPECIES	TAC in metric tonnes 2019	TAC in metric tonnes 2021
Crab	3 400	3 900
Hake	154 000	154 000
Horse Mackerel	349 000	330 000
Monk Fish	8 000	7 300
Sardine / Pilchard	0*	0*
Rock Lobster	200	180
* In 2018 the Namibian government declared a three-year fishing moratorium after significant declines in landings from the pilchard fishery. It is not clear whether the pilchards stocks have declined, or have migrated elsewhere (Esau, 2019). **Note:** There is no TAC for Albacore tuna as this is an effort-controlled sector with no restriction on catch.		

Table 4.3: Fishing methods for different species (Source: MSP 2017).

TARGET SPECIES	FISHING METHOD
Crab	Bottom trawl
Hake	Bottom trawl
Hake	Long line
Monk (full time)	Bottom trawl
Hake/Monk	Bottom trawl
Horse mackerel	Midwater trawl
Large pelagic fish (Swordfish, sharks, tuna)	Long line
Snoek	Pole and hook
Albacore tuna	Pole and line
Small pelagic shoaling fish	Purse seine

Commercially targeted species of fish are fished in at different water depths along the length of the Namibian coast with more details and distributions of a selection of commercially valuable species provided in Annex 2.

4.4.3.2 Fish and Commercial Fisheries Sensitivity

The Lüderitz upwelling cell in southern Namibia is an important area for commercial fish stocks. Commercial trawl, long-line and tuna pole-and-line fisheries operate out of Lüderitz Bay. Long-line and pole-and-line tuna fishers operate in southern Namibia, close to the border with South Africa. About 90 % percent of the catch is Albacore tuna (Thunnus alalunga) with the rest being Bigeye, Yellowfin and Skipjack tuna (Namibia Fishing Industry, 2015). Albacore is the only tuna species which may be marketed as "white meat tuna" in the United States of America. Tuna catches are exported to Spain. Pelagic sharks are often taken as bycatch. Swordfish (Xiphias gladius) are also targeted by longline fishers.

Owing to the fact that these large pelagic target species are highly migratory, this fishery is widespread, with no specified fishing grounds. However, most vessels are found offshore of the shelf break, with the highest catch effort focused south of 28°S in the vicinity of Tripp Sea Mount (29.81°S,14.22°E). Pelagic long-line vessels set a drifting mainline at or near the surface that can be up to 100 km long. Baited hooks are placed at the end of snood lines, which hang from the main line every 50m.

The potential impact of the seismic survey on the fishing industry is two-fold:

(i) Through disturbance of the target species, causing it to move out of its regular locale, resulting in a reduction in catch, and.

(ii) By interrupting travel to fishing grounds as well as fishing due to exclusion zones around the operating seismic vessel.

A regional overview of known fish locations and fishing grounds relative to the relative to the proposed survey area are provided in Annex 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 2D / 3D seismic survey 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.

The 500 m exclusion zone that will be established around the survey vessel and equipment if any, is very limited temporary disruptions to Hake and Monkfish trawl commercial fishing activities overlapping with the survey area (Fig. 4.10).

However, the bulk of the targeted survey area is situated to the west in the deeper water with no known commercial fishing activities. Provided key stakeholders in the 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.

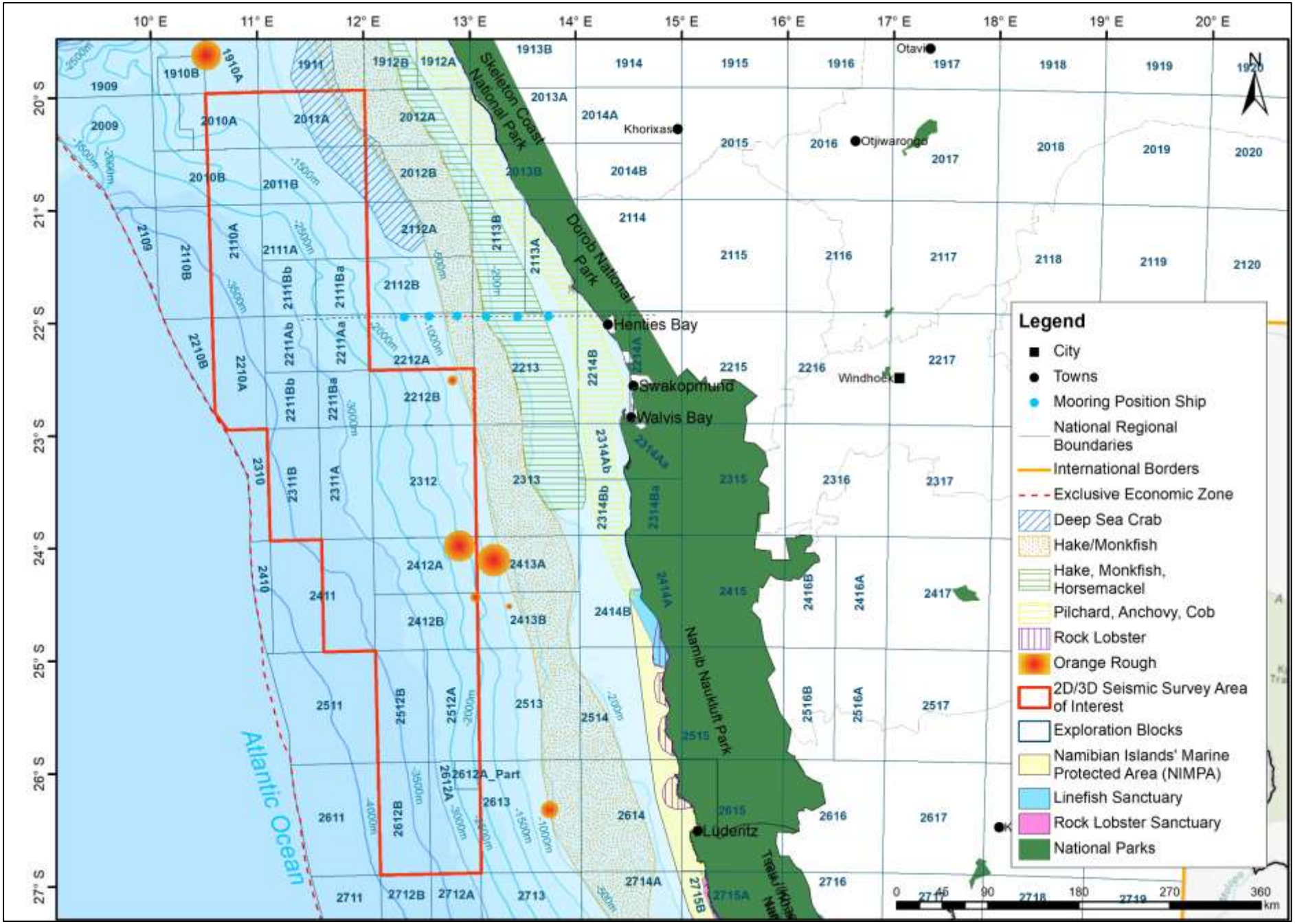


Figure 4.10: Known commercial fishing grounds relative to the proposed 2D / 3D seismic survey area excluding Tuna (Data Source: MFMR and Monteiro et al, 2006).

4.4.3.3 Commercial Species Relative the Proposed Survey Area

Horse mackerels occur across a section of the proposed survey grid. The seismic survey vessel locations and timetable should be communicated to this fishery well in advance of the onset of proposed operations (Annex 2). Monkfish are targeted at depths less than -750m. As with hake, the proposed survey grid overlaps the southern limited of the offshore edge of this fishery (Fig. 4.10 and Annex 2). If there is any disruption to fishing it will most likely be caused by exclusion safety limits when the seismic vessel is turning at the ends/beginnings of inshore lines.

Demersal trawlers target Monkfish and both Cape and Deep-water hake (Merluccius capensis and M. paradoxus). This is one of the most productive and valuable of the Namibian fisheries, with around 100 Namibian-registered vessels trawling bottom waters ranging from -300 m to -600 m depth for the entire length of the Namibian coastline. Demersal long-line fisheries targeting hake utilise the same grounds. Demersal long-lines are weighed down near the sea floor. Concrete blocks, marked by floats, anchor the lines at both ends. Shallow-water Cape hake and Horse mackerel are distributed along the entire Namibian coastline, but predominantly in inshore waters. The proposed survey grid is predominantly offshore of this fishery, except for a small overlap with the most southern extreme of the known fishing grounds (Fig. 4.10 and Annex 2).

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 and north of the proposed seismic grid, so this fishery will not be impacted by the seismic operations. Large migratory pelagic fish species such as swordfish and a number of 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. Pelagic long-line vessels set a drifting mainline, that can be 100 km long, at or near the surface. Baited hooks are placed at the end of snood lines, which hang from the main line every 50 m.

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 4.4, Fig. 4.11 and Annex 2) 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 4.4: 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 Sea Mount 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 (Annex 2).

4.4.3.4 Fishing Industry Conclusions

A critical time that seismic exploration should not occur is when the Ministry of Fisheries and Marine Resources is conducting its annual stock assessment surveys to make recommendations for total allowable catches (TAC's) for the following fishing year. Given the sensitivity of the surveys, any seismic interference could potentially have an overly negative impact on data results when it comes to setting the TAC's.

There is strong evidence that seismic survey negatively impacts migratory fishes such as Albacore Tuna and Snoek. Specifically, Albacore Tuna in the South Offshore Region where seismic exploration has been intense in the last three (3) years around Tripp Seamount, catches dropping from over 4,000 tonnes to 650 tonnes in the space of three seasons. Catches of Snoek were also disrupted in 2012, when the Snoek which is in deeper water from July through September, only arrived at the northern fishing grounds in December instead of October. Seismic survey occurred from May through September 2012 in the area where the Snoek were, suggesting a potential link.

The Pilchard fishery is concerned about the seismic survey because their fishing season is short, and the TAC much reduced from the past, so canning factories are well underutilised, and any disruption could potentially have a significant economic impact on the sector. The longline hake sector has experienced direct disruptive impacts in terms of fish becoming nervous and scattered following a seismic vessel passing through, vessels wasting a lot of time till the fish became catchable again.

The hake trawl sector experienced erratic catches which they cannot explain. The fishing industry is, however, increasingly concerned by the potential impact of seismic exploration on the ecological health of the fisheries resource, as well as the disruptive side to fishing operations, both of which have economic implications for the fishing industry. There is a window of opportunity to undertake the proposed 2D / 3D seismic survey in AOI. It is highly recommended that the Proponent must notify all the key stakeholders in the fishing industry of the intention to undertake the survey during the tuna fishing season (Fig. 4.11).

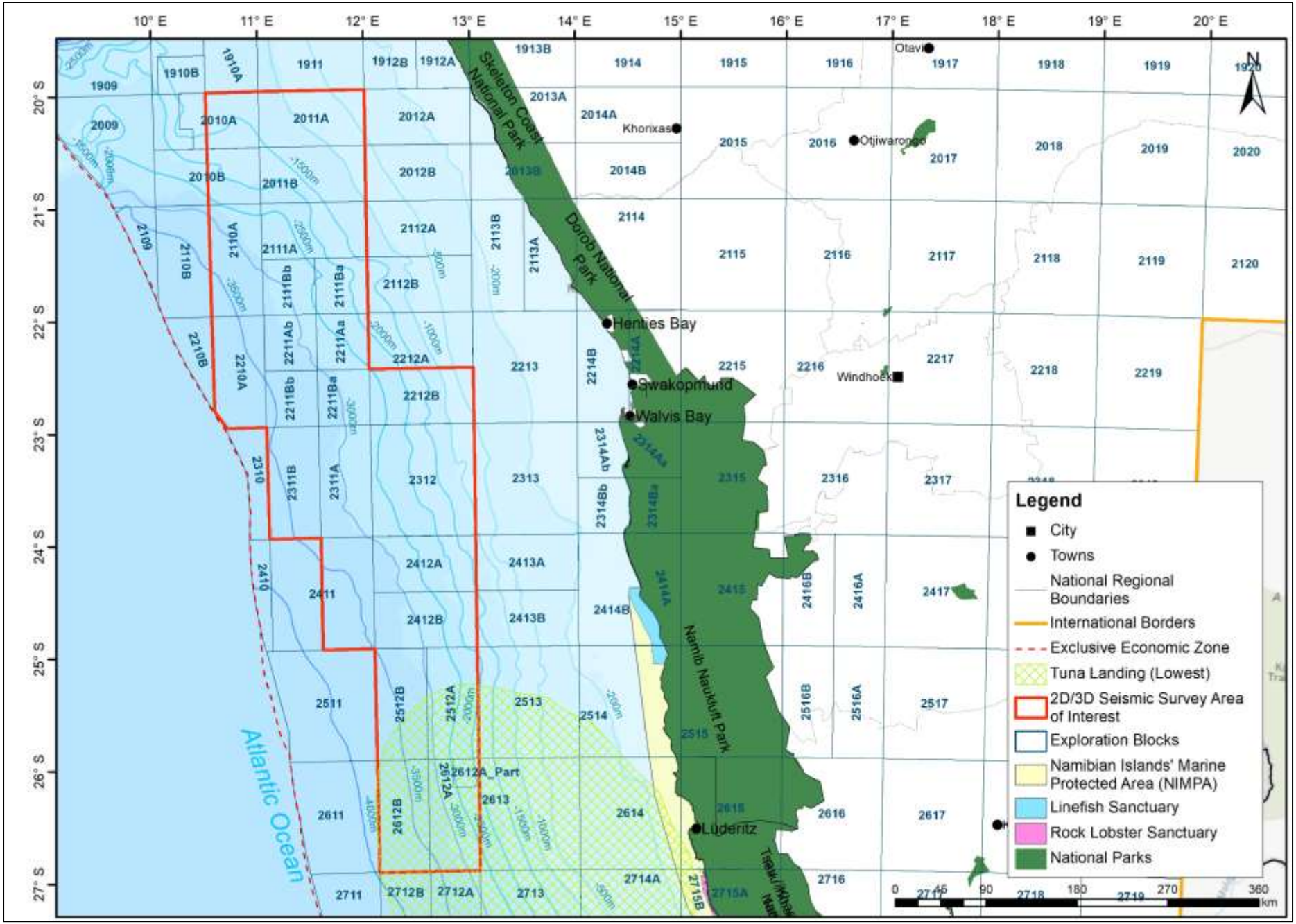


Figure 4.11: Known tuna landing areas relative to AOI with highest catches shown in red and pink around Tripp Seamount Excluded from the proposed survey (green circle) (Extracts from RBS, 2020 Map series).

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 (Annex 2). 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 (Annex 2):

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

Detailed information on the sea turtles is provided in Annex 2.

4.4.4.2 General Threats to Sea Turtles

Apart from natural predation turtles are threatened by human action including (Annex 2):

- 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 (Annex 2). 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 (Annex 2). 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 (Annex 2). 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 (Annex 2).

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 (Annex 2):

- 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 (Annex 2 and 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 (Annex 2 and 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.

Detailed information on the various marine mammals found in the Namibian water are provided in Annex 2 and as illustrated in Figs. 4.12-4.22 relative to the proposed 2D / 3D seismic survey area.

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 (Annex 2).

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.

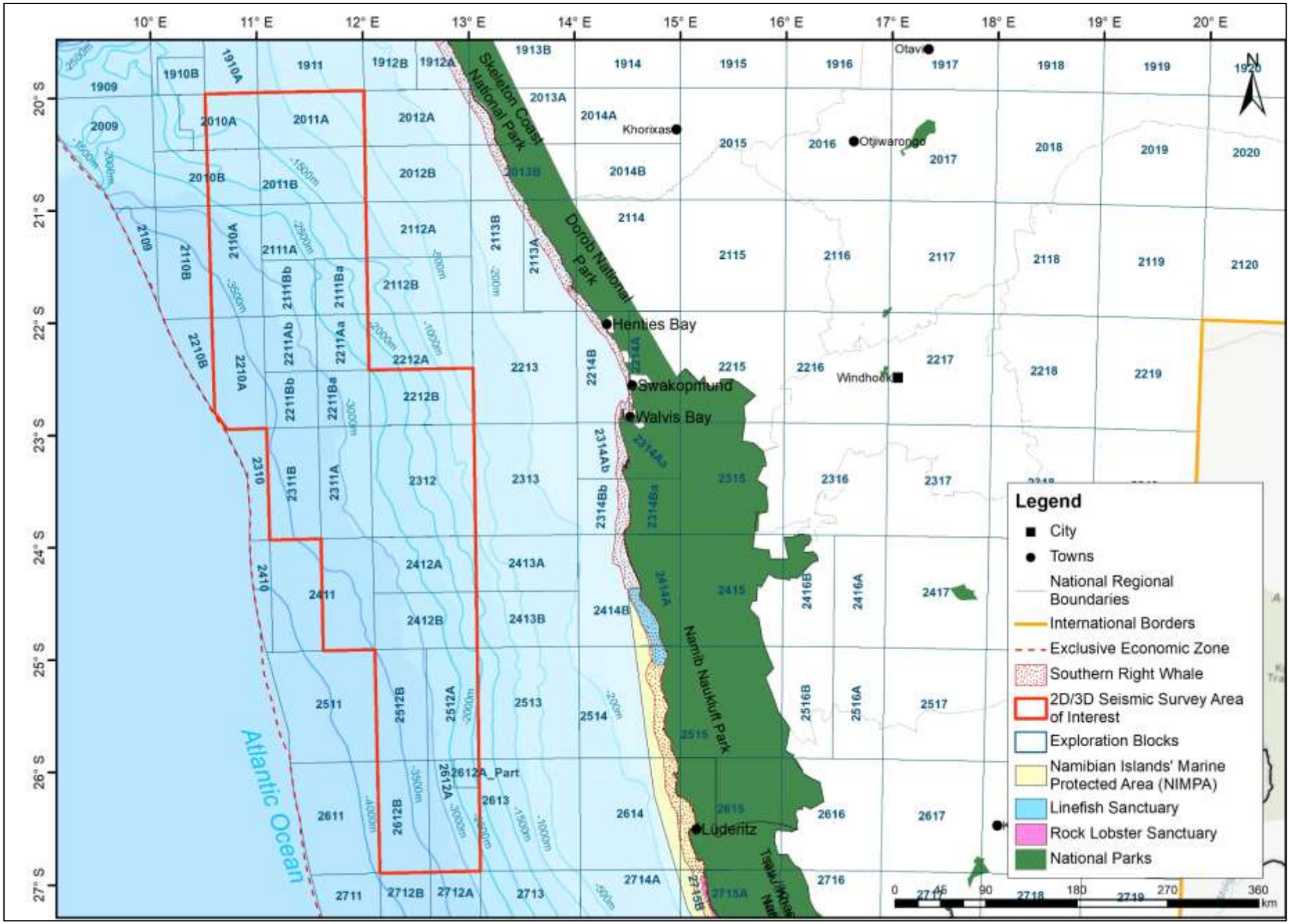


Figure 4.12: Known migratory occurrences of Southern Right whales relative to the proposed survey area. These animals are vulnerable to habitat disruption and vessel impacts in shallow waters near Lüderitz Bay not related to the proposed survey area.

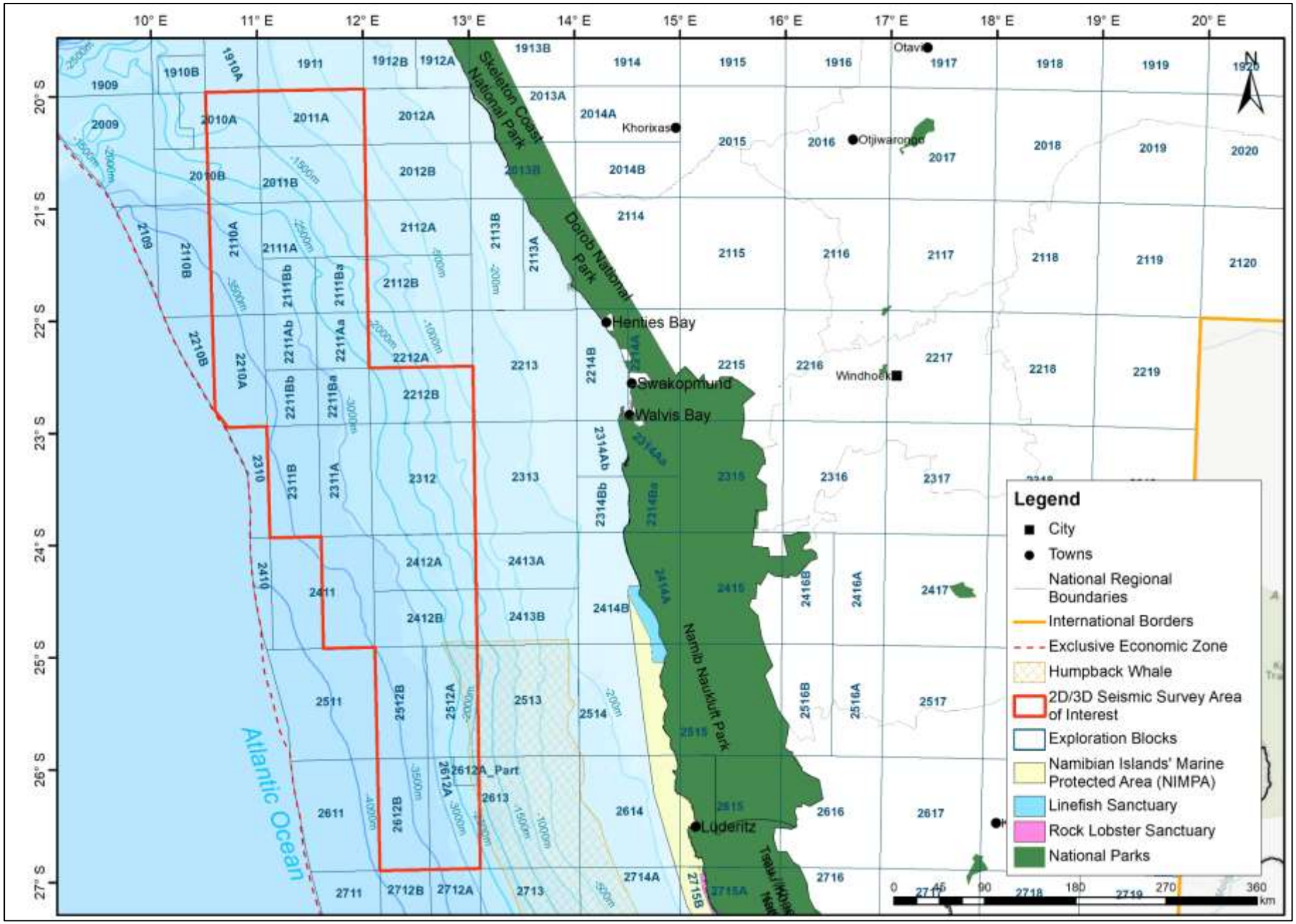


Figure 4.13: Known migratory occurrences of Range of Humpback Whale relative to the proposed survey area. These animals are vulnerable to habitat disruption and vessel impacts in shallow waters near Lüderitz Bay not related to the proposed survey area.

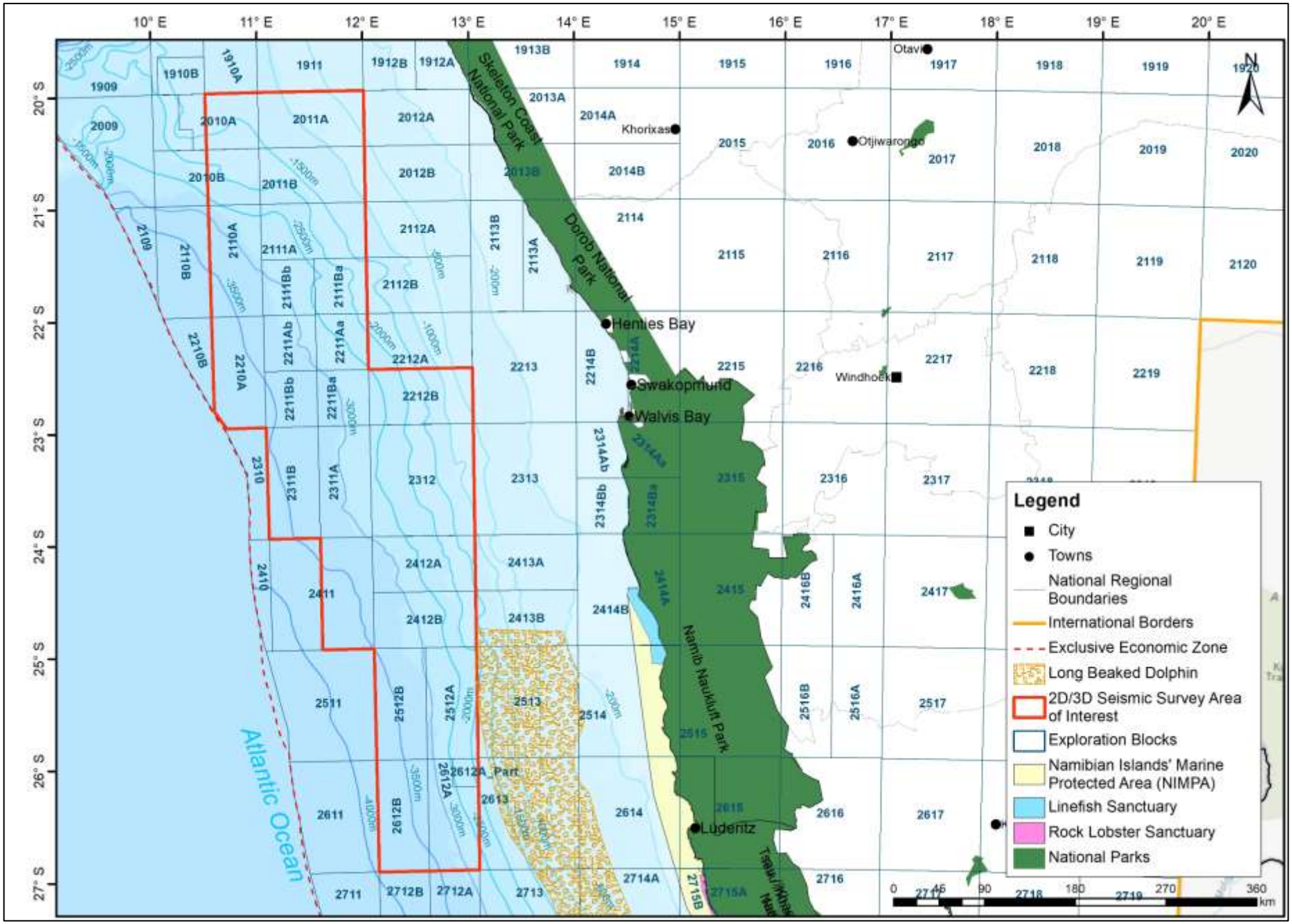


Figure 4.14: Known migratory occurrences of Range of Long Beaked Dolphins relative to the proposed survey area. These animals are vulnerable to habitat disruption and vessel impacts in shallow waters near Lüderitz Bay not related to the proposed survey area.

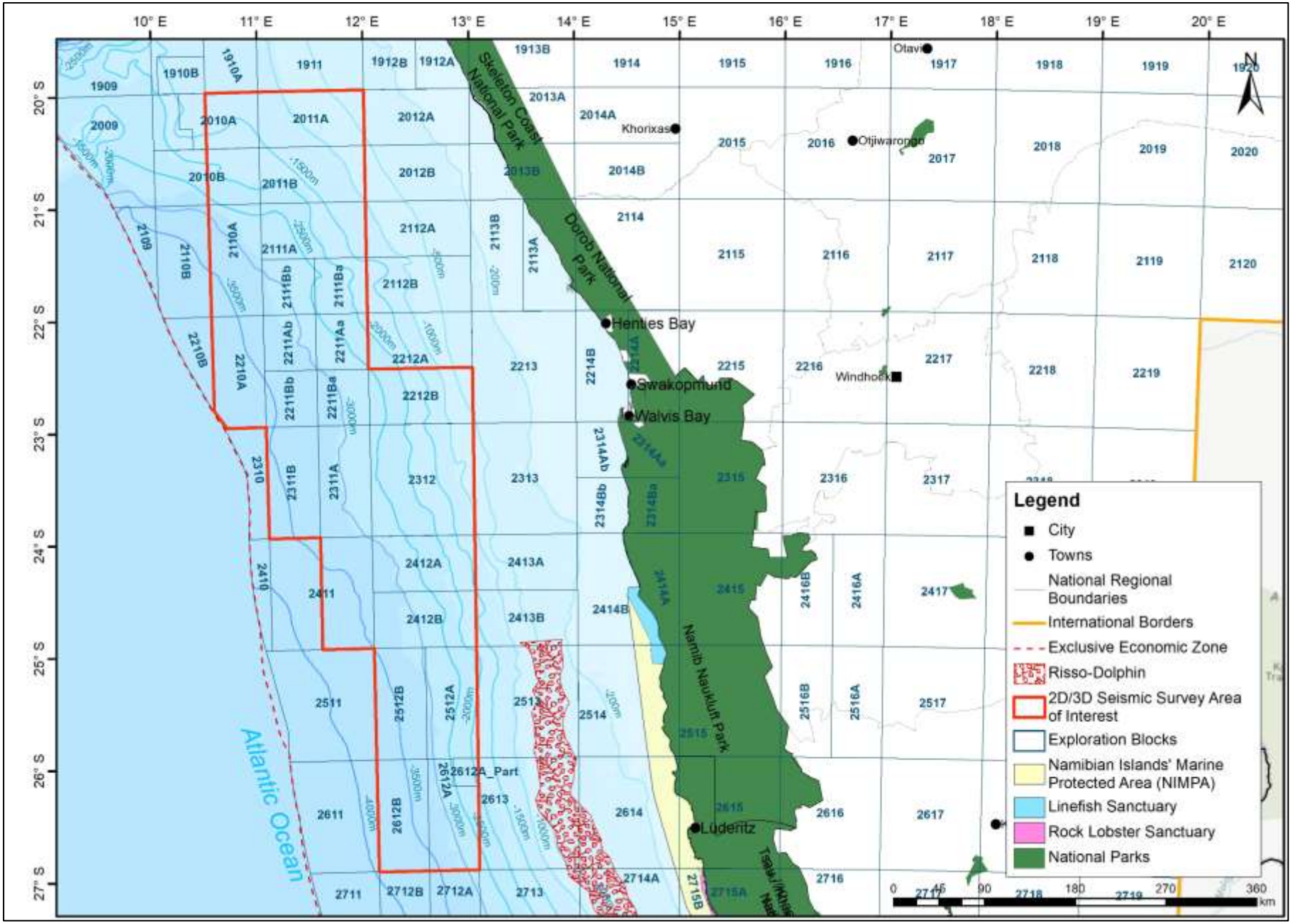


Figure 4.15: Known migratory occurrences of Range of Risso-Dolphins relative to the proposed survey area. These animals are vulnerable to habitat disruption and vessel impacts in shallow waters near Lüderitz Bay not related to the proposed survey area.

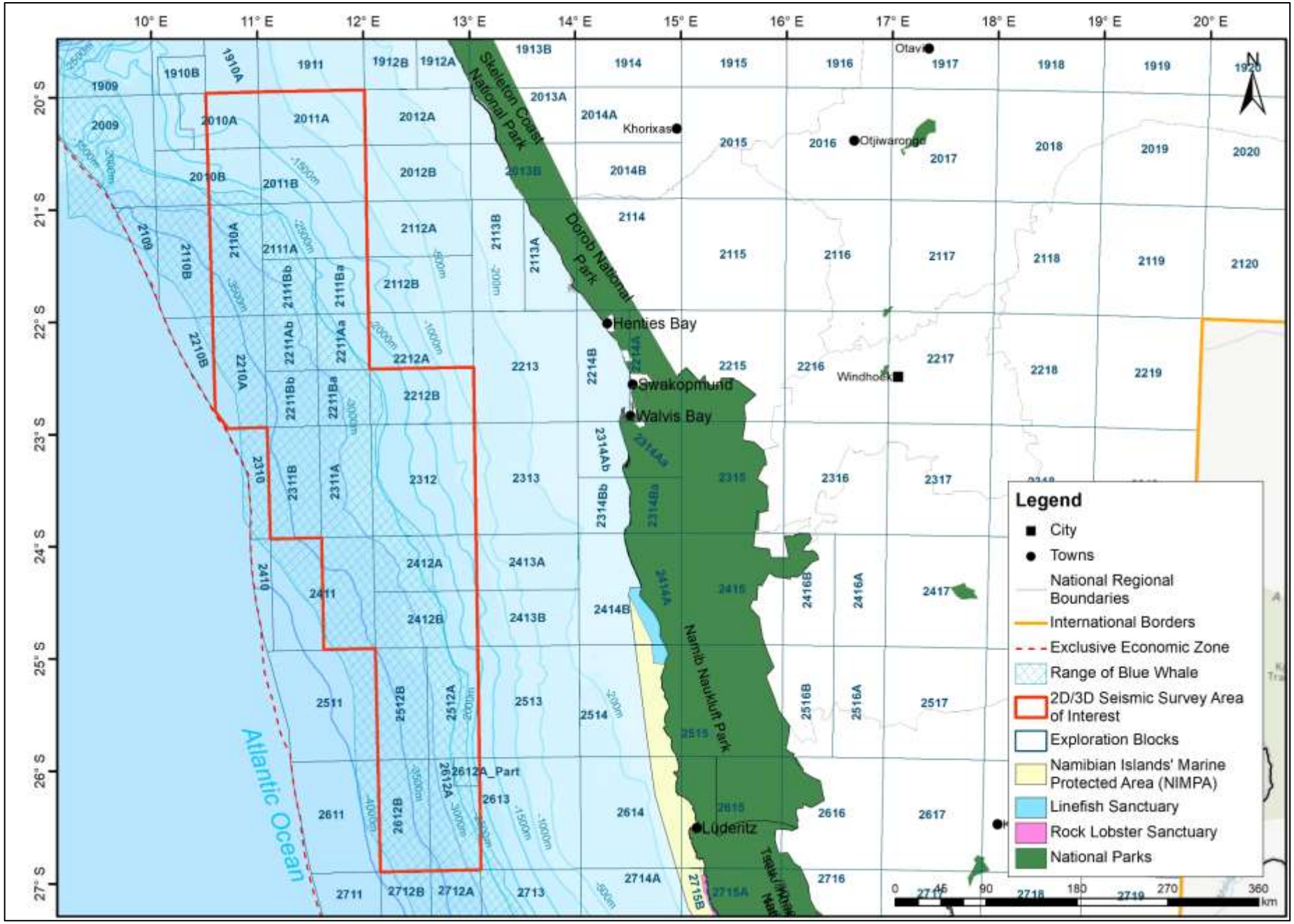


Figure 4.16: Known migratory occurrences of blue whales relative to the proposed survey area. Known migration paths of these exceptionally large mammals cross the proposed survey area and appropriate mitigation measure shall be provided.

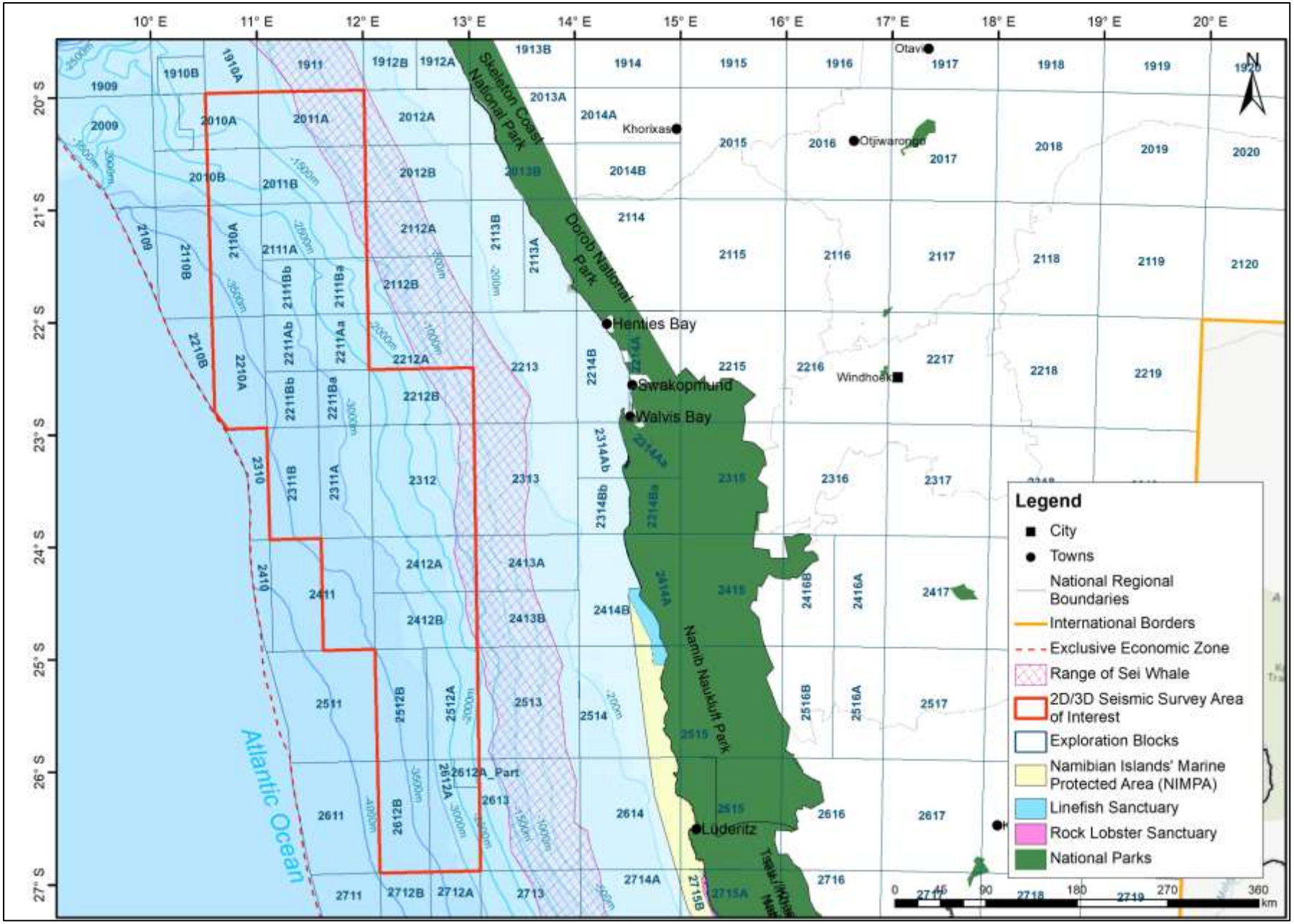


Figure 4.17: Known migratory occurrences of Sei whales relative to the proposed survey area. Encounters with Sei whales are only likely by vessels in transit to and from Lüderitz harbour not related to the proposed survey area.

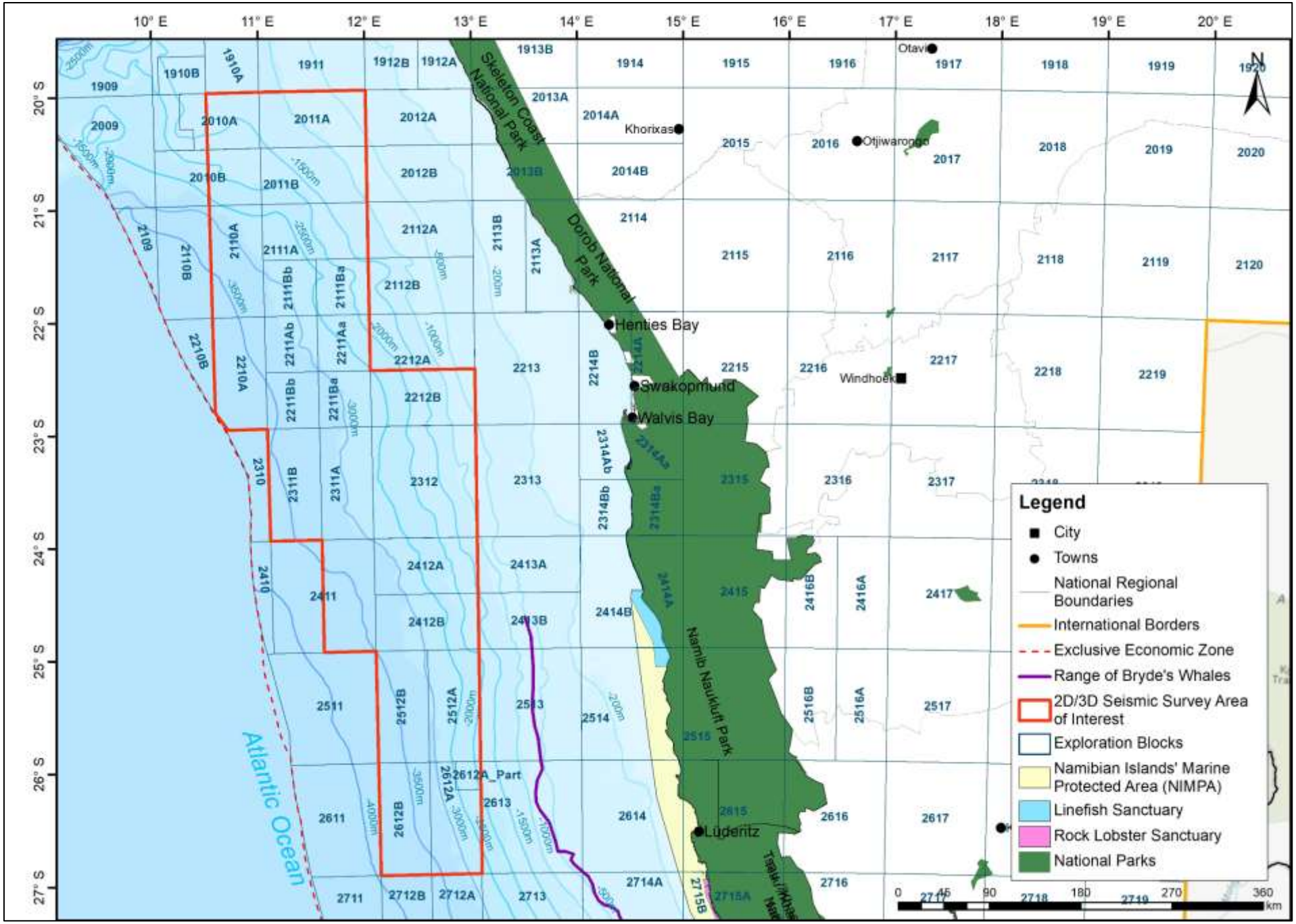


Figure 4.18: Known migratory occurrences of Bryde's whales relative to the proposed survey area (Preferred habitat seaward of -1000m).

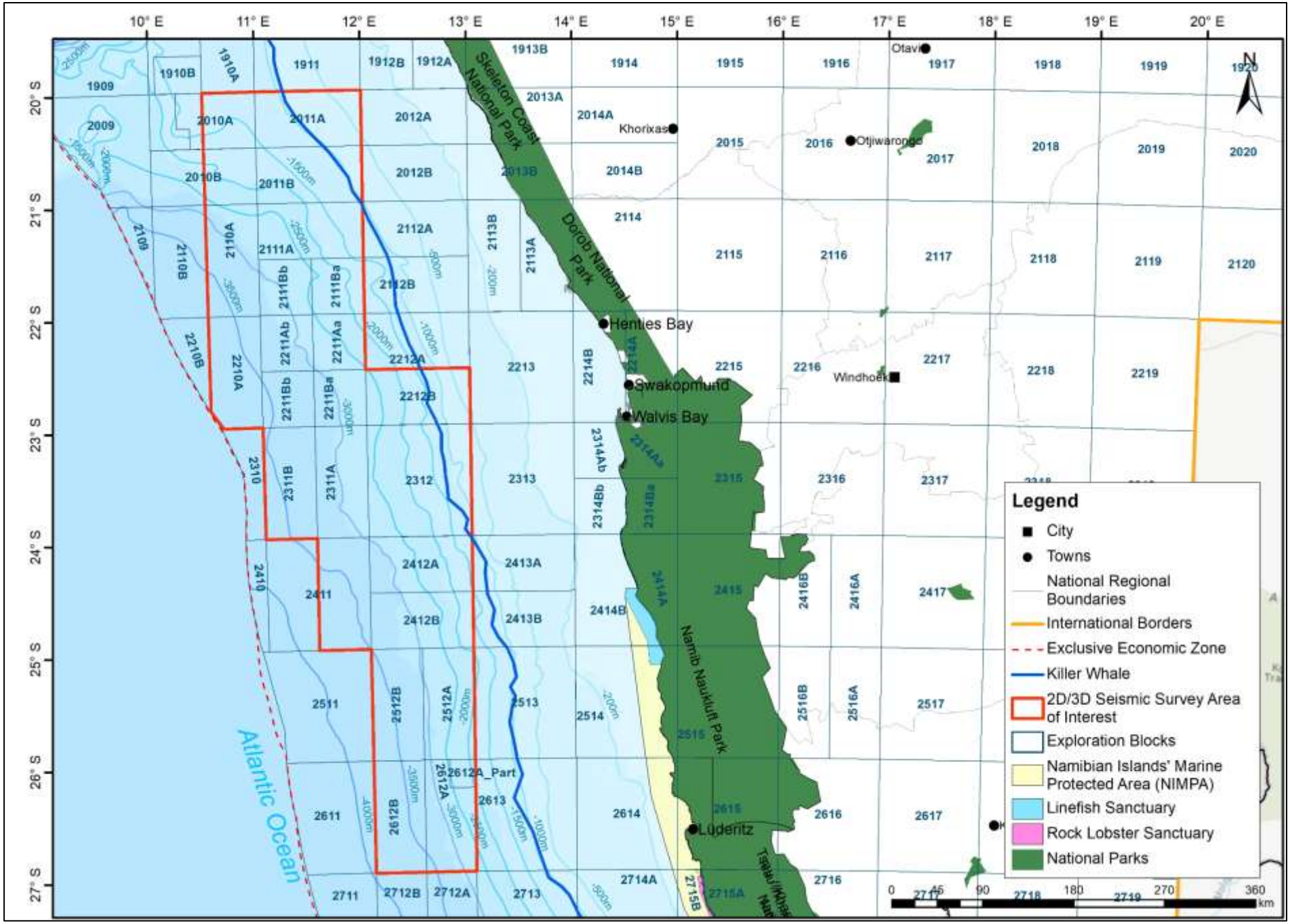


Figure 4.19: Known migratory occurrences of False Killer whales relative to the proposed survey area (Preferred habitat seaward of -1000 m).

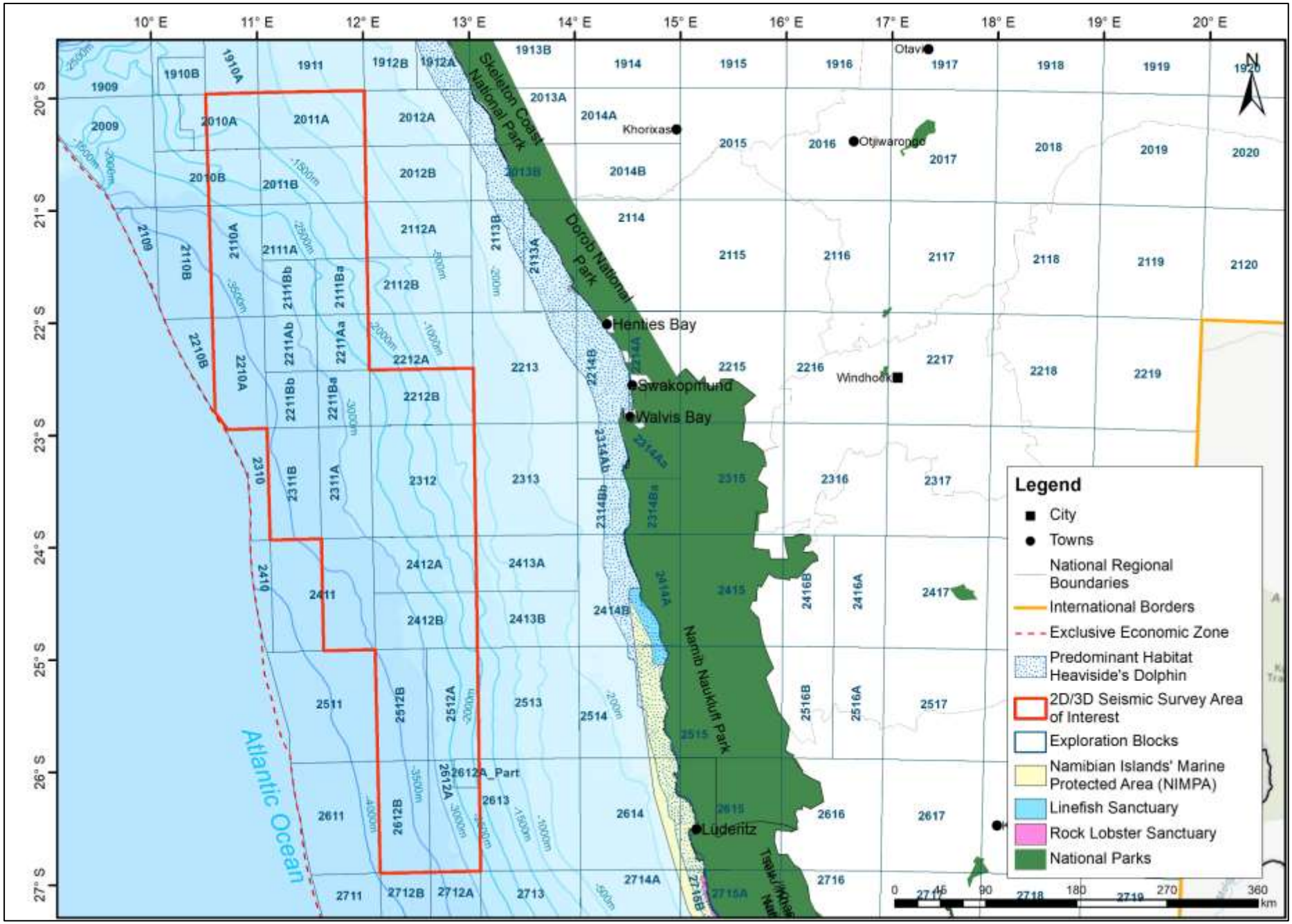


Figure 4.20: Known migratory occurrences of Heaviside's dolphins relative to the proposed survey area (Vessel impact and disturbance en route to Lüderitz harbour not related to the survey area).

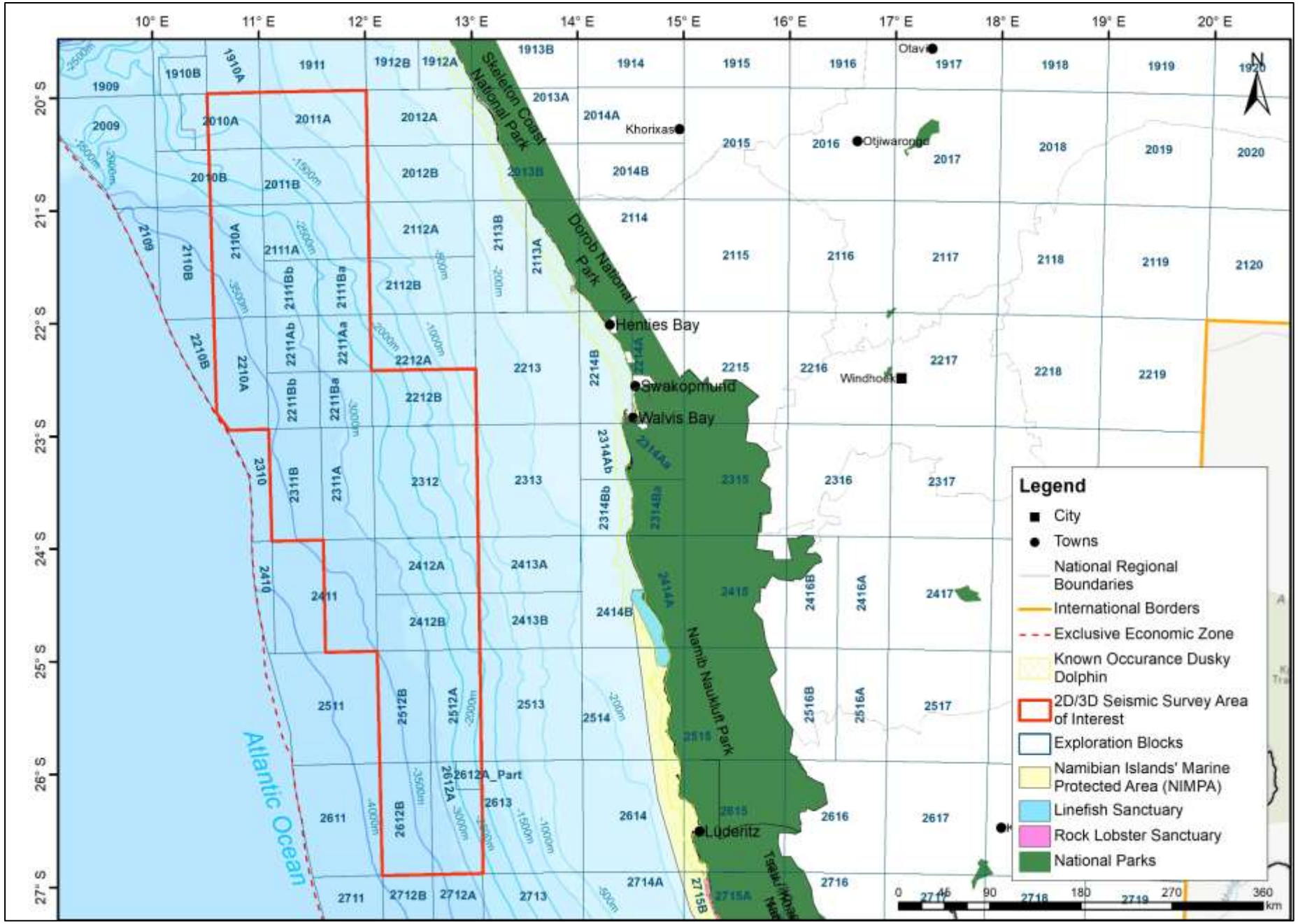


Figure 4.21: Known migratory occurrences of Dusky dolphins relative to the proposed survey area (Vessel impact and disturbance en route to Lüderitz harbour not related the proposed survey area).

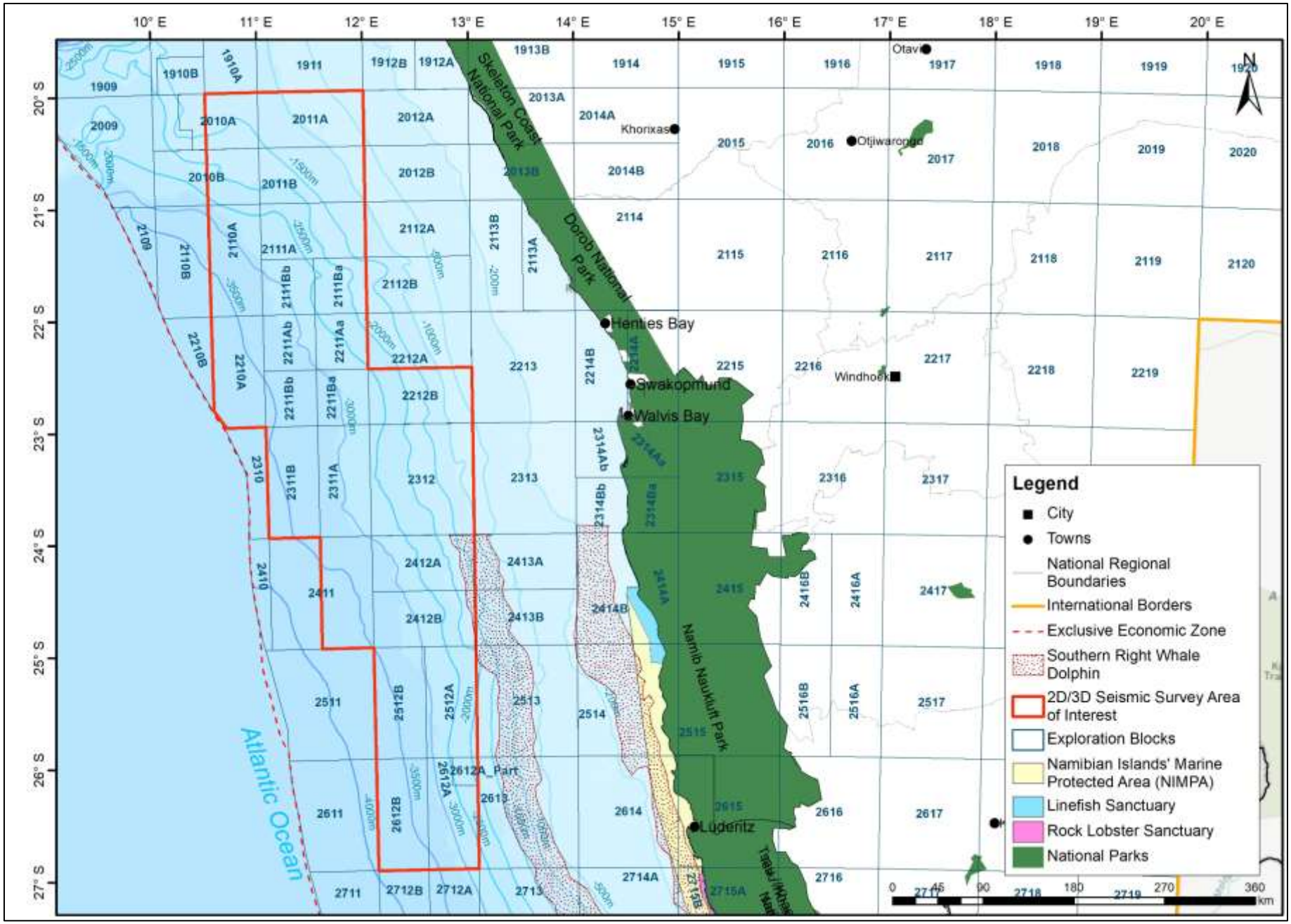


Figure 4.22: Known migratory occurrences of Southern Right-whale dolphins relative to the proposed survey area (Vessel impact and disturbance enroute to Lüderitz harbour not related to the proposed survey area).

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 Lüderitz and Walvis 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.

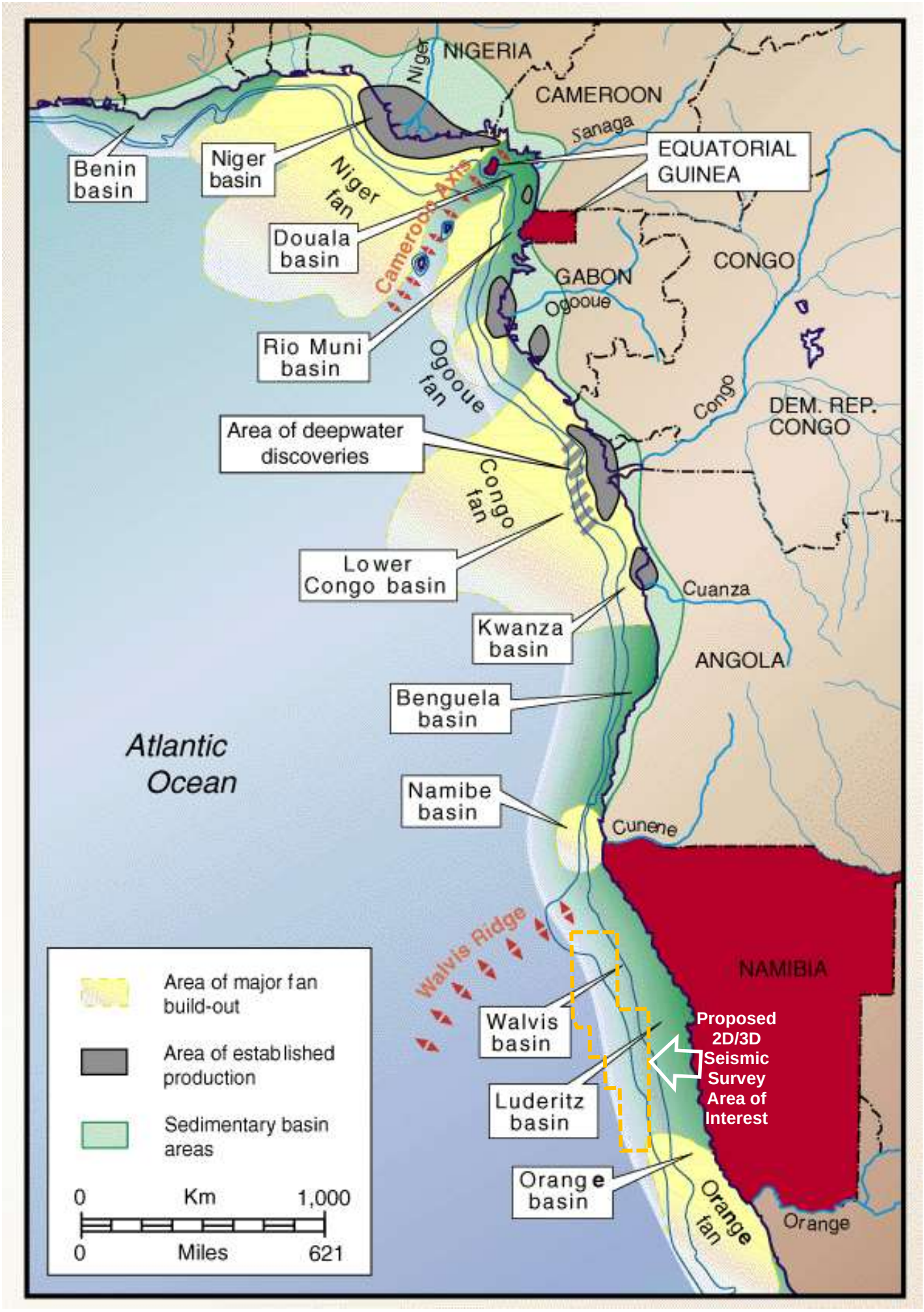


Figure 4.23: Basins of Central and Southern Africa (Bray and Lawrence, 1999).

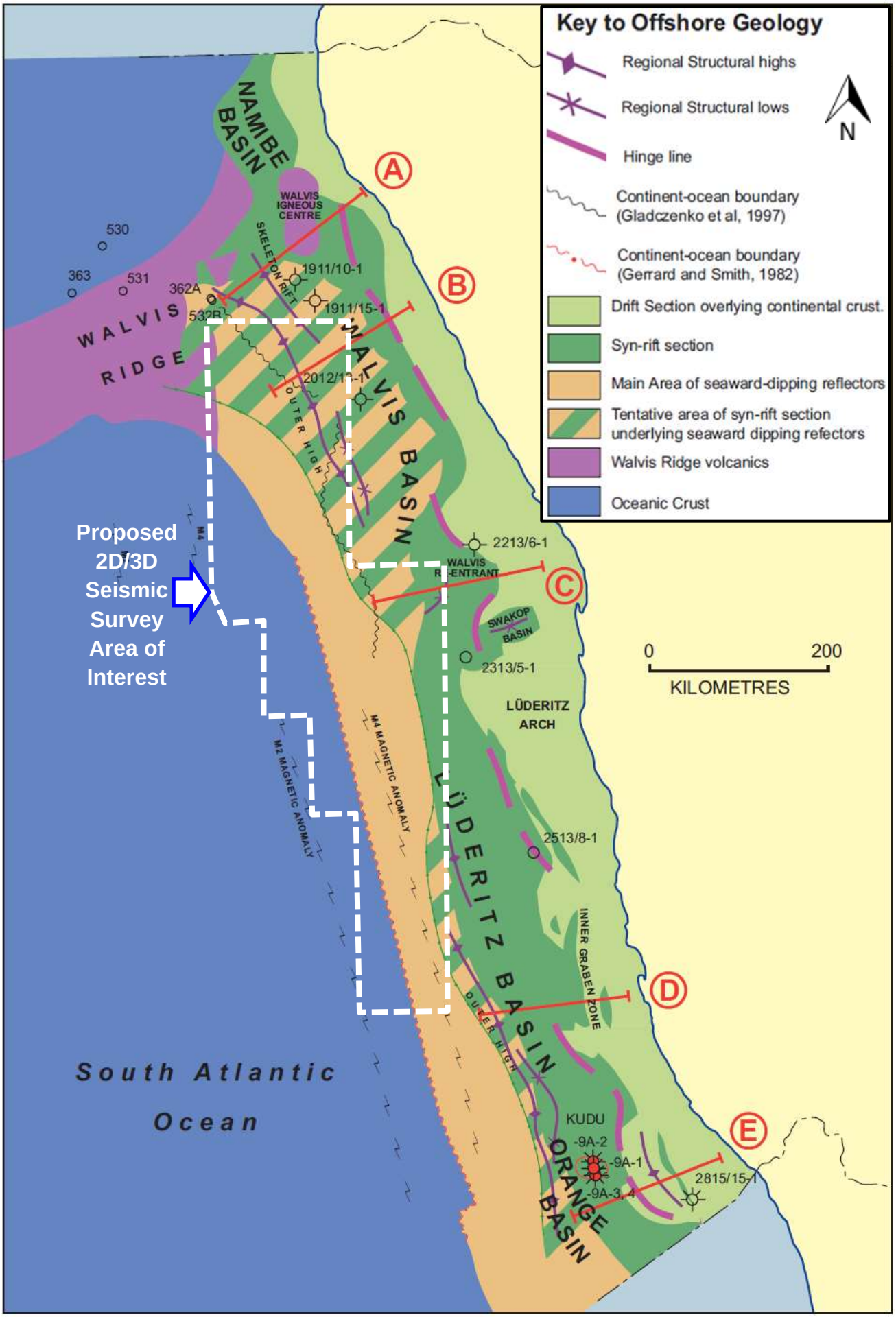


Figure 4.24: The offshore Basins of Namibia with detailed geological cross section lines A-E shown in Fig. 4.17 (Source: Bray *et. al.,* 1998).

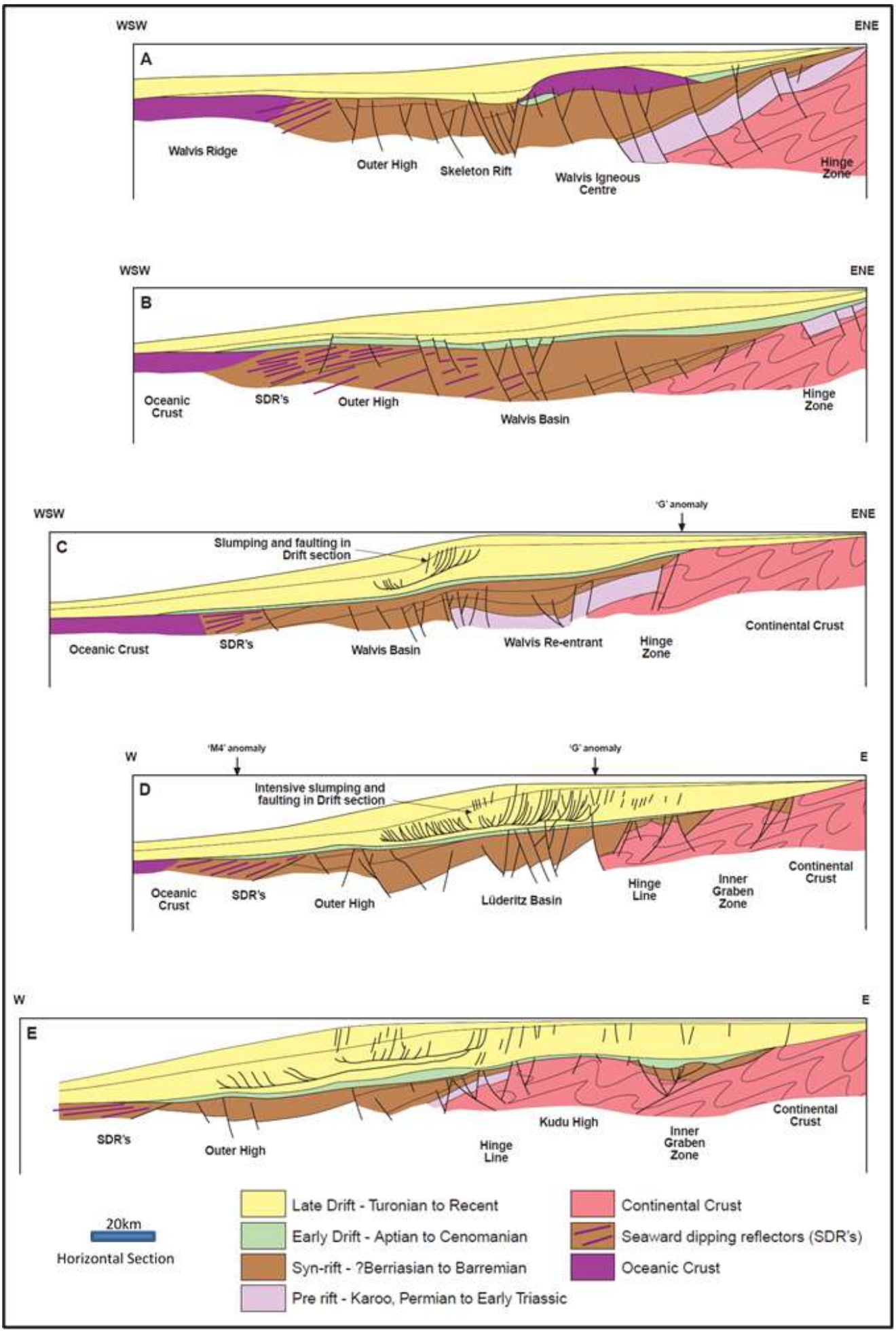


Figure 4.25: Geological section lines A-E shown in Fig. 4.16 (Source: Bray *et. al*., 1998).

4.6 Socioeconomic Environment, Submarine and Historical Artefacts

4.6.1 Socioeconomic Environment

The Namibian economy rests on four main pillars: Mining, agriculture, fishery, and tourism. Namibia is rich in natural resources with 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. The proposed 2D / 3D seismic survey area falls offshore and opposite the //Karas Region in southern Namibia. //Karas Region borders the Hardap Region in the north, Botswana in the east, South Africa in the south and the shores of the Atlantic Ocean in the west. The region's economy is attributed to its diamonds; it is home to the country's largest mining activities (NSA, 2013c). The immediate community of interest are the residents of Lüderitz and Oranjemund. The following is summary demographic and socioeconomic information of the //Karas Region:

- There has been a proportional decline in the population of the //Karas Region as only 3.66% of the country's population live in the region and the region's population is growing at a slower rate (1.1%) than the national growth rate (1.4%).
- There is high migration rate from especially the north central regions to the //Karas region.
- There are more males than female indicating that either migratory male job seekers had moved away from the region.
- A high proportion (63%) of the population is of working age (between 15 and 59 years).
- There is a large urban population (54% compared to 43% nationally average).
- The main source of income in the region is wages and salaries (72%) and the fishing and mining industries are the largest employers.
- There is a high labour force participation rate of 75.4% for the region.
- There is a shortage of skills which hampers development projects.
- Infrastructure and facilities are available in the region, but are not fully operational or utilised, such as the railway, and.
- Lüderitz experiences a shortage of houses resulting in large informal settlements.

The economy of Lüderitz is dependent on local resources of fishing, mining and tourism while the Town of Oranjemund largely depend on the onshore and marine diamond mining operations being undertaken by Namdeb and Debmarine Namibia, respectively. Several marine mineral exploration and marine diamond mining operations are undertaken in Namibian waters (Fig. 4.26). None of the marine minerals exploration or mining licenses overlaps with the proposed 2D / 3D seismic survey area (Fig. 4.26). Marine minerals exploration or mining operations are undertaken in shallow waters of less than -200m where us the proposed 2D / 3D seismic survey area are situated in Deepwater (Fig. 4.26). The various activities and logistical arrangements of the proposed survey operations falls in the following regions, towns, and general areas:

(i) Survey location is located offshore southern Namibia and its opposite the //Karas Region coastline and bordering northern South Africa waters.

(ii) Oranjemund, diamond mining town, is the only coastal town opposite the survey area.

(iii) The Port of Lüderitz which may be used as the shore base is situated in the //Karas Region, and.

(iv) The entire southern coast line from Lüderitz to Oranjemund falls within the Tsau //Khaeb (Sperrgebiet) National Park.

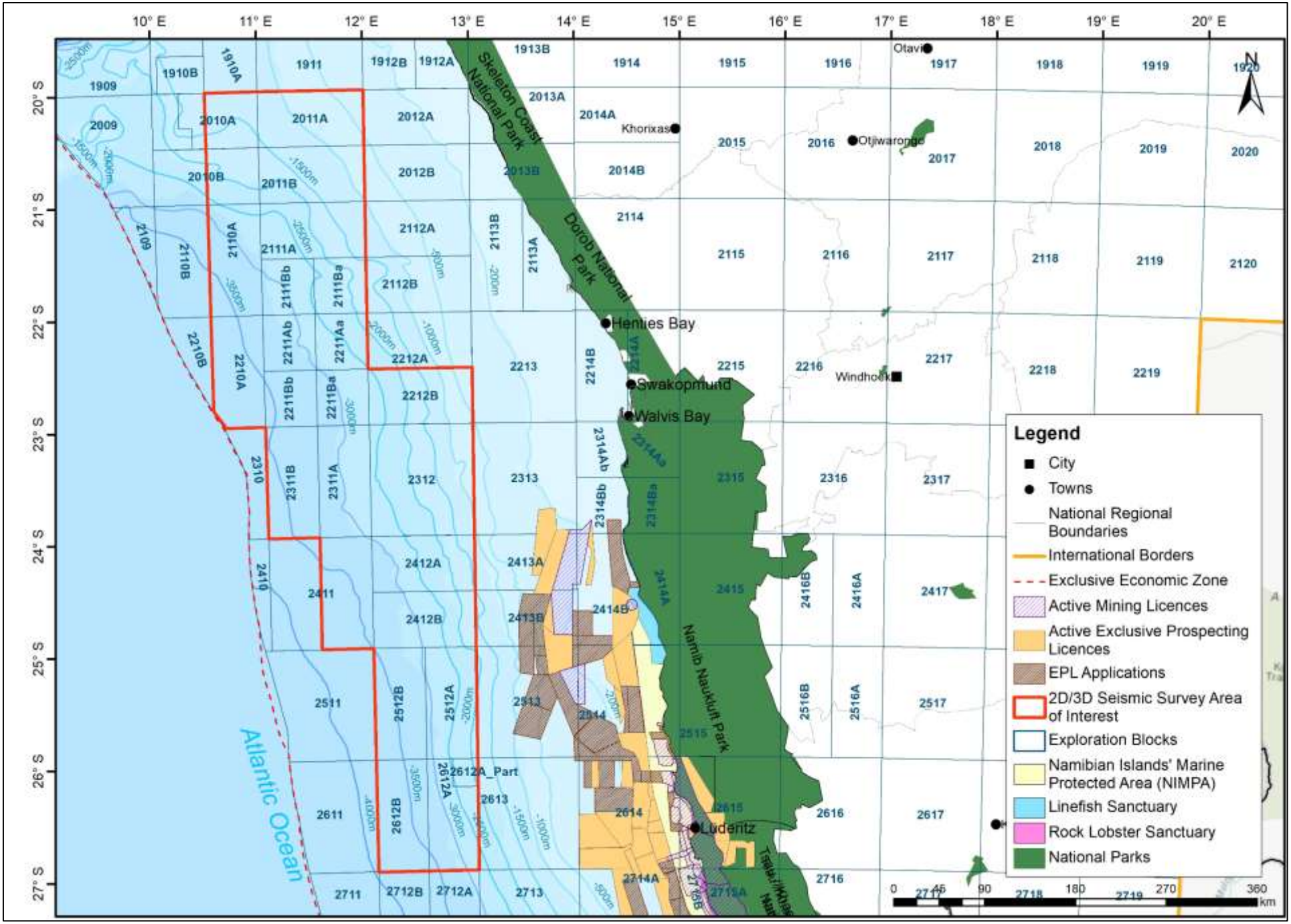


Figure 4.26: Marine minerals licenses area with respect to the proposed 2D / 3D seismic survey area (Data Source: www.mme.gove.na).

4.6.2 Submarine Communication Cables

As shown in Fig. 4.27, the above 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.

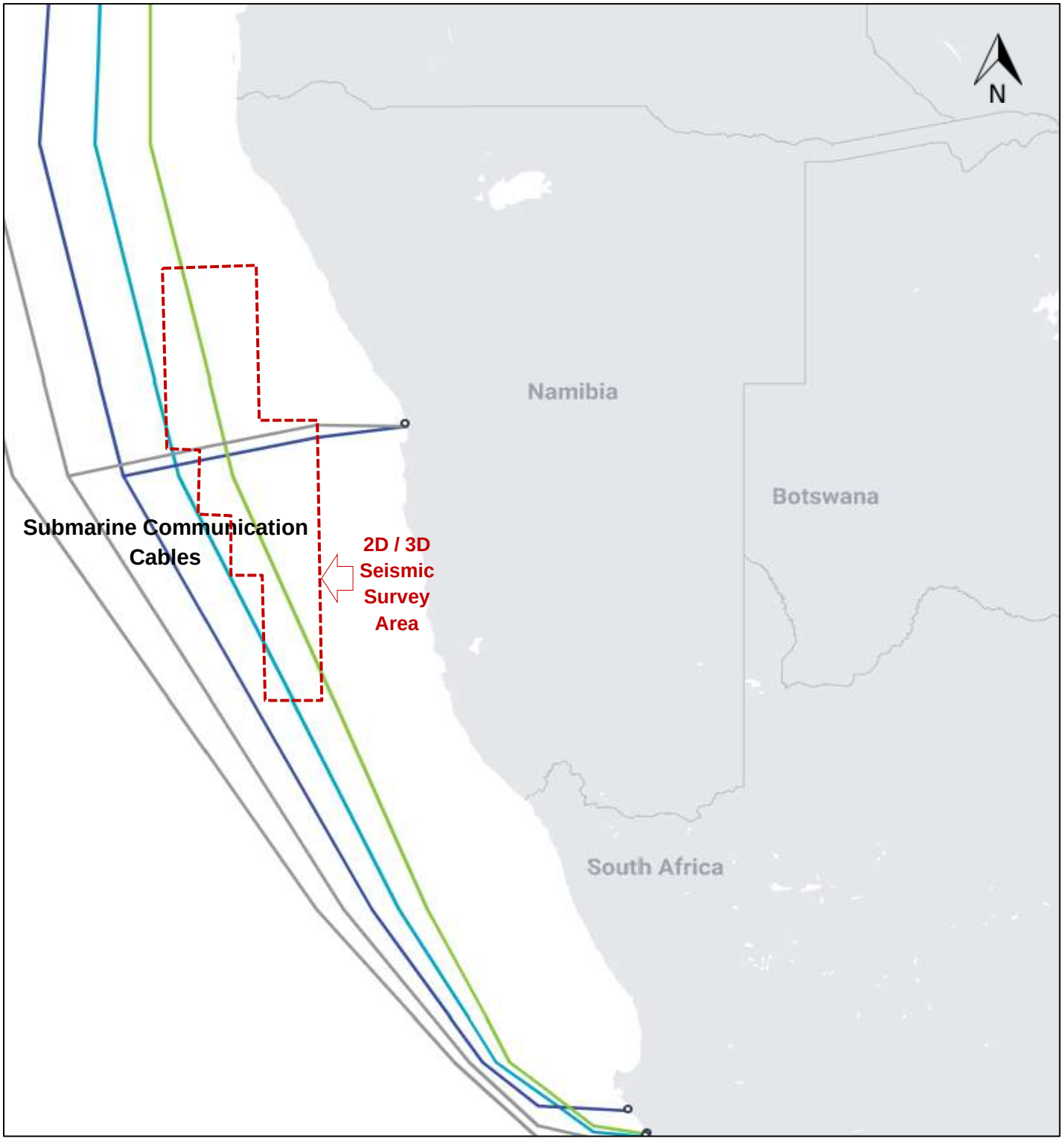


Figure 4.27: Map of Submarine Communication Cables with respect to proposed 2D / 3D seismic survey area (Source: www.submarinecablemap.com).

4.6.3 Historical Artefacts

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 4.5 and 4.6).

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 4.5 and 4.6 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 4.5: 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 4.6 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 Walvis Ridge is a deep-water seafloor area classified as an Ecologically or Biologically Significant Marine Area (EBSA) covering the northern portions of the proposed 2D/3D seismic survey area of interest (Fig. 4.28). The Walvis Ridge EBSA is primarily recognised as a geological feature but the biota in the area could be vulnerable to fishing and future oil and gas exploration activities (GEOMAR, 2014). According to GEOMAR (2014), the Walvis Ridge includes a number of deep-sea features, seamounts and guyots, such as steep canyons, embayments formed by massive submarine slides, trough-like structures, a graben, abyssal plains, and a fossilized cold-water coral reef mound community. Based on these physical features, the ridge can be divided into three sections (Fig. 4.28 and GEOMAR 2014). The portion of the ridge within the proposed EBSA forms part of the northern section, which extends

SW from the Namibian shelf, with a steep NW scarp, ridge-type seamounts, and guyots with rift arms (Fig. 4.28 and GEOMAR 2014).

Oil and gas seismic survey and well drilling operations have been undertaken in this area with the Welwitschia-1 well drilled in 2014 (EIA Supported by Risk-Based Solutions) at 20°11'9.79"S, 11°19'3.27"E being the latest operations to have been undertaken in the area. Although previous drilling operations were unsuccessful, future drilling activities based on the outcomes of the proposed survey in the area are likely. According to Holness *et a*l., (2014), the Walvis Ridge EBSA is largely in good condition, though some impacted areas exist on the far eastern edge.

This unique feature forms a submarine ridge running north-east to south-west from the Namibian continental margin to Tristan da Cunha and Gough islands at the southern Mid-Atlantic Ridge (Holness et al., 2014). The Walvis Ridge Namibia EBSA encompasses the globally rare connection of a hotspot track to continental flood basalt in the Namibian EEZ (https://cmr.mandela.ac.za/Research-Projects/EBSA-Portal/Namibia/Walvis-Ridge-Namibia).

According to the ongoing researches (https://cmr.mandela.ac.za/Research-Projects/EBSA-Portal/Namibia/Walvis-Ridge-Namibia), high habitat heterogeneity associated with the complex benthic topography, it is likely that the area supports a relatively higher biological diversity, and is likely to be of special importance to vulnerable sessile macrofauna and demersal fish associated with seamounts. Productivity in the Namibian portion of Walvis Ridge is also particularly high because of upwelling resulting from the interaction between the geomorphology of the feature and the nutrient-rich, north-flowing Benguela Current (Fig. 4.28).

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. 4.28 and 4.29). The coastal belt is a very pristine and sensitive area and should be protected under one or another measure or control (Plates 4.1 and 4.2).

A number of ephemeral rivers mouths between Swakopmund and Kunene River Mouth play a significant role and are key habitat areas of the coastal zone (Plates 4.1 and 4.2). 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 (Plate 4.1). 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).

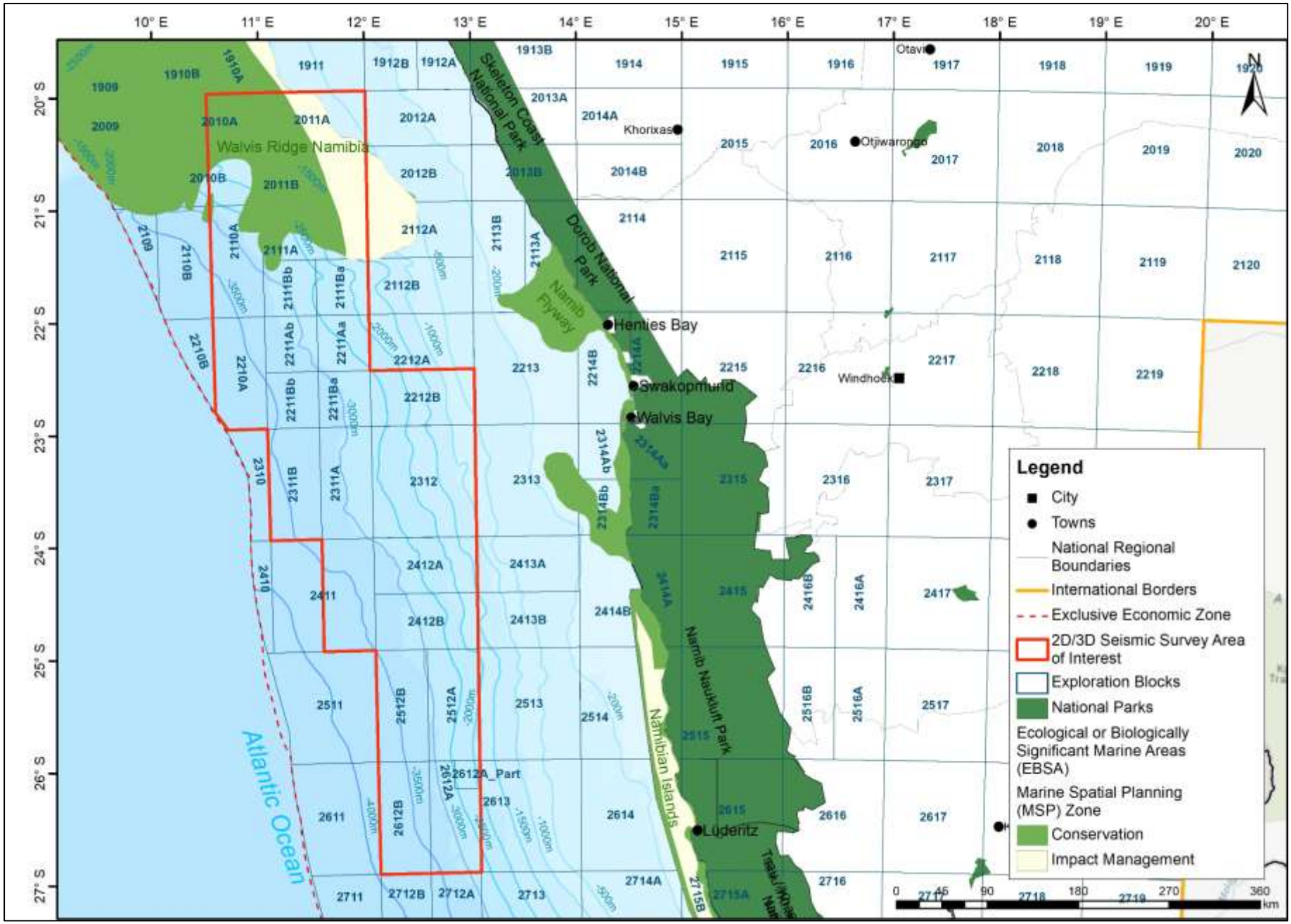


Figure 4.28: Ecologically or Biologically Significant Marine Area (EBSA) with respect to the proposed 2D / 3D seismic survey area of interest (Data Source: MFMR, https://geodata.benguelacc.org).

Figure 4.29: 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).

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 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 TGS Geophysical Company (UK) Limited corporate requirements. The RBS Consultant Ms. Emerita Ashipala, Mr. Samson Mulonga, Ms. Ilta Asser, Christine Links and Ms. Meriam Kauyama were responsible for the implementation of the consultation process including organising and conducting 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. TGS Geophysical Company (UK) Limited 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

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, was key step of the EIA Process for the proposed activities.

In line with the provisions of the EIA Regulations, 2012, the public consultation process was undertaken during the month October 2022. A Stakeholder Registered was opened on 7th October 2022 as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and EIA Regulations, 2012 (Annex 4).

During the month October 2022, 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. 4.30 - 4.34):

(i) Confidente Weekly English Newspaper dated 7th October – 13th October 2022.

(ii) Market Watch Insert in Allgemeine Zeitung (Namibian German) Daily Newspaper dated Thursday 13th October 2022.

(iii) Market Watch Insert in Namibian Sun (Namibian English) Daily Newspaper dated Thursday 13th October 2022.

(iv) Market Watch Insert in Republikein (Afrikaans Newspaper) Daily Newspaper dated Thursday 13th October 2022, and.

(v) New Era Daily English Newspaper dated Monday, 17th October 2022.

The deadline for registration and submission of inputs, comments or objection was Friday, 28th October 2022 (Figs. 4.30 - 4.34). Public notices were also placed at the following key multiple strategic locations in the towns of Henties Bay, Swakopmund, Walvis Bay and Lüderitz (Plates 4.3-4.6).

(i) Henties Bay Public Notices placed at the Henties Bay Municipality Public Notice Board and the University of Namibia, Dr Sam Nujoma Campus Public Notice Board (Plates 4.3).

(ii) Swakopmund Public Notices placed at the Erongo Regional Council Offices entrance doors (and Swakopmund Municipality public notice board (Plates 4.4).

(iii) Walvis Bay Public Notices placed at NamPort Offices Notice Board and Walvis Bay Municipality Main Building Entrance (Plates 4.5), and.

(iv) Lüderitz Public Notices placed at the popular OK Food Shop Outlet Public Notice Board and at the Lüderitz Town Council Public Notice Board (Plates 4.6).

A public and stakeholder meeting PowerPoint and Posters presentations was organised and conducted in Swakopmund on Thursday 20th October 2022, at Namib Primary School Hall, from 14hrs00-17hrs00 (Plate 4.7 and Annex 4). Minutes of the meeting are provided in Annex 4.

Key identified institutional, organisations and individual stakeholders were contacted by emails and provided with Background Information Document (BID) and the Final Environmental Scoping Report (Annex 4). Table 4.7 provides detailed information on the timing and type of activities that have been undertaken as part of the environmental assessment process during the months September and October 2022.

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

No written objections to the proposed 2D / 3D seismic survey operations in Lüderitz and Walvis Basins, offshore Namibia have been received during the consultation process undertaken during the month October 2022 and details of all the public and stakeholder consultations and communications send out and received, are provided in Annex 4. It is important that all the registered stakeholders and especially all the other marine users including all the key fishing companies and associations, petroleum operators / PEL holders, Debmarine and Namdeb Diamond Exploration and Mining company, 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 implementation each of the proposed 2D / 3D seismic survey survey event operations by TGS.

Table 4.7: Detailed activities and timing of Interested and Affected Parties (I&APs) consultation process.

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

ACTIVITIES	2022			
	Sep	Oct	Nov	Dec
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 contact and engage 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. Published Public Advert / Notice to in the Local Newspapers: **Note**: ❖ Publish the notice once a week for two consecutive weeks in at least two (2) newspapers circulated widely in Namibia ❖ Twenty (21) days for input period from the date of 1st publication				
8. Prepared Final Scoping / BID, Draft EIA and EMP Report				
9. Conducted stakeholder meeting in Swakopmund DATE: Thursday 20th October 2022, PLACE: Namib Primary School Hall, TIME: From 14hrs00-17hrs00				
10. Updated the Draft EIA and EMP Reports as may be applicable based on the inputs and comments obtained during the public and stakeholder consultation process				
11. Submitted 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 to be undertaken
3. Final EIA and EMP Reports

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) will undertake the activities on behalf of TGS
- ❖ TGS will provide all the applicable proposed project survey coordinates, boundary, maps, survey vessels/s to be used, and the proposed 2D/3D seismic survey technical specifications

It's been rough but I'm not giving up - Ewin

• BY MARTHA NANGOMBE

LOCAL model, Ewin Bailey say even though his journey has been a rough one, he is not willing to give up his dream of becoming a global model icon.

A Mechanical Engineering student at Kayec Namibia, Bailey modelling expedition will see him take to the runway in Johannesburg, South Africa from December 1 to 3 2022

"My dream is being hampered by lack of financial resources. I need money for my traveling but that is not stopping me from realising my dream. I need a sponsor to assist me financially, to only cover my transport, but also other expenses that goes along with it," he said.

Bailey is expected to have a photo-shoot on October 28-29 as he prepares for another runway romp at the next Figure Showcase on November 12 in Johannesburg.

"Soon after that I will travel for another competition in Johannesburg South Africa and from there, I will have another event in Durban, South Africa for the Cruise between March 23 and 24 2023," he said.

The 20- year old began modelling early this year and says he has always had a passion for modelling.

"Apart from doing Mechanical Engineering, I am also a student at Figures Model Finesse International. This is my first year at the agency and it is a whole different world. I was chosen to participate in various competitions within the agency," he said.

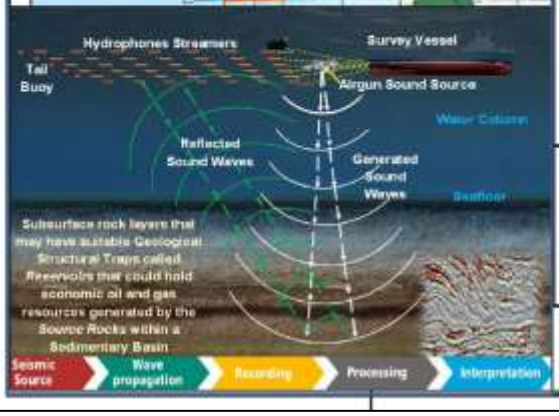
Figures is one of the largest franchised modelling academies in South Africa and has over 20 franchises worldwide , including one in Namibia. The studios are fully equipped to train the students in 17 different courses. The franchises cater for various competitions which also includes meeting and performing in front of international agents and casting directors.

Ewin Bailey

PUBLIC NOTICE FOR APPLICATION FOR ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

TGS

TGS Geophysical Company (UK) Limited (the Proponent) Proposed Multiclient 3D / 2D Seismic Survey Aera of Interest (AOI) Over Blocks, 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A Walvis and Lüderitz Basins Offshore Namibia



TGS Geophysical Company (UK) Limited (PROPONENT) is proposing to conduct Multiclient (MC) 3D / 2D Seismic Surveys over the Area of Interest (AOI) covering Blocks 2010A, 2011A, 2010B, 2011B, 2111A,2110A, 2111Bb, 2111Ba, 2210A, 2211Ab, 2211Aa, 2211Bb, 2211Ba, 2212B, 2311B, 2311A, 2312, 2411, 2412A, 2412B, 2512B, 2512A, 2612B, 2612A_Part, 2612A, 2612B, and 2612A falling within the Walvis and Lüderitz Basins, Offshore Namibia with average water depth of ca-2000 m. The overall aim of the proposed MC 3D/2D seismic surveys is to map the subsurface of the key selected 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 and petroleum systems of the deep-water offshore Namibia. The datasets from the proposed MC 3D/2D 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 to be generated is not only used for petroleum exploration but also highly useful for other marine / seafloor related studies and researches such as Deep-Sea Minerals (DSM) exploration and production and the search for natural suitable Carbon Capture and Storage (CCS) terrains as one of the possible options for Climate Change long-term global mitigation strategies.

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. In offshore environment, the vessel towed airguns (energy source) release compressed air to generate seismic acoustic signals / waves at regular intervals. The controlled generated acoustic waves that travel deep into the earth is reflected by various rock formations of the subsurface below the seafloor, and returns to the surface where it is recorded and measured by receiving devices called hydrophones. By analysing the travel times of seismic waves through the various subsurface rock layers 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 potential commercial hydrocarbons resources. 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 Area of Interest. 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 Area of Interest within a Sedimentary Basin. 3D and 2D Seismic Surveys are acquired on local to subregional dense and regional widely spaced survey grids / spacings, respectively.

The proposed multiclient 3D/ 2D seismic surveys will be conducted using a MARPOL / Namibian Maritimes Laws compliant vessels and will adopt 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 proposed 3D/2D seismic survey activities cannot be undertaken without an Environmental Clearance Certificate (ECC) as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. In fulfilment of the environmental requirements, the Proponent has appointed Risk-Based Solutions (RBS) CC as the Environmental Consultant, led by Dr Siedila Mwaya and supported by Ms Emerita Ashipala and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare EIA and Environmental Management Plan (EMP) Reports to support the application for ECC. All Interested and Affected Parties (I&APs) are hereby invited to register and submit written comments / objections / inputs with respect to the proposed multiclient 3D/2D seismic surveys covering the deep-water Walvis and Lüderitz 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), interested and / or affected party is required to disclose any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the application.

REGISTER BY EMAIL WITH: Ms Emerita Ashipala (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email:** emerita.ashipala@gmail.com or Mr Samison Mulonga (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email:** mulongas@gmail.com. For more technical clarifications on marine seismic survey and oil and gas exploration please contact Dr Siedila Mwaya EAP/Technical Permitting Advisor / International Resources Consultant, **Email:** frontdesk@rbs.com.na

REGISTRATION & WRITTEN SUBMISSIONS DEADLINE IS: FRIDAY, 28th OCTOBER 2022

Public meetings will be organised in Lüderitz and Walvis Bay / Swakopmund during the month of October 2022 depending on the public interest / number of registered stakeholders

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. 7362, Siwela House-Home of RBS, Tel: +264-61-306058 / 224780 / 236588

Figure 4.30: Copy of the Public Notice Advert No. 1 published in the Confidente Weekly English Newspaper dated 7th October – 13th October 2022.

NUUSREDAKTEUR
Paterson Graad: D1

NMH, 'n gelyke geleenthede werkgewer, het die volgende vakature vir 'n dinamiese en energieke persoon met Namibiese burgerskap.

Sleutelprestasieareas
- Bereik teikens wat vir daaglikse aanlyn nuusdekking gestel is
- Bereik teikens wat vir daaglikse video inhoud gestel is
- Bereik teikens wat vir infografika gestel is
- Voldoen aan teikens wat vir algehele produksie gestel is
- Bestuur bydraes vir aanlynprogramme
- Hou toesig oor die bestuur van en monitor aanlyn kommentaar
- Bestuur inhoud van die gedrukte uitgawe
- Stap 'n omvattende nuusdagboek en ken stories aan verslaggewers toe deur met ander koerante en aanlynpublikasies te koördineer
- Bly op hoogte van nasionale en belangrike internasionale nuus
- Koördineer nuusinsameling
- Identifiseer en ontwikkel nuusberigte en -temas
- Gee opdragte aan verslaggewers en ontleed waar nodig

Kandidate op die kortlys moet 'n aanbieding van 20 minute voorberei oor hoe hulle van plan is om die sleutelprestasieareas hierbo gelys te bereik wat hulle tydens die onderhoud moet aanbied.

Belangstellende kandidate wat vir hierdie pos kwalifiseer, kan hul CV met gewaarmerkte afskrifte van kwalifikasies en relevante dokumentasie stuur aan:

Die Menslike Hulpbronne Departement
E-pos: vacancies@nmh.com.na. Skryf asseblief **"NUUSREDAKTEUR - Paterson Graad: D1"** in die onderwerpreël. Vir verdere besonderhede oor posvereistes en bekwaamhede besoek http://nmh.com.na/vacancies

Slegs kandidate op die kortlys sal gekontak word.
Geen dokumente sal teruggestuur word nie.

Covid-19-inenting word vereis. Die mees geskikte kandidaat sal aangestel word.

SLUITINGSDATUM: 20 OKTOBER 2022
ONDERHOUDE: 25 OKTOBER 2022

NMH NAMIBIA MEDIA HOLDINGS

VACANCIES

AECI MINING

SENIOR ACCOUNTANT - NAMIBIA
PERMANENT POSITION BASED IN SWAKOPMUND

CORE RESPONSIBILITIES
- Perform tax validation on invoices
- Submit bank instruction form to banks / FSSC for processing
- Engage with FSSC regarding the following transactions: one time vendor payments, early payments, blocked invoices, blocked payments and reversal AP payments
- Obtain and ensure completion of customer credit application documents and submit for approval
- Inform Business Manager / customer of the credit application result
- Manage the submission of bank statements to FSSC where required
- Liaise with banks on any queries
- Manage petty cash process
- Prepare manual journal vouchers
- Assist with income statement and balance sheet preparation
- Review recons and engage with FSSC to communicate any queries
- Analyse fixed costs against budget per cost centre
- Ensure that invoices are submitted to customers in time
- Ensure the invoice contains the customer's order and reference attached
- Liaise with customers and document controllers to resolve any queries
- Prepare, coordinate external / internal audit requirements and assist with addressing audit queries
- Prepare monthly reports as required
- Perform tax calculations and submit for approval
- Submission of all tax returns and documentation
- Ensure compliance to all legislation in relation to accounting matters

QUALIFICATIONS, EXPERIENCE AND SKILLS REQUIREMENTS
The incumbent should have the following:
- BCom Financial Accounting or equivalent qualification, or
- CA / CIMA/ ACCA or equivalent qualification
- 3-5 years relevant financial experience
- SAP knowledge
- Intermediate MS Office skills
- English and Afrikaans Proficiency

AECI Namibia offers a competitive remuneration package with benefits associated with an established commercial explosives supplier.
Only candidates who meet the above requirements need apply enclosing a current curriculum vitae and certified copies of certificates to:
Kago.Mmolawa@aeciworld.com &
Christel.Steenkamp@aeciworld.com
Closing Date: 20 October 2022
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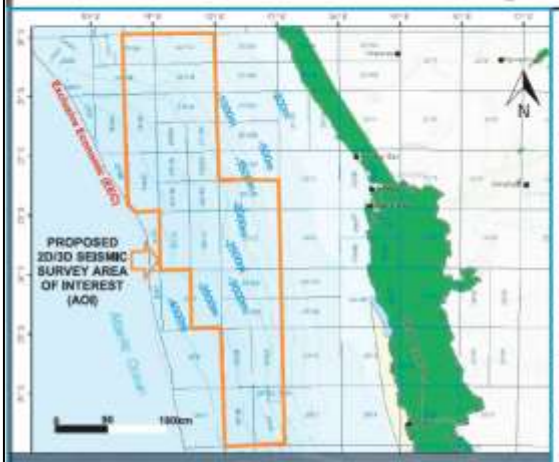

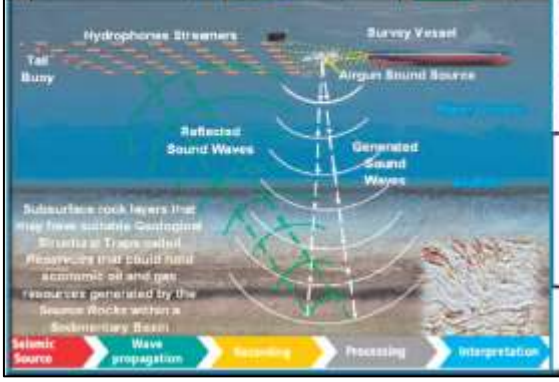

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REGISTRATION & WRITTEN SUBMISSIONS DEADLINE IS: FRIDAY, 28th OCTOBER 2022
A PUBLIC MEETING HAS BEEN ORGANISED IN SWAKOPMUND AS FOLLOWS:
DATE: Thursday 20th October 2022, PLACE: Namib Primary School Hall, TIME: From 14hrs00-17hrs00

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, Sivilela House-Home of RBS, Tel: +264-61-306058 / 224780 / 236598

Figure 4.31: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Allgemeine Zeitung (Namibian German) Daily Newspaper dated Thursday 13th October 2022.

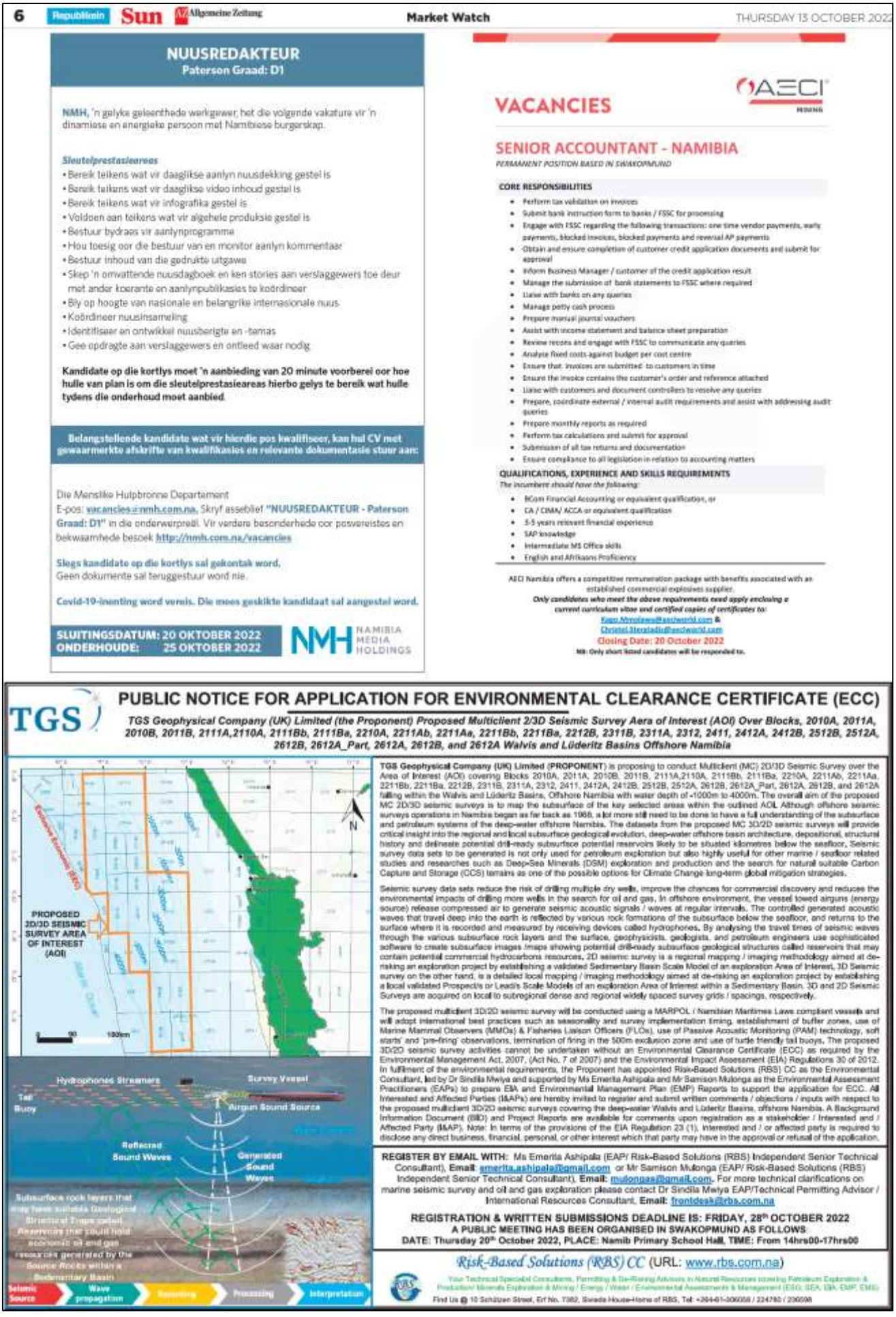
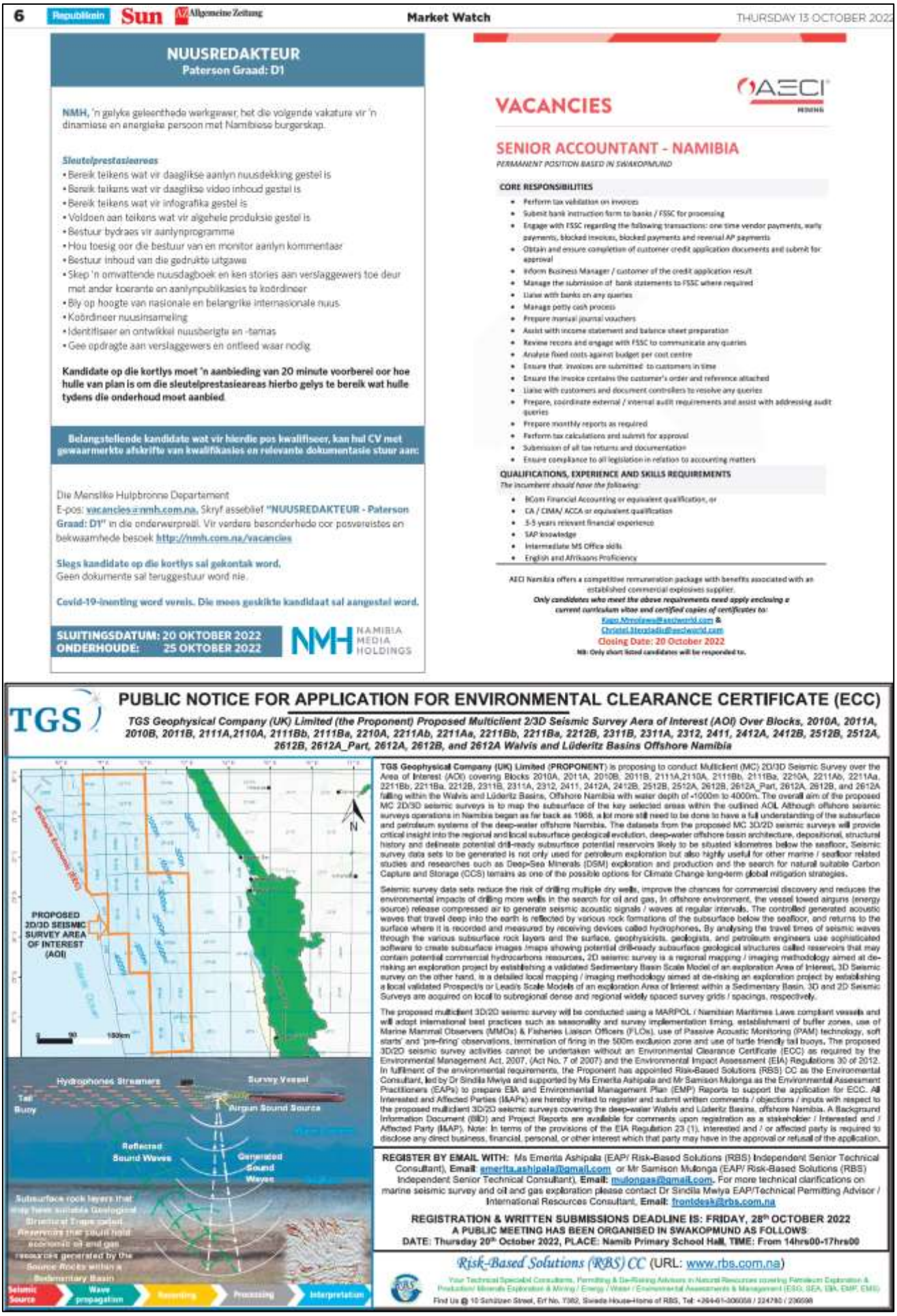


Figure 4.32: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Namibian Sun (Namibian English) Daily Newspaper dated Thursday 13th October 2022.



6 Republikein Sun Allgemeine Zeitung Market Watch THURSDAY 13 OCTOBER 2022

NUUSREDAKTEUR
Paterson Graad: D1

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E-pos: vacancies@nmh.com.na. Skryf asseblief **"NUUSREDAKTEUR - Paterson Graad: D1"** in die onderwerpreël. Vir verdere besonderhede oor posvereistes en bekwaamhede besoek **http://nmh.com.na/vacancies**

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Kapo.Mwalawa@aeciworld.com &
Christel.Stegstadt@aeciworld.com

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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 for oil and gas. In offshore environment, the vessel towed airguns (energy source) release compressed air to generate seismic acoustic signals / waves at regular intervals. The controlled generated acoustic waves that travel deep into the earth is reflected by various rock formations of the subsurface below the seafloor, and returns to the surface where it is recorded and measured by receiving devices called hydrophones. By analysing the travel times of seismic waves through the various subsurface rock layers 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 potential commercial hydrocarbons resources. 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 Area of Interest. 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 Area of Interest within a Sedimentary Basin. 3D and 2D Seismic Surveys are acquired on local to subregional dense and regional widely spaced survey grids / spacings, respectively.

The proposed multiclient 3D/2D seismic survey will be conducted using a MARPOL / Namibian Maritimes Laws compliant vessels and will adopt 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 proposed 3D/2D seismic survey activities cannot be undertaken without an Environmental Clearance Certificate (ECC) as required by the Environmental Management Act, 2007, (Act No. 7 of 2007) and the Environmental Impact Assessment (EIA) Regulations 30 of 2012. In fulfilment of the 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 and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare EIA and Environmental Management Plan (EMP) Reports to support the application for ECC. All Interested and Affected Parties (I&APs) are hereby invited to register and submit written comments / objections / inputs with respect to the proposed multiclient 3D/2D seismic surveys covering the deep-water Walvis and Lüderitz 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), interested and / or affected party is required to disclose any direct business, financial, personal, or other interest which that party may have in the approval or refusal of the application.

REGISTER BY EMAIL WITH: Ms Emerita Ashipala (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email:** emerita.ashipala@gmail.com or Mr Samison Mulonga (EAP/ Risk-Based Solutions (RBS) Independent Senior Technical Consultant), **Email:** mulongas@gmail.com. For more technical clarifications on marine seismic survey and oil and gas exploration please contact Dr Sindila Mwiya EAP/Technical Permitting Advisor / International Resources Consultant, **Email:** frontdesk@rbs.com.na

REGISTRATION & WRITTEN SUBMISSIONS DEADLINE IS: FRIDAY, 28th OCTOBER 2022
A PUBLIC MEETING HAS BEEN ORGANISED IN SWAKOPMUND AS FOLLOWS
DATE: Thursday 20th October 2022, PLACE: Namib Primary School Hall, TIME: From 14hrs00-17hrs00

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, Swieda House+Home of RBS, Tel: +264-61-306058 / 224780 / 230598

Figure 4.33: Copy of the Public Notice Advert No. 2 published in the Market Watch Insert in Republikein (Afrikaans Newspaper) Daily Newspaper dated Thursday 13th October 2022.

Creative space for innovators and entrepreneurs

■ Paheja Siririka

The Namibia University of Science and Technology (NUST)'s vice-chancellor Erold Naomab has implored the academic community to support the MTC Innovation Centre and Mobile Home, which are set to encourage rapid innovation and promote entrepreneurship.

He said this at the High-Tech Transfer Plaza Select (HTTPS) centre, where the grand opening of the MTC Innovation Centre and Mobile Home took place last week. The mobile home will be offering various MTC services, including the registration of sim cards, while the centre is a national hub for innovation designed to aid the public, academic community and industry at large to bring innovative ideas to life.

The ethos of the HTTPS concept is to improve competitiveness through trans-disciplinary research, and the transfer of specialised knowledge and technology.

Naomab stated: "We have made notable strides towards fulfilling the mandate of this ecosystem, which is to facilitate a functional, technologically-inspired space for the university, industries, development partners and entrepreneurs".

The partnerships are targeted at key areas such as professional development for staff, curriculum development, hosting of students for work-integrated learning, and sharing of research facilities.

National hub... Namibia University of Science and Technology (NUST) vice-chancellor Erold Naomab (left) and MTC managing director Licky Erastus (second from left) were some of the officials at last week's launch of the MTC Innovation Centre and Mobile Home at the university's High-Tech Transfer Plaza Select (HTTPS) centre. Photo: Emmency Nuukala

MTC managing director Licky Erastus said while the nation ought to celebrate the milestone between the two institutions, industry needs to accelerate and set itself fit for the fourth industrial revolution.

"This is an innovation hub, where industry experts and academics will be appreciating and leveraging synergies to transform innovative ideas and concepts to life," he noted.

Erastus added that in the fast digital space, inclusive of both public and private sectors, innovation must be the order of business existence, intimating that a nonchalant approach to it must be discarded as it is injurious to the socio-welfare and national economic development.

Meanwhile, information minister Peya Mushelenga stated that in the long run, the perpetual search for new and better ways of doing things drives human learning and, ultimately, prosperity for all should be the aiming point.

"All things considered for technological innovations to excel – young people should be at the helm, supported by an array of interventions to grow the economy as well as to grow minds and cultivate ideas. This is especially as we recover from a catastrophic global pandemic, where we need to give expression to how the role of technology is advancing the growth of our young people, and how we as a government can contribute to this," he urged. – *psiririka@nepc.com.na*

Namib Mills to increase product prices

Namib Mills has announced an increase in prices on their various products with effect from 14 November 2022.

Namib Mills said in a media statement on Wednesday that the price increases are necessitated by the decline in the value of the Namibia Dollar compared to the US Dollar, shedding 17% of its value over the last couple of months.

The product range to increase includes maize meal at 13% ; instant maize porridge by 9%; and Pasta Polana and Pasta King at 3%. Wheat flour and complete mix will rise by 5%; bread at 4%; and sugar at 6.5%.

The company noted that there is a strong correlation between the maize price and the exchange rate because of maize being exported from South Africa.

Price increase... Namib Mills last week announced a price increase that will include maize meal at 13% ; instant maize porridge by 9%; and Pasta Polana and Pasta King at 3%. Wheat flour and complete mix will rise by 5%; bread at 4%; and sugar by 6.5%. Photo: Contributed

It also said the Russian conflict with Ukraine continues to disrupt both energy, food and financial markets, noting that Ukraine grows enough food to feed an estimated 400 million people worldwide. This includes 50% of the world's sunflower oil supply, 10% of the worldwide grain supply, and 13% of global maize supply.

"Due to the war, crop areas in Ukraine will either not be planted or not be harvested this year, and the supply chains from Ukraine have been disrupted because of the closure of the Black Sea ports and limited ability to transport commodities through the Western border.

These factors all continue to increase the risk of grain availability and hence pricing remains high," the statement added.

- *Nampa/AFP*

Figure 4.34: Copy of the Public Notice Advert No. 3 published in the New Era Daily English Newspaper dated Monday, 17th October 2022.

Plate 4.3: Henties Bay Public Notices placed at the Henties Bay Municipality Public Notice Board (top image), and University of Namibia, Dr Sam Nujoma Campus Public Notice Board (bottom right image).

Plate 4.4: Swakopmund Public Notices placed at the Erongo Regional Council Offices entrance doors (top images), and Swakopmund Municipality public notice board (bottom left image).

Plate 4.5: Walvis Bay Public Notices placed at NamPort Offices Notice Board (top image), and Walvis Bay Municipality Main Building Entrance (bottom image).

Plate 4.6: Lüderitz Public Notices placed at the popular OK Food Shop Outlet Public Notice Board (top image) and at the Lüderitz Town Council Public Notice Board (bottom image).

Plate 4.7: Public and stakeholder meeting PowerPoint (top image) and Posters (bottom image) presentations conducted in Swakopmund on Thursday 20th October 2022, at Namib Primary School Hall, from 14hrs00-17hrs00 .

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 stakeholders 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 (Lüderitz and Walvis 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 Significant

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 Lüderitz and Walvis 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 Lüderitz and Walvis 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 Lüderitz and Walvis 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 Lüderitz and Walvis 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 Lüderitz and Walvis 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 TGS.
- 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 Lüderitz and Walvis 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 (Annex 3). 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 (Annex 3). Baseline data on the living marine resources has been provided through a specialist study that has been conducted by Dr Amanda Rau (Annex 2).

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 and Fig. 2.2 in Annex 3. (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).

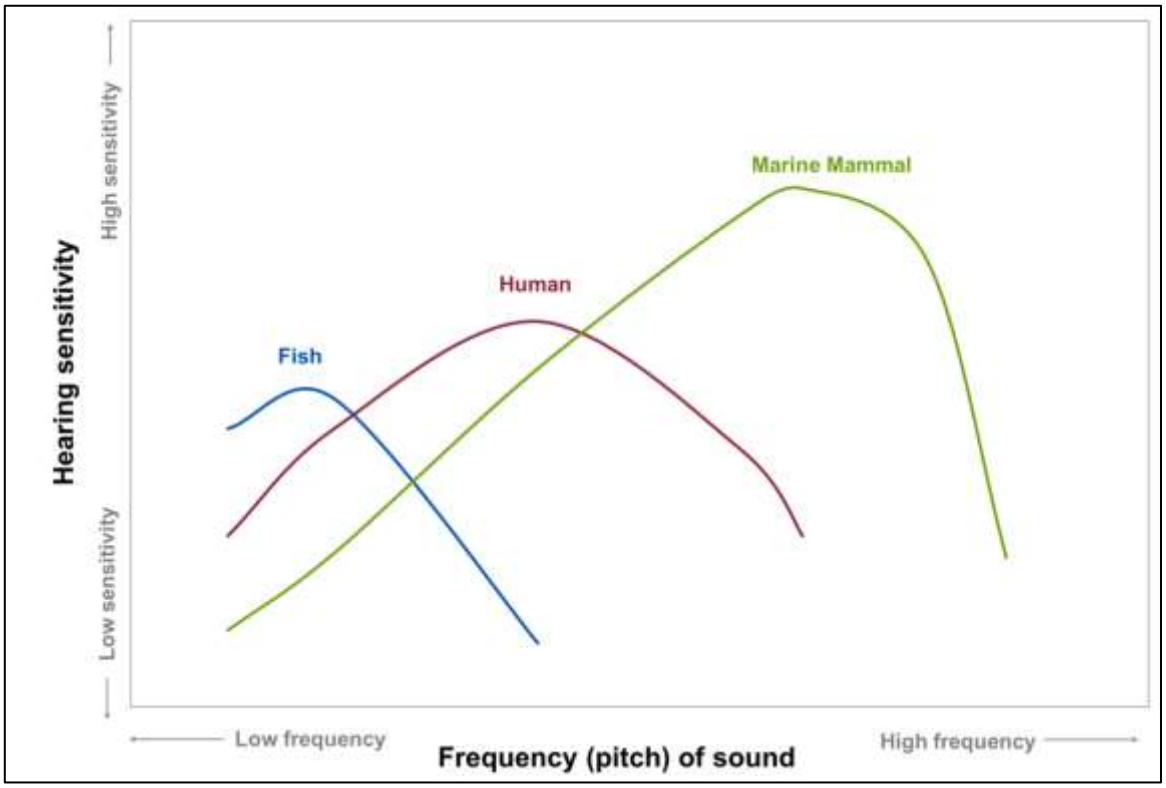

Figure 5.1: Comparison between hearing thresholds of different animals (Seiche Ltd, 2022 / Annex 3).

Based on the results of acoustic modelling specialist assessment as detailed in Annex 3, and without any mitigation measures in place, seismic survey activities have been identified as having the potential to cause injury to low frequency cetaceans at a range of up to 291 m from the source array and 798 m for very-high frequency cetaceans. However, the injury radius is only 25 m for high-frequency cetaceans. Given the potential for injury (and disturbance) from the survey, it is recommended that further mitigation measures should be adopted (Annex 3). These injury zones can effectively be monitored using Marine Mammals Observers (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. It is therefore concluded that it is unlikely that marine mammals will be injured as a result of the survey. Recoverable injury could occur in some fish at a range of up to 363 m from the source array (for fish with swim bladders and eggs and larvae). For fish without swim bladders, the potential range of effect reduces to a maximum of 194 m from the source array. Some sea turtles could be injured at ranges of up to 363 m from the source array.

5.4.2.2 Discussion on the Impact Assessment of Seismic Survey Airgun

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 (Annex 3). 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. 5.3 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 SURVEY					
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

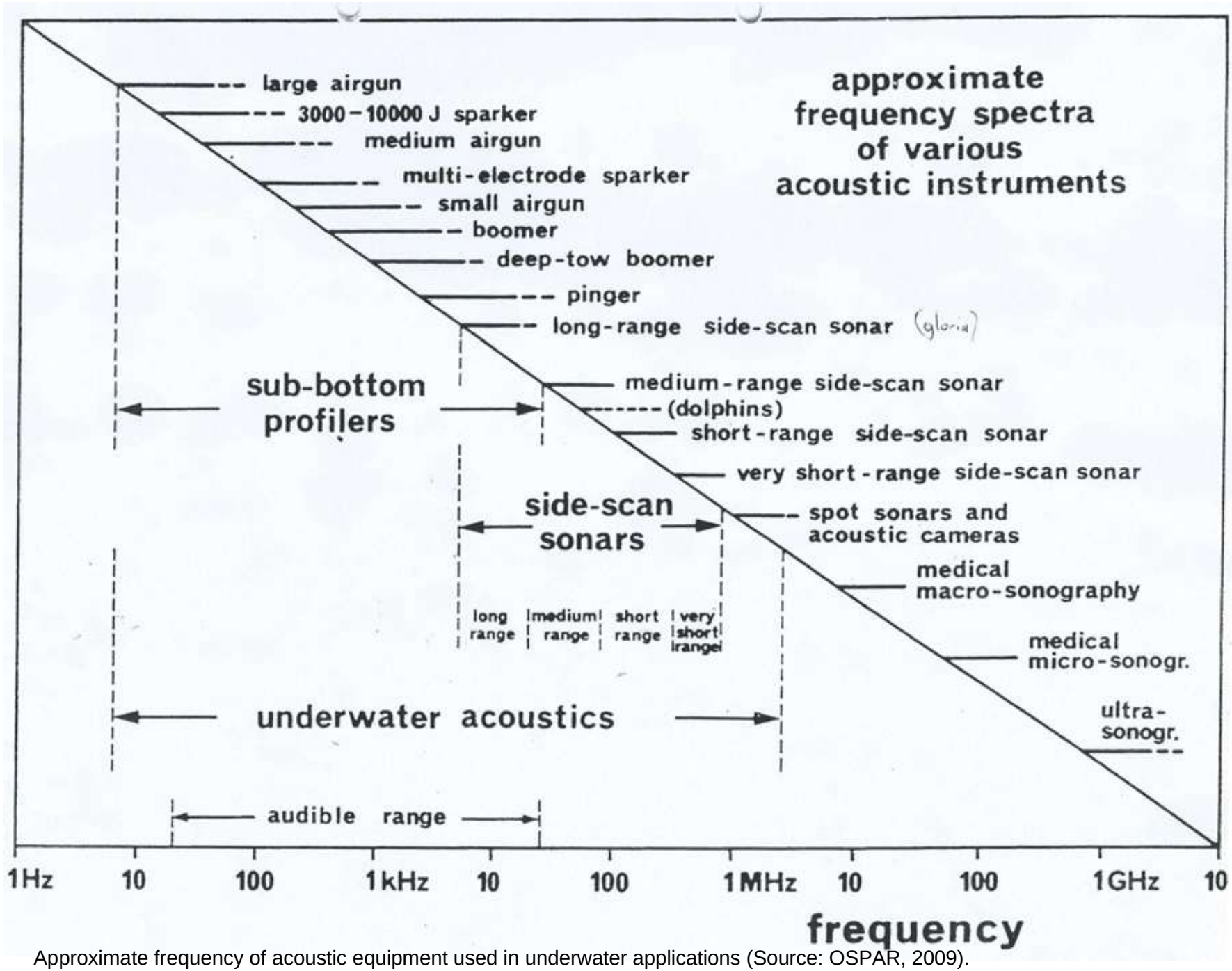

Figure 5.2: Approximate frequency of acoustic equipment used in underwater applications (Source: OSPAR, 2009).

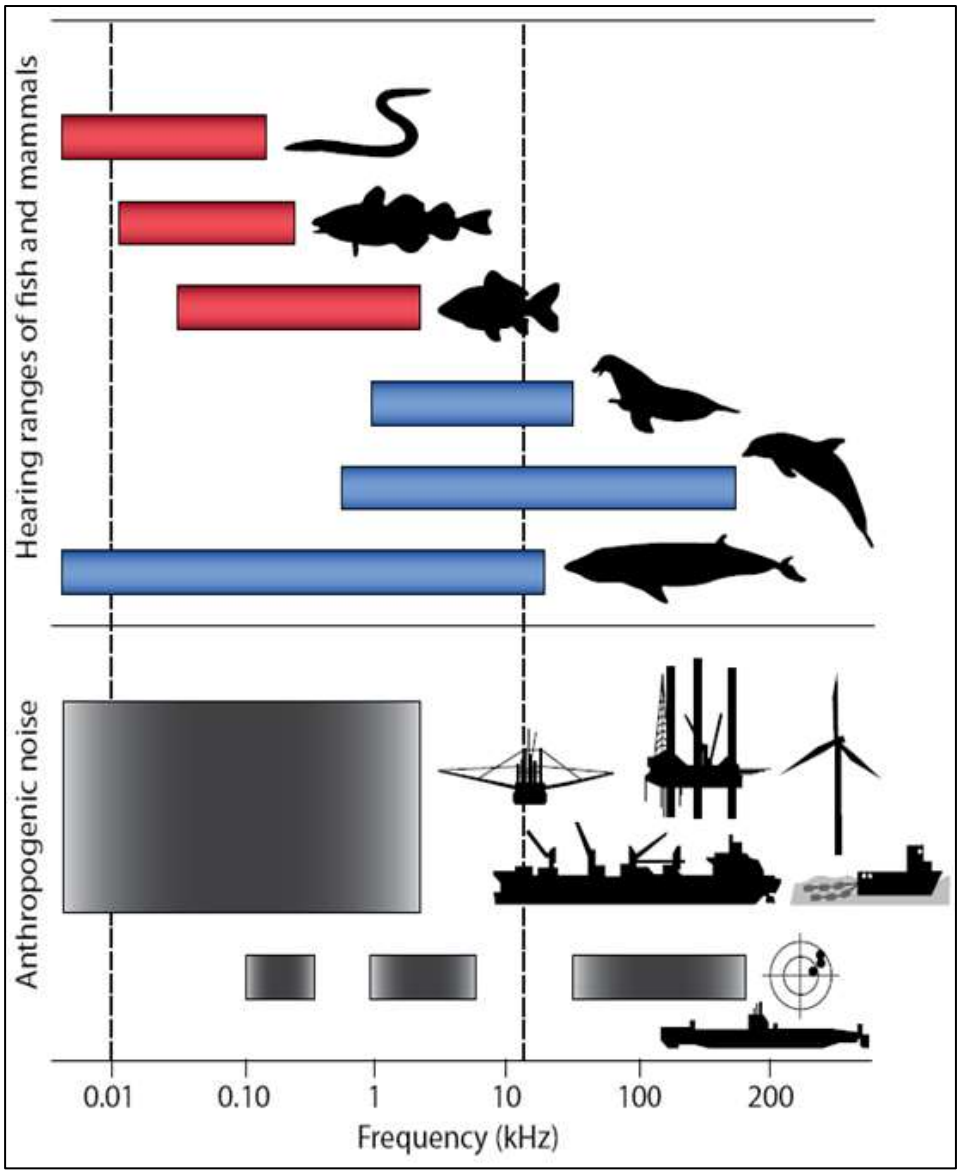

Figure 5.3: The hearing ranges of different kinds fish and mammals together with the overlap in frequency with different sources of human-generated noise (Sources: Slabbekoom *et al.,* 2010).

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 (Annex 3). 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 (Annex 3). 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).

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

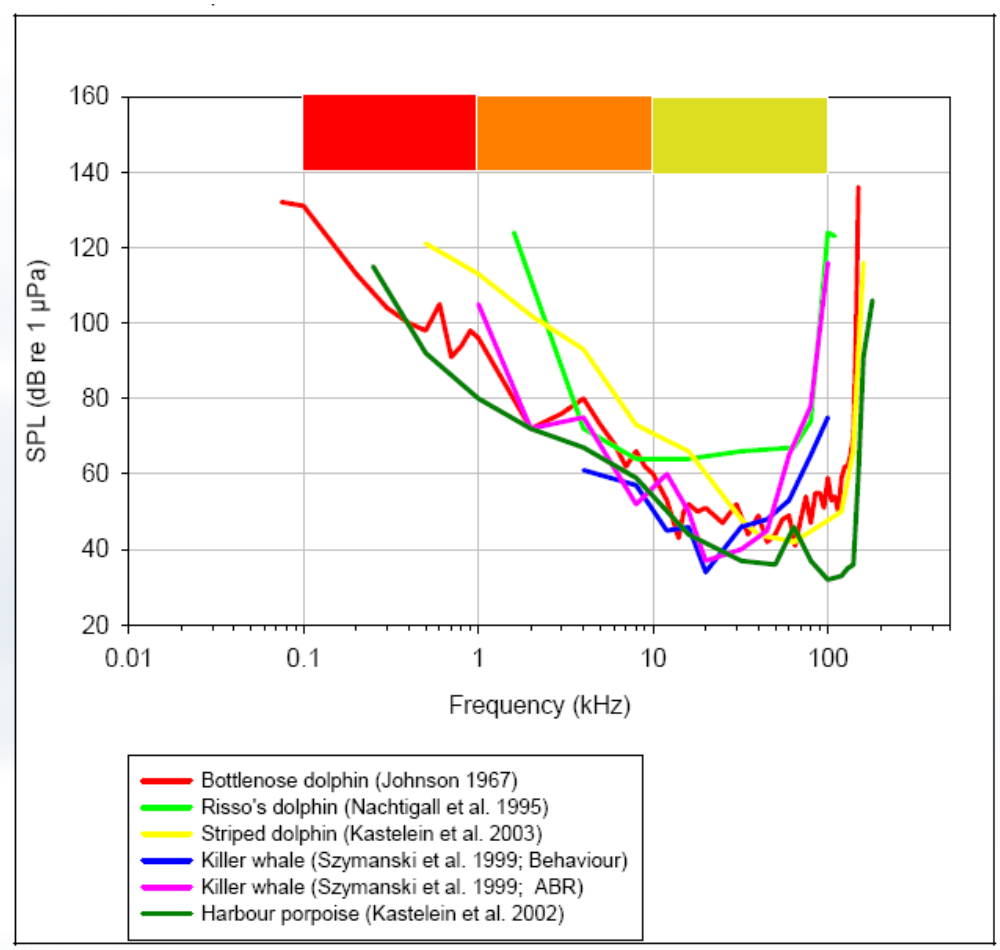

Figure 5.4: Representative audiograms of some common odontocetes. ABR = auditory brainstem response. The colours at the top represent the bandwidth and relative energy content of dredging noise: red = high orange = low gold = very low (After Thomsen at al., 2009).

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).

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)

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.

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		

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 5.11: 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 Summary of Negative Impacts

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 airgun 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 (firing of the airgun array) 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). Airgun arrays 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-airgun array, 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. airguns) are by-and-large not lethal to fish. Significant physiological impacts are only seen in fish swimming within a few meters of the firing airgun (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 airgun 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 airguns 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 firing 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 airgun 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 airgun, 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 airgun array and only for the duration of the actual firing 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 Lüderitz and Walvis 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 airguns (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 airgun 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 airgun 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 Lüderitz and Walvis 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 Lüderitz and Walvis 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 Lüderitz and Walvis 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. 4.16, 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.

Potential cumulative impacts from other similar ongoing or proposed activities have been assessed under Section 5.4.2.12 Other Socioeconomic Activities. 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 Lüderitz and Walvis 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 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 airguns 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.

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																		
		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																		
ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES		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 airguns 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: 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)

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																	
		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	0
			OFFSHORE																	
	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	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 airguns 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: 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 airguns 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: 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 airguns 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: 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 airguns 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: Significance of impacts.

SIGNIFICANCE

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 airguns 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 proposed 2D / 3D seismic survey activities covering the Lüderitz and Walvis Basins, offshore Namibia, shall go-ahead. The likely negative impacts of the proposed 2D / 3D seismic survey operations on the receiving marine environment will be localised and limited to a small section of the entire Namibian offshore waters. The proposed 2D / 3D seismic survey in the Lüderitz and Walvis Basins, offshore Namibia can coexist with other proposed and ongoing marine related activities in the area. The proposed 2D / 3D seismic survey operations 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. As shown in Table 6.1, October to April is the most favourable weather window to undertake the proposed 2D / 3D seismic survey operation especially in the deeper waters where there are lesser likely negative influences / overlaps of the proposed survey activities / area on the receiving sensitivity marine environments such as the fish, fisheries, and marine mammals. Within the deep-water portion of the proposed survey area, operations may be undertaken without major influences from the other marine users except the for the poor winter weather between June-October.

As shown in Table 6.2, short and long-term likely negative impacts of the seismic noise (short term), seismic noise (long term, light disturbance, aircraft noise (short term), aircraft noise (long term), vessel exclusion zone (short term), vessel exclusion zone (long term), 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. 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 are applied (Tables 6.1 and 6.2 and Annexes 2 and 3).

Table 6.1 Logframe for evaluating the window of opportunity for undertaking the proposed 2D / 3D seismic survey activities and promotion of coexistence with other marine users and activities with respect to the outlined Area of Interes (AOI).

<table>
<tr><th>Month of Year</th><th colspan="2">Key Fishing Season (Key Species)</th><th>Main Spawning Activities (Key Species)</th><th>Key Cetaceous Presences / Migratory Times</th><th>Other Key Users Such as Minerals and Petroleum Operations</th><th>Weather Window</th><th>Marine seismic Survey Opportunity Window</th></tr>
<tr><td>January</td><td rowspan="8">Hake, Monkfish trawl, Deep-Sea Crabs and Orange Rough especially in the Shallow waters (-100 to -600 m) not covered by the proposed survey area.</td><td rowspan="2">Tuna Fishery (Southern Portions of the AOI)</td><td></td><td></td><td rowspan="12">International Shipping Lanes throughout the year</td><td rowspan="3">Good</td><td rowspan="4"></td></tr>
<tr><td>February</td><td></td><td>Leatherback</td></tr>
<tr><td>March</td><td></td><td>Turtles</td></tr>
<tr><td>April</td><td></td><td rowspan="2">Blue Whales Moving North</td><td rowspan="2">Moderate Mixed</td></tr>
<tr><td>May</td><td rowspan="7"></td><td></td></tr>
<tr><td>June</td><td></td><td></td><td rowspan="5">Poor</td><td></td></tr>
<tr><td>July</td><td></td><td></td><td></td></tr>
<tr><td>August</td><td></td><td></td><td></td></tr>
<tr><td>September</td><td rowspan="3">Coby (Inshore)</td><td></td><td></td></tr>
<tr><td>October</td><td rowspan="3">Ministry of Fisheries and Marine Resources (MFMR) Stock Assessments undertaken in less than -1000 m water depth</td><td rowspan="3">Tuna Fishery (Southern Portions of the AOI)</td><td></td><td>Moderate Mixed</td><td rowspan="3"></td></tr>
<tr><td>November</td><td></td><td rowspan="2">Good</td></tr>
<tr><td>December</td><td></td><td></td></tr>
</table>

Table 6.2: Summary of Impact Assessments with no mitigation applied (Source: Annex 2).

Potential Impacting Factors	Impacted Sectors – WITHOUT mitigation measures applied									
	Air quality	Water quality	Marine Mammals Cape Fur Seals	Marine Mammals Cetaceans	Marine 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 - High 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 impact	No impact	No impact

6.2 Recommendations

The following are the key recommendations:

(i) The proposed 2D / 3D seismic survey by TGS covering the southern offshore Namibia shall be issued with an Environmental Clearance Certificate (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 presented in the EMP Report have been modelled around two main concepts: Industry best practice and local phenomena unique to the area of exploration (Lüderitz and Walvis 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 International Association of Geophysical Contractors (IAGC)'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).
- ❖ Use of 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.
- ❖ 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, Debmarine and all fishing companies operating in the Lüderitz and Walvis 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 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.

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, Environmental Impact Assessment (EIA) Regulations Government Notice No. 30, Government Gazette No. 4878 of 6 February 2012 as well as all other relevant Namibian laws, regional and international environmental and petroleum exploration standards and practices applicable for offshore seismic survey in marine environment.

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8. ANNEXES

Annex 1 – BID and Final Environmental Scoping Report

Annex 2 – Marine Mammals, Birds, Fish and Fisheries Specialist Report

Annex 3– Underwater Acoustic Modelling Specialist Report

Annex 4 – Proof of Public and Stakeholder Consultation Materials

Annex 5 – Proposed Survey, Vessel and Associated Specifications