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Proposed Appraisal Well Drilling in Block 2814A (PPL 003), Orange Basin, off the coast of southern Namibia

Final Scoping Report

FOR: **BW Kudu Limited**

SLR Project No.: 733.023088.00001 Revision: 1

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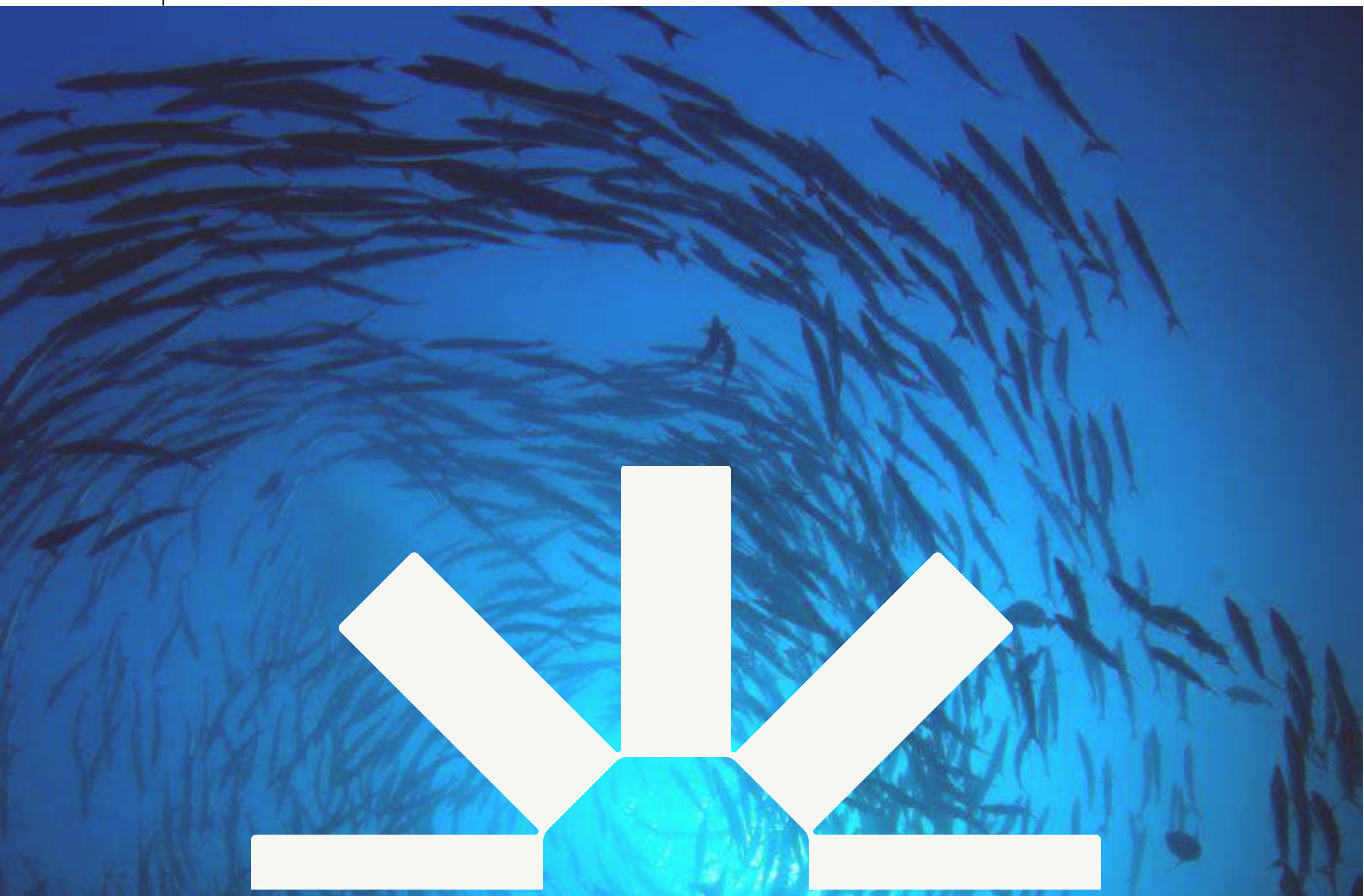
31 October 2024



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Revision	Date	Prepared By	Checked By	Authorized By
Draft	18 September 2024	R. Christians	J. Blood	S. Reuther
Final	31 October 2024	R. Christians	J. Blood	S. Reuther

Basis of Report

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Executive Summary

1. Introduction

This Executive Summary provides a synopsis of the Final Scoping Report (FSR) prepared as part of the Scoping and Environmental Impact Assessment (EIA) process (hereafter collectively referred to as "Environmental and Social Impact Assessment" or "ESIA" process) that is being undertaken for an application to undertake appraisal well drilling in Block 2814A off the southern coast of Namibia (**Figure 1**).

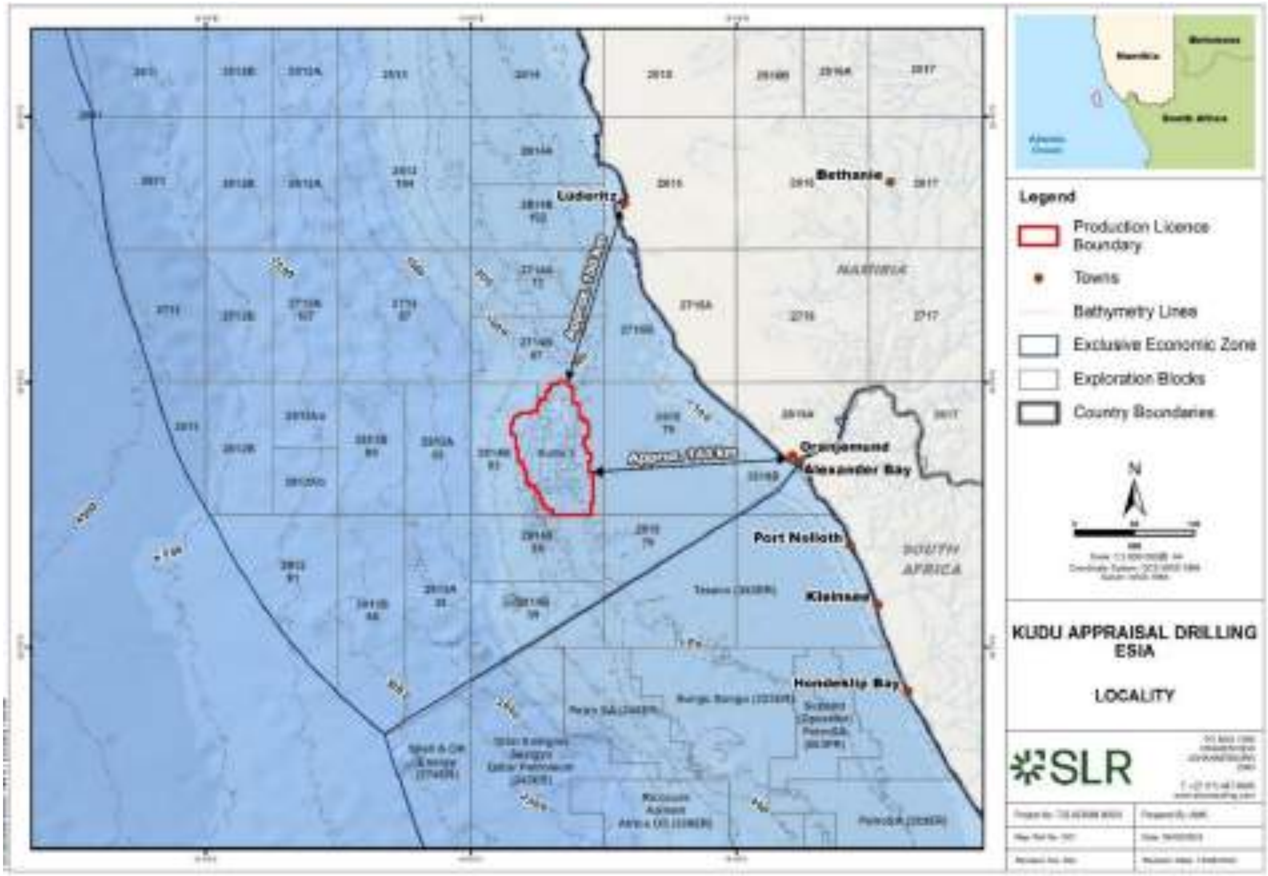

Figure 1: Locality map of Block 2814A (PPL 003) off the southern coast of Namibia and surrounding Blocks

1.1 Project Background and Location

BW Kudu Limited (BW Kudu), a subsidiary of BW Energy, is the holder of a Petroleum Production Licence (PPL) 003 for Block 2814A, which covers an area of approximately 4 568 km^2 and is located 144 km offshore at its closest point, in water depths ranging from 150 m to 750 m.

BW Kudu is applying to undertake appraisal activities within Block 2814A. The proposed offshore appraisal programme includes:

- Seabed sampling; and
- Drilling up to four appraisal wells, including:
  - o Vertical Seismic Profiling (VSP);

- o Well testing; and
- o Plugging and abandonment of wells in the deep offshore.

SLR Environmental Consulting (Namibia) (Pty) Ltd (SLR) has been appointed by BW Kudu to undertake ESIA process for the proposed appraisal activities.

1.2 Objective and Purpose of this Report

This FSR has been prepared in compliance with Section 8 of the EIA Regulations 2012 as part of the ESIA process that is being undertaken for the application by BW Kudu for proposed appraisal well drilling activities in Block 2814A. The key objective of this report is to define the scope of the ESIA by ensuring that all potential environmental and social impacts that need to be addressed, and alternatives to be considered, have been identified.

The compilation of the FSR has been informed by comments and issues received following the distribution of the Draft Scoping Report (DSR) for a 30-day comment period (18 September to 18 October 2024) and those raised during the two public meetings held in Lüderitz and Walvis Bay. Comments received by SLR have been recorded and responded to in a Comments and Responses Report (see Appendix B.9 of the FSR). **It should be noted that all significant changes to the draft report are underlined and in a different font (Times New Roman) to the rest of the text.**

This report is submitted to the competent authority, the Ministry of Mines and Energy (MME): Directorate of Petroleum Affairs for consideration and review. MME will then make a recommendation on the acceptance or rejection of this report to the Ministry of Environment, Forestry and Tourism (MEFT): Directorate of Environmental Affairs (DEA), who will make the final decision regarding the acceptance of the FSR.

2. ESIA Process

The ESIA process consists of two phases (namely Scoping and Impact Assessment) and a series of steps to ensure compliance with the EIA Regulations, 2012 (**Figure 2**).

2.1 Scoping Phase

Objective: To define the scope of the proposed activities, identify potential environmental and social impacts, and develop the terms of reference (i.e. plan of study) for specialist studies. This phase aims to ensure that all relevant issues are identified at the start of the ESIA for consideration in the next phase.

Key Activities:

- **Notification of interested and affected parties (I&APs)**: Stakeholders, including local communities, government agencies, and non-governmental organisations, are informed about the proposed activities and invited to participate in the ESIA process.
- **Public and Stakeholder Consultations**: The DSR was released for comment and meetings were held to gather input and concerns from I&APs. These consultations provided valuable insights into local conditions and stakeholder expectations. The public consultation process undertaken during the Scoping Phase is detailed in Chapter 4.0 of the FSR. As noted above, comments received by SLR have been recorded and responded to in a Comments and Responses Report.

- **Identification of Key Environmental and Social Aspects**: Potential impacts are identified based on the proposed activities, baseline studies, and stakeholder input. This forms the basis for further investigation during the Impact Assessment Phase.

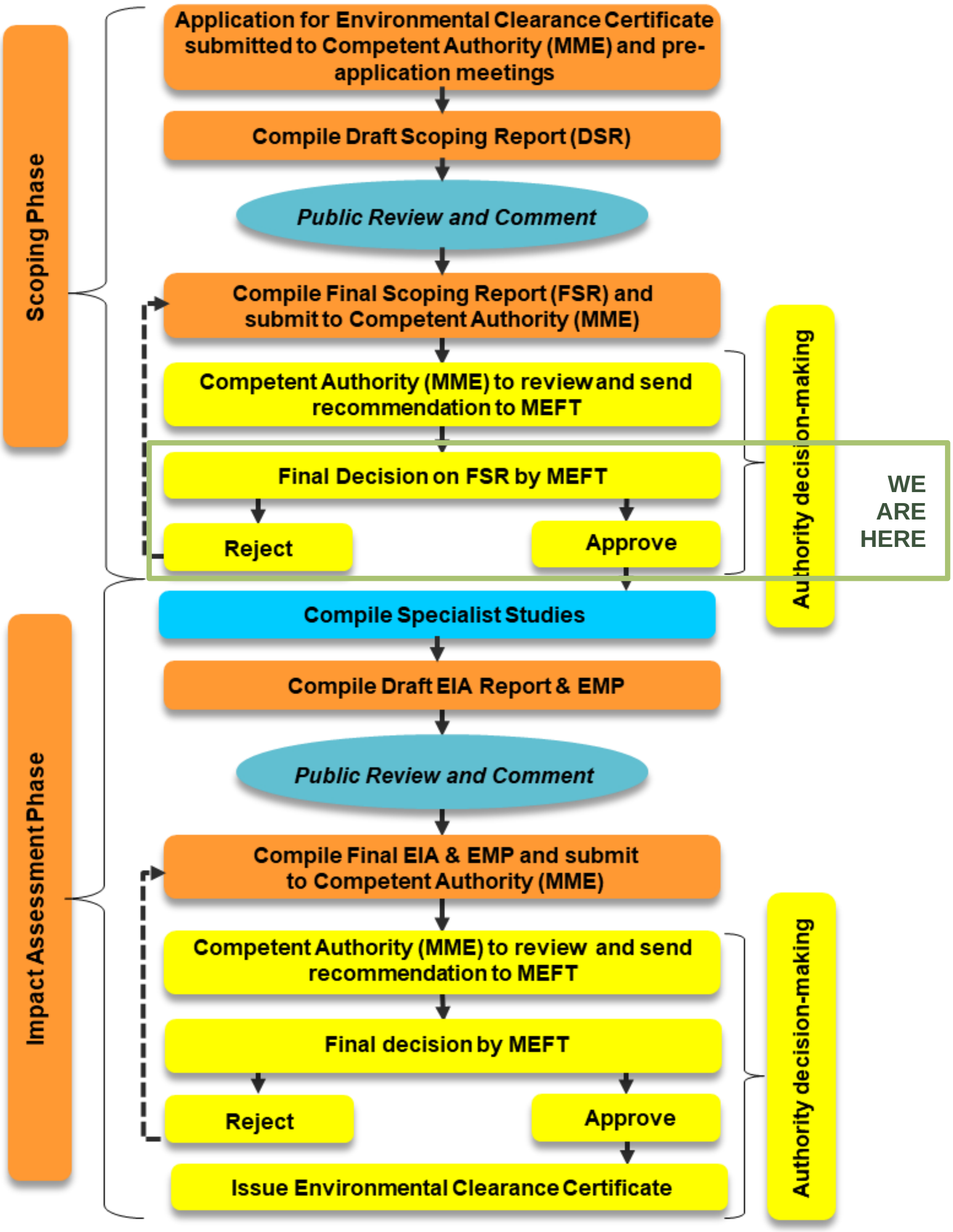

Figure 2: Namibian ESIA Process.

2.2 Impact Assessment Phase

Objective: To carefully study and understand the potential impacts identified in the Scoping Phase and to develop mitigation measures to avoid and / or reduce their effects. This phase aims to ensure the proposed activities moves forward with minimal negative effects on the environment and society.

Key Activities:

- **Modelling Studies**: Advanced models are used to assess underwater noise, drilling discharges and oil spills. These models help predict the extent and severity of potential impacts. This helps plan how to respond effectively to potential impacts.
- **Technical and Specialist Studies**: Detailed investigations are conducted on marine ecology, fisheries, socio-economic, cultural heritage, air quality and climate change impacts. These studies provide an understanding of the potential impacts and inform the development of mitigation measures.
- **Mitigation Hierarchy:** The assessment follows a plan to avoid, minimise, and manage negative impacts. This makes sure the proposed activities use the best and most sustainable solutions available.
- **Public and Stakeholder Consultations**: The Draft ESIA Report is released for comment and meetings are held to present the findings of the impact assessment.

3. Need and Desirability

The Need and Desirability of the project is detailed in Chapter 5.0 of the FSR. This section summarises the need for, and desirability, of the proposed appraisal activities based on its 'fit' with the policy and planning framework adopted by the Namibia administration.

3.1 Energy-Related Plans and Polices

Policies are careful to frame the need for locally produced hydrocarbon products in the Namibian economy in the context of, and as a supplement to, the desired increase in renewable energy generation capacity. In this sense the use of petroleum products, notably gas, is not deemed contradictory to, and rather supportive of, the continued development of renewable energy in Namibia. Appraisal for hydrocarbon resources, such as the current project, is one necessary step in the process of potentially increasing the gas resource base, if appraisal results in the identification of viable resources and required production permits are obtained (as noted previously BW Kudu already has a valid Petroleum Production Licence). The proposed appraisal activities are thus in keeping with and furtherance of energy-related plans and policy in Namibia.

3.2 Economy-Related Plans and Polices

Promoting economic growth is a key proclaimed focus of the Namibian Government, with a focus on increased energy security, in conjunction with a declared intent to mitigate the effects of climate change and diversify the energy mix away from fossil fuels while exploring the use of natural gas, including indigenous resources, as a less carbon intensive transitional fuel. Policy clearly lays out the social need for economic development and opportunities, and that this should be achieved through a managed energy transition that includes a mix of energy sources, including fossil fuels for some time, and possibly the production of indigenous oil and gas resources. Appraisal of indigenous resources will improve the knowledge of potential oil and gas resources in Namibia and thereby improve the Government's capability to plan scenarios in this regard. The proposed appraisal activities are deemed in keeping with and furtherance of economy-related plans and policy in Namibia.

3.3 Climate Change-Related Plans and Policies

Namibia's policies aim to reduce greenhouse gas (GHG) emissions while ensuring enough energy for growth. Provided that a project has a broadly neutral or net positive effect on Namibia's overall GHG emissions, it could be deemed broadly in line with climate change-related plans and policies. The proposed appraisal activities generally do not emit significant quantities of GHGs, and the proposed activities are thus not deemed incompatible with such policies.

3.4 Summary

Namibia's policies recognise the need to progressively reduce GHG emissions while, at the same time, ensuring a stable and sufficient energy supply and enabling just and enabling just and inclusive economic growth. Appraisal of indigenous hydrocarbon resources is in principle compliant with and in furtherance of several energy, economy and resource-related policies and plans, and is not incompatible with climate change-related policies and targets.

Given the importance of energy to economic activity and growth and the importance of economic growth to ensuring a prosperous and stable society in Namibia, coupled with the complexity and fluidity of global trends and supply chains, retaining optionality and diversification in national income, economy and energy supply appears desirable in itself.

Notwithstanding the likely continued demand for (and supply of) hydrocarbon resources globally and in Namibia (although the production of hydrocarbons is not proposed as part of the current application), and the in-principle compliance of appraisal drilling with Namibian policies, the need and desirability of a particular activity (or project) is also determined by the acceptability of residual environmental and social impacts of the proposed activities, which will be assessed during the Impact Assessment Phase. This will inform the evaluation of the sustainability and the need and desirability of the proposed appraisal activities.

4. Description of the Proposed Activities

4.1 Overview of Proposed Activities

The key activities and components are summarised in **Table 1**.

Table 1: Summary of key activities and components

Seabed Sampling	
Purpose	Characterise the seafloor and for laboratory geochemical analyses for drilling unit anchoring purposes
Method	Piston and box coring (or grab samples)
Number of samples	Up to 50
Duration	6 weeks
Appraisal Drilling	
Purpose	Confirm and test the presence and quality of hydrocarbon resources
Number of wells	Up to 4 appraisal wells
Size of area for drilling	4 568 km^2
Well depth	~ 4 900 m
Water depth range in Block	150 m - 750 m
Duration to drill each well	• 100 days in total per well:

	o Mobilisation: 5 days (within country) o Well drilling: 70 days, o Well testing (drill stem test): 15 days (optional) o Well abandonment: 5 days per well o Demobilisation: up to 5 days
Commencement of drilling and anticipated timing	• Commencement is not confirmed, but anticipated to be in the Q3 of 2025. The ESIA assumes two wells could be drilled in the first year and two wells in the second year.
Proposed drilling fluids (muds)	• Water-Based Muds (WBM) during the riserless drilling stage • Non-Aqueous Drilling Fluid (NADF) during the risered drilling stage (closed loop system)
Drilling and support vessels	• Drill ship or semi-submersible drill rig • Three support vessels. These vessels will be on standby at the drilling site, and move equipment and materials between the drilling unit and the onshore base
Operational safety zone	Minimum 500 m around drilling unit; however, operators are likely to request 2 nm
Flaring (non-routine)	If hydrocarbons are discovered, well testing / drill stem test (DST) may be performed
Logistics base	Walvis Bay (preferred location) or the Port of Lüderitz
Logistics base components	Office facilities, laydown area, mud plant
Support facilities	Helicopter support base in Lüderitz (preferred alternative) or Oranjemund
Staff requirements	• Specialised drilling staff supplied with hire of drilling unit • Specialised international and local staff at logistics base
Staff changes	Rotation of staff every four weeks with transfer by helicopter to shore

4.2 Drill Unit, Vessel Support and Onshore Logistics Base

- *Drilling Unit*: BW Kudu is proposing to use a drill ship or semi-submersible drilling unit to undertake the proposed appraisal activities. The final drilling unit selection will depend on availability and final design specifications. The drilling unit will either be dynamically positioned (water depths > 450 m) or need to be anchored (water depths < 450 m). A temporary 500 m safety zone (or large if the drilling unit is anchored) around the drilling unit will be enforced at all times during operation.
- *Support vessels*: The drilling unit is expected to be supported by up to three support vessels between the drilling unit and onshore logistics base.
- *Helicopter support*: Transportation of personnel to and from the drilling unit by helicopter is the preferred method of transfer to and from Lüderitz/Oranjemund.
- *Logistics base*: The primary onshore logistics base will be located at either the Port of Walvis Bay (preferred alternative) or the Port of Lüderitz.

4.3 Drilling Operation

- *Final Drilling Site Selection*: Site selection will be based on further detailed analysis of available seismic, pre-drilling survey data and the geological target. A Remote Operating Vehicle (ROV) will be used to finalise the well position based on, *inter alia*, the presence of seafloor obstacles or the presence of any sensitive features that may become evident during a pre-drilling survey.

- *Drilling Sequence or Stages*: A well will be created by drilling a hole into the seafloor with a drill bit attached to a rotating drill string, which crushes the rock into small particles, called "cuttings". After the hole is drilled, casings of steel pipe (which provide structural integrity to the newly drilled hole), are placed in the hole and permanently cemented into place. The diameter of the well decreases with increasing depth. Drilling is undertaken in two stages, namely the riserless and risered drilling stages (**Figure 3**).
    - *Initial (riserless) drilling stage:* At the start of drilling, a 42" hole will be drilled approximately 75 m deep and the conductor pipe will be run into the hole and cemented into place, after which a low pressure wellhead will be placed on top of the conductor. Further sections are then drilled to diameter of 26" to a depth of approximately 625 m. These initial sections of the hole will be drilled using seawater (with viscous sweeps) and Water Based Muds (WBMs). All cuttings and WBM from this initial drilling stage will be discharged directly onto the seafloor adjacent to the hole.
    - *Risered drilling stage:* This stage commences with the lowering of a Blow-Out Preventer (BOP) and installing it on the wellhead, which seals the well and prevents any uncontrolled release of fluids (e.g. oil, gas or condensate) from the well (a 'blow-out'). A lower marine riser package is installed on top of the BOP which isolates the drilling fluid and cuttings from the environment creating a "closed loop system". Drilling is continued by lowering the drill string through the riser, BOP and casing, and rotating the drill string. During the risered drilling stage, should the WBMs not be able to provide the necessary characteristics required to safely drill the well, a low toxicity Non-Aqueous Drilling Fluid (NADF) will be used. In instances where NADFs are used, cuttings will be treated to reduce oil content to <3% Oil On Cutting and discharged overboard.
- *Well Logging*: Once the target depth is reached, the well will be logged and possibly tested. Well logging involves the evaluation of the physical and chemical properties of the rocks in the sub-surface, and their component minerals, including water, oil and gas, to confirm the presence of hydrocarbons and the petrophysical characteristics of the rock through which the hole has been drilled. Vertical Seismic Profiling (VSP) is an evaluation tool that is used when the well reaches target depth to generate a high-resolution seismic image of the geology in the well's immediate vicinity. The VSP images are used for correlation with surface seismic images. VSP uses a small airgun array, which is operated from the drilling unit. During VSP operations, receivers are positioned in a section of the borehole and the airgun array is discharged at intervals. This process is repeated for different stations in the well and may take up to nine hours to complete. BW Kudu is proposing to undertake one VSP operation per well, which would be scheduled towards the end of the drilling operations.

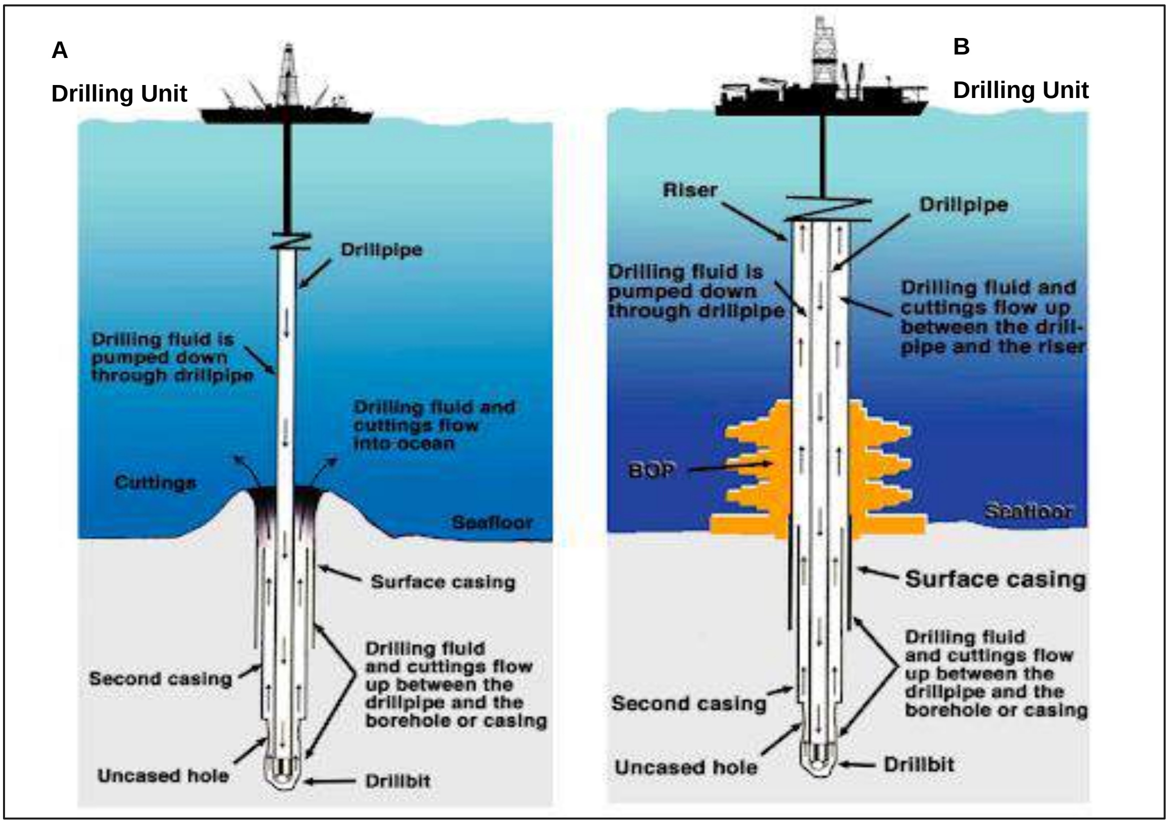

Figure 3: Drilling stages: (a) riserless drilling stage; and (b) risered drilling stage.

- *Well (flow) testing*: In case of hydrocarbon discovery, a well or flow test can be undertaken to determine the economic potential of the discovery before the well is either abandoned or suspended. A typical well test would take up to three days to complete (1 day flaring during clean-up, 2 days flaring during main test). For well flow-testing, hydrocarbons would be burned at the well site. If water from the reservoir arises during well flow testing, these would be separated from the oily components and treated onboard to reduce the remaining hydrocarbons from these produced waters. Treated produced water will then either be discharged overboard or transferred to an onshore facility for treatment and disposal (estimated volume of 300 m^3).
- *Well Sealing and Plugging:* Once drilling and logging are completed, the well(s) will be sealed with cement plugs, tested for integrity and abandoned according to international best practices.
- *Demobilisation:* After the appraisal wells have been sealed and tested for integrity, a decision would be made as to whether the wells would be abandoned or suspended. If the well(s) are to be abandoned, the wellheads will be removed (with casings cut-off below the seafloor). However, if the well(s) are to be suspended, the intention is to leave the wellhead(s) on the seafloor if it is deemed safe to do so based on a risk assessment. A final clearance survey check will be undertaken using an ROV, after which the drilling unit and supply vessels will demobilise from the offshore licence area.

4.4 Emergency Response

In the unlikely event of an oil spill, BW Kudu and the drilling contractor will have an emergency response plan and equipment in place to clean-up such a spill. In addition, BW Kudu will become a member of Oil Spill Response Limited (OSRL), which provides response equipment (e.g., dispersants, booms, and dispersant spray equipment including aircraft and the use of globally advanced capping stacks and other) in the event of a well blow-out.

These capping stacks are advanced devices designed to seal off a well and prevent oil from spilling into the ocean. OSRL keeps one of these capping stacks at its facility in Saldanha Bay, situated on the West Coast of South Africa. This equipment can be rapidly transported anywhere in the world by sea or air in case of an emergency.

5. Description of the Receiving Environment

This section provides a brief description of the attributes of the receiving environment of the Licence Block and the central to southern Namibian offshore regional area.

Receptor/ Variable	Description Summary
1. Bio-physical considerations	
Climate	• The climate of the Namibian coastline is classified as hyper-arid with typically low, unpredictable winter rains and strong predominantly south-easterly winds. • Mild temperatures prevail year-round, averaging around 16°C along the coast and increasing inland. • Winds are one of the main physical drivers of the near shore Benguela region. During summer, wind is strongest with southerlies dominating most of the time. Winter remains dominated by southerly winds, but the proximity of winter cold-front systems introduces a significant north-westerly component. • Frequent fog occurs along the coast, mainly from February through May.
Bathymetry and Sediments	• Block 2814A is located on the outer shelf, shelf edge and upper slope in water depths ranging from 150 m to 750 m. • Tripp Seamount is a geological feature situated approximately 74 km south-west of Block 2814A . The seamount rises from the seabed at a depth of approximately 1 000 m to a depth of 150 m. This seamount is an important feature because it attracts an abundance of marine life and is a productive fishing ground. • Sediments in the vicinity of Block 2814A is likely dominated by ‘sand’ and ‘muddy sand’. Hard substrate may be present.
Benguela Current and Upwelling	• The Namibian coastline is strongly influenced by the Benguela Current system. The coastal upwelling region in the Benguela current is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. • The Lüderitz upwelling cell is the most intense upwelling cell in the system, with the seaward extent reaching nearly 300 km. • The Lüderitz Upwelling Cell - Orange River Cone (LUCORC) area forms a major environmental barrier between the northern and southern Benguela sub-systems. Although upwelled nutrients may be high within Block 2814A, plankton levels and spawning are likely low due to the proximity to the LUCORC area.
Marine Fauna	• The benthic habitat at depths beyond 500 m have been assigned a threat status of ‘Least Threatened’, as they comprise large areas in the Namibian

Receptor/ Variable	Description Summary
	EEZ and experience limited impacts. However, the continental shelf is considered 'Endangered' due to habitat degradation from trawling (**Figure 4**). • Spawning levels near Block 2814A are expected to be low due to its proximity to the LUCORC area (**Figure 5**). • Small pelagic fish species usually occur in mixed shoals near within the 200 m depth contour, and thus are likely in the shallower regions of Block 2814A. Large migratory pelagic fish species, such as tunas, billfish and sharks, may be encountered in the area of interest. • Leatherback turtle occurrence in the area of interest is possible, but abundances are similarly expected to be low. • The shallower parts of Block 2814A are located within the foraging ranges of Cape fur seals and Cape gannets. • Thirty-five species of whales and dolphins are known or likely to occur in Namibian waters and thus could be encountered in Block 2814A. Cetacean species most likely to be encountered in the area of interest are long-finned pilot, Bryde's and humpback whales, as well as various dolphin species. • The closest fur seal colonies to Block 2814A are at van Reenen Bay and Baker's Bay approximately 90 km inshore and to the north-east of the block, in the Tsau//Khaeb (Sperrgebiet) National Park.
Conservation and Protected Areas	• The Lüderitz Bay and Ichaboe Island Rock-Lobster Sanctuaries are 150 km north-east of Block 2814A. • Inshore of Block 2814A, the coastline of Namibia is part of a continuum of protected areas that stretch along the entire Namibian coastline. • The Namibian Islands' Marine Protected Area (NIMPA) lies inshore of Block 2814A, with the closest point being over 65 km away. The Orange Shelf Edge MPA is 75 km south of Block 2814A at its closest point, in South African waters. • Block 2814A lies offshore of the three of the designated coastal Ramsar sites in Namibia (including Orange River Mouth, Sandwich Harbour, and Walvis Bay Wetland). • Block 2814A lies offshore from all coastal Important Bird Areas (IBA), but lies within the proposed Atlantic Southeast 21 marine IBA. • Block 2814A is almost entirely located within the Orange Seamount and Canyon Complex transboundary Ecologically or Biologically Significant Marine Area (EBSA). • Block 2814A partially overlaps with an ESA bordering the Orange Seamount and Canyon Complex EBSA.
2. Socio-economic considerations	
Commercial Fisheries	• Block 2814A overlaps directly with the large pelagic longline, demersal trawl, demersal longline and pole-line sectors (**Figures 6 to 9**). Namibia promotes mariculture, particularly in Lüderitz's nutrient-rich waters, with allocated plots for various seafood cultivation.
Marine traffic	• The block overlaps the main traffic route that passes around southern Africa. The coastal region south of Lüderitz is a restricted diamond mining area, which limits public access (**Figure 10**).
Other Human Uses	• Current diamond mining operations exist to depths of 150 m, and as such there is no overlap with Block 2814A. • Block 2814A does not overlap with any submarine cables.
Lüderitz	• Lüderitz is a small, relatively well serviced town. The remoteness of the town has impacted on the economic opportunities and connectivity with the rest of

Receptor/ Variable	Description Summary
	Namibia. It is, however, well placed to handle investments, in that it has infrastructure and is able to provide water, power and other basic services.
Walvis Bay	• Walvis Bay is an established, well serviced, medium sized, industrial harbour town. It is the most important harbour in Namibia. The town and its associated facilities, including the port services and accommodation, are sufficiently developed and have the capacity to cater for development projects.

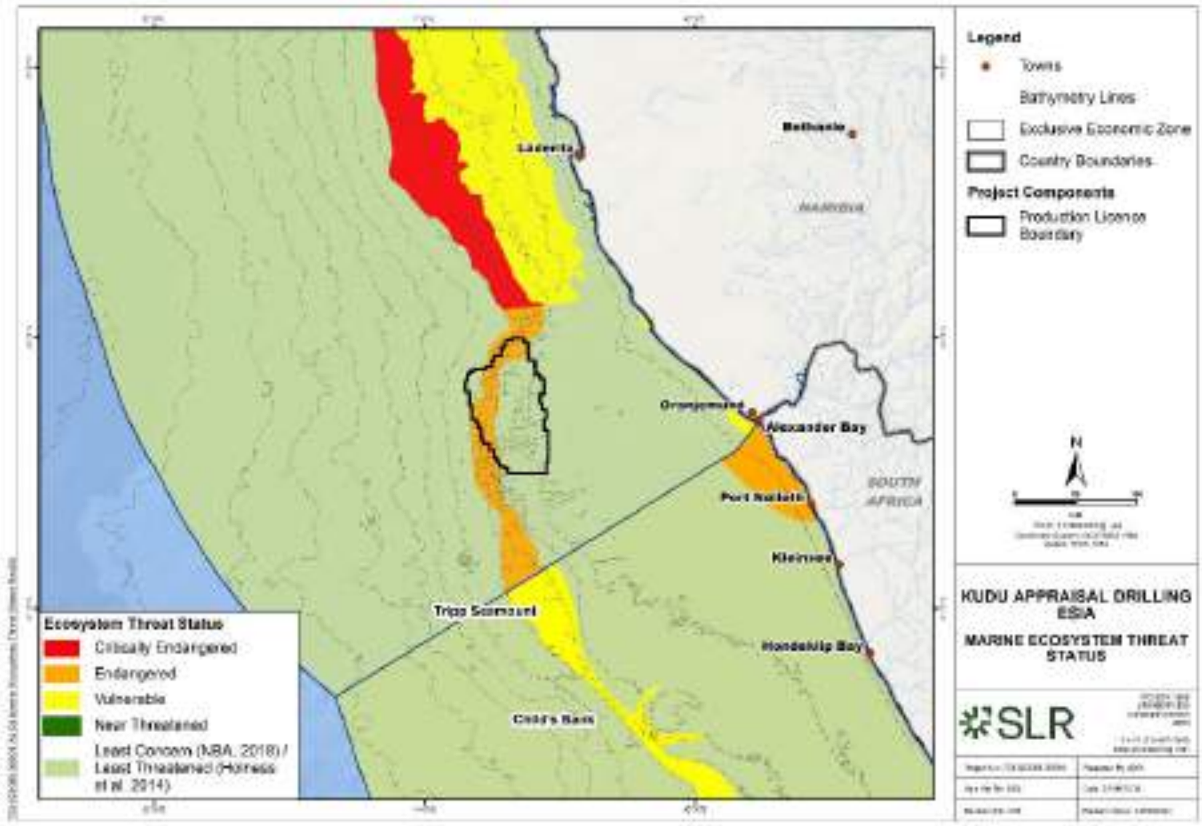

Figure 4: Block 2814A (black polygon) in relation to ecosystem threat status.

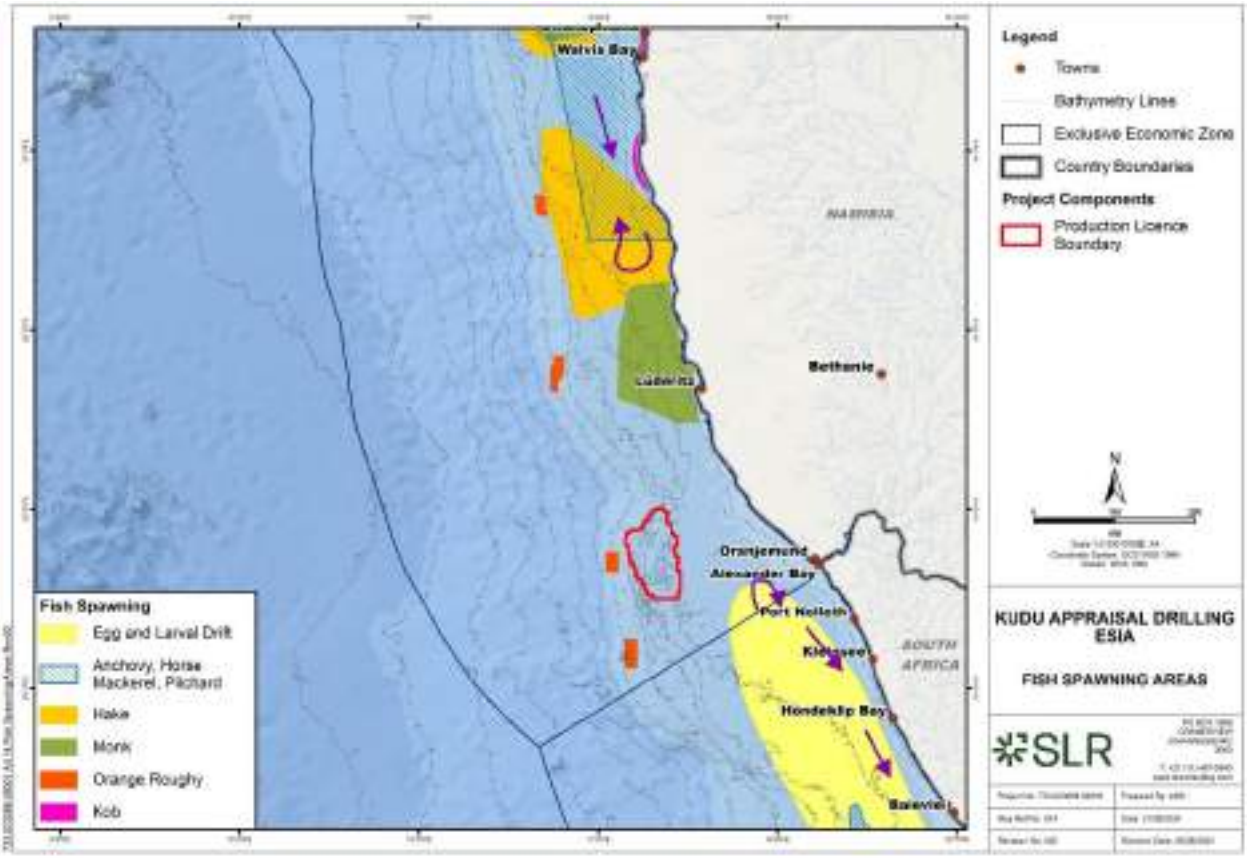

Figure 5: Block 2814A (red polygon) in relation to major spawning areas in southern Namibia.

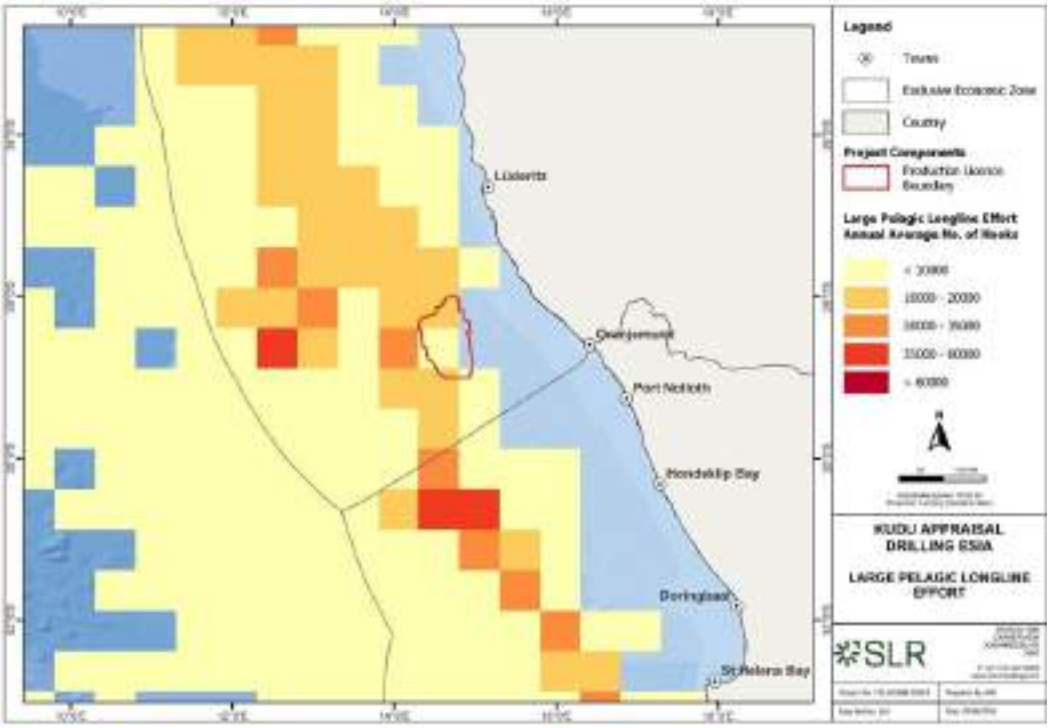

Figure 6: Spatial distribution of effort recorded by the large pelagic longline fishery in Namibia and South Africa in relation to Block 2814A.

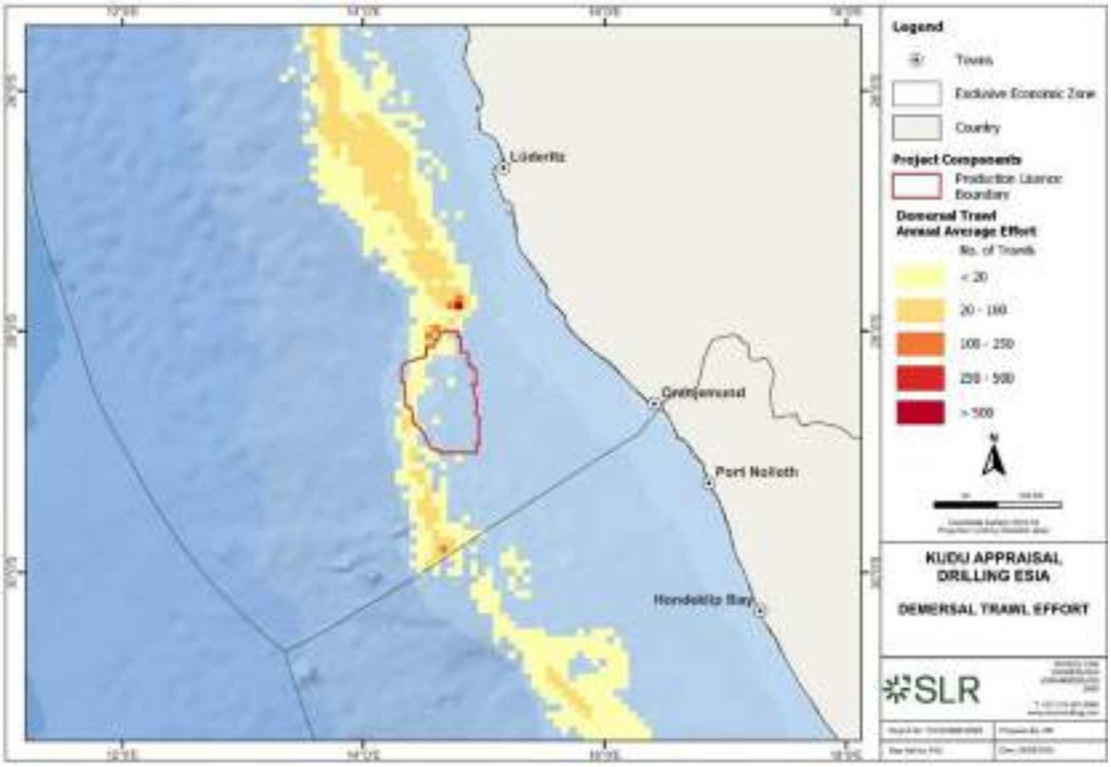

Figure 7: **Spatial distribution of effort recorded by the demersal trawl fishery in Namibia and South Africa in relation to Block 2814A.**

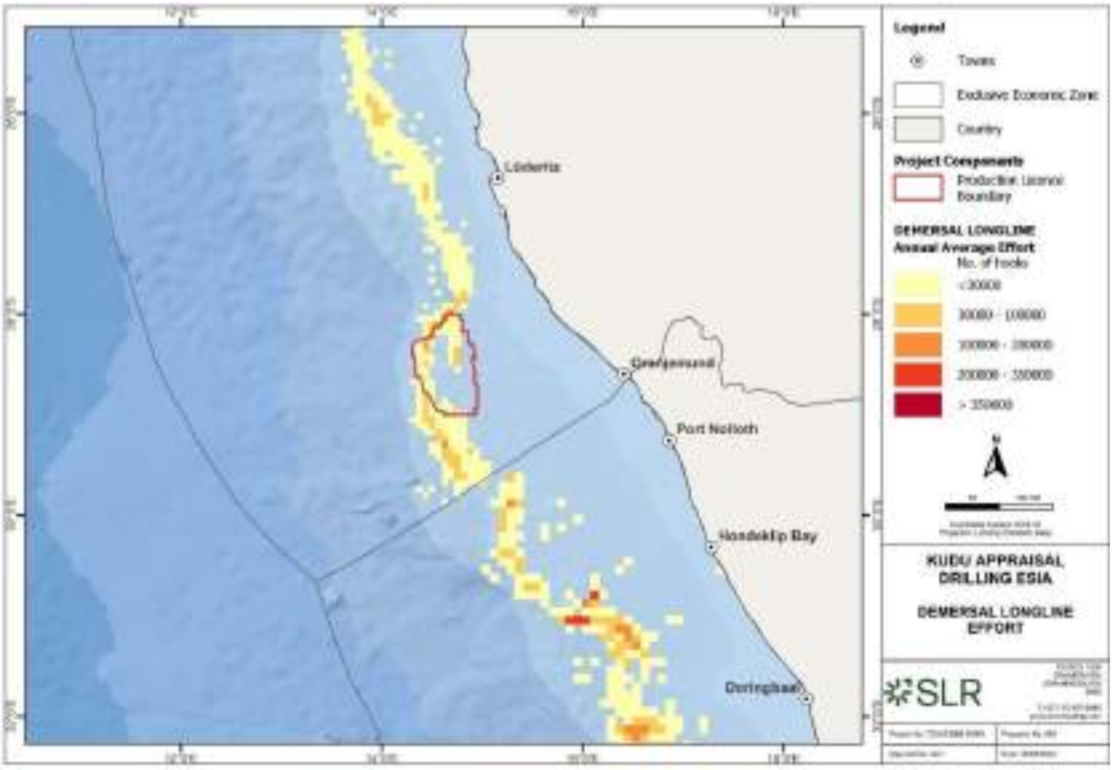

Figure 8: **Spatial distribution of effort recorded by the demersal longline fishery in Namibia and South Africa in relation to Block 2814A.**

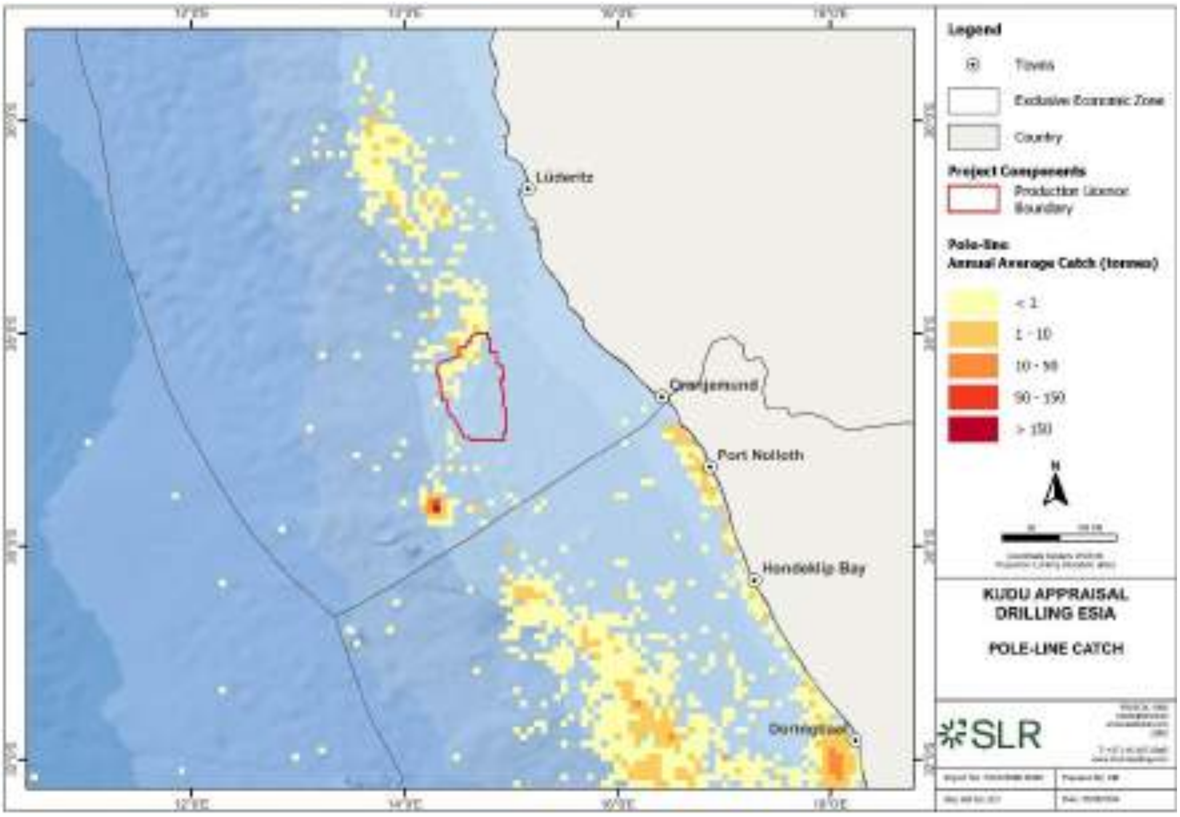

Figure 9: Spatial distribution of catch recorded by the pole-line fishery in Namibia and South Africa in relation to Block 2814A.

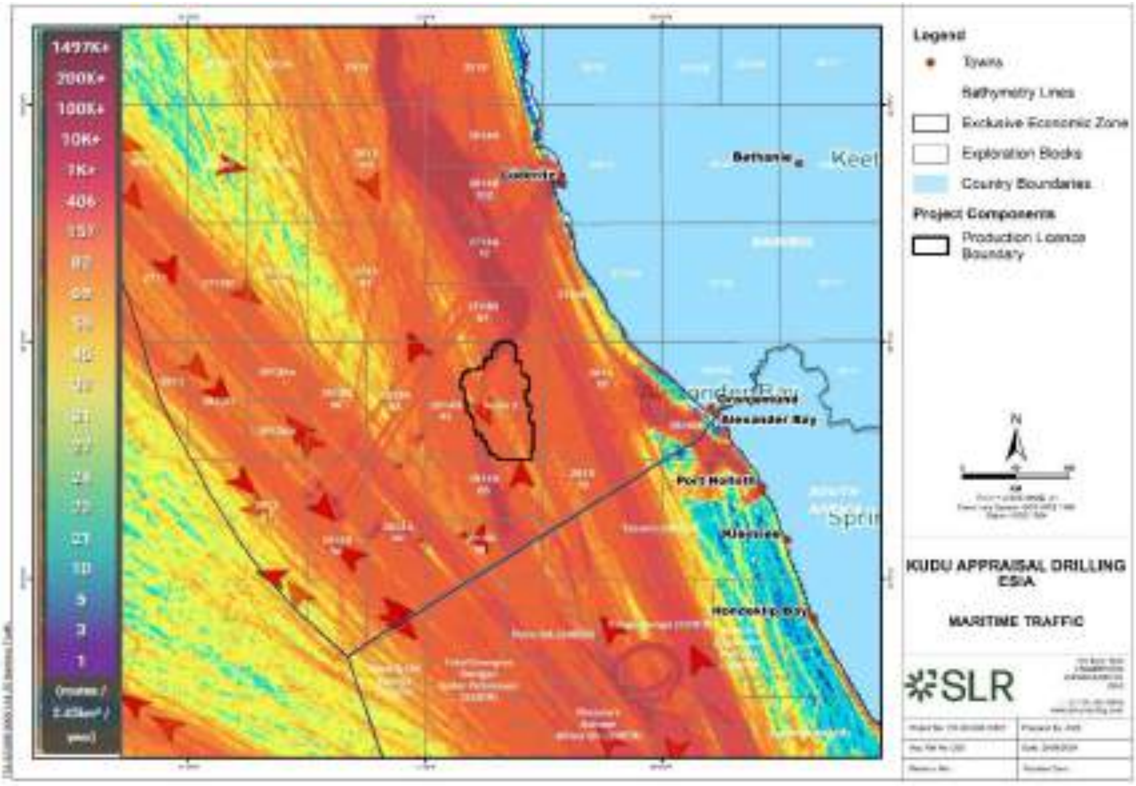

Figure 10: Block 2814A in relation to shipping density around southern Africa.

6. Environmental and Socio-Economic Screening and Key Impacts

The environmental and social interaction matrix prepared for the proposed activities is presented in **Table 2**. Shaded cells indicate where a proposed activities may interact with a certain physical characteristic and, in turn, biological or socio-economic receptor. Interactions are broadly grouped into minor interactions and potentially significant interactions (which need to be confirmed by specialist assessments). Key considerations that inform the potential interactions are the far offshore location of the area of interest (located 144 km offshore at its closest point) and the short duration of the proposed activities (approximately three months for drilling and testing of each well).

During normal operations, the biological receptors that may be most affected by proposed activities include benthic communities, fish and marine mammals (although other receptors are also considered). Socio-economic receptors (or activities or resources) that may be most affected by proposed activities include fishing, income / livelihoods, maritime shipping, cultural heritage, public health and safety, and GHG levels.

Potential interactions with receptors in the event of **unplanned events**, associated with potential activity risks such as vessel collisions, minor hydrocarbon spills, loss of drilling-related equipment, blow-out during well drilling or a leak from a plugged well, were also considered to ensure a comprehensive assessment. These unplanned events are unlikely to occur and measures are in place to actively prevent them in line with Industry Best Practice.

6.1 Key Potential Environmental and Socio-Economic Impacts

6.1.1 Potential Impacts on Marine and Coastal Ecology

One of the potentially most significant impacts associated with the proposed appraisal drilling (normal operations) relates to the physical disturbance and / or smothering of vulnerable or sensitive hardground benthic communities during spudding and the discharge of drill cuttings. In addition to the smothering impact, benthic and pelagic fauna may also suffer indirect toxicity and bioaccumulation effects due to leaching of potentially toxic additives from the drilling fluids. The discharge of produced water, as well as hydrocarbon ‘drop out’ from inefficient combustion of hydrocarbons during flaring, can also add to these toxic effects on marine fauna.

Underwater noise generated by the “project” vessels and drilling, as well as VSP operations, could further impact marine fauna in number of different ways, including physiological injury (permanent or temporary), disturbance and / or behavioural changes. Helicopters operations between the drilling unit and the onshore helicopter base may also impact fauna behaviour and breeding success.

Further to the potential impacts related to normal operations, various unplanned events will be assessed. The greatest environmental threat from offshore drilling operations, although highly unlikely, is a major spill of crude oil and/or natural gas occurring either from a loss of well control or well blow-out, which could severely impact the offshore and coastal environments.

Table 2: Environmental and Social Interaction Matrix.

See legend at the end of the table.

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment																
										Biological receptors / resources								Socio-economic receptors / resources								
			Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air quality / GHG	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Coastal / seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income loss	Employment / Procurement	Maritime / cultural heritage	GHG levels	Visual / sense of place	Services availability	Public health and safety
1. Normal Operations																										
Mobilisation	Establishment of onshore logistics base and mobilisation of staff	Procurement of facilities and services																								
		Employment of staff																								
	Transit of drilling unit and support / survey vessels to site	Vessel presence																								
		Underwater noise from manoeuvring																								
		Vessel air emissions																								
		Vessel lighting																								
		Routine discharges to sea																								
		Discharge of ballast water																								
Operation	Operation of drilling unit and support / survey vessels	Underwater noise from manoeuvring and dynamic positioning																								
		Vessel / drill unit air emissions																								
		Vessel / drill unit lighting																								
		Routine discharges to sea																								
		Implementation of safety zone																								
		Supply vessel transit																								
		Procurement of facilities and services																								
		Employment of staff																								
	Coring, well drilling and installation of well infrastructure	Underwater noise from drilling																								
		Seabed disturbance																								
		Discharge of drill cuttings, mud and residual cement																								
		Treatment and/or disposal at a landfill																								
	VSP	Impulsive underwater noise																								
	ROV operation	Sediment dislodging																								
	Well (flow) testing	Flaring of gas and liquid hydrocarbons																								

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment																
										Biological receptors / resources								Socio-economic receptors / resources								
			Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air quality / GHG	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Coastal / seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income loss	Employment / Procurement	Maritime / cultural heritage	GHG levels	Visual / sense of place	Services availability	Public health and safety
		Discharge of treated produced water																								
	Operation of helicopters	Atmospheric and underwater noise																								
Demobilisation	Abandonment of well	Discharge of residual cement to seabed																								
		Infrastructure on seabed																								
	Demobilisation of drilling unit and support vessels	Vessel presence																								
		Underwater noise from manoeuvring																								
		Vessel air emissions																								
		Vessel lighting																								
		Routine discharges to sea																								
	Demobilisation of logistics base and work force	End of procurement																								
		Release of staff																								
2. Unplanned Events																										
Unplanned	Operation of drilling unit and support vessels	Vessel collision with marine fauna																								
		Minor oil spill caused by vessel or equipment failure and refuelling																								
	Well drilling and installation of well infrastructure	Loss of equipment at sea																								
		Loss of well control / Blow-out																								
	Well abandonment	Hydrocarbon leak from plugged well																								

Legend

No significant interaction	Interaction of aspects with key physical characteristics in the area of influence	Potentially minor interaction screened out as described in Section 8.3	Potentially significant negative interaction to be assessed in ESIA	Potentially significant positive interaction to be assessed in ESIA

How the issues will be addressed in the ESIA:

A *marine ecology impact assessment* will be commissioned to assess the potential impacts on the marine and coastal environment during normal drilling operations and upset conditions (small accidental spills and large blow-out).

Outputs from the *technical modelling studies* will be used to assess the potential impacts related to the discharge of drill cuttings and associated muds, increased underwater noise (zones of impact related to non-impulsive and impulsive noise), and a large oil spill associated with a well blow-out on the marine ecosystem and biota.

6.1.2 Potential Impacts on Commercial and Small-Scale Fisheries

The implementation of the 500 m safety zone around the drilling unit (or larger if drilling unit is anchored) will effectively exclude fishing from a relatively small area around the drilling unit (up to three months per well). Considering the historical fishing effort and catch of all fisheries operating off Namibia, four sectors directly overlap with Block 2814A (including large pelagic longline, demersal trawl, demersal longline and pole-line) and thus may be impacted by the implementation of the safety zone is the large pelagic longline fishery. In addition, the sediment plume from drilling discharges and elevated noise levels from drilling activities could result in behavioural changes causing fish to be displaced from known fishing grounds, potentially resulting in reduced catch and/or increased fishing effort.

An oil spill can also result in several indirect impacts on fishing, including:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort;
- Mortality of animals (including eggs and larvae) leading to reduced recruitment and loss of stock (e.g., mariculture); and
- Gear damage due to oil contamination.

How the issues will be addressed in the ESIA:

A *fisheries impact assessment* will be commissioned to, *inter alia,* confirm the historical fishing effort and catch off south Namibia within the area of influence and to assess the impact of the proposed activities on these sectors, with input from the technical modelling studies. As noted for the marine ecology assessment above, outputs from the *technical modelling studies* will be used to inform the fisheries assessment.

In addition, a *socio-economic impact assessment* will be undertaken, which will assess the impacted related to any disruption of fisheries. The level of information given to the economic aspects of potential impacts and benefits on environmental and social receptors is considered adequate to inform the assessment of impacts and to inform decision-making in this regard.

6.1.3 Potential Impacts on the Socio-Economic Environment

The proposed activities would result in some temporary socio-economic benefits associated with the procurement of local goods and services, employment of some local staff and contractors and State income from taxes and levies.

Potential socio-economic impacts could be associated with any reduction in income if fishing is materially affected, any impacts on the social fabric from the presence of “project” staff travelling to and from site and the logistics base. In the unlikely event of a major spill, socio-economic impacts could be associated with a reduction in livelihoods and income, should these be affected.

How the issues will be addressed in the ESIA:

A *socio-economic impact assessment* will be commissioned to, *inter alia*, provide an overview of the social context of the proposed activities and determine the potential socio-economic impacts and benefits associated with the proposed appraisal drilling activities, including unplanned events. This assessment will draw on information provided by the related *technical modelling and specialist studies*.

6.1.4 Potential Impacts on Cultural Heritage

Intangible cultural heritage relates primarily to ritual and spiritual valuations and relations with the elements (wind, water, fire), ritual practices (ancestral veneration) and beliefs (natural-spiritual beliefs in the water sourcing / bearing deities). Well drilling will result in some disturbance of physical elements, such as drilling on portions of the seafloor (which are small relative to the overall block or offshore area), discharges to the water column (including cuttings and drilling fluids) and underwater noise, which could potentially affect peoples' spiritual connectivity with those elements and associated aspects, such as ancestral connections, which in turn may affect peoples' customs, sense of place, wellbeing or rituals.

How the potential impacts will be addressed in the ESIA:

The potential impacts on indigenous people's rights and their religious and ritual connections to the coast and sea during normal drilling operations and upset conditions (well blow-out) will be assessed in the ESIA. This assessment will be based on the findings of a recent study to assess potential cultural heritage impacts of the proposed activities. A standalone study will not be undertaken.

6.1.5 Potential Impacts on Air Quality and Climate Change

The proposed well drilling activities will generate air emissions through the operation of the drilling unit, movement of vessels and helicopters, and flaring during well testing (if a hydrocarbon resource is found). The release of gaseous pollutants (principally nitrogen oxides, sulphur oxides, carbon monoxide, particulate matter and non-methane volatile organic compounds) from related activities has the potential to impact local air quality close to the emissions source, which may in turn have negative effects on human health (e.g., respiratory effects). In addition, some of the gaseous pollutants (mainly carbon dioxide, methane and nitrous oxide) contribute to global GHG emissions, which are the primary driver of changes in the global climate system (increased temperatures, changing weather patterns and sea level rise).

Further to the potential emissions related to normal operations, there would also be fugitive emissions in the unlikely event of a well blow-out. Natural gas (predominantly methane) could be released during a well blow-out, in addition to the combustion emissions related to any response efforts (vessels and helicopters).

How the potential impacts will be addressed in the ESIA:

An *air emissions impact assessment* will be undertaken to establish an emissions inventory of key emission sources (including fuel combustion and flaring during normal operations) and determine the ground-level impacts of emissions using dispersion modelling. On completion of the dispersion modelling, the impact of particulate and gaseous emissions on the receiving environment will be assessed through comparison of calculated ambient concentrations with national standards and international guidelines, as applicable. This assessment will also establish an emissions inventory of an unplanned event and assess the potential impact thereof.

Further to the above, a *climate change risk assessment* will be commissioned for the proposed appraisal drilling (not production). The aim of this study will be to quantify the annual GHG emissions generated during normal operations and an unplanned event and assess (i) the potential risk of a changing climate to the proposed activities, (ii) the potential implications of climate change for "project-affected" communities and natural ecosystems, and (iii) the potential of the proposed activities to contribute to the build-up of GHGs in the atmosphere.

6.2 Summary of Key Potential Impacts and Preliminary Mitigation Measures

A summary of key potential impacts and / or those likely to be of public concern is presented in **Table 3** below, together with preliminary mitigation measures. This is not intended to be an exhaustive list of all the impacts identified, but rather a high-level summary of key impacts and preliminary mitigation measures. These will be formally assessed by the specialists during the Impact Assessment Phase based on the technical modelling studies. Refer to Chapter 9 of the FSR for the "Terms of Reference for Detailed Assessment".

Table 3: Summary of Key Impacts and Preliminary Mitigation / Project Controls.

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls
1	**Marine Ecology**		
1.1	Smothering and disturbance of benthic fauna	• Seabed disturbance from seabed sampling, anchoring and drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • Discharge of residual cement to seabed (Demobilisation)	• Pre-drilling environmental baseline survey or pre-spudding site survey (video footage) to implement buffers around sensitive hardgrounds and vulnerable habitats if present. • Monitor discharges.
1.2	Modification of benthic habitat through additional hard substrate	• Infrastructure on seabed (Demobilisation)	• N/A
1.3	Turbidity, bioaccumulation, toxicity and hypoxic effects on marine fauna	• Discharge of drill cuttings, mud and residual cement (Operation) • Flaring of gas and liquid hydrocarbons (due to 'drop out') (Operation) • Discharge of treated produced water (Operation)	• Drilling discharges: o Usage of low-toxicity drilling fluids and cement. o Monitor discharges. • Flaring: o Optimise well test programme to reduce flaring as much as possible. o Use a high-efficiency burner when flaring to maximise combustion of the hydrocarbons. • Produced water: o Onboard treatment of hydrocarbon component to <30 mg/l or ship to shore.
1.4	Behavioural disturbance of marine fauna	• Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Vessel / drill unit lighting (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Underwater noise from drilling (Operation) • VSP impulsive underwater noise (Operation) • Helicopter atmospheric and underwater noise (Operation)	• Vessel operations: o Reduce the lighting on the "project" vessels to a minimum compatible with safe operations whenever and wherever possible. o Control vessel transit speed between the drill site and port. • VSP operations: o Pre-shoot watch by Marine Mammal Observer, including Passive Acoustic Monitoring. o Implement 'soft start' to VSP activities for slow ramp up of power output. o "Soft-start" procedures. o Shut-downs for animals in mitigation zone.

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls
			• Helicopter operations: o Minimum flying heights and flight paths to avoid sensitive habitats.
1.5	Injury of marine fauna	• Underwater noise from vessel and drilling operations (Mobilisation, Operation, Decommissioning) • VSP impulsive underwater noise (Operation)	• Refer to VSP operations above.
2	**Fisheries**		
2.1	Displacement of fishing vessels	• Vessel presence (Mobilisation, Operation, Demobilisation) • Implementation of safety zone (Operation)	• Stakeholder engagement and notification. • Navigational warning. • Fisheries Liaison Officer. • Survey and accurately charted wellheads with the South African Navy Hydrographic Office (SANHO). • Grievance management.
2.2	Reduced fishing grounds	• Infrastructure on seabed (Demobilisation)	
2.3	Changes in catch due to behavioural change in fish	• Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Vessel / drill unit lighting (Operation) • Underwater noise from drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation)	
2.4	Loss of income from any disruption of fisheries (large pelagic longline)	• Vessel presence (Mobilisation, Operation, Demobilisation) • Implementation of safety zone (Operation) • Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Vessel / drill unit lighting (Operation) • Underwater noise from drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation) • Infrastructure on seabed (Decommissioning)	

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls
3	**Other Socio-economic**		
3.1	Income and skills training for workers	• Employment of staff (Mobilisation, Operation, Decommissioning)	• Appointment of local service providers as far as possible. • Operator's local content policy. • Manage community expectations. • Stakeholder engagement.
3.2	Income from local procurement and spending	• Procurement of facilities and services (Mobilisation, Operation, Decommissioning)	
3.3	State income from taxes and levies	• Procurement of facilities and services (Mobilisation, Operation, Decommissioning)	• N/A
3.4	Deterioration of shore-based community health and safety	• Employment of staff (Mobilisation, Operation, Demobilisation)	• Implement Code of Conduct policy.
3.5	Deterioration of cultural heritage links to the sea	• Routine discharges to sea (Mobilisation, Operation, Decommissioning) • Discharge of ballast water (Mobilisation) • Seabed disturbance from seabed sampling, anchoring and drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation) • Infrastructure on seabed (Demobilisation)	• Stakeholder engagement and notification. • Implement, where necessary, a ritual event/s. • Grievance management.
3.6	Increase in Atmospheric Pollutants and associated Health Risks	• Vessel / drill unit air emissions (Mobilisation, Operation, Decommissioning) • Flaring of gas and liquid hydrocarbons (Operation)	• Optimise rig positioning, rig movement, support / survey vessel routes and the logistics (number of trips required to and from the onshore logistics base) in order to lower fuel consumption. • Optimise well test programme to reduce flaring as much as possible. • Use a high-efficiency burner when flaring to maximise combustion of the hydrocarbons.
3.7	Contribution to GHG emissions		
4	**Unplanned Events**		
4.1	Injury of marine fauna	• Vessel collision with marine fauna (Mobilisation, Operation, Decommissioning)	• Control vessel transit speed between the drill site and port.
4.2	Potential disturbance and damage to seabed habitats and associated fauna	• Loss of equipment (Operation)	• Post drilling ROV survey. • Retrieve of lost objects / equipment, where practicable.
4.3	Collision hazards for other vessels		• Retrieve of lost objects / equipment, where practicable. • Notify SANHO.

<table>
<tr><th>No.</th><th>Potential impact</th><th>Aspects potentially resulting in impact</th><th>Preliminary Mitigation Measures / Project Controls</th></tr>
<tr><td>4.4</td><td>Ecological effects from pollutants in water column and on the surface</td><td rowspan="6">• Vessel or equipment failure and refuelling (Mobilisation, Operation, Decommissioning)
• Loss of well control / blow-out (Operation)</td><td rowspan="6">• Spill training and clean-up equipment.
• Design and Technical Integrity.
• Detailed Technical Risk Analysis.
• Blow-out Preventer.
• Well-specific response strategy and plans (Oil Spill Contingency Plan, Emergency Response Plan, Shipboard Oil Pollution Emergency Plan).
• Capping and Containment Equipment.
• Well-specific oil spill modelling.
• Surface and subsea response.
• Deploy and/or pre-mobilise shoreline response equipment.
• Refuelling procedure.
• Stakeholder engagement.
• Grievance management.</td></tr>
<tr><td>4.5</td><td>Displacement of fishing vessels and target species</td></tr>
<tr><td>4.6</td><td>Loss of income from any disruption of fisheries and other secondary and tertiary sectors that support tourism, recreational, and other coastal economies</td></tr>
<tr><td>4.7</td><td>Deterioration of cultural heritage links to the sea and coast</td></tr>
<tr><td>4.8</td><td>Increase in Atmospheric Pollutants and associated Health Risks</td></tr>
<tr><td>4.9</td><td>Contribution to GHG emissions</td></tr>
</table>

Table of Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
BID	Background Information Document
BOP	Blow-Out Preventer
CITES	Convention on International Trade of Wild Fauna and Flora Endangered Species
CLC	Convention on Civil Liability for Oil Pollution Damage
CMS	Convention on Migratory Species
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DEA	Directorate of Environmental Affairs
DSR	Draft Scoping Report
EBSA	Ecologically or Biologically Significant Area
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPL	Exclusive Prospecting Licence
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FSR	Final Scoping Report
ICCAT	International Convention for the Conservation of Atlantic Tunas
GHG	Greenhouse Gases
GN	Government Notice
HPP	Harambee Prosperity Plan
I&Aps	Interested and Affected Parties
IEA	International Energy Agency
IMO	International Maritime Organisation
LUCORC	Lüderitz upwelling cell – Orange River Cone
LWD	Logging While Drilling
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978
MEFT	Ministry of Environment, Forestry and Tourism
MFMR	Ministry of Fisheries and Marine Resources
MME	Ministry of Mines and Energy
MOC	Management of Change
MoU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
MSP	Marine Spatial Planning
MTI	Ministry of Trade and Industry
MWT	Ministry of Works and Transport
NADF	Non-Aqueous Drilling Fluid
NBSAP	National Biodiversity Strategy and Action Plan
NCCC	National Climate Change Committee
NCCSAP	National Climate Change Strategy and Action Plan
NDC	Nationally Determined Contribution
NDP5	Fifth National Development Plan
NIMPA	Namibian Islands’ Marine Protected Area
NIRP	National Integrated Resource Plan

Acronym/ Abbreviation	Definition
NMVOC	Non-Methane Volatile Organic Compounds
OECD	Organisation for Economic Co-operation and Development
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
PAH	polycyclic aromatic hydrocarbon
PIT	Petroleum Income Tax
PM	Particulate Matter
ROV	Remote Operating Vehicle
SAN	South African Navy
SIA	Socio-Economic Impact Assessment
SLR	SLR Environmental Consulting (Namibia) (Pty) Ltd
SME	Small and Medium Enterprise
SOLAS	International Convention for the Safety of Life at Sea, 1974
TB	Tuberculosis
UNCBD	United Nations Convention on Biological Diversity
UNCLOS	United Nations Law of the Sea Convention
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compounds
VSP	Vertical Seismic Profiling
WBM	Water-Based Mud

1.0 Introduction

This chapter provides the background and location of the proposed activity, and describes the purpose of and structure of this report.

1.1 Background and Location

BW Kudu Limited (BW Kudu), a subsidiary of BW Energy, is the holder of a Petroleum Production Licence (PPL) 003 for Block 2814A, located off the southern coast of Namibia (see Figure 1-1). Block 2814A covers an area of approximately 4 568 km^2 and is located 144 km offshore at its closest point, in water depths ranging from 150 m to 750 m.

BW Kudu is applying to undertake appraisal activities within Block 2814A. The proposed offshore appraisal programme includes:

- Seabed sampling; and
- Drilling up to four appraisal wells, including:
  - Vertical Seismic Profiling (VSP);
  - Well testing; and
  - Plugging and abandonment of wells in the deep offshore.

SLR Environmental Consulting (Namibia) (Pty) Ltd (SLR) was appointed as the independent Environmental Assessment Practitioner (EAP) to undertake a Scoping and Environmental Impact Assessment (EIA) process for the proposed appraisal activities (hereafter collectively referred to as “Environmental and Social Impact Assessment” or “ESIA” process).

1.2 Objective and Purpose of this Report

This Final Scoping Report (FSR) has been compiled as part of the ESIA process that is being undertaken for proposed appraisal well drilling in Block 2814A, off the southern coast of Namibia.

The objectives of the Scoping Phase and this FSR are to, amongst others:

- Identify policies and legislation relevant to the proposed activity;
- Present the need and desirability of the proposed activity;
- Describe the proposed activity, technology, and site(s) (including any alternatives);
- Describe the receiving (baseline) environment to provide an understanding of the environmental and social context and sensitivities within which the proposed activities would occur;
- Screen and identify potential impacts that will be further investigated in the Impact Assessment Phase; and
- Outline the public participation process and scope of specialist studies to be undertaken in the impact assessment phase, as well as the impact assessment methodology to be used to define impact significance (see Section 9.0).

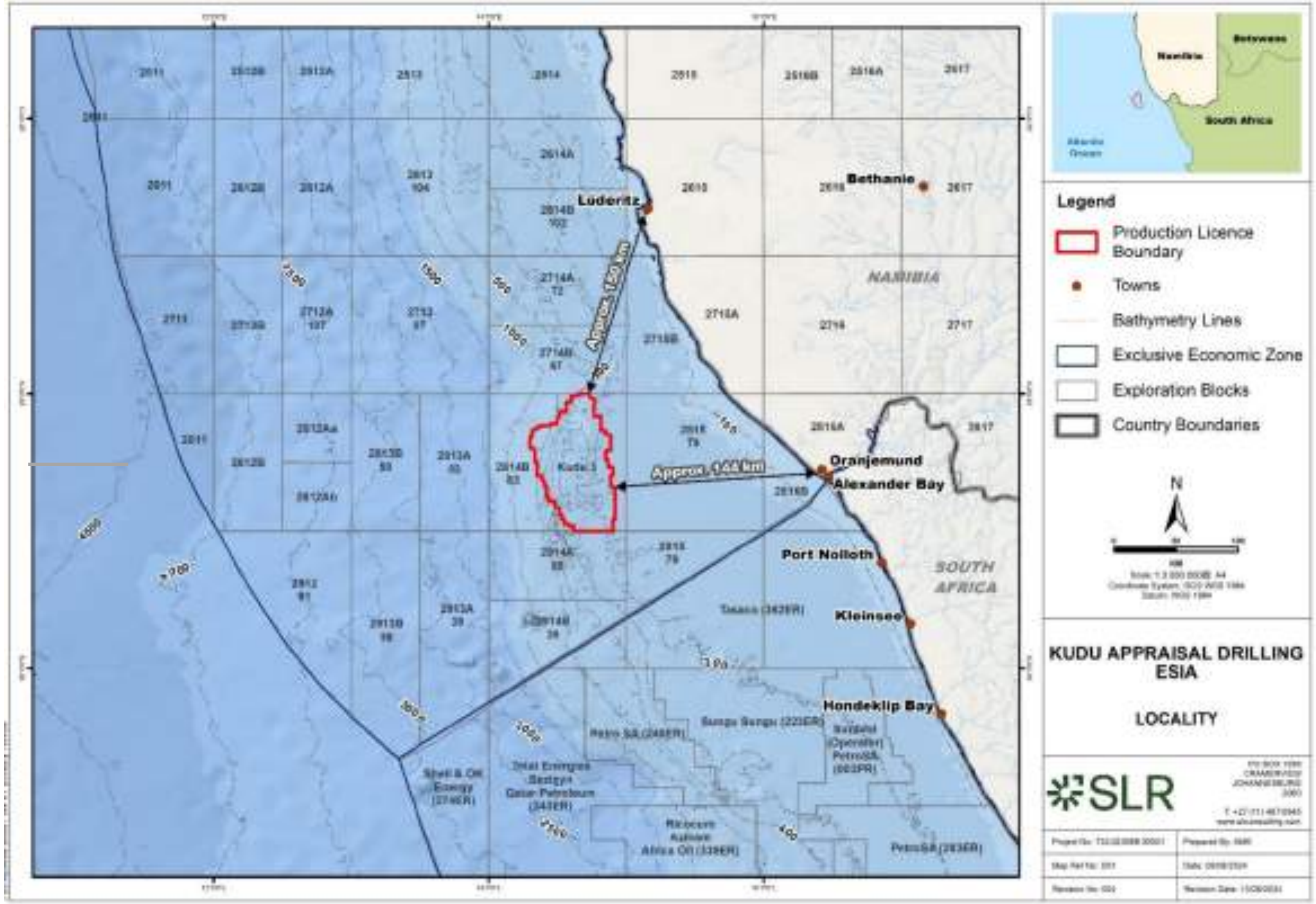

Figure 1-1: Locality Map of Block 2814A (PPL 003) off the southern coast of Namibia and surrounding Blocks

The compilation of the FSR has been informed by comments and issues received following the distribution of the Draft Scoping Report (DSR) for a 30-day comment period (18 September to 18 October 2024) and those raised during the two public meetings held in Lüderitz and Walvis Bay. Comments received by SLR have been recorded and responded to in a Comments and Responses Report (see Appendix B.9 of the FSR). **It should be noted that all significant changes to the draft report are underlined and in a different font (Times New Roman) to the rest of the text.**

This report is submitted to the Ministry of Mines and Energy (MME): Directorate of Petroleum Affairs for consideration and review. In terms of Section 32 of the Environmental Management Act, 2007 (No. 7 of 2007), MME is then required to make a recommendation on the acceptance or rejection of the report to the Ministry of Environment, Forestry and Tourism (MEFT): Directorate of Environmental Affairs (DEA), who will make the final decision regarding the acceptance of the FSR.

1.3 Structure of this Report

This report has been prepared in compliance with Section 8 of the EIA Regulations 2012 (see Table 3-2). An overview of the structure and content of this report is given in Table 1-1 below.

Table 1-1: Structure and content of the Final Scoping Report.

Section	Contents
Executive Summary	Provides a synopsis of the DSR.
Chapter 1	**Introduction** Provides the background and location of the proposed activity, and describes the purpose and the structure of this report.
Chapter 2	**Administrative and Legal Framework** Outlines the Namibian administrative framework, key legislative requirements and other relevant local legislation and international conventions applicable to the proposed activities and ESIA process.
Chapter 3	**ESIA Approach and Methodology** Presents the ESIA project team, ESIA assumptions and limitations, and outlines the approach and process followed during the ESIA.
Chapter 4	**Public Consultation Process** Presents and describes the public consultation process undertaken during the ESIA process.
Chapter 5	**Need and Desirability** Provides an overview of the national policies informing the need and desirability for the proposed activity.
Chapter 6	**Description of the Proposed Activities** Provides general information and a detailed description of the proposed activities and associated alternatives.
Chapter 7	**Receiving Environment** Describes the existing physical, biological, socio-economic and cultural environment that could potentially be affected by the proposed appraisal activities.

Section	Contents
Chapter 8	**Screening of Environmental and Socio-Economic and Key Impacts** Provides a high-level screening of the interaction between the proposed activities and the biophysical and social environment; identifies key issues and impacts associated with the proposed appraisal activities; and describes alternatives and options for further consideration in the ESIA.
Chapter 9	**Plan of Study for Impact Assessment** Outlines the scope of further investigations (including the specialist studies) to be undertaken during the Impact Assessment Phase and sets out the proposed approach to the assessment of impacts.
Chapter 10	**References** Provides a list of the references used in compiling this report.
Appendices	Appendix A: Curricula Vitae of the SLR ESIA Project Team Appendix B : Public Participation Process Documents Appendix B.1: List of Stakeholders Appendix B.2: Advertisements Appendix B.3: Site Notices Appendix B.4: I&AP notification letters and emails Appendix B.5: Non-Technical Summary Appendix B.6: Public meeting presentation Appendix B.7: Meeting minutes and photographs of public meetings Appendix B.8: I&AP correspondence received during the DSR comment period Appendix B.9: Comments and Responses Report

2.0 Administrative and Legal Framework

This chapter outlines the Namibian administrative framework, key legislative requirements and other relevant local legislation and international conventions applicable to the proposed activities and ESIA process.

2.1 Namibian Institutional and Administrative Framework

2.1.1 Ministry of Environment, Forestry and Tourism

MEFT is the custodian of Namibia's natural environment, and its mission is to "*promote biodiversity conservation in the Namibian environment through the sustainable utilisation of natural resources and tourism development for the maximum social and economic benefit of its citizens*". MEFT develops, administers and enforces environmental legislation and policy.

The Ministry comprises six directorates; one of which is the DEA. DEA gives effect to Article 95L of the Constitution by promoting environmental sustainability. The Environmental Commissioner serves as head of the DEA. The DEA administers ESIA processes undertaken in terms of the Environmental Management Act, 2007 and the EIA Regulations 2012 and will be responsible for issuing a decision on the ESIA based on the recommendation from MME. If approved, the DEA will issue an ECC.

2.1.2 Ministry of Mines and Energy

The MME is responsible for promoting and regulating the development and use of Namibia's natural resources. The Ministry comprises seven directorates; one of which is the Directorate of Petroleum Affairs.

The Directorate of Petroleum Affairs regulates the petroleum industry. It issues licences for petroleum exploration and production.

MEFT requires that applications for ECCs for oil and gas appraisal activities must be submitted to MME as the Competent Authority, with responsibility assigned to the Petroleum Commissioner. On conclusion of the ESIA process, MME will make a recommendation on the application to MEFT, who in turn is required to make the final decision on the application for ECC.

2.1.3 Ministry of Works and Transport

The Ministry of Works and Transport (MWT) is responsible for infrastructure development and setting transport policy and regulation. MWT comprises the four departments, one of which is the Department of Transport.

The Directorate of Maritime Affairs falls under the Department of Transport. This Directorate is responsible for ensuring the safety of life and property at sea; the prevention and combat of pollution of the marine environment by ships; and promotion of Namibia's maritime interests.

2.1.4 Namibian Ports Authority

The Namibian Ports Authority (Namport) is a public entity that reports to MWT. The National Ports Authority Act, 1994 (No. 2 of 1994) gives Namport the responsibility of protecting the environment within harbour areas. Namport manages both the Port of Walvis Bay and the Port of Lüderitz.

2.1.5 Ministry of Fisheries and Marine Resources

The Ministry of Fisheries and Marine Resources (MFMR) is responsible for the management and development of fisheries and aquaculture in Namibia. The Ministry is comprised of four directorates; two of which are the Directorate of Resource Management and Directorate of Operations.

The Directorate of Resource Management is responsible for scientific research and providing advice on the state of commercially important marine fish stocks and recommending catch quotas. It is also responsible for managing and regulating species fish size limits, dates of closed fishing seasons, declaring areas closed to fishing and determining fishing gear use.

The Directorate of Operations is responsible for monitoring, controlling and surveillance of fishing-related activities both at sea and onshore.

2.2 Laws and Policies Applicable to Oil and Gas Appraisal Drilling

2.2.1 Introduction

The Republic of Namibia has five tiers of law, namely:

- The Constitution;
- Statutory law;
- Common law;
- Customary law; and
- International law.

The Constitution of the Republic of Namibia (1990) sets founding principles which govern Namibian law. Article 95 (L) of the Constitution commits the State to promote sustainable development by "*maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians both present and future…*".

The key policy and legislative requirements and guiding principles underpinning the ESIA process are outlined below (see Section 3.4 for information on the ESIA process itself).

2.2.2 Policy and Legal Framework for ESIA

2.2.2.1 Environmental Assessment Policy for Sustainable Development and Environmental Conservation, 1995

Namibia's Environmental Assessment Policy was published in 1995 and promotes sustainable development and economic growth while protecting the environment in the long-term. The government recognises that EIA (termed Environmental Assessment in the Policy) is a key tool to further the implementation of a sound Environmental Policy that strives to achieve Integrated Environmental Management. EIAs ensure the consequences of development projects are considered and incorporated into the planning process. Marine petroleum exploration and production are listed as an activity that requires an EIA. This ESIA aims to fulfil the requirements of this Policy.

2.2.2.2 Environmental Management Act, 2007

The Environmental Management Act, 2007 (No. 7 of 2007) was promulgated in December 2007 and came into effect on 6 February 2012. The main objectives of this Act are to ensure that:

- Significant effects of activities on the environment are considered carefully and timeously;
- There are opportunities for timeous participation by I&APs throughout the assessment process; and
- Findings are considered before any decision is made in respect of activities.

Section 3(2) of the Act provides a set of principles which give effect to the provisions of the Constitution for integrated environmental management. Decision-makers must take these principles into account when deciding on a proposed project or activity. This Act stipulates that no party, whether private or governmental, can conduct a listed activity without an ECC obtained from the Environmental Commissioner.

2.2.2.3 EIA Regulations 2012

The EIA Regulations 2012, promulgated on 6 February 2012 in terms of Section 56 of the Environmental Management Act, 2007 (Government Notice [GN] No. 30) provides for the control of certain listed activities. These listed activities are provided in GN No. 29 and are prohibited until an ECC has been obtained from MEFT. Such ECCs, which may be granted subject to conditions, will only be considered once there has been compliance with the EIA Regulations 2012. GN No. 30 sets out the procedures and documentation that need to be complied with in undertaking an EIA process. Listed activities applicable to the proposed activities are presented in Table 2-1.

Table 2-1: List of applicable activities that require an ECC in terms of the EIA Regulations 2012

Activity	Comment
2. Waste management, treatment, handling and disposal activities	
2.2 Any activity entailing a scheduled process referred to in the Atmospheric Pollution Prevention Ordinance, 1976.	There are currently no scheduled activities listed in terms of the Atmospheric Pollution Prevention Ordinance, 1976. This activity has, however, been included should the incineration of waste be listed in future.
2.3 The import, processing, use and recycling, temporary storage, transit or export of waste.	Waste would be generated by the drilling unit and transported to shore by the support vessels. Also refer to Section 6.4.5 for operational discharges and wastes.
3. Mining and quarrying activities	
3.2 Other forms of mining or extraction of any natural resources whether regulated by law or not.	The objective of the proposed appraisal well drilling is to investigate the hydrocarbon potential of the geological structure of the "prospect" in the license area. This may result in the extraction of oil or gas during well testing. Refer to Section 6.4.3.4 for a description of well drilling operations.
3.3 Resource extraction, manipulation, conservation and related activities.	

Activity	Comment
3.4 The extraction or processing of gas from natural and non-natural resources, …	
9. Hazardous substance treatment, handling and storage	
9.1 The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974	Non-aqueous drilling fluid (NADF) and hydrocarbons are not specifically defined in the Hazardous Substances Ordinance, 1974. This activity has, however, been included, as components of the drilling fluid are hydrocarbons and could be considered to have hazardous properties. Refer to Section 6.4.3.3 for a description of drilling fluids.
9.3 The bulk transportation of dangerous goods using pipeline, funiculars or conveyors with a throughout capacity of 50 tons or 50 m^3 or more per day.	The proposed drilling operation would make use of infrastructure (particularly the pipe casings inside the wellbore) which could convey oil or gas from the geological structure to the drilling unit at the surface. This activity is included to provide for a situation where the throughput capacity of hydrocarbons is 50 tons (t) or 50 m^3 or more per day. Refer to Section 6.4.3.4 for a description of well drilling procedure, including the installation of pipe casings in the wellbore and well testing.
9.4 The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 m^3 at any one location.	The proposed drilling operation would make use of infrastructure which would handle and store oil, gas and/or fuel (diesel, marine gas oil). This activity is included to provide for a situation where the combined storage capacity exceeds 30 m^3 at any one location. Refer to Section 6.0 for a detailed description of the proposed well drilling programme including, *inter alia*, drilling unit, drilling equipment and procedure and onshore support infrastructure.
10. Infrastructure	
10.1 The construction of (e) any structure below the high-water mark of the sea;	The proposed drilling operations would result in the placement of drilling equipment (i.e. a wellhead) on the seabed. However, during decommissioning, the wellhead(s) will be removed (with casings cut-off below the seafloor). Refer to Sections 6.4.3.6 and 6.4.4 for a description of the well plugging procedure and decommissioning, respectively.

2.2.3 Policy and Legal Framework for Oil and Gas Production

2.2.3.1 Petroleum (Exploration and Production) Act, 1991

The Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991) governs oil and gas exploration in Namibia. Section 9 of this Act requires a licence is obtained from the MME before any reconnaissance, exploration or production operations for petroleum can be undertaken. Prior to the granting of an Exploration or Production Licence, a Petroleum Agreement must be entered into between the Minister and the potential licence in terms of

Section 13 of the Act. The Petroleum Agreement prescribes that all companies must undertake EIAs for production activities.

2.2.3.2 Petroleum (Exploration and Production) Act Regulations, 1999

The Petroleum (Exploration and Production) Act Regulations, 1999, promulgated under Section 76A of the Petroleum (Exploration and Production) Act, 1991, sets out the obligations of the operator to:

- take all such precautions as may be necessary to protect the environment and natural resources;
- make copies of these regulations available to people employed by or performing work for the operator (sub-contractors);
- provide funds and take measures to ensure the health, safety and welfare of employees and the protection of other persons, property, the environment and natural resources from hazards arising from petroleum activities;
- undertake EIA studies provided for in the Model Petroleum Agreement between the Minister and the operator;
- register the installation and ensure that it has a certificate of fitness;
- report the location of the installation to the Petroleum Commissioner and ensure that it is published in a “Notice to Mariners”;
- ensure the installation is properly marked (see International Regulations for Preventing Collisions at Sea as incorporated into the Merchant Shipping Act, 1951);
- equip the installation with the necessary equipment to record environmental data;
- ensure hazardous substances are properly transported, handled and stored;
- ensure an Emergency Preparedness Plan is in place and updated as necessary;
- establish an appropriate safety / exclusion zone and communicate it to the Petroleum Commissioner, and ensure it is published in the “Notice to Mariners”; and
- communicate any emergency to the Petroleum Commissioner immediately.

2.2.3.3 Minerals Policy of Namibia, 2004

The Policy sets out guiding principles for the development of the “mining” sector (which includes mining, energy and oil / gas), while at the same time operating within environmentally acceptable limits. One of the objectives of the Policy is ensuring compliance with national environmental policy and other relevant policies to develop a sustainable mining industry.

The Policy commits MME to ensuring:

- that the development of the mining industry proceeds on an environmentally sustainable basis;
- that mineral / resource development in proclaimed protected areas commences only when rehabilitation is guaranteed; investigating the establishment of financial mechanisms (environmental trust funds or bonds) for environmental rehabilitation and aftercare in other areas; and
- to developing national waste management standards and guidelines in consultation with the mining industry.

The provisions of this policy have been given effect through the enactment of the Petroleum (Exploration and Production) Act 2 of 1991 and Regulations.

MME is in the process of drafting a new National Minerals Policy, the "draft National Minerals Policy, 2018"; this Policy notes that minerals are valuable natural resources being the vital raw material for the core sectors of the economy, and that mining must be carried out in an environmentally sustainable manner.

2.2.4 Other Laws and Policies Relevant to Oil and Gas Appraisal Drilling

Other legislation relevant to the proposed activities are summarised in Table 2-2 below. Not all items are relevant to the ESIA process, and other legislation may also apply.

Table 2-2: Sectorial Laws and Regulation

Aspect	Law	Key Provisions
Petroleum sector	Petroleum Products and Energy Act (No. 13 of 1990) and relevant regulations	This Act provides for the application of environmental standards and the avoidance of environmental harm caused by the keeping, handling, conveying, using and disposing of petroleum products.
	Petroleum Laws Amendment Act (No. 24 of 1998)	This Act amends the Petroleum (Exploration and Production) Act, 1991 so as to, *inter alia*, make provision for the extension of the duration of exploration licences.
	Petroleum (Taxation) Act (No. 3 of 1991)	This Act provides for the levying and collection off a petroleum income tax and an additional profits tax in respect of certain income received by or accrued to or in favour of persons in connection with exploration operations, development operations or production operations carried out in Namibia in relation to petroleum.
Transport and Maritime sector	Marine Traffic Act (No. 2 of 1981) (as amended by the Marine Traffic Amendment Act (No. 15 of 1991)	This Act provides for the regulation of marine traffic within the Republic of Namibia.
	The Merchant Shipping Act (No. 57 of 1951)	This act regulates, *inter alia,* the nature and variety of goods to be shipped and the safety of ships and life at sea.
	Namibian Ports Authority Act (No. 2 of 1994) and Port Regulations	The Act provides for the establishment of the Namibian Ports Authority, which is charged with the management and control of ports and lighthouses in Namibia and the provision of facilities and services related thereto.
	Civil Aviation Act (No. 6 of 2016) and associated regulations	This Act consolidates the laws relating to civil aviation and civil aviation offences.
	Road Traffic and Transport Act (No. 22 of 1999)	This Act provides for the control of traffic on public roads, the licensing of drivers, the registration and licensing of vehicles, and the control and regulation of road transport across Namibia's borders.
	Wreck and Salvage Act (No. 4 of 2004)	This Act provides for the salvage of ships, aircraft and life and the protection of the marine environment.
	Territorial Sea and Exclusive Economic Zone of Namibia Act (No. 3 of 1990)	This act claims the various maritime zones to which Namibia is entitled under international law (in this case, UNCLOS).

Aspect	Law	Key Provisions
	The Territorial Sea and Exclusive Economic Zone of Namibia Amendment Act (No. 30 of 1991)	This Act changes the extent of the territorial zone to 24 miles.
Pollution	Atmospheric Pollution Prevention Ordinance (Ordinance 11 of 1976)	This Act provides for the prevention of the pollution of the atmosphere.
	Dumping at Sea Control Act (No. 73 of 1980)	This Act provides for the control of dumping of substances in the sea within 12 nautical miles of the low water mark.
	International Convention for the Prevention of Pollution from Ships Act (No. 2 of 1986)	This Act provides for the application of the MARPOL 73/78.
	International Convention relating to Intervention on the High Seas in cases of Oil Pollution Casualties Act (No. 64 of 1987)	This Act provides for the application of the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties.
	Prevention and Combating of Pollution of Sea by Oil Act (No. 6 of 1981) and associated Regulations	This Act provides for the prevention and combating of pollution of the sea by oil and determines liability in certain respects for loss and damage caused by the discharge of oil from ships, tankers and offshore installations. The provisions relating to offshore installations only apply to such installations as are situated within 50 nautical miles of the low water mark.
	Marine Notice (No. 2 of 2012): Transfer of Oil Outside Harbours	This notice sets out the requirements to transfer oil within Namibian waters.
Environmental/ Conservation	Marine Resources Act (No. 27 of 2000) and Regulations relating to the Namibian Islands' Marine Protected Area (NIMPA)	This Act provides for the conservation of the marine ecosystem and the responsible utilisation, conservation, protection and promotion of marine resources on a sustainable basis.
	Nature Conservation Ordinance (No. 4 of 1975)	The Regulations relating to the NIMPA provide with respect to the protection of resources of the Namibian Islands Marine Reserve. The Regulations delineate the protected areas, give coordinates of the All-encompassing buffer zone of the NIMPA, and places restrictions on various activities in the protected area and the buffer zone.
	Nature Conservation Amendment Act (No. 5 of 1996)	This Ordinance consolidates and amends the laws relating to the conservation of nature; the establishment of game parks and nature reserves; and the control of problem animals.
	National Heritage Act (No. 27 of 2004)	This Act amends the Nature Conservation Ordinance, 1975, so as to insert and substitute certain definitions; to provide for a proper administrative, legal and procedural framework for tourism concessions in protected areas and other State land; to control the import and export of live

Aspect	Law	Key Provisions
		game or animal, and to increase the penalties; and to provide for incidental matters.
	Water Act (No. 54 of 1956)	This Act provides for, inter alia, the protection and conservation of places and objects of heritage significance.
	Water Resources Management Act (No. 11 of 2013)	This Act provides for the control, conservation and use of water for domestic, agricultural, urban and industrial purposes and for the control of certain activities on or in water in certain areas.
Hazardous Substances	Hazardous Substances Ordinance (Ordinance 14 of 1974)	These provide for the control of toxic substances which may cause injury, ill health or death of human beings.
	The Hazardous Substances Ordinance 14 of 1974: Group I Hazardous Substances	
Labour	Labour Act (No. 11 of 2007)	This Act sets out the fundamental rights of workers and basic conditions for work.
	Regulations relating to the health and safety of employees at work (GN 156 of 1997)	These Regulations establish health and safety regulations for the workplace.
	Employee's Compensation Act (No. 30 of 1941), as amended	This Act provides for employees' compensation.
Health	Health Act (No. 21 of 1988)	This Act only relevant in as much as workers must be protected from harm.

A summary of other policies, plans and guidelines applicable to the proposed activities is provided in Table 2-3. Some of these documents are discussed in more detail in Chapter 5.0.

Table 2-3: Applicable Policies and plans

Policy	Key Provisions
White Paper on the Energy Policy, 1998	The White Paper on the Energy Policy (1998) is the overarching policy document which guides future policy and planning in the energy sector (see Section 2.3.1.1).
Namibia Vision 2030	This outlines the country's development programmes and strategies to achieve its national objectives. One of the major objectives of Vision 2030 is to “ensure the development of Namibia’s ‘natural capital’ and its sustainable utilisation, for the benefit of the country’s social, economic and ecological well-being” (see Section 2.3.1.2).
Fifth National Development Plan 2017/18 – 2021/22 (NDP5)	Namibia’s Fifth National Development Plan (2017/18 – 2021/22) provides the context for all development in Namibia, with the overarching aim of economic and social development (see Section 2.3.2.2).
Namibia’s Industrial Policy (2012 & 2015)	Namibia’s Industrial Policy advocates a targeted approach towards industrialisation within the country (see Section 2.3.2.3).
Namibia’s National Energy Policy (2017)	Namibia’s National Energy Policy spells out the Government’s intent, direction and undertaking regarding the development and future of the Namibian energy sector (see Section 2.3.1.2).
Namibia’s Climate Change Policy Framework (2021 update)	Namibia’s Climate Change Policy Framework sets key milestones for Namibia’s response to climate change (see Section 2.3.3.1).
Namibia’s Updated Nationally Determined Contribution (NDC; 2021)	Namibia’s NDC sets out it’s mitigation commitment to decrease its Greenhouse Gas (GHG) emissions by 2030 (see Section 2.3.3.2).
Harambee Prosperity Plan (HPP), 2015	In 2015, the Harambee Prosperity Plan (HPP) was compiled to complement Vision 2030 and NDP5. The five-year plan aims to achieve social advancement through economic and infrastructure development and effective governance. It promotes the need for the mining sector to develop or support Small and Medium Enterprises (SMEs) through the procurement supply chain and to provide housing for its employees.
Strategic Plan, 2017/2018 – 2021/2022	In order to achieve the objectives in Vision 2030, HPP and NDP5, MME developed the Strategic Plan (2017/2018 – 2021/2022). This Plan provides the strategic direction of MME aimed at achieving its Mandate, Vision, Mission and Strategic Objectives. It aims to ensure the development of Namibia’s natural capital and its sustainable utilisation for the benefit of the country’s social, economic and ecological well-being. The HPP also includes elements from the Ministry of Trade and Industry’s (MTI) industrialisation strategy, “Growth at Home”, which promotes local value addition of raw materials before they are exported, building and promoting regional value chains and bilateral cooperation, nurturing infant industries, and the continuous reform of the business environment to become more competitive (MTI, 2015).

Policy	Key Provisions
Policy for Prospecting and Mining in Protected Areas and National Monuments, 1999	The aim of this Policy is to promote sustainable development in Namibia by permitting prospecting and mining in the country's Protected Areas and National Monuments. It stipulates that government must ensure that short- to medium-term mining projects do not jeopardise the potential for long-term sustainable development.
Policy for the Conservation of Biotic Diversity and Habitat Protection, 1994	This Policy was drafted by MEFT to ensure adequate protection of all species and subspecies, of ecosystems and of natural life support processes.
National Policy on Prospecting and Mining in Protected Areas, 2018	This Policy guides decision-making with regards to exploration / appraisal and mining in protected areas. This policy has been developed to complement various regulations and policies relevant to prospecting and mining in order to ensure minimal negative impacts on the environment.
National Waste Management Policy, 2010	This Policy provides a framework for guidelines for safe and sustainable waste management practices, as well as the formulation of legislations on waste management for Namibia.
National Biodiversity Strategy and Action Plan (NBSAP) 1 and 2 (2013-2022)	The NBSAP is the key national level implementing instrument of the objectives of the United Nations Convention on Biological Diversity.
National Agriculture Policy, 2015	This Policy recognises the problems of bush encroachment, desertification and environmental degradation caused by the destruction of forest cover, soil erosion, overgrazing and bush encroachment.
New Equitable Economic Empowerment Framework Policy, 2011	The ultimate objective of this Policy is to create an equitable and socially just society in which the distribution of income becomes far more equitable than it is at present.
National Environmental Health Policy, 2002	This Policy provides a framework and guidelines to prevent and control environmental health hazards and risks that may adversely affect health and quality of life for all the people in Namibia.

2.3 Local and National Policy and Planning Frameworks

2.3.1 Energy-Related Plans and Policies

2.3.1.1 White Paper on the Energy Policy (1998)

The White Paper on the Energy Policy (1998) is the overarching policy which guides planning in the energy sector. This White Paper embodies a new, comprehensive energy policy aimed at achieving security of supply, social upliftment, effective governance, investment and growth, economic competitiveness, economic efficiency and sustainability. The legislative framework governing upstream oil and gas is well developed, and the White Paper merely clarifies an accepted policy framework which seeks to optimise national benefits while achieving the necessary balance of interests to attract investment. The focus of the White Paper is on creating a policy and legislative framework, which attracts initial investment into the sector, while maintaining options for competition in the future and the fair distribution of economic rents.

2.3.1.2 Namibia's National Energy Policy 2017

The National Energy Policy spells out the Government of Namibia's intent, direction and undertakings regarding the development and future of the Namibian energy sector (MME, 2017).

For the electricity sector, the key policy thrusts are the development of local generation capacity to improve security of supply through appropriate planning at national level, reviewing the present electricity market model, ensuring the on-going viability and development of the transmission and distribution networks, strengthening the regulatory framework, and shaping the electricity mix of the future (MME, 2017).

For the upstream oil and gas sector, the key policy thrust is aimed at promoting the country's exploration potential, attracting investments to further explore Namibia's oil and gas potential, and strengthening the capacity in the sector as well as the regulation of the sector to support such investments, while also protecting Namibia's national interests. The Government resolves to:

- Strengthen the national investment climate, to ensure certainty, stability and competitiveness through favourable commercial, legal and fiscal terms.
- Facilitate private sector investments and support the development of necessary expertise in the exploration and development of the country's oil and gas resources.
- Continue to promote investments in the oil and gas sector at international, regional and national events. encourage collaboration between existing licence holders to carry out joint exploration programmes (MME, 2017).

2.3.1.3 National Integrated Resource Plan 2022

Namibia's National Integrated Resource Plan (NIRP) 2022 is an updated strategic framework for the country's electricity supply industry. It is a 20-year development plan outlining the country's energy goals and the steps needed to achieve covering the period from 2022 to 2042.

- Renewable Energy Commitments: The plan includes commitments to add 2 850 MW of renewable energy generation capacity and 650 MW of battery energy storage by 2040.
- Load Forecasting and Supply/Demand Balance: Updated projections for electricity demand and supply, ensuring that future energy needs are met efficiently.
- Policy Scenarios and Investment Choices: Various scenarios and investment options are evaluated to determine the most cost-effective and sustainable energy solutions.
- Integration of Renewable Energy: Continued focus on integrating solar and wind energy into the national grid.

The NIRP 2022 aims to ensure a reliable, sustainable, and cost-effective energy supply for Namibia, aligning with national policy goals and environmental standards.

The NIRP 2022 specifically notes that it is desirable to make appropriate use of indigenous energy resources in supplying the electricity demand in Namibia, including the Kudu Gas Field. It further mentions BW Energy's intensions to develop a proposed 420 MW gas-fired power plant with a production life of at least 20 years. The development of the Kudu Gas Field is included in the planning scenarios.

2.3.2 Economy-Related Policies

2.3.2.1 Vision 2030

In 2004, Namibia adopted Vision 2030, which outlines the country's development programmes and strategies to achieve its national objectives. One of the major objectives of Vision 2030 is to *"ensure the development of Namibia's 'natural capital' and its sustainable utilisation, for the benefit of the country's social, economic and ecological well-being".*

The vision for non-renewable resources is that Namibia's mineral resources are strategically exploited and optimally beneficiated, while ensuring that environmental impacts are minimised. Vision 2030 acknowledges that poorly planned or badly managed mining can result in a great variety of impacts that threaten human health and environmental integrity. Vision 2030 further notes that with EIAs applied during the planning phase and the implementation of ESMPs during operational phase, operations are increasingly better planned and negative impacts can usually be mitigated and localised.

2.3.2.2 Fifth National Development Plan 2017/18 – 2021/22

Vision 2030 is being implemented through a series of five-year National Development Plans. The Fifth National Development Plan 2017/18 – 2021/22 (NDP5) aims to achieve rapid industrialisation, while adhering to the four integrated pillars of sustainable development:

- Economic Progression;
- Social Transformation;
- Environmental Sustainability; and
- Good Governance.

NDP5 recognises the use of Namibia's natural resources in an efficient and sustainable way to achieve sustainable development and improve the welfare of the nation's citizens. In this regard, it emphasises the importance of partnerships between government, the private sector, communities and civil society in ensuring that economic progress is achieved in an environment of social harmony.

It also plans to achieve economic progression by developing value added industrialisation, substituting imports for locally produced goods, creating value-chains of production, and to accelerate Small and Medium Enterprise (SME) development (NPC, 2017).

2.3.2.3 Namibia's Industrial Policy

In 2012, the then Ministry of Trade and Industry (MTI) developed Namibia's Industrial Policy. Three years after drafting the Industrial Policy, the MTI produced an execution strategy for industrialisation in 2015 called "Growth at Home" (MTI, 2015).

The strategy advocates a targeted approach towards industrialisation. In the first phase of Growth at Home, sectors in which Namibia already has some sort of comparative advantage will be targeted (MTI, 2015). Mining (and other extraction) is identified as one of a number of particular sectors to be targeted. The strategy sets out a broad outline of how downstream industries should be developed to ensure that the job creation and socio-economic benefits which stem directly and indirectly from primary production are maximised (MTI, 2015).

2.3.2.4 Local and Regional Socio-Economic Policy

With respect to regional planning, the socio-economic development objectives of the Erongo Region have a special focus on uplifting the standard of living within the region (ERC, 2015). They include the following:

- ensuring regional and rural economic development;
- creating employment opportunities;
- improving infrastructure, with the delivery of basic services to rural areas a priority;
- co-ordinating training of community members in entrepreneurial skills; and
- educating the community with regard to the prevalence of HIV/Aids and Tuberculosis cases.

The strategic socio-economic development objectives for the //Karas Region (KRC, 2017) include the following:

- enhancing spatial planning;
- improving key infrastructure;
- providing basic services and housing;
- enhancing food security;
- promoting economic opportunities; and
- ensuring inclusive and equitable quality education for all.

The //Karas Regional Council also notes on its webpage that "[t]*he region still possesses many untapped raw materials, such as offshore natural gas and other minerals that promise new industries*" (KRC, 2015).

The town councils of both Lüderitz and Walvis Bay seek to ensure that their economies are well diversified. The Walvis Bay Town Council has pointed out that Walvis Bay, with its deep-water port, ship repair and logistics handling facilities, is particularly well placed to serve an oil extraction industry which could develop in the wake of a significant oil discovery (WBTC, 2017).

2.3.3 Climate Change-Related Policies

2.3.3.1 Namibia's Climate Change Policy Framework

Namibia has a policy framework in place to deal with climate change. The key milestones in Namibia's Climate Change Policy Framework include:

- In 1995 Namibia ratified the United Nations Framework Convention on Climate Change (UNFCCC). The ultimate objective of the Convention is the stabilisation of greenhouse gas concentrations in the atmosphere.
- Namibia established the National Climate Change Committee (NCCC) in 2001.
- Namibia developed their National Climate Change Policy in 2010-2011. This document presents information about the main expected impacts of climate change in Namibia and about those most vulnerable. The document also proposes objectives that the Government will aim to achieve through an effective and efficient response to climate change.
- Namibia published a National Disaster Risk Management Plan in 2011. This Plan aims to provide guidance and strengthen national capacity for disaster risk management and to provide a framework for sectoral and regional disaster risk management in Namibia.

- The National Climate Change Strategy and Action Plan (NCCSAP, 2013-2020) lays out the guiding principles responsive to climate change that is effective, efficient and practical. It further identifies priority action areas for adaptation and mitigation.
- A new climate action plan (Intended Nationally Determined Contribution) was submitted to the UNFCCC in September 2015, ahead of the 2015 Paris Agreement. It was converted to a Nationally Determined Contribution in 2016.
- In April 2016 the president of the Republic of Namibia signed the Paris Agreement and followed that up in September 2016 by ratifying the Agreement. The Paris Agreement is a comprehensive framework which aims to guide international efforts to limit GHG emissions and to meet challenges posed by climate change. Each individual country is responsible for determining their contribution (referred to as the “Nationally Determined Contribution” (NDC)) in reaching this goal. The Agreement requires that these contributions should be "ambitious" and "represent a progression over time". The contributions should be reported every five years and are to be registered by the UNFCCC Secretariat. As a signatory to the Agreement, Namibia was required to adopt the agreement within its own legal systems, through ratification, acceptance, approval or accession.

Estimates as reported by Namibia Country Diagnostic (2017) puts Namibian GHG emissions per capita at 9.15 Gg CO_2-eq with the total national emissions estimated at 0.02% of the global total. Namibia aims to reduce GHG emissions by 89% by 2030, compared to the “Business as Usual” scenario. The focus areas to achieve this mitigation objective are sustainable energy (including green hydrogen and green ammonia), transport and Agriculture, Forestry and Other Land Use (AFOLU).

2.3.3.2 Namibia’s Updated Nationally Determined Contribution, 2021

Namibia is committed to the Paris Agreement and to taking actions to reduce emissions and ensure a climate-resilient economy. In line with its Climate Change Policy, Namibia's mitigation commitment is in the form of a decrease in GHG emissions compared to the "Business as Usual" baseline over the 2015-2030 period, which presents an improvement in its commitment to meeting the Paris Agreement goal and meeting the goal of net zero emissions by 2050.

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. The updated NDC includes climate-friendly and energy-efficient refrigeration and air conditioning. Low Global Warming Potential technology options, particularly technology with natural refrigerants, exist as an alternative to HFCs for almost any refrigeration and air conditioning appliance. In the "agriculture, forestry, and other land uses" sector, the main driver of the 2030 goal is to reduce the deforestation rate. Namibia has acknowledged that reforestation, agroforestry and urban forests are vital to both carbon and timber productivity through best forest management practices. Under the waste sector, energy utilisation measures such as Municipal Solid Waste transformation into compost and electricity are the most important opportunities.

2.4 International Laws and Conventions

Relevant international conventions and treaties which have been ratified by the Namibian Government and which have become law through promulgation of national legislation are listed in Table 2-4 below.

Table 2-4: Ratified International Conventions and Treaties

Conventions and Treaties	Summary of legislative provisions
Air and Atmosphere	
Kyoto Protocol on the Framework Convention on Climate Change, 1997	This Protocol was the key instrument on which the 1992 United National Framework Convention on Climate Change is based.
Montreal Protocol on Substances that Delete the Ozone Layer, 1987	This Protocol lays down a timetable for the reduction of controlled substances that deplete the ozone layer and have adverse effects on health and the environment.
Paris Agreement (United Nations Framework Convention on Climate Change), 2015	The Paris Agreement is a comprehensive framework that aims to guide international efforts to limit GHG emissions and to meet challenges posed by climate change. The Paris Agreement was adopted on 12 December 2015 at the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC CoP21). The agreement was signed by Namibia in April 2016. The long-term goals of the Paris Agreement are: • Limit the global temperature increase to below 2°C above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels. • Increasing countries' ability to adapt to the effects of climate change and to foster climate resilience. • Encouraging low GHG emissions development that does not compromise food production. • Making finance flows consistent with a pathway towards low GHG emissions and climate resilient development. • Reaching a peak in GHG emissions 'as soon as possible', while recognising that the timeframes for achieving this will differ between developed and developing countries. • Achieving carbon neutrality from 2050 onwards. Each individual country is responsible for determining their contribution (referred to as the "nationally determined contribution") in reaching this goal. The Agreement requires that these contributions should be "ambitious" and "represent a progression over time". The contributions should be reported every five years and are to be registered by the UNFCCC Secretariat. As a signatory to the Agreement, Namibia will be required to adopt the agreement within its own legal systems, through ratification, acceptance, approval or accession. Under the Agreement, Namibia is also required to investigate alternatives to existing industries which have high carbon-emissions. A shift away from coal-based energy production within the energy sector and increased reliance on alternative energy sources is therefore anticipated. "Natural gas, and in particular liquefied natural gas, has potential to play a role for Africa as a rich and reliable source of energy, which can serve as a bridging fuel on the path to

Conventions and Treaties	Summary of legislative provisions
	the carbon-neutral goal of the Paris Agreement (Source: https://www.kslaw.com/blog-posts/the-paris-agreement-on-climate-change-implications-for-africa). Following the signing of the Paris Agreement, Namibia had in 2021 participated in COP26 where it recommitted to its efforts to reduce GHG emissions by 2030.
United Nations Framework Convention on Climate Change – UNFCCC, 1992	The United Nations Framework Convention on Climate Change (UNFCCC) objective is to stabilise greenhouse gas concentrations in the atmosphere. The framework sets non-binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms.
Vienna Convention for the Protection of the Ozone Layer, 1985	The Convention is the first global agreement that recognised that the ozone was a serious enough problem to warrant international regulation.
Chemicals and Waste	
Convention on the control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 1989)	This Convention was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. The convention was ratified by Namibia in 1995.
Stockholm Convention on Persistent Organic Pollutants, 2001	This Convention is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have harmful impacts on human health or on the environment.
Flora, Fauna and Protected Areas	
African Convention for the Conservation of Nature and Natural Resources (Algeria, 1968) and the revised version (Maputo, 2003)	The objectives of this Convention are to enhance environmental protection, to foster the conservation and sustainable used of natural resources, and to harmonise and coordinate polices in these fields.
Convention on the Conservation of Migratory Species of Wild Animals, also known as the Convention on Migratory Species (CMS) or the Bonn Convention, 1983	This Convention is an international agreement that aims to conserve migratory species within their migratory ranges. CMS covers a great diversity of migratory species. The Appendices of CMS include many mammals, including land mammals, marine mammals and bats; birds; fish; reptiles and one insect.
Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000	This Protocol is an international agreement on biosafety as a supplement to the Convention on Biological Diversity effective since 2003. The Biosafety Protocol seeks to protect biological diversity from the potential risks posed by genetically modified organisms resulting from modern biotechnology.
United Nations Convention on Biological Diversity (UNCBD), 1992	The UNCBD has three main goals: (1) the conservation of biological diversity (or biodiversity); (2) the sustainable use of its components; and (3) the fair and equitable sharing of benefits arising from genetic resources. The convention was ratified by Namibian in 1997.

Conventions and Treaties	Summary of legislative provisions
Convention on International Trade of Wild Fauna and Flora Endangered Species (CITES), 1975	CITES is a multilateral treaty to protect endangered plants and animals.
Convention on Wetlands of International Importance (Ramsar Convention), 1971	This Convention is an international treaty for the conservation and sustainable use of wetlands.
International Convention for the Conservation of Atlantic Tunas (ICCAT)	This Convention provides for the management and conservation of tuna and tuna-like species in the Atlantic Ocean and adjacent seas.
Memorandum of Understanding (MoU) concerning Conservation Measures of Marine Turtles of the Atlantic Coast of Africa, 1999	This MoU focuses on the protection of six marine turtle species that are estimated to have rapidly declined in numbers along the Atlantic Coast of Africa.
United Nations Convention to Combat Desertification in those Countries Experiencing serious Drought and/or Desertification, Particularly in Africa, 1994	This is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.
Marine Pollution	
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78)	MARPOL 73/78 was developed by the International Maritime Organization with an objective to minimise pollution of the oceans and seas, including dumping, oil and air pollution. MARPOL is divided into Annexes according to various categories of pollutants, each of which deals with the regulation of a particular group of ship emissions: • Annex I: Prevention of pollution by oil and oily water; • Annex II: Control of pollution by noxious liquid substances in bulk; • Annex III: Prevention of pollution by harmful substances carried by sea in packaged form; • Annex IV: Pollution by sewage from ships; • Annex V: Pollution by garbage from ships; and • Annex VI: Prevention of air pollution from ships. All ships flagged under countries that are signatories to MARPOL are subject to its requirements, regardless of where they sail and member nations are responsible for vessels registered on their national ship registry.
International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969 and its protocol (Amends the 1969 Convention with regard to the method of calculation for the limitation of liability)	This Convention provides for a compensation fund for clean-up costs and environmental damage subject to certain conditions and ceilings.

Conventions and Treaties	Summary of legislative provisions
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)	This Convention is an international maritime convention establishing measures for dealing with marine oil pollution incidents nationally and in co-operation with other countries.
International Convention on the establishment of an International Fund for Compensation for Oil Pollution Damage (The Fund Convention), 1971	This is an international maritime treaty, which was drawn up as an enhancement to CLC meant to relieve ship owners from unfair liabilities due to unforeseeable circumstances and remove liability caps that some member states thought were too low. The fund is obliged to pay victims of pollution when damages exceed the ship owner's liability, when there is no liable ship owner, or when the ship owner is unable to pay its liability.
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention) and 1996 Protocol	The 1996 Protocol deals with the incineration and dumping of waste at sea, including the disposal of exploration / production platforms and dredged material.
International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties, 1969	This Convention is an international maritime convention affirming the right of a coastal State to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate danger to their coastline or related interests from pollution or threat of pollution of the sea by oil, following upon a maritime casualty or acts related to such a casualty.
Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil, 1973	This Protocol take such measures on the high seas as may be necessary to prevent, mitigate or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution by substances other than oil following upon a maritime casualty or acts related to such a casualty, which may reasonably be expected to result in major harmful consequences.
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2017	This Convention aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments.
Marine Safety	
Convention on the International Regulations for Preventing Collisions at Sea (COLREGS), 1972	This Convention sets an international standard for shipping and navigation. It deals with safety at sea issues and prescribes international standards for shipping, particularly to reduce the risk of collisions at sea. The rules for the prevention of collisions at sea apply to all vessels using the high seas.
International Convention for the Safety of Life at Sea, 1974 (SOLAS) with its protocol of 1978	This Convention is an international maritime treaty which requires signatory flag states to ensure that ships flagged by them comply with minimum safety standards in construction, equipment and operation.
The International Convention on Load Lines, 1966 and its protocol of 1988	This Protocol was adopted to harmonise the survey and certification requirement of the 1966 Convention with those contained in SOLAS and MARPOL 73/78. All assigned load lines must be marked

Conventions and Treaties	Summary of legislative provisions
	amidships on each side of the ships engaged in international voyages.
International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978	This Convention sets qualification standards for masters, officers and watch personnel on seagoing merchant ships.
Marine Resources	
Convention for Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central and Southern African Region (Abidjan Convention), 1984	The objective of this Convention Is to protect the marine environment, coastal zones and related internal waters falling within the jurisdiction of the States of the West and Central African region.
Convention of the International Maritime Organisation (IMO), 1948	This Conventions deals with the establishment of the IMO which is a specialist United Nations agency dealing with maritime issues, including development of all the marine pollution control conventions.
United Nations Law of the Sea Convention (UNCLOS), 1982	This Convention seeks to establish a comprehensive legal regime to regulate activities on and in relation to the world's oceans and seas, i.e. requiring states to adopt legislation to reduce marine pollution from seabed activities in the Exclusive Economic Zone (EEZ) and on the continental shelf. The convention was ratified by Namibia in 1994.
Archaeology and Cultural Heritage	
Convention concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972)	This Convention provides for the identification, protection and conservation of the cultural and natural heritage for future generations.
United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage, 2001	This Convention is intended to protect all traces of human existence having a cultural, historical or archaeological character, which have been under water for over 100 years. This extends to the protection of shipwrecks, sunken cities, prehistoric art work, treasures that may be looted, sacrificial and burial sites, and old ports that cover the oceans' floors.
Fishing	
Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas, 1993	This Agreement promotes compliance with international conservation and management measures by fishing vessels on the high seas.
Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean, 2001	This Convention provides for the long-term conservation and sustainable use of the fishery resources in the South East Atlantic Ocean.

3.0 ESIA Approach and Methodology

This chapter provides the details of the ESIA Project Team and outlines the ESIA assumptions, limitations, approach and methodology.

3.1 ESIA Project Team

The project team and specialists appointed to undertake the ESIA process are presented in Table 3-1. The CVs for the SLR project team are attached in Appendix A. SLR and specialist consultants have no vested interest in the proposed project other than fair payment for consulting services rendered as part of the ESIA process.

Table 3-1: Details of the ESIA project team and specialists

Company	Name	Qualifications	Experience (years)	Role
ESIA Project Team				
SLR Namibia / Africa	Sue Reuther	MPhil (Environmental Management), University of Cape Town (UCT) BSc Hons (Economics), University College London	19	Project Director and QA/QC
	Jeremy Blood	MSc (Conservation Ecology), University of Stellenbosch	23	Project Manager and report compilation. Technical advice and report review
	Robyn Christians	BSc. Murdoch University, Perth LLB, UCT	8	Report compilation Project management Liaison with authorities, public consultation
	Cindy Jones	BA (Hons) (Geography and Environmental Studies), Stellenbosch University BSocSci (Environmental and Geographical Science), University of Cape Town	1	Project assistance
	Ayanda Mkhwanazi	BSc Hons (Geography), University of the Witwatersrand	8	GIS data management and mapping
Specialist Team				
CLS Brasil	Marcelo Cabral	PhD (Coastal and Oceanic Eng.), University de Rio de Janeiro, Brazil	25	Drill cuttings and oil spill modelling
	Ingrid Trindade	Oceanographer, State University of Rio de Janeiro, Brazil	3	

Company	Name	Qualifications	Experience (years)	Role
	Ana Boechat	MSc (Computational Modelling in Environmental Engineering, Federal University of Rio de Janeiro, Brazil)	12	
	João Deboni	Oceanographer, Federal University of Espírito Santo, Brazil	2	
SLR Canada	Jonathan Vallarta	PhD (Underwater Acoustics), Heriot-Watt University	19	Underwater Noise Modelling
	Justin Eickmeier	PhD (Physical Oceanography), University of Delaware, MS (Ocean Engineering), Florida Institute of Technology	9	
SLR Namibia / Africa	Alice McGrath	MSc (Biological Sciences), UCT BSc Hons (Ocean & Atmosphere Science), UCT	7	Marine Ecology Impact Assessment
	Andrea Pulfrich	PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany	28	
	Alice McGrath	MSc (Biological Sciences), UCT BSc Hons (Ocean & Atmosphere Science), UCT	7	Fisheries Impact Assessment
	Dave Japp	MSc. (Ichthyology and Fisheries Science), Rhodes University	36	
	Duncan Keal	MA (Geography) & Advanced Certificate in Social Impact Assessment	13	Socio-Economic Impact Assessment
	Michael van Niekerk	MSc (Environmental Science), University of KwaZulu-Natal	16	Climate Change Risk Assessment
	Lisa Ramsay	MPhil and PhD, University of Cambridge	17	Air Emissions Impact Assessment
	Loren Dyer	BsocSci Hons (Geography & Environmental Management), University of KwaZulu-Natal	15	

3.2 ESIA Assumptions and Limitations

The assumptions and limitations pertaining to this ESIA are listed below:

- SLR assumes that all relevant information has been provided by the applicant and is correct and valid at the time of conducting the ESIA;
- Proposed well sites are to be located within Block 2814A, but precise locations are not yet confirmed. The ESIA will assess generic (worst-case) well drilling locations within Block 2814A and the impact assessment is representative of well drilling in any location within the licence area (PPL 003);
- The indicative technical specifications for well drilling are based on generic industry information, previous and future drilling campaigns and may vary slightly from well to well. It is assumed that the technical specifications on which this ESIA is based are

representative to that which will be used during the proposed future drilling campaigns;

- This ESIA will consider potential impacts of the proposed appraisal activities on the biophysical and social environments that have been identified within the activities' area of influence, which encompasses areas affected by:
    - Activities and facilities that are directly owned, operated or managed by the applicant (including contractors and sub-contractors) as part of the proposed activities;
    - Potential unplanned events, which are unintended but may occur as a result of accidents or abnormal operating conditions; and
    - Indirect impacts on biodiversity or ecosystem services upon which potential affected communities' livelihoods depend.
- The ESIA considers the assessment of activities proposed as part of the planned appraisal programme, including cumulative impacts, but does not aim to identify or assess the impacts or benefits of possible future exploration, appraisal or production activities or outcomes, as these depend on appraisal results and are not reasonably foreseeable at this stage;
- No significant changes to the activity description or surrounding environment that could substantially influence findings and recommendations with respect to mitigation and management will occur between the submission of the Final ESIA Report and implementation of the proposed activities; and
- The applicant (including contractors and sub-contractors) will undertake the proposed appraisal well drilling in line with Namibian Legislation, international regulations and best practices, as well as the applicable company standards and the Environmental and Social Management Plan (ESMP) that will be compiled as part of this ESIA.

These assumptions and limitations are in line with typical assumptions and limitations for (predictive) impact assessments and are not expected to materially affect the confidence in the ESIA results.

3.3 ESIA Objectives

The ESIA process has the following objectives:

- Provide the opportunity for I&APs to comment and make input into the ESIA process (during both the Scoping and Impact Assessment phases);
- Identify the key environmental and social issues and potential impacts that could result from the proposed activities (during the Scoping Phase);
- Identify feasible alternatives related to the proposed activities (during the Scoping Phase);
- Assess potential impacts of the proposed activities and alternatives during the different phases (during the Impact Assessment Phase);
- Define feasible mitigation or optimisation measures to avoid or minimise potential impacts or enhance potential benefits (during the Impact Assessment Phase); and
- Through the above, enable informed, transparent and accountable decision-making by the relevant authorities, as well as the presentation of the findings to the public.

3.4 ESIA Process

The ESIA process consists of two phases: Scoping Phase and Impact Assessment Phase (see flowchart in Figure 3-1).

This ESIA process is currently in the Scoping phase.

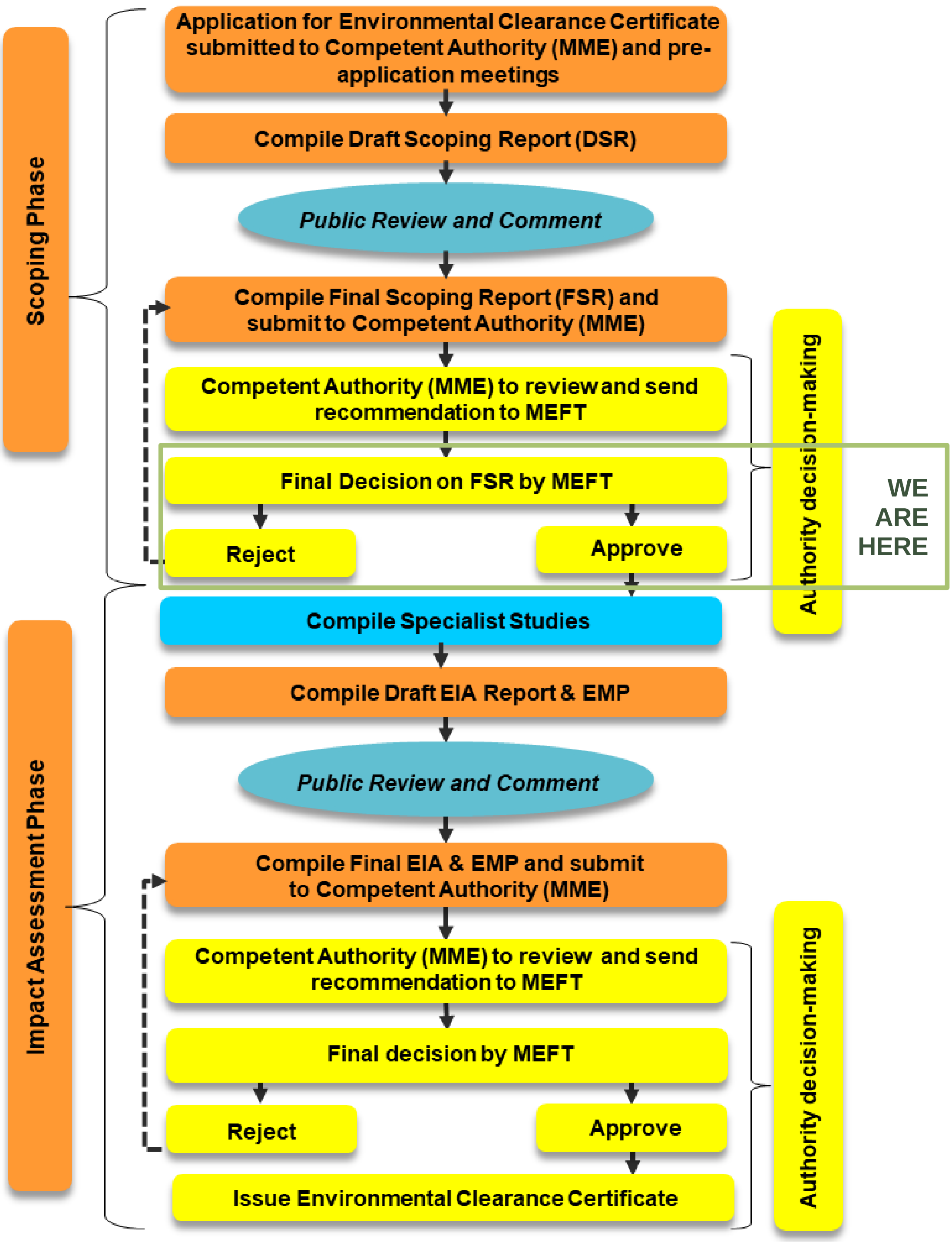

Figure 3-1: Illustration of ESIA Process phases and steps

3.4.1 Scoping Phase

The objectives of the Scoping Phase are to:

- Confirm the ESIA process to be followed;
- Identify the opportunities for I&AP engagement and comment;
- Clarify the scope of the proposed activities;
- Identify and confirm the activities, technologies employed and alternatives;

- Identify and confirm the area of interest for the activities;
- Identify the key issues to be addressed in the impact assessment phase and the approach to be followed in addressing these issues; and
- Confirm the level of assessment to be undertaken during the ESIA.

The Scoping Phase involves a process of:

- Notifying I&APs of the proposed activities and the steps in the ESIA process;
- Creating an opportunity for I&APs to interact with the ESIA project team; and
- Providing information for I&APs to ensure that all key environmental and social issues are identified.

Key steps (excluding public consultation) of the Scoping Phase are summarised below. The public consultation process is summarised in Chapter 4.0.

3.4.1.1 Project Initiation and Regulatory Engagement

An Application for ECC was compiled and uploaded onto MEFT's online portal. On 5 September 2024 MEFT acknowledged that the application had been registered with application number **APP-004608**. The Application for Environmental Clearance was also submitted to the Petroleum Commissioner (MME) on 28 August 2024.

3.4.1.2 Baseline Environmental Assessment

SLR commissioned marine ecology, fisheries and social specialists to describe the receiving environment, screen for sensitive habitats and identify issues and impacts as part of the preparation of the Scoping Report.

3.4.1.3 Compilation and Review of the Draft Scoping Report

The DSR was prepared in compliance with Section 8 of the EIA Regulations (see Table 3-2). The Regulations make provision for the Scoping Report to include an assessment of impacts and an ESMP if sufficient information is available at the Scoping Phase. However, for the proposed activities an assessment was not yet possible as technical modelling studies and specialist studies need to be completed to assess the key issues identified. It was also not possible to compile the ESMP at this stage, as the recommended management and mitigation measures will be based on the findings and recommendations of the specialist studies. The specialist studies that will be undertaken and their terms of reference are presented in Chapter 9.0.

The preparation of the DSR was informed by specialist baseline inputs and a review of previous marine seismic and well-drilling ESIAs undertaken for offshore projects in southern Namibia and the South African West Coast.

The DSR was released for a 30-day review and comment period (18 September to 18 October 2024). Steps undertaken as part of the DSR review process are summarised in Chapter 4.0.

3.4.1.4 Compilation of Final Scoping Report

This FSR complies with the requirements of Section 8 of the EIA Regulations (see Table 3-2) and has also been informed by comments received on the DSR and issues raised during public meetings. A summary of the issues and concerns raised is provided in Section 4.2.3.7 of this report. All written submissions have been collated, and responded to, in a Comments and Responses Report (see Appendix B.9).

The key potential environmental and social impacts that will be addressed and / or assessed in the next phase of the ESIA are summarised in Section 8.4 of this report. Impacts of little magnitude (consequence) that have been screened out for full description and assessment are presented in Section 8.3.

3.4.1.5 Completion of the Scoping Phase

As noted in Section 1.2, this FSR is submitted to MME for consideration and review. MME will then forward it and a recommendation to MEFT for a decision on the acceptance or rejection of the report. If the FSR is accepted, the project will proceed onto the Impact Assessment Phase (see Section 3.4.2).

Table 3-2: Requirements of a Scoping Report in terms of the EIA Regulations 2012.

Section 8	Content of Scoping Report	Completed (Y / N)	Section in Scoping Report
(a)	The curriculum vitae of the EAP who prepared the report;	Y	Appendix A
(b)	A description of the proposed activity;	Y	Chapter 6.0
(c)	A description of the site on which the activity is to be undertaken and the location of the activity on the site;	Y	Chapter 6.0
(d)	A description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed listed activity;	Y	Chapter 7.0 & 8.0
(e)	An identification of laws and guidelines that have been considered in the preparation of the scoping report;	Y	Chapter 2.0
(f)	Details of the public consultation process conducted in terms of Regulation 7(1) in connection with the application, including: (i) the steps that were taken to notify potentially interested and affected parties of the proposed application;	Y	Chapter 4.0
	(ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given;	Y	Appendix B.2 – B.5
	(iii) a list of all persons, organisations and organs of state that were registered in terms of Regulation 22 as interested and affected parties in relation to the application; and	Y	Appendix B.1
	(iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;	N	Appendix B.7 & B.9

Section 8	Content of Scoping Report		Completed (Y / N)	Section in Scoping Report
(g)	A description of the need and desirability of the proposed listed activity and any identified alternatives to the proposed activity that are feasible and reasonable, including the advantages and disadvantages that the proposed activity or alternatives have on the environment and on the community that may be affected by the activity;		Y	Chapter 5.0 and Section 8.0
(h)	A description and assessment of the significance of any significant effects, including cumulative effects, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the proposed listed activity;		Partial	A full assessment of impacts will be included in the ESIA Report. Refer to Chapter 8.0 & Section 9.2 for a description of the key issues to be assessed and the assessment methodology, respectively.
(i)	Terms of reference for the detailed assessment; and		Y	Chapter 9.0
(j)	A draft management plan, which includes:			
	(i)	information on any proposed management, mitigation, protection or remedial measures to be undertaken to address the effects on the environment that have been identified including objectives in respect of the rehabilitation of the environment and closure;	Partial	See Section 8.4 for a Summary of Key Impacts and Preliminary Mitigation. ESMP will be included in the ESIA Report.
	(ii)	as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of the activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and	Partial	
	(iii)	a description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation remedy the cause of pollution or degradation and migration of pollutants.	Partial	

3.4.2 Impact Assessment Phase

3.4.2.1 Specialist Studies

Three technical modelling studies and five specialist studies will be commissioned to address the key issues that require further investigation and detailed assessment. These include:

- Technical Modelling Studies (see Section 9.1.1):

    - Drilling Discharges Modelling.
    - Oil Spill Modelling.
    - Underwater Noise Modelling.
- Specialist Studies / Assessments (see Section 9.1.2):
    - Marine Ecology Impact Assessment.
    - Fisheries Impact Assessment.
    - Socio-Economic Impact Assessment.
    - Climate Change Risk Assessment
    - Air Quality Impact Assessment.

The technical modelling studies will predict the potential extent of outputs from the proposed appraisal well drilling and associated operations to inform specialist impact assessments.

Specialists will review modelling output and secondary data to identify and assess environmental impacts that may occur as a result of the proposed appraisal well drilling and associated operations. These impacts will be assessed according to pre-defined rating scales (see Section 9.2). Specialists will also recommend appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively.

The terms of reference for all the technical modelling and specialist studies are presented in Section 9.1. The ESIA specialist team is listed in Table 3-1.

3.4.2.2 ESIA Report and ESMP

The specialist findings and other relevant information will be integrated into a Draft ESIA Report and ESMP and specialist studies will be included as appendices to that report. The Draft ESIA Report and ESMP will be released for a 30-day review and comment period (see Chapter 4.0).

After closure of the comment period on the Draft ESIA Report and ESMP, all comments received will be incorporated into the Final ESIA Report and ESMP, which will include the final Comments and Responses Report. The Final ESIA Report and ESMP will be submitted to MME for consideration and review. MME will then forward it and a recommendation to MEFT for a decision on the application. The decision taken by MEFT will be distributed to all I&APs registered on the project database.

3.5 Management of Change

As with most large, complex projects, refinement of the design of the proposed activities is an ongoing and sometimes lengthy process. This ESIA considers the current “worst case scenario” when assessing impacts and developing mitigation measures. However, should the design change after submission of the ESIA Report, a Management of Change (MOC) Procedure will be implemented. The MOC Procedure applies to any changes to the approved activities (“project description”), impact assessment and / or mitigation and monitoring measures described in the ESIA Report and ESMP.

The level of change will determine the action to be taken to ensure the changes do not affect the ability to meet environmental and social performance requirements outlined in the ESIA Report and ESMP, ECC and other relevant Namibian legislation (see Table 2-3). All future design changes will undergo an “internal Screening” exercise in order to determine whether the change triggers a ‘Level 1’ or a ‘Level 2’ change. The Management of Change procedure is presented in Table 3-3.

Table 3-3: Management of Change Procedure

Level of Change	Description of Level of Change and Action
Level 1: Minor Change	This applies where the change is largely deemed to be **immaterial to the ESIA findings**, the listed activities that were applied for are still relevant and it does not affect the ability to meet environmental and social performance requirements outlined the ESIA Report and ESMP. Assuming the proposed activities is approved by MEFT, the ECC will need to be renewed every three years. As part of the ECC renewal application, the relevance of the ESMP should be reviewed and amendments proposed where necessary. These changes and their evaluation should be communicated to MME and MEFT for information purposes and the ESMP revised where necessary.
Level 2: Significant Change	This applies where a change would **lead to a significant departure from the base-case** or a key aspect of it, such that the existing ESIA Report or ESMP does not adequately address potential impacts or require additional mitigation. This would imply that a new listed activity(s) is triggered or an approved activity would change. This requires an update of the ESIA Report and ESMP through an amendment application in terms of the Environmental Management Act, 2007 and Regulations 19 and 21 of the EIA Regulations 2012, and submission thereof to MEFT for review and decision.

4.0 Public Consultation Process

This chapter presents the principles of public consultation and the process undertaken during the Scoping Phase and that proposed for the Impact Assessment Phase.

4.1 Principles

The key principles of stakeholder engagement applied in this ESIA conforms to international standards:

- Providing meaningful information in a format and language that is readily understandable and tailored to the needs of the target stakeholder group(s);
- Providing information in advance of consultation activities and decision-making;
- Disseminating information in ways and locations that make it easy for stakeholders to access it;
- Respect for local traditions, languages, timeframes, and decision-making processes;
- Two-way dialogue that gives both sides the opportunity to exchange views and information, to listen, and to have their issues heard and addressed;
- Inclusiveness in representation of views;
- Processes free of intimidation or coercion;
- Clear mechanisms for responding to people's concerns, suggestions, and grievances; and
- Incorporating feedback into project or programme design and reporting back to stakeholders.

4.2 Scoping Phase

The steps undertaken for the Scoping Phase included:

- Identification of stakeholders;
- Regulatory engagement;
- Project notification to stakeholders;
- Public disclosure of DSR for review and comment;
- Production of Comments and Response Report; and
- Production of FSR and disclosure for information purposes.

4.2.1 Stakeholder Engagement Plan

Although not a legal requirement in Namibia, a Stakeholder Engagement Plan (SEP) was prepared to meet good practice requirements. The SEP outlines the stakeholder engagement (or public participation) in the ESIA process and describes the approach and methods to be used for stakeholder engagement. It also reflects the considerations underlying the selected approach to the public participation process for this Project, which are based on the nature of the proposed activities, characteristics of stakeholders, legal requirements, and experience on previous comparable processes.

4.2.2 Stakeholder Identification

A preliminary I&AP database (see Appendix B.1) was compiled based on:

- SLR's existing databases from other offshore oil and gas ESIAs undertaken in southern Namibia; and

- Input from the fisheries specialist in order to ensure the stakeholders and contact details from fisheries sector is comprehensive and up to date.

This initial database focused on Namibian authorities, Non-Governmental Organisations (NGOs), Community-based Organisations, fishing industry associations / companies, adjacent licence holders and other relevant business entities. The initial database included 361 stakeholders who may be directly or indirectly affected by the proposed activities. These stakeholders were divided into the following categories:

- Authorities:
  - Namibian Government (national, regional and local).
  - Maritime Authorities.
- Business:
  - Fishing associations and companies.
  - Offshore Oil and Gas Operators.
  - Other Businesses.
- Civil Society:
  - Environmental and NGOs.
  - General Public.

The I&AP database has been continually updated during the Scoping Phase and will continue to be updated during the remainder of the ESIA process. Additional I&APs have been added to the initial database based on comments received on public documents and attendance at public meetings. At the time of compiling the FSR there were **370 registered I&APs registered on the Project database** (see Appendix B.1).

4.2.3 Consultation and Disclosure Methods

4.2.3.1 Pre-Application Meeting with MEFT

A meeting was held with MEFT on **22 August 2024** to provide notification of the proposed activities and BW Kudu's intent to submit an application for ECC, as well as consult on the ESIA process (including associated public participation strategy) and MEFT requirements.

4.2.3.2 Advertising

Two sets of advertisements announcing the proposed activities, the availability of the DSR and the I&AP registration / comment period have been placed in the Namibian (English) and the Republikein, the Sun and the Allgemeine Zeitung (in English and Afrikaans) on **18 and 25 September 2024**. Text and proof of newspaper placement will be provided in the Appendix B.2.

4.2.3.3 Site Notices

Site notices (in English and Afrikaans) have been placed at the Walvis Bay Library and at the Lüderitz Town Council. A copy of the site notice and Proof that the site notices were erected will be provided in Appendix B.3.

4.2.3.4 Availability of the DSR

The DSR was released for a 30-day review and comment period from **18 September to 18 October 2024**. The objective of the DSR review and comment period was to ensure that I&APs were notified about the proposed activities, given a reasonable opportunity to register on the project database and given an opportunity to provide initial comments of the proposed activities and scope of the assessment. Copies of the DSR were made available on the SLR website for download, as well as at the Walvis Bay and Lüderitz public libraries.

4.2.3.5 Notification Letter

All I&APs on the initial project database were notified of the application and ESIA process on 18 September 2024. A copy of the letter and proof of distribution is be provided in Appendix B.4. A copy of the Non-Technical Summary (in English and Afrikaans) was attached to the notification letter (see Appendix B.5).

4.2.3.6 Public Meetings

Two public meetings were held during the DSR comment and review period. These included meetings in Lüderitz (8 October 2024) and Walvis Bay (9 October 2024).

At these meetings, BW Kudu and SLR presented an overview of the proposed activities and ESIA process and will provide stakeholders the opportunity to raise any issues or concerns. Minutes of these meetings are be presented in Appendix B.7.

4.2.3.7 Comments and Responses Report and Final Scoping Report

All comments received on the DSR have been collated and responded to in a Comments and Responses Report (see Appendix B.9). The comments received have been considered in the preparation of the FSR. A summary of the main issues raised through the public participation process to date is summarised below.

- Maximise use of local service provides.
- Impact on existing local business in terms of loss of staff due to the development of an oil and gas sector.
- Use both Lüderitz and Walvis Bay for the onshore logistics base.
- Corporate Social Responsibility (CSR) contribution of BW Kudu to Namibia and the //Kharas Region.
- Impact of underwater noise on marine fauna.
- Increase the ESIA participation of local community members.
- Plugging and abandonment of wells must be in accordance with international best practice.

This list above does not include every issue raised. The full submissions and responses (by EAP and applicant) are included in the Comments and Responses Report.

Stakeholders on the project database will be notified of the submission of the FSR to MME and MEFT for consideration and acceptance and where responses to submitted comments can be viewed.

4.3 Impact Assessment Phase

Tasks in Impact Assessment Phase include:

- *Release of Draft ESIA Report and ESMP for review and comment:* The Draft ESIA Report and ESMP will be released for a 30-day review and comment period and will be available for download on the SLR website. Hardcopy reports will be available at public venues in Walvis Bay and Lüderitz for the duration of the review and comment period.
- *Notification letters:* Notification letters will be emailed to all I&APs registered on the project database. The letter will provide details of the release of the Draft ESIA

Report and ESMP, and information on where the report can be reviewed. To provide information in a quick and easily readable format, a Non-Technical Summary will be attached to the email.

- *Stakeholder meetings:* Stakeholders will be invited to attend public meetings in Walvis Bay and Lüderitz.
- *Disclosure of decision:* The decision by the MEFT: Environmental Commissioner will be uploaded onto the SLR website for information purposes. All I&APs registered on the project database will be notified via e-mail.

5.0 Need and Desirability

This chapter analyses the need for and desirability of the proposed activities based on its ‘fit’ with the policy and planning framework adopted by the Namibian administration, as discussed in Section 2.3. In this context it is noted that:

- The evaluation of merits of national government policy, global trends, geopolitics and feasibility of the proposed activities are complex, evolving and sometimes contradictory, and fall outside of the scope of this “project-level” ESIA. The analysis thus relies on relevant current commitments, policies and targets as markers against which to evaluate the need and desirability of the proposed activities;
- The focus is on discussing the need of the *appraisal* activities (rather than production)[1], though some comments on the greater context of oil and gas projects are also provided;
- The analysis assumes that the applicant is satisfied with the current economic feasibility of the proposed activities[2]; and
- Need and desirability can relate to different aspects, e.g. social, economic, and environmental aspects, which are not always aligned, and the proposed activities may be needed and desirable in terms of some but not other such aspects.

5.1 Fit of Petroleum Appraisal Drilling with the Namibian Planning Framework

5.1.1 Energy-Related Plans and Polices

The energy-related plans and policies discussed in Section 2.3.1 have identified an existing and continuing demand for hydrocarbon products in Namibia, with an aim of promoting the country’s exploration and production potential, specifically mentioning the Kudu Gas Field for development.

Policies are careful to frame the need for locally produced hydrocarbon products in the Namibian economy in the context of, and as a supplement to, the desired increase in renewable energy generation capacity. In this sense the use of petroleum products, notably gas, is not deemed contradictory to, and rather supportive of, the continued development of renewable energy in Namibia.

[1] A 2020 ruling by the Norwegian Supreme Court stated in a similar context that there will be no significant global environmental consequences of exploration, that the effects will not occur until profitable discoveries have been made and licences have been awarded for development and operation, and that the authorities will have to consider greenhouse gas emissions when assessing the application for an operation license (Supreme Court of Norway, 2020).

[2] The potential environmental and social impact of a project should it become a stranded asset and decommission ahead of its anticipated lifespan can be further mitigated by ensuring that sufficient provision has been made for rehabilitating the project impacts at any point during the project implementation.

In relation to the argument that a licensee will have incurred large exploration costs by the time a decision that incorporates the consideration of GHG emissions is made on the granting of a production licence, based on the assumption that these will be covered by the development of a profitable discovery, the Norwegian Supreme Court rightly noted that the licensee does not have a legal claim for approval of its operations license (Supreme Court of Norway, 2020) (which also holds true in other countries) – or indeed, one could add, a guarantee of viable finds during the exploration phase.

Appraisal for hydrocarbon resources, such as the current project, is one necessary step in the process of potentially increasing the gas resource base, if appraisal results in the identification of viable resources[3] and required production permits[4] are obtained (as noted previously BW Kudu already has a valid Petroleum Production Licence).

The proposed appraisal activities are thus in keeping with and furtherance of energy-related plans and policy in Namibia.

5.1.2 Economy-Related Plans and Polices

Economic policies are naturally complex in that they relate to and seek to combine a wide range of objectives, tools and desired outcomes. Promoting economic growth is a key proclaimed focus of the Namibian Government, with a focus on increased energy security, in conjunction with a declared intent to mitigate the effects of climate change and diversify the energy mix away from fossil fuels while exploring the use of natural gas, including indigenous resources, as a less carbon intensive transitional fuel.

Policy clearly lays out the social need for economic development and opportunities, and that this should be achieved through a managed energy transition that includes a mix of energy sources, including fossil fuels for some time, and possibly the production of indigenous oil and gas resources.

Appraisal of indigenous resources will improve the knowledge of potential oil and gas resources in Namibia and thereby improve the Government's capability to plan scenarios in this regard. **The proposed appraisal activities are deemed in keeping with and furtherance of economy-related plans and policy in Namibia.**

5.1.3 Climate Change-Related Plans and Policies

Similar to economic policies, climate change-related policies seek to accommodate a number of goals, notably low-carbon and socially just and equitable economic growth. Namibia has stated its commitment to reduce GHG emissions through its National Policy on Climate Change and its updated Nationally Determined Contribution (NDC). The country aims to reduce greenhouse gas emissions by 91% by 2030, with a strong focus on renewable energy sources like solar and wind. These policies emphasize sustainable development, resilience building, and reducing the vulnerability of its population to climate impacts. Balancing these priorities with Namibia's active promotion oil and gas exploration and production is a challenge for Namibia, as it is for many other countries, as it seeks to leverage its natural resources for economic growth while also addressing the urgent need to combat climate change.

Provided that a project has a broadly neutral or net positive effect on Namibia's overall GHG emissions, it could be deemed broadly in line with climate change-related plans and policies. **The proposed appraisal activities generally do not emit significant quantities of GHGs** (see Footnote 1 read with Footnote 2)**, and the proposed activities are thus not deemed incompatible with such policies.**

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[3] Viability will be determined by a number of factors, such as the volume, nature and accessibility of the resource in relation to the cost and risks of extraction (which can only be confirmed by exploration), and the market conditions for the commodity expected over the project lifetime.

[4] With present requirements, a production project will need a wide range of permits, including a stand-alone Environmental Authorisation (and ESIA process).

5.2 Oil and Gas Industry History, Policy and Promotion Initiatives

Exploration aims to identify commercially viable reserves of hydrocarbons such as oil and gas. The first step in the search for hydrocarbons is to undertake geophysical surveys. These allow for the evaluation of the structure and composition of subsurface formations. Geophysical surveys include magnetometric, aerial photogrammetric, gravimetric, seismic, radiographic and stratigraphic surveys, all of which provide a more detailed understanding of the likelihood of the existence of commercially viable hydrocarbons. The certainty which can be achieved through surveys is limited and to prove the existence of commercially viable reserves, exploration and appraisal drilling is necessary (UKDTI, 2001).

The first Namibian oil and gas exploration wells were drilled in the 1960s, but it wasn’t until 1974 that the presence of hydrocarbons was confirmed through the discovery of the Kudu Gas Field on the northern section of the Orange Basin, directly west of Oranjemund. By 1991, fewer than 10 hydrocarbon wells had been drilled in Namibia, with no commercially viable reserves having been discovered (OGJ, 1991). Following unsuccessful attempts to prove commercially viable reserves, interest in Namibian oil and gas waned.

In recent years there has been a resurgence in Namibian hydrocarbon exploration, with the government allocating exploration licences to major oil companies. Improvements in deep-water drilling technology have increased the economic viability of what were previously considered sub-commercial reserves. Between 2010 and 2014, 13 wells were drilled in Namibia, bringing the total number of offshore hydrocarbon wells drilled in Namibian waters to 32. Of these, 15 had been exploratory wells, seven appraisal wells and a further ten had been drilled for scientific research (NAMCOR, 2017a). Since 2018, more than seven wells have been drilled in the Walvis and Lüderitz basins. The collection of survey, seismic and aeromagnetic data has contributed to a substantial geological and geophysical database for the country and has revealed the existence of four offshore frontier basins of interest to explorers: the Orange, Lüderitz, Walvis and Namibe basins.

Although BW Kudu has a valid Petroleum Production Licence, no oil or gas has been produced in Namibia. BW Kudu has, however, undertaken the following activities under PPL 003:

- 3D seismic survey acquired in 2023, which is currently being interpreted.
- Acquired the West Leo, a semi-submersible drilling vessel, which will be converted into a Floating Production Facility (FPF), as a reservoir fluids processing facility.
- Completed Pre-FEED / Concept Study Work and produced the “Kudu Development Facilities Conceptual Studies Report”.
- Completed a high-level Environmental and Social Screening (ESS) study in respect of the proposed Kudu Gas to Power Project.

Regulation of the Namibian oil and gas industry is the mandate of MME. The fiscal regime is outlined in the Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991), the Petroleum (Taxation) Act, 1991 (No. 3 of 1991) and the Petroleum Laws Amendment Act, 1998 (No. 24 of 1998). Administrative provisions are also provided in the Income Tax Act, 1981 (No. 24 of 1981).

Some key features of the fiscal regime associated with exploration and production are as follows (Deloitte, 2016; Ernst and Young, 2016; NAMCOR, 2017a and b; KPMG, 2020):

- A licence application fee of between N$3 000 and N$30 000 is charged prior to exploration, followed by an annual licence area rental charge ranging between N$60 and N$150 per km^2;
- Petroleum Income Tax (PIT) is levied at 35% on the taxable base. By comparison, the standard corporation tax rate is 32% while non-diamond mining companies are taxed at a rate of 37.5% and diamond miners at 55%;
- An incremental, three-tiered Additional Profit Tax is charged on after-tax net cash flow from petroleum production operations when they achieve relatively higher profits. Exploration, development and operating expenditures, along with royalties, PIT and annual licence rental charges are all fully deductible; and
- A royalty is levied at 5% of gross production revenue.

Overall, the tax regime is designed to encourage exploration with a view to increasing production, which is ultimately where the state would generate significant amounts of revenue if a substantial, commercially viable reserve is proven.

Policy advice is provided to MME by NAMCOR, a state-owned company which is also responsible for promoting exploration and production in the country. NAMCOR also has "*the mandate to carry out reconnaissance, exploration and production operations either on its own or in partnership with other organisations in the industry*" (NAMCOR, 2017b). NAMCOR is actively engaged in identifying prospects and leads, as well as in promoting and marketing the oil and gas potential of Namibia to local and international companies.

5.3 Compatibility of 'Fit' of the Proposed Activities and Benefits

Fundamental issues around energy mix and transition are too complex to comprehensively and conclusively analyse at a project level – policy priorities are decided and set at a national policy level (see also Footnote 1 in this regard).

The analysis of Namibian policy shows that it aims to progressively reduce GHG emissions while, at the same time, ensuring a stable and sufficient energy supply and enabling just and inclusive economic growth. Appraisal of indigenous hydrocarbon resources is in principle compliant with and in furtherance of several energy, economy and resource-related policies and plans, and is not incompatible with climate change-related policies and targets.

Given the importance of energy to economic activity and growth and the importance of economic growth to ensuring a prosperous and stable society in Namibia, coupled with the complexity and fluidity of global trends and supply chains, retaining optionality and diversification in national income, economy and energy supply appears desirable in itself.

Empirical data indicates that hydrocarbon resources are critical to the global and Namibian energy supply at present, and that they are likely to remain an important source of energy for some time to come even in the light of intense efforts to develop alternative low- or no-carbon energy sources, given the low penetration thereof in the energy mix at present.

Notwithstanding the likely continued demand for (and supply of) hydrocarbon resources globally and in Namibia[5], and the in-principle compliance of appraisal drilling with Namibian

[5] While the proposed drilling activity may produce results that ultimately lead to a Project to produce hydrocarbons, the current proposed activities do not relate to such a Project.

policies, the need and desirability of a *particular* activity (or project) is also determined by the acceptability of residual environmental and social impacts of the proposed activities; these indicate the sustainability of a specific activity or project, which is an important criterium of policy.

While Sections 5.1 and 5.2 discuss the in principle fit of the proposed appraisal activities with Namibian policy and principles, the biophysical and socio-economic impacts of the proposed activities will be assessed during the Impact Assessment Phase. This will inform the evaluation of the sustainability of these particular activities, and the need and desirability of these proposed appraisal activities will be re-evaluated on that basis in the EIA Report.

6.0 Description of the Proposed Activities

This chapter describes the scope of the proposed activities for consideration in the EIA, provides technical information on the proposed appraisal activities, and summarises the alternatives.

6.1 Right Holders and Licence Area Details

BW Kudu Limited and NAMCOR hold the participating interest in PPL 003. BW Kudu has a 95% working interest in license area, while NAMCOR holds 5%. The details of the Licence Block are provided in Table 6-1 below. The co-ordinates of the Block are presented in Figure 6-1.

Table 6-1: Summary of Licence Block

Licence Block No.:	Block 2814A / PPL 003
Size of licence area:	4 568 km^2
Water depths across licence area:	150 m to 750 m
Distance offshore (at closest boundary):	144 km

6.2 Proposed Components and Activities

A summary of the key components and activities is provided in Table 6-2.

Table 6-2: Summary of key activities and components

Seabed Sampling	
Purpose	Characterise the seafloor and for laboratory geochemical analyses for drilling unit anchoring purposes
Method	Piston and box coring (or grab samples)
Number of samples	Up to 50
Duration	6 weeks
Appraisal Drilling	
Purpose	Confirm and test the presence and quality of hydrocarbon resources
Number of wells	Up to 4 appraisal wells
Size of area for drilling	4 568 km^2
Well depth	~ 4 500 m
Water depth range in Block	150 m - 750 m
Duration to drill each well	• 100 days in total per well: o Mobilisation: 5 days (within country) o Well drilling: 70 days, o Well testing (drill stem test): 15 days (optional) o Well abandonment: 5 days per well o Demobilisation: up to 5 days
Commencement of drilling and anticipated timing	• Commencement is not confirmed, but anticipated to be in the Q3 of 2025. The ESIA assumes two wells could be drilled in the first year and two wells in the second year.
Proposed drilling fluids (muds)	• Water-Based Muds (WBM) during the riserless drilling stage

	• Non-Aqueous Drilling Fluid (NADF) during the risered drilling stage (closed loop system)
Drilling and support vessels	• Drill ship or semi-submersible drill rig • Three support vessels. These vessels will be on standby at the drilling site, and move equipment and materials between the drilling unit and the onshore base
Operational safety zone	Minimum 500 m around drilling unit; however, operators are likely to request 2 nm
Flaring (non-routine)	If hydrocarbons are discovered, well testing / drill stem test (DST) may be performed
Logistics base	Walvis Bay (preferred location) or the Port of Lüderitz
Logistics base components	Office facilities, laydown area, mud plant
Support facilities	Helicopter support base in Lüderitz (preferred alternative) or Oranjemund
Staff requirements	• Specialised drilling staff supplied with hire of drilling unit • Specialised international and local staff at logistics base
Staff changes	Rotation of staff every four weeks with transfer by helicopter to shore

The key activities of the proposed appraisal programme are summarised in Table 6-3 and described more fully in the sections that follow.

Table 6-3: Summary of appraisal activities and phases

Appraisal phases	Appraisal activities	
1. Seabed sampling	**Geotechnical site characterisation**	Drop or box coring
2. Drilling	**1. Mobilisation Phase**	Establishment of onshore logistic base in Walvis Bay (preferred location) or Lüderitz using existing infrastructure and rental of quay space for use as laydown area and warehouse
		Appointment of international and local service providers and staff
		Procurement of long lead items, importation and transportation of drilling equipment and bulk materials
		Accommodation rental and local spend (e.g., food and supplies)
		Transit of drilling unit and supply vessels to drill site (including discharge / exchange of ballast water)
	2. Operation Phase	Operation of drilling unit and supply vessels, including certain discharges to sea / air and lighting
		Operation of helicopters for crew changes from Lüderitz
		Well drilling (including Remote Operating Vehicle operation; spudding; installation of conductor pipes, wellhead, blow-out preventer, marine riser, etc.)
		Discharge of cuttings onto the seabed (riserless drilling stage) and from the drilling unit (risered drilling stage)
		Vertical Seismic Profiling (VSP) to generate a high-resolution seismic image of the geology in the well’s immediate vicinity

Appraisal phases	Appraisal activities	
		Well (flow) testing and associated flaring of any gas/oil to determine the economic potential of the discovery before the well is either abandoned or suspended, including the possible discharge of treated produced water
		Operation of onshore logistics base and procurement of operational services and supplies
	3. Demobilisation Phase	Abandonment of well (including plugging well with cement, integrity testing, wellhead removal (with casings cut-off below the seafloor) and seabed clearance survey)
		Demobilisation of drilling unit and support vessels
		Demobilisation of logistics base, services and work force

6.3 Seabed Sampling

Seabed sediment sampling may be undertaken to characterise the seafloor and for laboratory geochemical analyses for drilling unit anchoring purposes. Piston and box coring (or grab samples) may be used to collect seabed sediment samples. These are described below.

The seabed sediment sampling may be undertaken in small specific areas across the block. **A total of up to 50 samples may be taken, which will take in the order of up to six weeks to complete.**

6.3.1.1 Piston / Drop Coring

Piston core (or drop core) is one of the more common methods used to collect seabed geochemical samples, with the sequence of operation illustrated in Figure 6-2. The piston coring rig is comprised of a trigger assembly, the coring weight assembly, core barrels, tip assembly and piston. The core barrels are in lengths of up to 10 m with a diameter of 10 cm.

The piston corer is lowered over the side of the survey vessel on a line and allowed to free fall from about 3 m above the seafloor to allow better penetration (see Figure 6-2A). As the trigger weight hits the bottom (see Figure 6-2B), it releases the weight on the trigger arm and the corer is released to "free-fall" the 3 m distance to the bottom (see Figure 6-2B & C), forcing the core barrel to travel down over the piston into the sediment (see Figure 6-2D). The movement of the core barrel over the piston creates suction below the piston and expels the water out the top of the corer. When forward momentum of the core has stopped, a slow pull-out of the winch commences. This suction triggers the separation of the top and bottom sections of the piston. The corer and sample are then slowly pulled from the seafloor and retrieved.

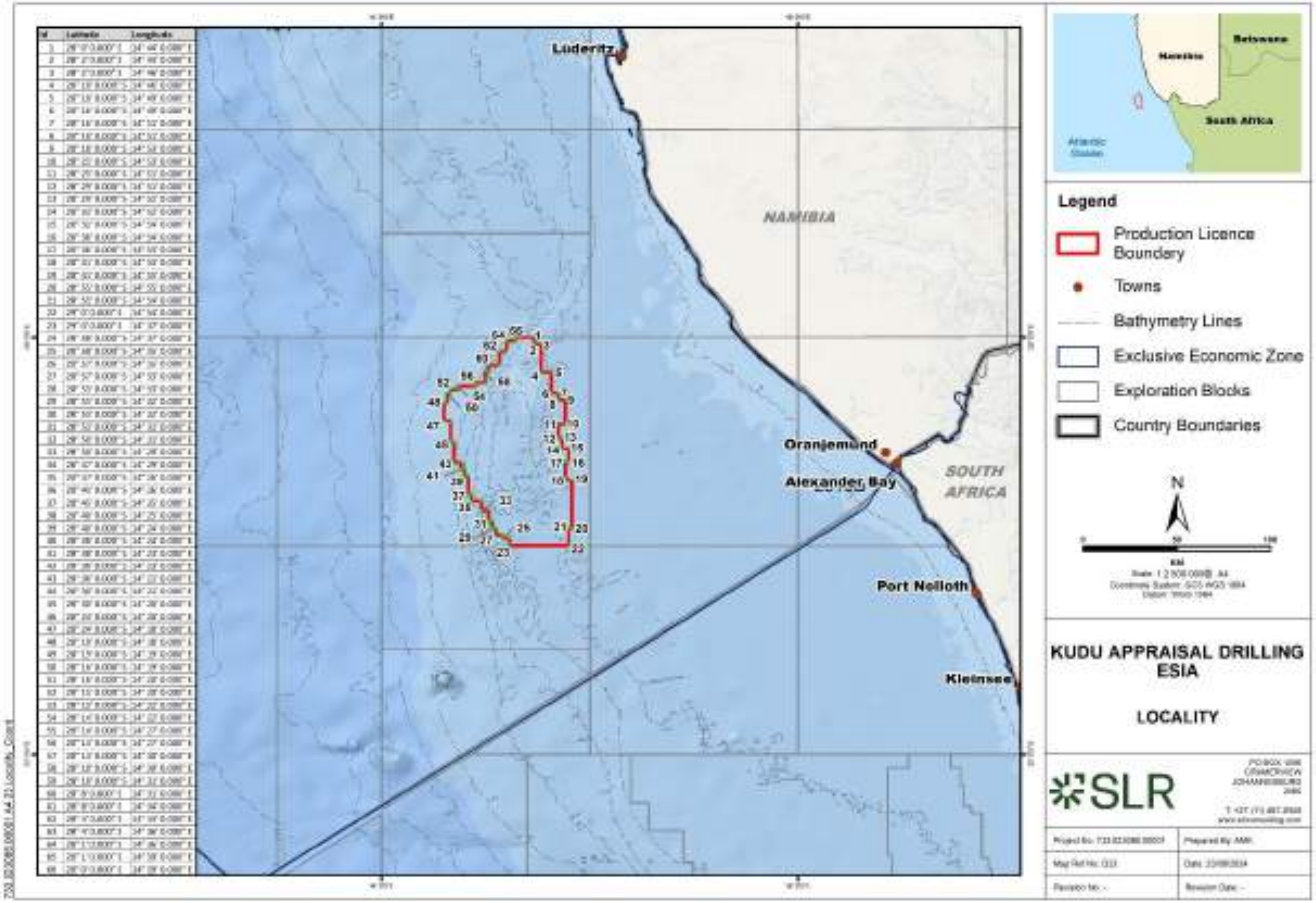

Figure 6-1: Locality Map of Block 2814A (with co-ordinates) off the southern coast of Namibia

The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting or oil staining) and sub-samples retained for further geochemical analysis in an onshore laboratory.

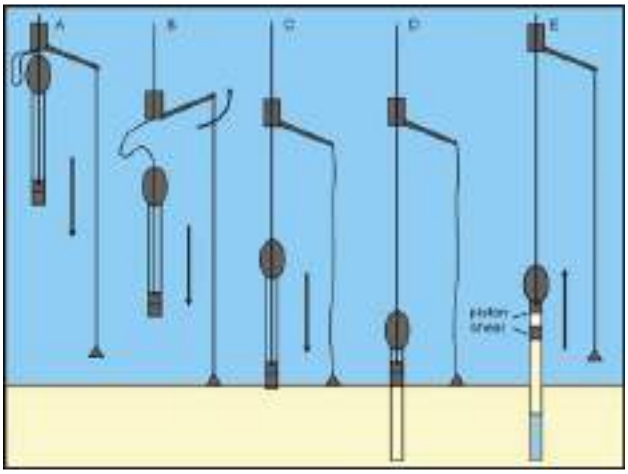

Figure 6-2: Schematic of a Drop or Piston Core Operation at the Seabed.
Source: TDI Brooks International

6.3.1.2 Box Coring

The box corer (see Figure 6-3) is deployed from a survey vessel by lowering it vertically to the seabed. At the seabed the instrument is triggered by a trip as the main coring stem passes through its frame. The stem has a weight of up to 800 kg to aid penetration. While pulling the corer out of the sediment, a spade swings underneath the sample to prevent loss. The recovered sample is completely enclosed after sampling, reducing the loss of finer materials during recovery. Stainless steel doors, kept open during the deployment to reduce any “bow-wave effect” during sampling, are triggered on sampling and remain tightly closed, sealing the sampled water from that of the water column. On recovery, the sample can be processed directly through the large access doors or via complete removal of the box together with its cutting blade. A spare box and spade can then be added, ready for an immediate redeployment. The operator is proposing to take box core samples (50 cm x 50 cm) to a sediment depth of less than 60 cm.

Figure 6-3: Box Corer
Source: Wikipedia

6.4 Appraisal Well Drilling

The sections that follow describe the equipment (i.e., drilling unit, vessels, etc.), drilling phases and anticipated discharges, waste and emissions from the drilling unit and support vessels. The description presented below is based on standard drilling requirements for a typical well where details may vary slightly for each well for aspects such as water depth, location, geology and seafloor conditions.

6.4.1 Drilling Logistics

This section describes the main drilling equipment / components.

6.4.1.1 Drilling Unit

Various types of drilling technology can be used to drill an appraisal well (e.g., barges, jack-up rigs, semi-submersible drilling units (rigs) and drill-ships) depending on, *inter alia*, the water depth and marine operating conditions experienced at the well site (see Figure 6-4). BW Kudu is proposing to use a drill ship or semi-submersible drilling unit to undertake the proposed appraisal activities. The final drilling unit selection will depend on availability and final design specifications.

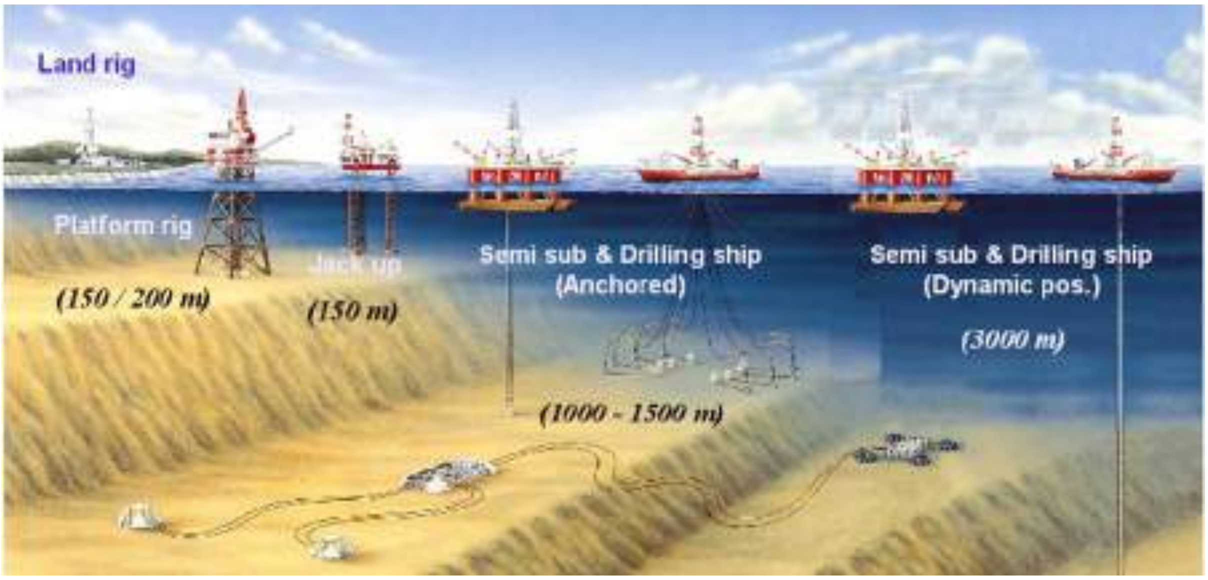

Figure 6-4: Drilling unit types

Source: https://seekingalpha.com/article/4043883-offshore-drilling-comprehensive-valuation-mobile-offshore-drilling-unit-today

A **drill-ship** is a purpose-built drilling vessel designed to operate in deep water conditions. The drilling “rig” is normally located towards the centre of the ship with support operations from both sides of the ship using fixed cranes. The advantages of a drill-ship over the majority of semi-submersible units are that a drill-ship has much greater storage capacity and is independently mobile, not requiring any towing and has a reduced requirement of supply vessels.

The use of a **semi-submersible drilling unit** might also be considered, depending on vessel availability. A semi-submersible drilling unit is essentially a drilling rig located on a floating structure of pontoons. When at the well location, the pontoons are partially flooded (or ballasted), with seawater, to submerge the pontoons to a pre-determined depth below the sea level where wave motion is minimised. This gives stability to the drilling vessel, thereby facilitating drilling operations.

The drilling unit will either be dynamically positioned (water depths > 450 m) or need to be anchored (water depths < 450 m). If anchored, the drilling unit is held in position by eight anchor chains and anchors typically weighing 12 to 20 tons each, which extend out for about 1 500 meters from each corner of the rig (see Figure 6-5). The anchor chains would be tensioned. Additional anchor chain and / or piggyback anchors may need to be laid to achieve the required tensions.

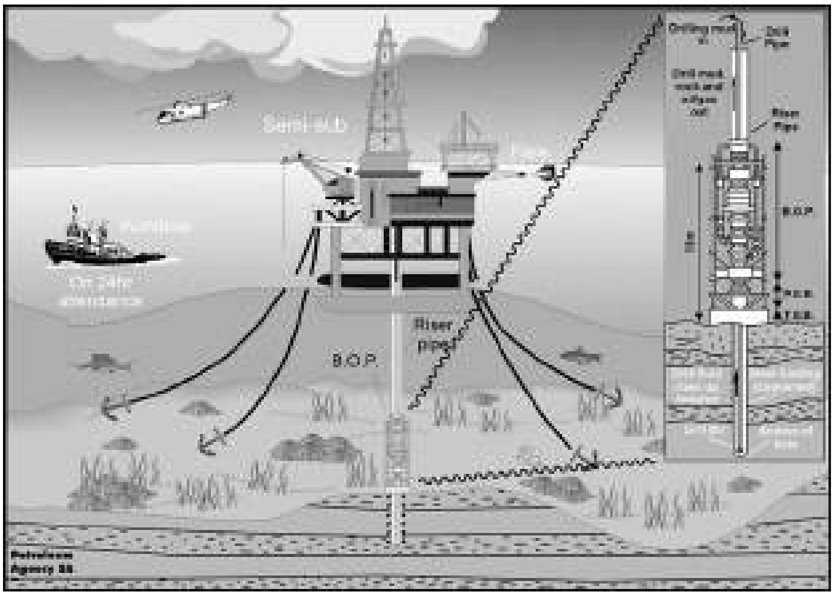

Figure 6-5: Schematic presentation of an anchored semi-submersible drilling unit

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a drilling unit that is engaged in underwater operations is defined as a "*vessel restricted in its ability to manoeuvre*", and power-driven and sailing vessels must give way to such vessels. Fishing vessels are required to keep out of the way of the well drilling operation and observe the operational safety zones.

Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), as amended by the Namibia Ports Authority Act No. 2 of 1994, a vessel used for the purpose of exploiting the seabed falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. The temporary 500 m safety zone around the drilling unit will be enforced at all times during operation and will be described in a Notice to Mariners as a navigational warning.

If the drilling unit is anchored, a larger safety zone is required to reduce risks from certain other activities (e.g. demersal trawling). This is due to the anchor chains and anchors extending out for some 1 500 m from the drilling unit.

6.4.1.2 Support Vessels

The drilling unit will be supported / serviced by up to three support vessels operating an expected two to three rotations per week, to facilitate the moving of equipment and materials between the drilling unit and the onshore base.

A support vessel will always be on standby near the drilling unit to provide support for firefighting, oil containment / recovery, rescue in the unlikely event of an emergency and supply any additional equipment that may be required. Support vessels can also be used for medical evacuations or transfer of crew if needed.

6.4.1.3 Helicopters

Transportation of personnel to and from the drilling unit by helicopter is the preferred method of transfer.

It is estimated that there could be up to three trips per week between the drilling unit and the helicopter support base in Lüderitz/Oranjemund (i.e., 14 weeks (approximately 100 days) x 3 = 43 trips per well). The helicopters can also be used for medical evacuations from the drilling unit to shore (at day- or night-time), if required.

6.4.1.4 Onshore Logistics Base

The primary onshore logistics base will be located at the Port of Walvis Bay (preferred location) or the Port of Lüderitz. The shore base will provide for the storage of materials and equipment (including pipes, drilling fluid, cement, chemicals, diesel and water) and a mud plant for mixing drilling fluids that will be transported by sea to / from the drilling vessel. The shore base will also be used for offices (with communications and emergency procedures / facilities), accommodation, waste management services, bunkering vessels, and stevedoring / customs clearance services.

The supply vessels will occupy the quay for about 12 hours per trip, depending on the quantity of material to be loaded / unloaded and time required for custom clearance.

The service infrastructure required to provide the necessary onshore support is already in place at both Ports and it is not anticipated that any additional permanent onshore infrastructure would be required for the proposed activities.

6.4.1.5 Accommodation

Shore-based staff will be accommodated in Walvis Bay, Lüderitz or Oranjemund, as required. This could be either via house rental or at Bed and Breakfast (B&B) type accommodation and hotels. In addition, accommodation during crew changes may be required for incoming or departing offshore staff. Although it is likely that staff will transfer directly from aircraft to helicopter and vice-versa on the same day.

6.4.2 Mobilisation Phase

The mobilisation phase will entail the required notifications, establishment of the onshore base, appointment of local service providers, procurement and transportation of equipment and materials from various ports and airports, accommodation arrangements and transit of the drilling unit and support vessels to the drilling area.

6.4.2.1 Stakeholder Notification

A formal notification will be submitted to MME prior to mobilisation of the drilling unit. This will include details of the activity location, drilling schedules, drilling unit / supply vessel specifications and contractor details. MME will be routinely notified through regular reports and meetings on the progress of activities throughout the drilling campaign.

Key stakeholders (e.g., fishing associations and companies, operators of the neighbouring licence blocks, local authorities, etc.) from the stakeholder database will also be notified of planned appraisal activities prior to commencement. Relevant authorities will be engaged as necessary for the establishment of the onshore logistics base (e.g., NAMPORT, local authority, etc.).

6.4.2.2 Mobilisation of Drilling Unit, Supply Vessels and Personnel

The procurement of a drilling unit could take six months to a year, depending on availability. The drilling unit and supply vessels could sail directly to the well site from outside Namibian waters or from a Namibian port, depending on which drilling unit is selected, and where it was last used. The drilling unit and supply vessels will be subject to customs clearance.

To maintain stability and trim of the drilling unit and support vessels, seawater would be pumped into ballast tanks and released to sea during mobilisation and transit to site.

Core specialist and skilled personnel would arrive in Namibia onboard the drilling unit and the rest of the personnel will be flown to Walvis Bay, Lüderitz or Oranjemund (as applicable). Drilling units are usually supplied with the required technical specialist core team on board.

Drilling materials, such as casings, mud components, cement and other equipment and materials will be brought into the country on the drilling unit itself or imported via a container vessel directly to the onshore logistics base from where the supply vessels will transfer it to the drilling unit.

6.4.3 Operation Phase

6.4.3.1 Final Drilling Site Selection

The selection of the specific well locations will be based on a number of factors, including further detailed analysis of available seismic, pre-drilling survey data and the geological target. A Remote Operating Vehicle (ROV)[6] will be used to finalise the well position and anchoring (if required) based on *inter alia* the presence of any seafloor obstacles or any sensitive features that may become evident during a pre-drilling survey.

6.4.3.2 Drilling Systems

The main systems of a drilling unit are hoisting, rotating, mud and drill cutting circulation, blow-out prevention and well-control, power, and storage. The general layout of the drilling infrastructure is shown in Figure 6-6.

Hoisting System

The hoisting system is used to raise and lower drill pipe in and out of the hole and to support the drill string to control the weight on the drill bit during drilling. The hoisting system consists of the derrick, traveling and crown blocks, the drilling line and the draw works.

The drilling unit uses a derrick, which is a steel tower that is used to support the traveling and crown blocks which are a set of pulleys that raise and lower the drill string (i.e., the drill bit and pipe) via a large diameter steel cable connected to a winch or draw-works). The crown block is a stationary pulley located at the top of the derrick while the traveling block

[6] A ROV is a small, unmanned, highly manoeuvrable underwater machine that is used to explore underwater features / seafloor while being operated by someone at the water surface.

moves up and down and is used to raise and lower the drill string. The draw-works contain a large drum around which the drilling cable is wrapped, and which spools the cable off or on in order to lower or raise the drill string depending on the direction the drum is rotated.

Rotating System

The rotating equipment turns the drill bit that is used to create the hole. It consists of the top drive, the rotary table, the drill pipe and the drill collars (drill string), Bottom Hole Assembly equipment and the drill bit. The top drive is a motor attached to the bottom of the traveling block, which is suspended from the derrick or mast of the rig and turns a shaft to rotate the drill string during drilling. A top drive allows drillers to engage and disengage pumps or the rotary equipment while removing or running the pipe more quickly. It travels up and down the vertical rails to avoid the mechanism from swaying with the movement of the ocean.

A hose, through which the drilling fluid enters the drill pipe, is connected to the top of the top drive. The drill pipe is a round pipe about 9 m long with a typical diameter of 5 or 5.5 inch (12.7 or 14 cm). Drill collars are heavy thick pipes that are used at the bottom of the drill string to add weight to the drill bit. The drill pipe has threaded connections on each end that allow the pipe to be joined together to form longer sections as the hole is drilled deeper. Drill bit sizes typically range from 36 inches (91 cm) to 6 inches (15 cm) in diameter.

Mud and Drilling Discharges Circulating System

The drilling operation uses drilling fluids (often referred to as ‘muds’) to reduce friction (lubricate and cool the drill bit), remove the drilled rock fragments (cuttings), and to equalise pressure in the wellbore and prevent other fluids from flowing into the wellbore.

During the risered drilling stage, the riser isolates the drilling fluid and cuttings from the environment, thereby creating a “closed loop system”. The circulation system of drilling fluid consists of the suction pits, pumps, surface piping (flowlines and standpipe), rotary hose (or kelly hose) and swivel, which is connected to the top drive.

The flow path of the drilling fluid is shown in Figure 6-7 and Figure 6-8. The circulating system pumps the drilling fluids (or drilling muds) down the hole, out of the nozzles in the drill bit and returns them to the surface where the cuttings are separated from the drilling fluid. While drilling is in progress, drilling fluid is continuously pumped down the inside of the hollow drill string.

The fluid emerges through ports (nozzles) in the drill bit and then rises (carrying the rock cuttings with it) up the annular space between the sides of the hole (the casing and riser pipe) and the drill string, to the drilling unit. The returned drilling mud is treated to remove the cuttings (shale shakers) from the re-circulating mud stream (see Figure 6-7).

The solids control system sequentially applies different technologies to recover and separate the drilling fluid for reuse from the cuttings. The solids waste stream will comprise the drilling discharges (small pieces of stone, clay, shale and sand) and solids in the drilling fluid adhering to the cuttings (barite and clays). A typical solids control system consists of the following main components:

- Shale shakers (to remove large-sized cuttings);
- Degasser (to remove entrained gas);
- Desanders (to remove sand-sized cuttings);
- Desilters (to remove silt-sized cuttings); and
- Centrifuge (to recover fine solids and weighting materials such as barite).

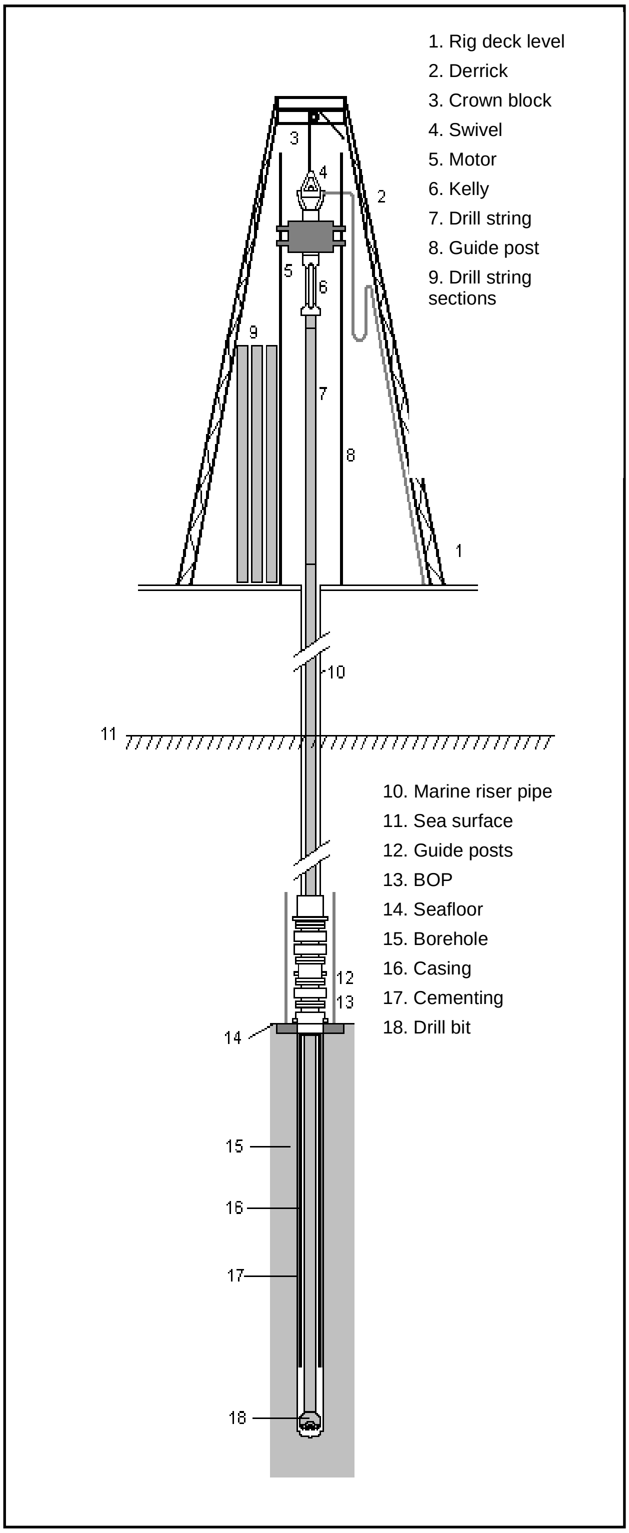

Figure 6-6: Generalised components of the drilling unit and drill string.

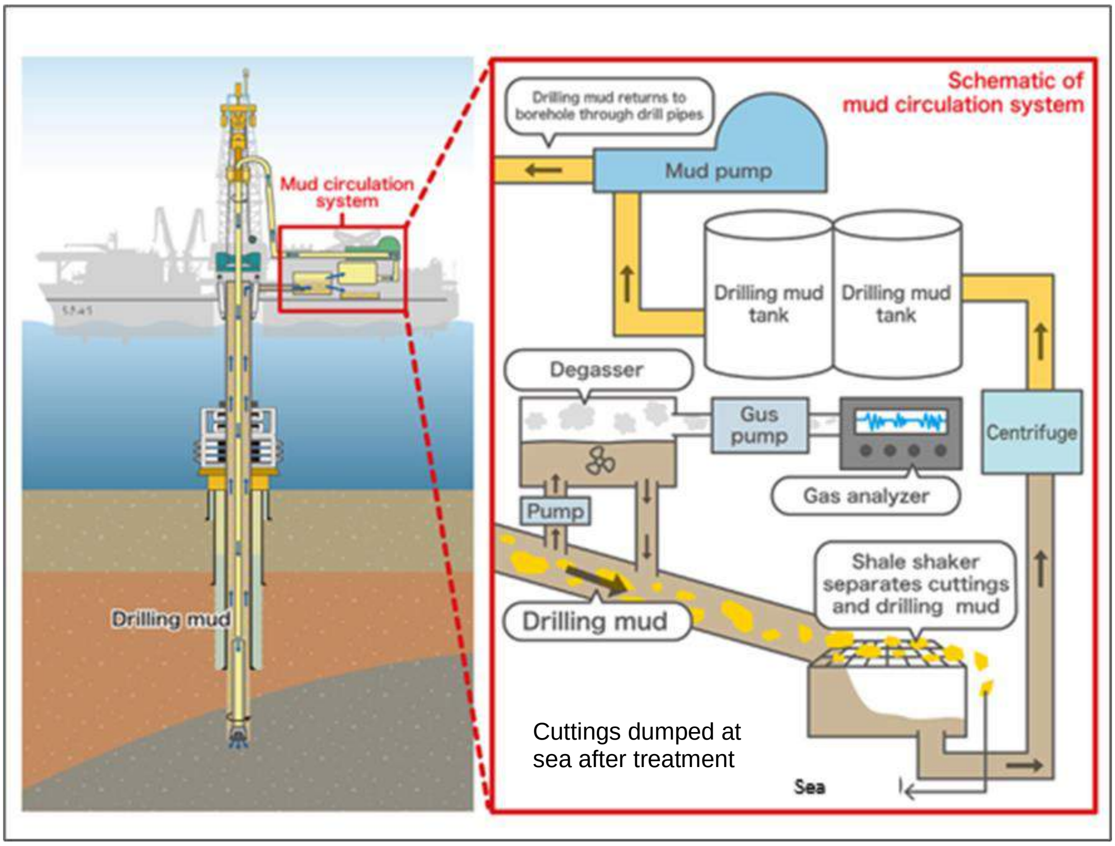

Figure 6-7: Simplified illustration of a mud circulating system.

Source: Apostolidou, 2019.

The components of the solids control system depend on the type of drilling fluid used, the type of geological formations being drilled, the available equipment on the drilling unit and the specific requirements of the disposal option. Solids control may involve both primary and secondary treatment steps.

As part of primary treatment, cuttings are first processed through shale shakers – the primary solids control devices. These are designed to trap cuttings on the screens and remove large cuttings through a series of shale shakers with sequentially finer mesh sizes designed to remove progressively smaller drill cuttings. The mud passes through the screens into the mud pits. The circulating pumps pick up this clean mud and pumps it back down the hole. Each stage of the process produces partially dried cuttings and a liquid stream.

Where secondary treatment is used, the partially dried cuttings may be further processed using specialised equipment commonly called cuttings dryers. This is followed by additional centrifugal processing and desanders (i.e., secondary solids control equipment that use a hydrocyclone to separate solids from the incoming fluid using the centrifugal force). Centrifuges are used to remove particles that can contribute to fines build-up. Secondary treatment allows recovery of additional synthetic-based drilling fluid for re-use and results in a waste stream (cuttings) with a lower percentage of the drilling fluid retained on the cuttings. The waste streams from the cuttings dryer and decanting centrifuge are then disposed overboard through a cutting chute a few metres below the sea surface.

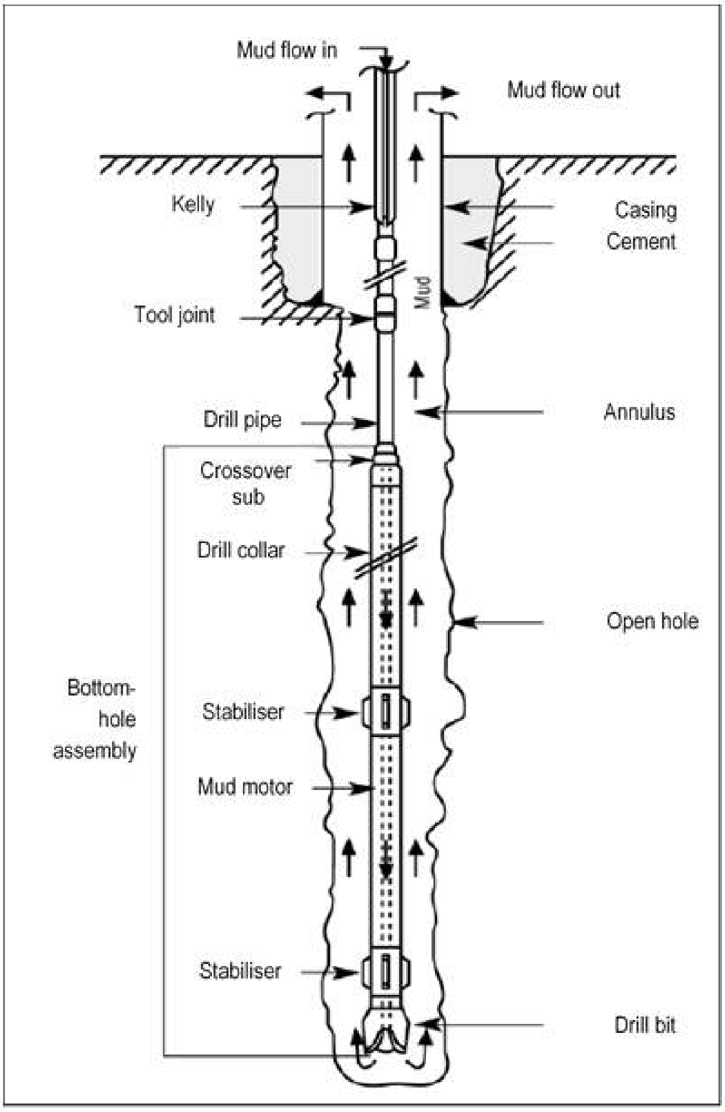

Figure 6-8: Drilling mud circulates down the drill pipe.

Adapted from: Candler and Leuterman, 2008

Blow-out Prevention and Well Control

Although the probability of a well blow-out[7] is extremely low (global data maintained by Lloyds Register, cited in IOGP Report 434-02, indicates that frequency of a blowout from normal exploration wells is in the order of 1.4 x 10^{-4} per well drilled[8]), it is a worst-case scenario that provides the greatest environmental risk during drilling operations. BW Kudu will have an Emergency Response Plan in place that sets out its detailed response plan and intervention strategy, to be implemented in the unlikely event of a blow-out.

The primary safeguard against a blow-out is the column of drilling fluid in the well, which exerts hydrostatic pressure on the wellbore. Under normal drilling conditions, this pressure

[7] The uncontrolled release of crude oil and/or natural gas from a well after pressure control systems have failed and is the worst case in the loss of well control.

[8] This equates to $1.4\times10^{-4}\times100=0.000014\%$, or one blow-out in approximately 7 143 wells drilled.

should balance or exceed the natural rock formation pressure to help prevent an influx of gas or other formation fluids. As the formation pressures increase, the density of the drilling fluid is increased to help maintain a safe margin and prevent “kicks” or “blow-outs”. However, if the density of the fluid becomes too heavy, the formation can break down and fracture. If drilling fluid is lost in the resultant fractures, a reduction of hydrostatic pressure occurs which can lead to an influx from a pressured formation. Therefore, maintaining the appropriate fluid density for the wellbore pressure regime is critical to safety and wellbore stability.

Abnormal formation pressures are detected by primary well control equipment, which generally consists of two sets of pit level indicators and return mud-flow indicators with one set manned by the drill crew and the other by the ‘mud logger’. The ‘mud logger’ also has a return mud gas detector, which monitors return mud temperature and changes in shale density for abnormal pressure detection. The drilling fluid is also tested frequently during drilling operations and its composition can be adjusted to account for changing downhole conditions.

The likelihood of a blow-out is further minimised by installing a specially designed item of safety equipment called a Blow-Out Preventer (BOP) (see Figure 6-9), which is a secondary control system that is especially important in deep-sea and strong metocean conditions. BOPs contain a stack of independently operated cut-off mechanisms, so there is redundancy in case of failure, and the ability to work in all normal circumstances with the drill pipe in or out of the well bore. The BOP is installed on the wellhead (on the seabed) and is designed to close in the well to prevent the uncontrolled flow of hydrocarbons from the reservoir in case the pressure of the reservoir exceeds the pressure of the drilling fluid in the reservoir resulting in hydrocarbons entering the wellbore. If this cannot be controlled, hydrocarbons could eventually exit the wellbore into the marine environment / atmosphere. Hence, the BOP system plays a key role in preventing potential risks to people, the environment and equipment. The BOP will undergo a thorough inspection prior to installation and will be subsequently pressure and function tested on a regular basis in terms of best industry practices.

The BOP stack usually consists of the following:

- <u>Annular preventer</u>: The annular-type blow-out preventer can close around the drill string, casing or a non-cylindrical object, such as a Kelly (i.e. a piece of equipment shaped like a pipe that is used in drilling). The drill pipe, including the larger-diameter tool joints (threaded connectors), can be "stripped" (i.e. moved vertically while pressure is contained below) through an annular preventer by careful control of the hydraulic closing pressure. Annular BOPs are typically located at the top of a BOP stack, with one or two annular preventers positioned above a series of several ram preventers.
- <u>Ram type preventers</u>: Ram type preventers are similar in operation to gate valves but use a pair of opposing steel plungers or rams. The rams extend toward the centre of the wellbore to restrict flow or retract open in order to permit flow. There are four common types of rams or ram blocks used in a BOP stack (or combination thereof):
  - o Pipe rams close around a drill pipe, restricting flow in the annulus (ring-shaped space between concentric objects) between the outside of the drill pipe and the wellbore, but do not obstruct flow within the drill pipe. Variable-bore pipe rams can accommodate tubing in a wider range of outside diameters than standard pipe rams, but typically with some loss of pressure capacity and longevity;

- o Blind rams (also known as sealing rams), which have no openings for tubing, can close off the well when the well does not contain a drill string or other tubing and seal it;
- o Shear rams cut through the drill string or casing with hardened steel shears; and
- o Blind shear rams (also known as shear seal rams or sealing shear rams) are intended to seal a wellbore, even when the bore is occupied by a drill string, by cutting through the drill string as the rams close off the well.

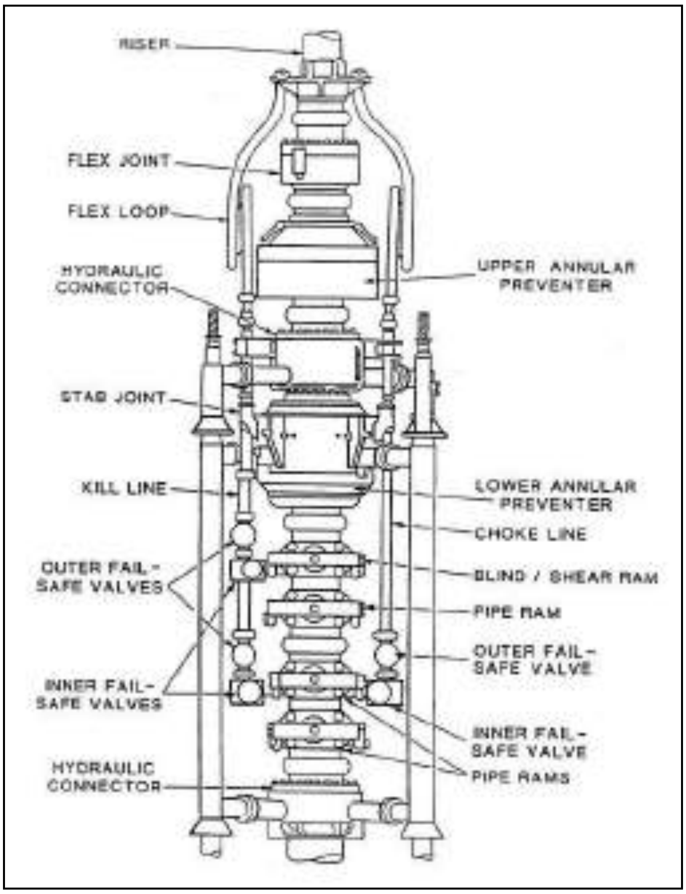

Figure 6-9: Schematic of a typical subsea BOP stack.

Source: CCA & CSM, 2001

In deeper offshore operations, there are four primary ways in which a BOP can be controlled, including (in order of priority):

- Electrical control signal, which is sent from the surface through a control cable (MUX cable). Functioning valves on the stack release high pressurised hydraulic fluid to function the rams or annulars. This method allows for multiple commands to be sent via a single conductor very rapidly;
- Acoustic control signal, which is sent from the surface via a modulated / encoded pulse of sound transmitted by an underwater transducer. This new technique allows for communication with the subsea BOP without the need of an umbilical;
- ROV intervention, which mechanically controls valves and provides hydraulic pressure to the stack (via “hot stab” panels); and

- Emergency Disconnect System - in the event the rig loses communication with the subsea BOP, then the BOP will automatically close the blind shear rams. High pressurised hydraulic fluid (released from accumulator bottles) is used to engage the shear rams.

Provisions in the event of an emergency blow-out are described in Section 6.4.5.4.

Power System

The drilling unit will require power to operate the circulating, rotating and hoisting systems. Diesel would be used to generate power and transmit electricity to the drilling unit.

Heating Ventilation Air Conditioning

The cooling of the drilling unit Living Quarters will involve a Heating Ventilation Air Conditioning (HVAC) system using refrigerant gas.

Storage Areas

The drilling unit will have dedicated storage for a variety of fluids and chemicals, including fuel (diesel), fresh water, drilling water, bulk (or liquid) mud and cement, mud chemicals, and cementing chemicals.

6.4.3.3 Drilling Fluids or Muds

Drilling fluid is a complex mixture of fluids, solids and chemicals that are carefully tailored to provide the correct physical and chemical characteristics required to safely drill the well. The main functions of drilling fluid or drilling mud (terms used interchangeably) are to:

- Maintain a stable wellbore and preventing the open hole from collapsing;
- Provide sufficient hydrostatic pressure to control subsurface pressures and prevent kicks or blow-outs;
- Transport the cuttings to the surface;
- Cool and lubricate the drill bit and drill string (reduce friction);
- Power the mud motors / downhole tools during the drilling process;
- Regulate the chemical and physical characteristics of returned mud slurry on the drilling unit; and
- Displace cements during the cementing process.

Two types of drilling fluid may be used during offshore drilling, namely Water-Based Mud (WBM) and Non-Aqueous Drilling Fluid (NADF). **BW Kudu is proposing to use WBM during the riserless drilling stage (the stage where a large-diameter pipe, the riser, connecting the well to the drilling unit has not yet been put in place) and NADF during the risered drilling stage** (see also Section 6.4.3.4) for operations in Block 2814A.

Water-Based Muds

Due to the variability in conditions that can be encountered, drilling fluid mixtures vary to some extent. Typically, the major ingredient making up 85 to 90% of the total volume of a WBM is fresh and / or seawater.

The remaining 10 to 15% of the volume of WBMs typically comprise barite, potato or corn starch, cellulose-based polymers, xanthan gum, bentonite clay, soda ash, caustic soda and salts (these are usually either potassium chloride [KCl] or sodium chloride [NaCl]). Other minor additives may be used in special circumstances such as citric acid for pH control; or polyethylene glycol butyl ether for clay inhibition, amongst others. Details for some of these are provided below:

- Barite (barium sulphate) is an inert compound used as a weighting agent;
- Potato or corn starch and other cellulose-based polymers are used to control the rate of filtration of water in the mud into the formation being drilled by forming a thin filter cake on the borehole wall;
- Xanthan gum and minor amounts of bentonite clay are used to provide viscosity and impart rheological properties (i.e. materials responding with plastic/liquid flow or flow of matter as a “soft solid”) to the mud for cuttings transport, as well as to provide gel strength for cuttings suspension;
- Caustic soda (sodium hydroxide) is used to maintain the required pH in the drilling fluid; and
- KCl or NaCl (table salt) are used to reduce the swelling tendencies of clays being drilled and help to maintain a stable wellbore.

All chemicals to be used will have associated Material Safety Data Sheet (MSDS) or other bioassay information for ecotoxicology data, where applicable. Selection of constituents will follow best industry practices and will consider ecotoxicity, biodegradability and bioaccumulation criteria. The overall conclusion drawn from toxicity tests around the world is that the majority of the components of WBMs currently used in offshore drilling operations constitute a low risk of chemical toxicity to marine communities.

Categories of materials typically used in WBM, their functions and typical chemicals in each category are provided in Table 6-4.

Table 6-4: Categories of materials used in water-based mud, their functions and typical chemicals.

Functional category	Function	Typical chemicals
Weighting Materials	Increase density (weight) of mud, balancing formation pressure, preventing a blowout	Barite, hematite, calcite, ilmenite
Viscosifiers	Increase viscosity of mud to suspend cuttings and weighting agent in mud	Bentonite or attapulgite clay, carboxymethyl cellulose, & other polymers
Thinners, dispersants, and temperature stability agents	Deflocculate clays to optimize viscosity and gel strength of mud	Tannins, polyphosphates, lignite, ligrosulfonates
Flocculants	Increase viscosity and gel strength of clays or clarify or de-water low-solids muds	Inorganic salts, hydrated lime, gypsum, sodium carbonate and bicarbonate, sodium tetraphosphate, acrylamide-based polymers
Filtrate reducers	Decrease fluid loss to the formation through the filter cake on the wellbore wall	Bentonite clay, lignite, Na-carboxymethyl cellulose, polyacrylate, pregelatinized starch
Alkalinity, pH control additives	Optimize pH and alkalinity of mud, controlling mud properties	Lime (CaO), caustic soda (NaOH), soda ash (Na_2CO_3), sodium bicarbonate ($NaHCO_3$), other acids and bases

Functional category	Function	Typical chemicals
Lost circulation materials	Plug leaks in the wellbore wall, preventing loss of whole drilling mud to the formation	Nut shells, natural fibrous materials, inorganic solids, and other inert insoluble solids
Lubricants	Reduce torque and drag on the drill string	Oils, synthetic liquids, graphite, surfactants, glycols, glycerine
Shale control materials	Control hydration of shales that causes swelling and dispersion of shale, collapsing the wellbore wall	Soluble calcium and potassium salts, other inorganic salts, and organics such as glycols
Emulsifiers & surfactants	Facilitate formation of stable dispersion of insoluble liquids in water phase of mud	Anionic, cationic, or non-ionic detergents, soaps, organic acids, and water-based detergents
Bactericides	Prevent biodegradation of organic additives	Glutaraldehyde and other aldehydes
Defoamers	Reduce mud foaming	Alcohols, silicones, aluminium stearate ($C_{54}H_{105}AlO_6$), alkyl phosphates
Pipe-freeing agents	Prevent pipe from sticking to wellbore wall or free stuck pipe	Detergents, soaps, oils, surfactants
Calcium reducers	Counteract effects of calcium from seawater, cement, formation anhydrites, and gypsum on mud properties	Sodium carbonate and bicarbonate (Na_2CO_3 & $NaHCO_3$), sodium hydroxide (NaOH), polyphosphates
Corrosion inhibitors	Prevent corrosion of drill string by formation acids and acid gases	Amines, phosphates, specialty mixtures
Temperature stability agents	Increase stability of mud dispersions, emulsions and rheological properties at high temperatures	Acrylic or sulfonated polymers or copolymers, lignite, lignosulfonate, tannins

Source: Boehm *et al.,* 2001

Non-Aqueous Drilling Fluids

NADF would be used during the risered drilling stage (“closed loop system”) to:

- Provide optimum wellbore stability and enable a near gauge hole to be drilled;
- Reduce torque and drag in high angle to horizontal wells;
- Minimise damage to reservoirs that contain clays that react adversely to WBM; and
- Obtain irreducible water saturation log data for gas reservoirs.

The main chemicals typically used in a NADF are presented in Table 6-5.

Table 6-5: Main chemicals used in a non-aqueous drilling fluid.

Material	Description
Base oil	Non-aqueous drilling fluids use base fluids with significantly reduced aromatics and extremely low polynuclear aromatic compounds. New systems using vegetable oil, polyglycols or esters have been and continue to be used.
Brine phase	$CaCl_2$, NaCl, KCl.
Gelling products	Modified clays reacted with organic amines.
Alkaline chemicals	Lime e.g., $Ca(OH)_2$.
Fluid loss control	Chemicals derived from lignites reacted with long chain or quaternary amines.
Emulsifiers	Fatty acids and derivatives, rosin acids and derivatives, dicarboxylic acids, polyamines.

Adapted from: Swan *et al.*, 1994

The disadvantage of using NADFs is that base fluid and other chemicals have a higher toxicity than WBMs and may result in an increase in toxicity in the marine environment where drill cuttings are discharged. Drill cuttings that derive from the reservoir section contain residual base fluids, which cannot be removed easily. The trend in the industry has been to move towards low toxicity NADF (Group III NADF) that are biodegradable with a lower aromatic content and will not persist in the long-term.

Three types of NADF are generally used for offshore drilling, as follows:

- Group I NADF (high aromatic content): These base fluids were used during initial days of oil and gas exploration and include diesel and conventional mineral oil-based fluids. They are refined from crude oil and are a non-specific collection of hydrocarbon compounds including paraffins, olefins and aromatic and polycyclic aromatic hydrocarbons (PAHs). Group 1 NADF is defined by having PAH levels greater than 0.35%.
- Group II NADF (medium aromatic content): These fluids are sometimes referred to as Low Toxicity Mineral Oil Based Fluids and were developed to address the rising concern over the potential toxicity of diesel-based fluids. They are also developed from refining crude oil but the distillation process is controlled such that the total aromatic hydrocarbon concentration is less than Group I NADF (0.5 – 5%) and the PAH content is less than 0.35% but greater than 0.001%.
- Group III NADF (low to negligible aromatic content): These fluids are characterised by PAH contents of less than 0.001% and total aromatic contents less than 0.5%. This group includes Synthetic Oil-Based Mud or synthetic-based muds, which are produced by chemical reactions of relatively pure compounds and can include synthetic hydrocarbons (olefins, paraffins and esters). Using special refining and/or separation processes, base fluids of Group III can also be derived from highly processed mineral oils (paraffins, enhanced mineral oil-based fluid).

For the current appraisal drilling, BW Kudu would only consider using Group III type NADF.

6.4.3.4 Drilling Method and Sequence

Drilling Method

The current well trajectory considered by BW Kudu is near vertical (simplest execution). Two drilling methods – rotary or downhole motor drilling - can be used on a drilling unit.

- In rotary drilling, the whole drill string, from the surface to the bit, is rotated to penetrate the formations. In downhole motor drilling a downhole motor is included in the bottom hole assembly to provide additional power to the bit and provides for steering and directional drilling to be conducted. The downhole motor is driven by the drilling fluid, which is pumped down the drill string.
- Downhole motor drilling also allows a well to be directionally drilled to achieve any inclination from vertical to horizontal and to also change the azimuth direction (direction measured from north, where north is 00) to reach the geological target (see Figure 6-10). The direction of the well can be changed by holding the drill string stationary and pointing the downhole motor, which has a slight bend in its body, in the direction required and slide drilling ahead.

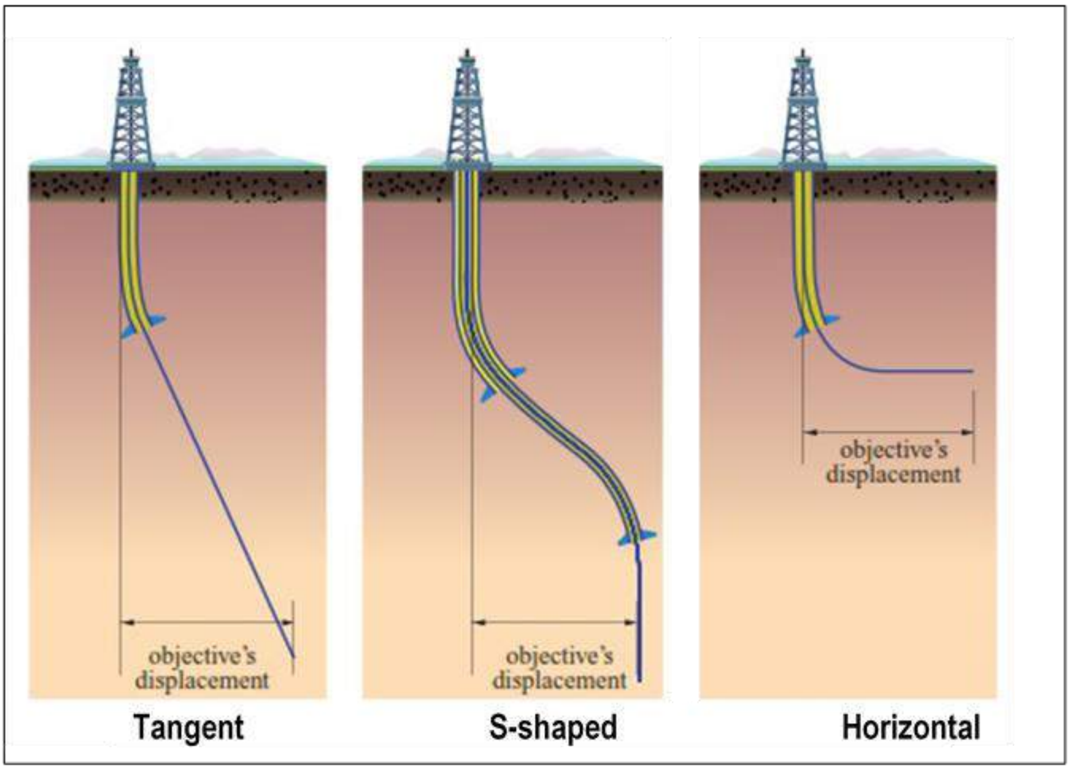

Figure 6-10: Different types of directional wells.

Adapted from http://www.valiantenergy.ca/services-2

Drilling Sequence or Stages

The well will be created by drilling a hole into the seafloor with a drill bit attached to a rotating drill string, which crushes the rock into small particles, called “cuttings”. After the hole is drilled, casings (sections of steel pipe), each slightly smaller in diameter, are placed in the hole and permanently cemented in place (cementing operations are described below). The hole diameter decreases with increasing depth (see Figure 6-11).

The casings provide structural integrity to the newly drilled wellbore, in addition to isolating potentially dangerous high-pressure zones from each other and from the surface. With these zones safely isolated, and the formation protected by the casing, the well will be drilled deeper with a smaller drill bit, and also cased with a smaller sized casing. For the current appraisal drilling, it is anticipated that there will be five sets of subsequently smaller hole sizes drilled inside one another, each cemented with casing, except the last phase that will remain an open hole without casing.

Drilling is essentially undertaken in two stages, namely the riserless (when the riser is not in place) and risered drilling stages (see Figure 6-12).

Initial (Riserless) Drilling Stage

The process of preparing the first section of a well is referred to as “spudding”. Sediments just below the seafloor are often very soft and loose, thus to keep the well from caving in and to carry the weight of the wellhead, a 36” diameter structural conductor pipe is installed. Jetting is generally the primary means of setting the 36” pipe where no cement is required. However, for the current drilling activities, it is likely that a 42" hole will be drilled and then the 36" conductor will be installed and cemented.

When the conductor pipe and low-pressure wellhead are at the correct depth, approximately 75 m deep (depending upon substrate strength), a new drilling assembly will be run inside the structural conductor pipe and the next hole section will be drilled by rotating the drill string and drill bit.

Below the conductor pipe, a hole of approximately 26” in diameter will be drilled to a depth of approximately 625 m below the seabed. The rotating drill string causes the drill bit to crush rock into small particles, called “cuttings”. While the wellbore is being drilled, drilling fluid is pumped from the surface down through the inside of the drill pipe, the drilling fluid passes through holes in the drill bit and travels back to the seafloor through the space between the drill string and the walls of the hole, thereby removing the cuttings from the hole. At a planned depth the drilling is stopped, and the bit and drill string is pulled out of the hole. A surface casing of 20-inch diameter is then placed into the hole and secured into place by pumping cement through the casing at the bottom of the hole and back up the annulus (the space between the casing and the borehole). The 20-inch casing will have a high-pressure wellhead on top; which provides the entry point to the subsurface and it is the connection point to the BOP.

These initial hole sections will be drilled using seawater (with viscous sweeps) and WBM. All cuttings and WBM from this initial drilling stage will be discharged directly onto the seafloor adjacent to the wellbore.

Risered Drilling Stage

The risered drilling stage (refer to Figure 6-12) commences with the lowering of a BOP and installing it on the wellhead. The BOP is designed to seal the well and prevent any uncontrolled release of fluids from the well (a ‘blow-out’). A lower marine riser package is installed on top of the BOP and the entire unit is lowered on riser joints. The riser isolates the drilling fluid and cuttings from the environment, thereby creating a “closed loop system”.

Drilling is continued by lowering the drill string through the riser, BOP and casing, and rotating the drill string. During the risered drilling stage, should the WBMs not be able to provide the necessary characteristics, a low toxicity NADF will be used. The drilling fluid emerges through nozzles in the drill bit and then rises (carrying the rock cuttings with it) up the annular space between the sides of the hole to the drilling unit.

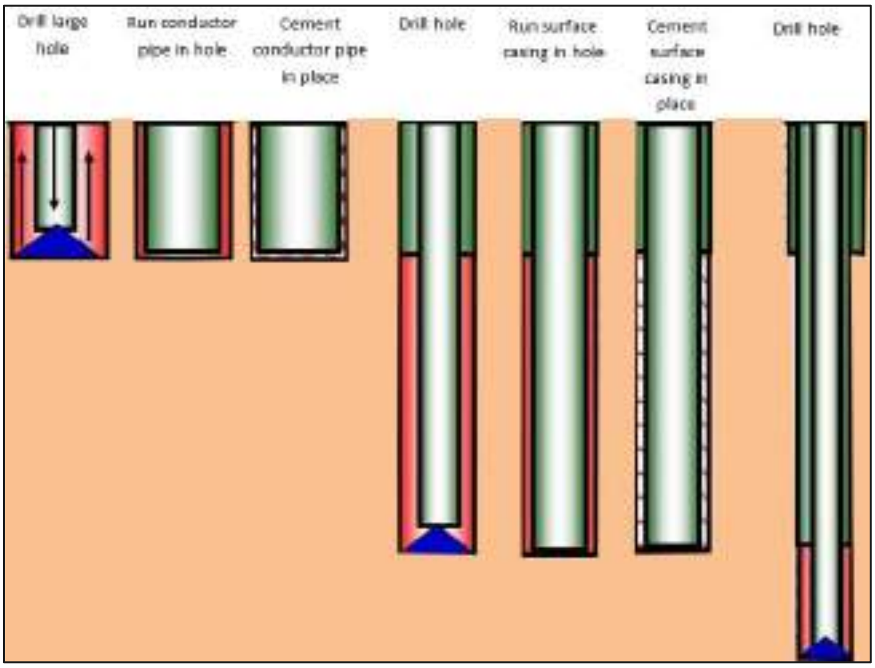

Figure 6-11: Simplified view of well drilling stages.

Adapted from Nergaard, 2005

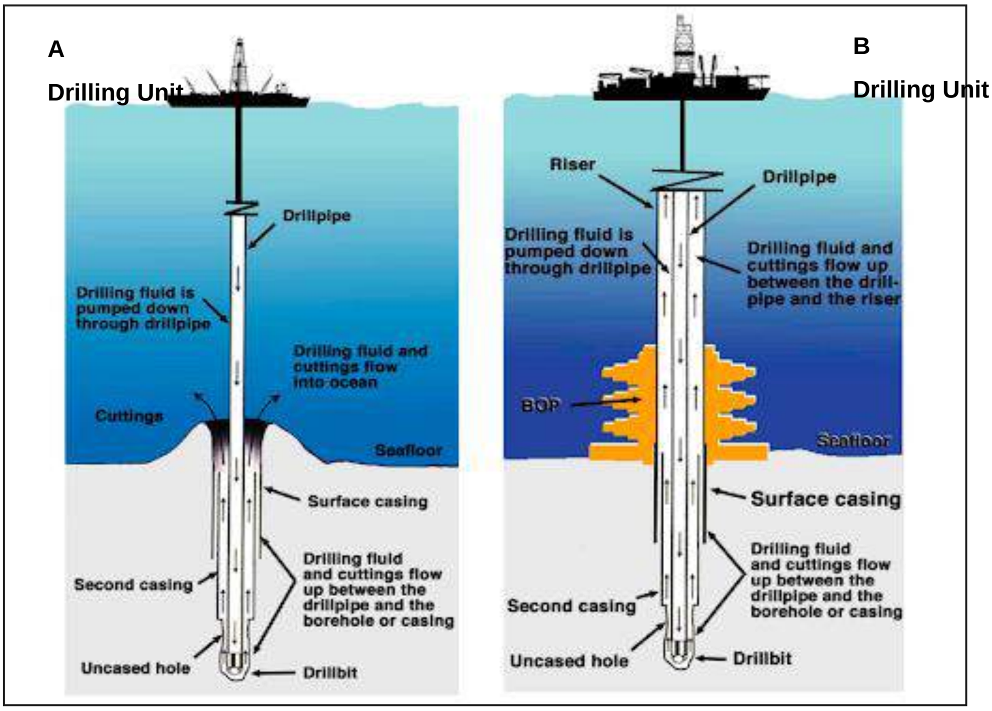

Figure 6-12 Drilling stages: (A) Riserless drilling stage; and (B) Risered drilling stage.

Source: http://www.kochi-core.jp/cuttings/

The cuttings are removed from the returned drill mud (as described in 6.4.5.2) and discharged overboard. In instances where NADFs are used, cuttings will be treated to reduce oil content and discharged overboard. Operational discharges are discussed further in Section 6.4.5.

The hole diameter decreases in steps with depth as progressively smaller diameter casings are inserted into the hole at various stages and cemented into place. The expected target drilling depth is not yet confirmed but the notional well depth is up to 4 500 m below the seafloor with a final hole diameter of between 8.5 inches and a casing diameter of 7 inches.

Cementing Operation

Cementing is the process of pumping cement slurry through the drill pipe and / or cement stinger at the bottom of the hole and back up into the space between the casing and the borehole wall (annulus). Cement fills the annulus between the casing and the drilled hole to form an extremely strong, nearly impermeable seal, thereby permanently securing the casings in place. To separate the cement from the drilling fluid in order to minimise cement contamination a cementing plug and/or spacer fluids are used. The plug is pushed by the drilling fluid to ensure the cement is placed outside the casing filling the annular space between the casing and the hole wall.

Cementing has four general purposes: (i) it isolates and segregates the casing seat for subsequent drilling, (ii) it protects the casing from corrosion, (iii) it provides structural support for the casing, and (iv) it stabilises the formation.

To ensure effective cementing, an excess of cement is often used. Until the marine riser is set, excess cement from the first casings emerges out of the top of the well onto the seafloor. This cement does not set and is slowly dissolved into the seawater.

Offshore drilling operations typically use Portland cements, defined as pulverised clinkers consisting of hydrated calcium silicates and usually containing one or more forms of calcium sulphate. The raw materials used are lime, silica, alumina and ferric oxide. The cement slurry used is specially designed for the exact well conditions encountered.

Additives can be used to adjust various properties in order to achieve the desired results. There are over 150 cementing additives available. The amount (concentrations) of these additives generally make up only a small portion (<10%) of the overall amount of cement used for a typical well. Usually, there are three main additives used: retarders, fluid loss control agents and friction reducers. These additives are polymers generally made of organic material and are considered non-toxic.

Once the cement has set, a short section of new hole is drilled, then a pressure test is performed to ensure that the cement and formation are able to withstand the higher pressures of fluids from deeper formations.

Notional Well Design (Base Case)

The well design ultimately depends upon factors such as planned depths, expected pore pressures and anticipated hydrocarbon-bearing formations. The various components of the notional well design are shown in Table 6-6. It should be noted that several contingency strings are typically made available depending on the geological uncertainties of a well.

Table 6-6: Notional base case well design and estimated drilling discharges.

<table>
<tr><th>Drill Section</th><th>Hole diameter (in)</th><th>Pipe diameter (in)</th><th>Length of section (m)</th><th>Drilling duration (hours)</th><th>Type of drilling fluid used</th><th>Volume of drilling fluid used (m^3)</th><th>Volume of cuttings (m^3)</th><th>Mass of cuttings (tonnes)</th><th>Drilling fluid and cuttings discharge location</th></tr>
<tr><td colspan="10">Riserless drilling stage</td></tr>
<tr><td>1</td><td>42"</td><td>36”</td><td>75</td><td>12</td><td rowspan="2">Seawater, viscous sweeps & WBM</td><td>162</td><td>67</td><td>174</td><td rowspan="2">Seabed</td></tr>
<tr><td>2</td><td>26”</td><td>20"</td><td>625</td><td>50</td><td>613</td><td>214</td><td>557</td></tr>
<tr><td colspan="10">Risered drilling stage</td></tr>
<tr><td>3</td><td>17-1/2"</td><td>13-3/8"</td><td>1 350</td><td>100</td><td rowspan="3">NADF</td><td>10</td><td>210</td><td>545</td><td rowspan="3">5 m below sea surface</td></tr>
<tr><td>4</td><td>12-1/4"</td><td>9 5/8”</td><td>1 600</td><td>150</td><td>6.1</td><td>122</td><td>316</td></tr>
<tr><td>5</td><td>8-1/2"</td><td>7"</td><td>200</td><td>24</td><td>0.4</td><td>7</td><td>19</td></tr>
<tr><td>Totals</td><td>-</td><td>-</td><td>4 500</td><td>336 (14 days)</td><td>-</td><td>WBM: 775
NADF: 16.5*</td><td>620</td><td>1 611</td><td>-</td></tr>
<tr><td colspan="10">* Total quantity of NABM mud discharged including Oil On Cuttings (OOC) @ 3% by weight of cuttings (metricT) + Other constituents.</td></tr>
</table>

Mud Logging

Evaluation of the petro-physical properties of the penetrated formations is carried out routinely during the drilling operation. Mud logging involves the examination of the drill cuttings brought to the surface by the drilling fluid. Mud logging also monitors for hydrocarbon gases that relate to changes in formation pressure and the volume or rate of returning fluid, which can aid in controlling the well, and to the intersection of reservoir rocks.

6.4.3.5 Well Logging and Testing

Once the target depth is reached, the well will be logged and possibly tested.

Well Logging

The evaluation of the physical and chemical properties of the rocks in the sub-surface, and their component minerals, including water, oil and gas, is undertaken during the drilling operation using Wireline Logging or Logging While Drilling (LWD) to log core data from the well. Information from engineering and production logs, as well as mud logging, may also be used.

Petrophysical evaluation typically includes the following activities:

- Distinguishing between reservoir and non-reservoir rock, thickness intervals, etc.;
- Determining the presence of hydrocarbons in reservoir rocks (for the reservoir intervals);
- Calculating oil and gas saturation in reservoir rocks to determine the hydrocarbon fraction; and
- Calculating petrophysical properties of rocks e.g., porosity, permeability, density, etc.

It is very common to use radioactive sources for certain types of data acquisition. The sources can be mounted in the Wireline and LWD tools, where it generates a field that interacts with the rocks penetrated at the wellbore. The measured response is directly related to the physical properties of the rocks. Contractors with the necessary accreditation and certification will handle those sources. The testing does not generate radioactive wastes.

The findings of the evaluation may provide proof of the presence of hydrocarbons and, if present, an indication of the level of difficulty that will be associated with the extraction of the hydrocarbons in place. This will enable the design of reservoir management strategies to optimise long-term hydrocarbon recovery.

Vertical Seismic Profiling

Vertical Seismic Profiling (VSP) is an evaluation tool that would be undertaken as part of the conventional wireline logging programme when the well reaches target depth to generate a high-resolution seismic image of the geology in the well’s immediate vicinity. The VSP images are used for correlation with surface seismic images and for forward planning of the drill bit during drilling.

VSP uses a small airgun (sound pressure generating) array (750 cubic inch volume), which is operated from the drilling unit. The airgun array is deployed between 7 m and 10 m below sea level and has a gun pressure of 2 000 pounds per square inch (psi). During VSP operations, four to five receivers are positioned in a section of the borehole and the airgun array is discharged approximately five times at 20 second intervals. The generated sound pulses are reflected through the seabed and are recorded by the receivers to generate a profile along a 60 to 75 m section of the well. This process is repeated as required for different stations in the well and it may take up to nine hours to complete approximately 200 shots, depending on the well's depth and number of stations being profiled. A typical VSP arrangement is provided in Figure 6-13.

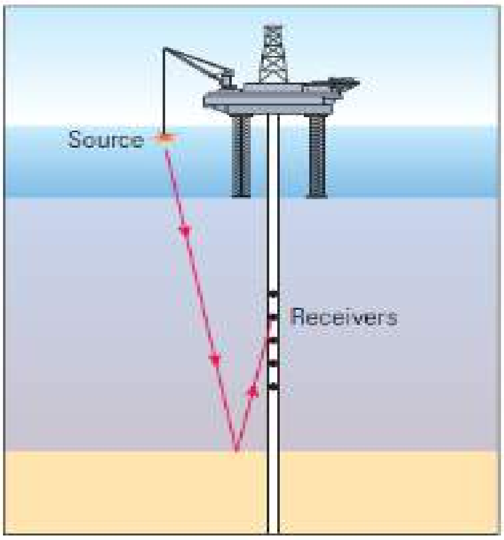

Figure 6-13: Schematic of a typical VSP arrangement.

BW Kudu is proposing to undertake one VSP operation per well, which would be scheduled towards the end of the drilling operations.

Well (Flow) Testing

In case of hydrocarbon discovery, a well or flow test can be undertaken to determine the economic potential of the discovery before the well is either abandoned or suspended. A typical well test would take up to three days to complete (1 day flaring during clean-up, 2 days flaring during main test). For well flow-testing, hydrocarbons would be burned at the well site. A high-efficiency flare is used to maximise combustion of the hydrocarbons. Burner heads which have a high burning efficiency under a wide range of conditions will be used.

The amount for fluids (hydrocarbons and water) to be produced during a well test cannot be reliably predicted due to variations in fluid composition (influenced by oil/gas/water saturation) and flow rates (influenced by reservoir pressure and permeability). Burners are manufactured to ensure emissions are kept to a minimum. The volume of hydrocarbons to be burned cannot be estimated with much accuracy because the actual test requirements can only be established after the penetration of a hydrocarbon-bearing reservoir. However, an estimated 20 mmscf (million standard cubic feet) of gas per day and 0.013 mmscf oil could be flared per test (refer to emissions in Section 6.4.5.3). If produced water is generated during well testing, it will be separated from the hydrocarbons (refer to discharges to sea in Section 6.4.5.2).

6.4.3.6 Well Sealing and Plugging

The purpose of well sealing and plugging is to isolate permeable and hydrocarbon bearing formations. Well sealing and plugging aims to restore the integrity of the formation that was penetrated by the wellbore. The principal technique applied to prevent cross flow between permeable formations is plugging of the well with cement, thus creating an impermeable barrier between two zones.

Once drilling and logging have been completed, the appraisal wells will be sealed with cement plugs, tested for integrity and abandoned according to international best practices. Cement plugs will be set to isolate hydrocarbon bearing and / or permeable zones and cementing of perforated intervals (e.g., from well logging activities) will be evaluated where there is the possibility of undesirable cross flow. These cement plugs are set in stages from the bottom up. Depending on the subsurface configuration, it is envisioned that three cement plugs would be installed: i.e. one each for isolation of the deep reservoir and the main reservoir; and a third as a second barrier for the main reservoir.

The integrity of cement plugs can be tested by a number of methods. The cement plugs will be tag tested (to validate plug position) and weight tested, and if achievable then a positive pressure test (to validate seal) and/or a negative pressure test will be performed. Additionally, a flow check may be performed to ensure sealing by the plug. Once the well is plugged, seawater will be displaced before disconnecting the riser and the BOP.

6.4.3.7 Resource Requirements

Personnel

The majority of the workforce will comprise highly specialised skilled staff on the drilling unit and support vessels (200 people on board depending on drilling operations). A limited number of local staff would also be employed at the onshore base for up to six months for an appraisal well (including mobilisation and demobilisation). The use of local labour will be prioritised where possible.

Water Requirements

The drilling campaign will use an estimated 4 800 m^3 of fresh water for water supply, cement and mud preparation. Fresh water will be supplied by tanker vessels and will also be produced onboard the drilling unit and supply vessels via seawater desalination.

Fuel Consumption

Marine gas oil (MGO) with a limit of 0.5% low sulphur (<0.5%) will be used as fuel for all vessels. Fuel will preferentially be obtained locally and transported to the drilling unit by the supply vessels. Jet-A-1 fuel will be used for helicopters. Estimates for the fuel use by a proposed drilling unit, supply vessels and helicopters during the drilling and mobilisation/demobilisation periods are presented in Table 6-7.

Table 6-7: Estimated fuel consumption for drilling campaign per well.

Source	Quantity	Units	No. units	Consumption of marine fuel (Tons)	Kerosene consumption (Tons)
1 x Drilling unit	35	Tons/day	90 days	3 150	-
3 x Supply vessels	15	Tons/day	90 days	1 350	-
Helicopter*	1**	Tons/round trip	43 round trips*	-	43
Airplane***	2	Tons/round trip	43 round trips*	-	86
Total				**4 500**	**129**

* Calculations based on 3 round trips per week (i.e., 14 weeks (˜100 days) x 3 = 43 trips for the campaign)
** Lüderitz to drill site round trip
*** Lüderitz to Windhoek round trip

Chemicals, fuels, oils and lubricants

The majority of chemicals to be used will be chemicals associated with drilling operations (e.g., drilling mud and additives – see Section 6.4.3.3) or fuels and lubricants. In addition, small quantities of various other chemicals will also be used (e.g., for maintenance and cleaning) aboard the vessels, at the supply base and at the helicopter base. The drilling unit could have a combustible and chemicals storage capacity larger than 5 000 m^3.

Explosive and Radioactive Materials

The drilling unit will be equipped with a secure store for explosives, plus igniter, booster, detonator and detonating cord. The drilling unit will also be equipped with a secure store for radioactive materials.

Waste Disposal Facilities

Depending on waste type, volume and timing, accumulated wastes may be stored temporarily at the onshore base and disposed at appropriately licenced waste facilities. Alternatively, wastes will be transferred directly to a waste contractor for treatment and / or disposal. Specific separated waste types would be disposed of in line with Namibian legal requirements for waste disposal. Envisaged waste types are summarised in Section 6.4.5.

6.4.4 Demobilisation Phase

After the appraisal wells have been sealed and tested for integrity (see Section 6.4.3.6), and based on the results of the drilling and logging, a decision would be made as to whether the wells would be abandoned or suspended.

If the well(s) are to be abandoned, the wellheads will be removed (with casings cut-off below the seafloor). However, if the well(s) are to be suspended, the intention is to leave the wellhead(s) on the seafloor if it is deemed safe to do so based on a risk assessment.

With the exception of the drilling discharges deposited on the seabed and possibly the suspended wellhead(s), no further physical remnants of the drilling operation will be left on the seafloor. A final clearance survey check will be undertaken using an ROV. The drilling unit and supply vessels will demobilise from the offshore licence area and either mobilise to the following drilling location or relocate into port or a regional base for maintenance, repair or resupply.

6.4.5 Discharges, Wastes and Emissions

6.4.5.1 Introduction

This section presents the main sources of discharges to water, waste and emissions that will result from the prosed drilling operations (including mobilisation and demobilisation). All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with international MARPOL requirements. Any oil spill related discharges would be managed by an Oil Spill Contingency Plan (OSCP) that BW Kudu will be required to compile and have approved by government. Onshore licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of drilling operations.

6.4.5.2 Discharges to Sea

Potential discharges to sea are expected to include:

- Drilling fluids/muds;
- Cement and cement additives;
- BOP hydraulic fluid;
- Produced water
- Bilge water from vessel machinery spaces;
- Deck drainage;
- Brine generated from onboard desalination plant;
- Sewage;
- Food wastes;
- Ballast water; and
- Detergents.

These discharges and their management are described in further detail below.

Drill Cuttings and Mud

Drill cuttings, which range in size from clay to coarse gravel and reflect the types of sedimentary rocks penetrated by the drill bit, are the primary discharge during well drilling. Drilling discharges would be disposed at sea in line with accepted drilling practices. This is in line with most countries (including Namibia) for early exploration and appraisal drilling phases. The rationale for this is based on the low density of drilling operations in the vast offshore area and the high energy marine environment. As such, BW Kudu proposes to use the “offshore treatment and disposal” option for their drilling campaign in Block 2814A.

During the riserless drilling stage, all cuttings and WBM will be discharged directly onto the seafloor adjacent to the wellbore. An estimated volume of 218 m^3 of cuttings and 775 m^3 of drilling fluid will be discharged on the seafloor.

For the current appraisal drilling, if NADFs are in use during the risered drilling stage, BW Kudu will treat cuttings offshore to reduce oil content to <3% Oil On Cutting (OOC) and discharge the 339 m^3 treated cuttings overboard (with 0.5 m^3 residual NADF). The 16 m^3 of NADF will be recycled and reused in subsequent drilling operations happening in the region (refer to 6.4.3.2). During this drilling stage the circulated drilling fluid will be cleaned and the cuttings discharged into the sea. The drill cuttings will be treated to reduce their mud content using shakers and a centrifuge as described in Section 6.4.3.2.

Cuttings released from the drilling unit during the risered drilling stage will be dispersed by the current and settle to the seafloor. The rate of cuttings discharge decreases with increasing well depth as the hole diameter becomes smaller and penetration rates decrease (refer to 6.4.3.4). Discharge is intermittent as actual drilling operations are not continuous while the drilling unit is on location.

Further drilling fluid totalling 600 m^3 will be released 1 m above the seafloor during well suspension and displacement (between drilling section 2 and 3). The mud used during these processes is a High Viscous Gel sweeps / KCl Polymer PAD mud[9].

The expected fall and spatial extent of the deposition of discharged cuttings will be investigated in the Drilling Discharges Modelling Study during the Assessment Phase (see Section 9.1.1.1 for the terms of reference for this study).

Cement and Cement Additives

Typically, cement and cement additives are not discharged during drilling. However, during the initial cementing operation (i.e. surface casing), excess cement emerges out of the top of the well and onto the seafloor in order to ensure that the conductor pipe is cemented all the way to the seafloor. During this operation a maximum of 150 - 200% of the required cement volume may be pumped into the space between the casing and the borehole wall (annulus). In the worst-case scenario, approximately 40 m^3 [10] of cement could be discharged onto the seafloor.

BOP Hydraulic Fluid

As part of routine opening and closing operations the subsea BOP stack elements will vent some hydraulic fluid into the sea at the seafloor. It is anticipated that between approximately 500 and 1 000 litres of oil-based hydraulic emulsion fluid could be vented per month during the drilling of a well. BOP fluids completely biodegrade in seawater within 28 days.

Produced Water

If water from the reservoir arises during well flow testing (estimated volume of 300 m^3 based on previous drilling campaigns), these would be separated from the oily components and treated onboard to reduce the remaining hydrocarbons from these produced waters. The hydrocarbon component will be burned off via the flare booms, while the water is temporarily collected in a slop tank. The water is then either directed to:

- a settling tank prior to transfer to supply vessel for onshore treatment and disposal; or
- a dedicated treatment unit where, after treatment, it is either:
  (i) if hydrocarbon content is < 30 mg/l, discharged overboard; or
  (ii) if hydrocarbon content is > 30 mg/l, subject to a second treatment or directed to tank prior to transfer to supply vessel for onshore treatment and disposal.

[9] PAD mud = Heavy weight mud pumped into the well prior to tripping pipe or prior to setting cement plug (source: https://www.sigmaquadrant.com/glossary-drilling-operations)

[10] 1.6% of the volume of an Olympic sized swimming pool

Vessel Machinery Spaces (Bilge Water)

Vessels will occasionally discharge treated bilge water. Bilge water is drainage water that collects in a ship's bilge space (the bilge is the lowest compartment on a ship, below the waterline, where the two sides meet at the keel). In accordance with MARPOL Annex I, bilge water will be retained on board until it can be discharged to an approved reception facility, unless it is treated by an approved oily water separator to <15 ppm oil content and monitored before discharge. The residue from the onboard oil/water separator will be treated / disposed of onshore at a licenced hazardous landfill site.

Deck Drainage

Deck drainage consists of liquid waste resulting from rainfall, deck and equipment washing (using water and a water-based detergent). Deck drainage will be variable depending on the vessel characteristics, deck activities and rainfall amounts.

In areas of the drilling unit where oil contamination of rainwater is more likely (i.e. the rig floor), drainage is routed to an oil / water separator for treatment before discharge in accordance with MARPOL Annex I (i.e. 15 ppm oil and grease maximum). There will be no discharge of free oil that could cause either a film, sheen or discolouration of the surface water or a sludge or emulsion to be deposited below the water's surface. Only non-oily water (i.e. <15 ppm oil and grease, maximum instantaneous oil discharge monitor reading) will be discharged overboard. If separation facilities are not available (due to overload or maintenance) the drainage water will be retained on board until it can be discharged to an approved reception facility. The oily residue from the onboard oil / water separator will be treated / disposed of onshore at an approved hazardous landfill site.

Brine generated from onboard desalination plant

The waste stream from the desalination plant is brine (concentrated salt), which is produced in the reverse osmosis process. The brine stream contains high concentration of salts and other concentrated impurities that may be found in seawater. Water chemical agents will not be used in the treatment of seawater and therefore the brine reject portion would be in a natural concentrated state. Based on previous well drilling operations, freshwater production amounts to approximately 40 m^3/day, which will result in approximately 35 g salt for each litre water produced (i.e., approx. 1 400 kg salt/brine per day).

Sewage and Grey Water

Discharges of sewage (or black water) and grey water (i.e. wastewater from the kitchen, washing and laundry activities and non-oily water used for cleaning) will occur from vessels intermittently throughout the duration of the proposed activities and will vary according to the number of persons on board, estimated at an average of 200 litres per person per day. All sewage discharges will comply with MARPOL Annex IV.

Sewage and grey water will be treated using a marine sanitation device to produce an effluent with:

- A Biological Oxygen Demand (BOD) of <25 mg/l (if the treatment plant was installed after 1/1/2010) or <50 mg/l (if installed before this date);
- Minimal residual chlorine concentration of 0.5 mg/l; and
- No visible floating solids or oil and grease.

Food (Galley) Wastes

The disposal into the sea of food waste is permitted, in terms of MARPOL Annex V, when it has been comminuted or ground to particle sizes smaller than 25 mm and the vessel is *enroute* more than 3 nm (approximately 5.5 km) from land. Disposal overboard without macerating is permitted for moving vessels greater than 12 nm (approximately 22 km) from the coast. On the drilling unit, all food waste will be macerated to particles sizes <25 mm and the daily discharge is typically about seven tonnes per month.

Ballast Water

Ballast water is used during routine operations to maintain safe operating conditions onboard a ship by reducing stress on the hull, providing stability, improving propulsion and manoeuvrability, and compensating for weight lost due to fuel and water consumption.

While it is essential for safe operations, discharge of ballast water can pose a risk to the receiving environment when discharged due to foreign marine species (e.g., bacteria and larvae) being carried in a ships' ballast water from one location to another when mobilising the drilling unit to Namibia. Ballast water is, therefore, discharged subject to the requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments. The Convention stipulates that all ships are required to implement a Ballast Water Management Plan and that all ships using ballast water exchange will do so at least 200 nautical miles (nm) (± 370 km) from nearest land in waters of at least 200 m deep when arriving from a different marine region. Where this is not feasible, the exchange should be as far from the nearest land as possible, and in all cases a minimum of 50 nm (± 93 km) from the nearest land and preferably in water at least 200 m in depth. Project vessels will be required to comply with this requirement. Block 2814A is located 144 km for the coast at its closest point; thus, any discharge within the license area would be compliant with the minimum requirements.

Detergents

Detergents used for washing exposed marine deck spaces will be discharged overboard. The toxicity of detergents varies greatly depending on their composition. Water-based detergents are low in toxicity and are preferred for use. Preferentially biodegradable detergents should be used. Detergents used on work deck space will be collected with the deck drainage and treated as described under deck drainage above.

Waste Management

A number of other types of solid wastes generated during the appraisal drilling activities will not be discharged at sea, but will be transported to shore for ultimate disposal in Lüderitz or Walvis Bay (where there are general and hazardous landfill sites). All onboard waste will be segregated, duly identified and transported to shore for disposal at a licenced waste management facility approved by the Operator. The treatment, disposal and recycling of all waste onshore will be fully traced through a waste manifest system.

In the event that NADF is necessary to be used for drilling, bulk volumes of NADF remaining at the end of well drilling, will either be shipped for onshore treatment and disposal through a licenced waste disposal company or re-used during the drilling of subsequent wells in the area or another drilling campaign.

The services of a licenced waste contractor will be used to collect all operational waste for treatment, disposal or recycling. A summary of the typical waste types expected to be generated are listed in Table 6-8.

Table 6-8: Typical waste types associated with the proposed appraisal well drilling activities.

Category	Waste Type
Non-hazardous	General domestic waste
	Wood
	Plastic
	Scrap metal
Hazardous	Oil rags and oil filters
	Used oil
	Batteries
	Medical waste
	Oil water (slops)
	Filter cartridges
	Drums (with residues)
	Other various wastes

6.4.5.3 Air Emissions

The principal sources of emissions to air from the proposed appraisal activities will be from vessel engines (drill unit, support vessels and helicopters) and well flow testing (i.e. flaring). The vessels will be supplied with marine gas oil (MGO) with a sulphur limit of 0.5% sulphur (mass) and helicopters will use kerosene. Conservative estimates for the fuel use by a drilling unit, supply vessels and helicopters during the drilling and mobilisation/demobilisation periods are presented in Table 6-7.

Typical combustion products from these unit operations include sulphur oxides (SO_x), oxides of nitrogen (NO_x, N_2O), carbon dioxide (CO_2), carbon monoxide (CO), volatile organic compounds (VOC) Methane (CH_4) and non-methane volatile organic compounds (NMVOC) and particulate matter (PM).

The estimated volume of hydrocarbons to be burned during possible well testing cannot be estimated with much accuracy. However, BW Kudu has estimated that 20 mmscf gas and 0.013 mmscf oil could be flared per appraisal well.

The anticipated emissions (GHG and non-GHG) from the proposed activities will be investigated in the Air Emissions Impact Assessment and Climate Change Risk Assessment (see terms of reference in Section 9.1.2.5 and 9.1.2.6, respectively).

Noise Emissions

The key sources generating underwater noise are vessel propellers (and positioning thrusters), drag on the riser, supply vessels and from drilling activities. This is expected to result in highly variable sound levels, being dependent on the operational mode of each vessel. The VSP survey would generate a short-term noise (less than nine hours). The main sources of noise from these activities are categorised below:

- <u>Drilling noise</u>: Drilling units generally produce underwater noise in the range of 10 Hz to 100 kHz (OSPAR commission, 2009) with major frequency components below

100 Hz and average source levels of up to 190 dB re 1 μPa at 1 m (rms) (the higher end of this range from use of bow thrusters). These noise levels will be assumed as indicative for the proposed appraisal drilling.

- Propeller and positioning thrusters: Noise from propellers and thrusters is predominately caused by cavitation around the blades whilst transiting at speed or operating thrusters under load to maintain a vessel's position. The noise produced by a drilling unit's dynamic positioning systems (assuming the drilling unit is not anchored) can be audible for many kilometres. Noise produced is typically broadband noise, with some low tonal peaks. The supply vessels will also contribute to an overall propeller noise generation.
- Machinery noise: Machinery noise is often of low frequency and can become dominant for vessels when stationary or moving at low speeds. The source of this type of noise is from large machinery, such as large power generation units (diesel engines or gas turbines), compressors and fluid pumps. Sound is transmitted through different paths, i.e. structural (machine to hull to water) and airborne (machine to air to hull to water) or a mixture of both. The nature of sound is dependent on a number of variables, such as the type and size of machinery operating; and the coupling between machinery and the vessel body. Machinery noise is typically tonal in nature. A ROV will be used to conduct a sweep of the drilling site to identify any debris; however, this is not expected to form a significant noise source.
- Well logging noise: VSP will be undertaken in order to generate a high-resolution image of the geology in the well's immediate vicinity (see Section 6.4.3.5). It is expected to use a small dual airgun array, comprising a system of three 250 cubic inch airguns with a total volume of 750 cubic inches of compressed nitrogen at about 2 000 psi. The volumes and the energy released into the marine environment are significantly smaller than what is required or generated during conventional seismic surveys. The airguns will be discharged approximately five times at 20 second intervals. This process is repeated, as required, for different sections of the well for a total of approximately 200 shots. A VSP is expected to take up to nine hours per well to complete, depending on the well's depth and number of stations being profiled.
- Well testing noise (see Section 6.4.3.5): if flaring is implemented, it would produce some air-borne noise above the sea level for up to 3 days while flowing and flaring.
- Equipment in water: Noise is produced from equipment such as the drill string. The noise produced will be low relative to the drilling noise and the dynamic positioning system assuming the drilling unit is not anchored).
- Helicopter noise: Helicopters will also form a source of noise, which can affect marine fauna both in terms of underwater noise beneath the helicopter and airborne noise.

The extent of activity-related noise above the background noise level may vary considerably depending on the specific vessels used and the number of supply vessels operating. It will also depend on the variation in the background noise level with weather and with the proximity of other vessel traffic (not associated with the proposed activities).

An Underwater Noise Modelling Study will be undertaken to determine the underwater noise transmission loss with distance from well site and compare results with threshold values for marine fauna to determine zones of impact (refer to the terms of reference in Section 9.1.1.3). These modelling results will be used in the assessment of impacts on marine fauna and commercial fisheries.

Light Emissions

Operational lighting will be required on the drilling unit and supply vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

Heat Emissions

Flaring during well testing generates heat emissions from the combustion of hydrocarbons at the burner head.

6.4.5.4 Emergency Response

BW Kudu a member of Oil Spill Response Limited (OSRL) which provides the use of globally advanced capping stacks in the event of a well blow-out, and BW Kudu will be included in its membership in 2025 for the proposed drilling campaign. Capping stacks are designed to shut-in an uncontrolled subsea well in the unlikely event of a blow-out. OSRL has a 10K capping stack housed at its Saldanha Bay Base off the West Coast of South Africa (see Figure 6-14). The capping stack is available for global mobilisation and transportation by sea and/or air in the event of an incident.

Figure 6-14: Example of an Oil Spill Response Limited Capping Stack.

Source: https://www.oilspillresponse.com/services/subsea-well-intervention-services/capping

The capping stack would only be deployed in a situation where the BOP has failed to serve its purpose and a blow-out has occurred. It is a piece of equipment that is placed over the blown-out well as a “cap”. Its purpose is to stop or redirect the flow of hydrocarbons and to buy time for engineers to permanently seal the well. It weighs as much as 100 tonnes and requires co-ordinated logistical planning and execution in quickly transporting it to the emergency location.

Before a capping stack arrives, an ROV would be deployed to inspect the seabed site for engineers to confirm precisely what equipment is needed. Any debris would then be removed and the wellhead prepared. After the equipment arrives, the capping stack would be carefully manoeuvred into place over the wellhead. The stack's valves would be closed to cap the well ("cap only") or, if necessary, the flow will be redirected to surface vessels through flexible pipes and risers ("cap and flow").

The mobilisation of these and other incident response equipment and services will be contained in BW Kudu's OSCP and Emergency Response Plan.

BW Kudu motivates that 30 days is a reasonable and realistic assumption for the installation of a capping stack in the unlikely event of a blow-out. The current state of knowledge, available technology and approach to well blow-out responses by the drilling industry has advanced since, and because of, the Deepwater Horizon spill event. As a result of this advancement, the duration of the Deepwater Horizon event is not considered relevant as a benchmark of a reasonable response period. It is relevant that subsea capping and subsea containment equipment (managed by OSRL, a cooperative dedicated to response to marine pollution by hydrocarbons) is installed at Saldanha Bay, South Africa and, therefore, well placed for a rapid response to an unplanned event in Block 2814A.

6.5 Activity Alternatives

"Alternatives" to a proposed activity are defined as "*a different means of meeting the general purpose and requirements of the activity, which may include alternatives to the:*

- *Property on which or location where the activity is proposed to be undertaken;*
- *Type of activity to be undertaken;*
- *Design or layout of the activity;*
- *Technology to be in the activity; or*
- *Operational aspects of the activity*."

A summary of activity alternatives considered during the design phase are summarised in Table 6-9. A comparative assessment of alternatives, where available, will be provided in the ESIA Report.

Table 6-9: Summary of activity alternatives considered in this ESIA.

MH	No.	Aspect	Description / Alternative	Consideration in ESIA
Avoidance	**1. Site / location alternatives**			
	1.1	Drill site locations	The specific drill site locations have not been finalised. Well locations within Block 2814A will be identified based on further analysis of available seismic data, geological target, seafloor obstacles and results from preceding well tests.	Drill site locations for the Drilling Discharges and Oil Spill Modelling will be selected based on a number of criteria (including metocean dataset, water depths, and proximity to coast and sensitive areas) to model and assess the plausible worst-case scenarios for predicted cuttings dispersion and an unlikely oil spill event.
	1.2	Onshore base location	BW Kudu considered two options for the onshore logistics base, including:	The ESIA will consider both the Walvis Bay and Lüderitz alternatives.

MH	No.	Aspect	Description / Alternative	Consideration in ESIA
			• Walvis Bay; and • Lüderitz. The preferred alternative is Walvis Bay.	Both Walvis Bay and Lüderitz have well-developed ports and adequate facilities exist to support the proposed appraisal activities. No additional onshore infrastructure is expected to be required to support the proposed appraisal activities. There is no material difference in impact significance between Walvis Bay and Lüderitz.
	1.3	Aviation base location	Aviation base locations are: • Lüderitz • Oranjemund.	The ESIA will consider both alternatives.
	2. Timing / Scheduling Alternatives			
	2.1	Timing of appraisal drilling	No up-front restrictions or alternative timelines are provided.	Drilling may have impact on marine fauna, such as whales, dolphins and turtles, that have seasonal occurrences in the Area of Interest. The ESIA will consider the implications of drilling in different seasons. The results of the modelling studies (drilling discharge, and underwater noise) will be used in the assessment of impacts on marine fauna and commercial fisheries and the possible need for mitigation e.g., restricting certain activities to specific seasons.
Avoidance	**3. No-Go alternative**			
	3.1	No-Go alternative	The No-Go alternative represents the option not to proceed with appraisal drilling, and thus the status quo, which implies that the area of influence remains in its current condition (see Section 7.1, noting there may be variations of the baseline environment due to natural causes or other human activities) in their current state and precludes the opportunity of potential future oil and gas development and attendant economic and social benefits that may be derived.	The ESIA will consider the implications of the No-Go alternative.

MH	No.	Aspect	Description / Alternative	Consideration in ESIA
Minimisation	**4. Design and Technology Alternatives**			
	4.1	Number of wells	The proposal is to drill up to 4 appraisal wells in Block 2814A.	The ESIA will assess the potential impacts associated with 4 wells in any location within the Block.
	4.2	Drilling unit	Given the oceanographic conditions and depth of the Block, a drill ship or semi-submersible vessel are being considered for the proposed well drilling activities.	The ESIA will assess the potential impacts of either a drill ship or semi-submersible vessel. There are no additional impacts or differences in impact significance relating to the choice of drilling unit (semi-submersible or drill ship).
	4.3	Drilling method	Two drilling methods can be employed on a drilling unit, namely rotary or downhole motor drilling.	The ESIA will assess the potential impacts related to either drilling method and will not distinguish between the two options. The environmental consequences of both methods are similar and do not make a material difference to the findings of the ESIA.
	4.4	Drilling fluid	Two types of drilling fluid could be used during drilling: WBM or NADF. BW Kudu proposes using WBMs during the riserless drilling stage and NADF during the risered drilling stage, if WBMs are not able to provide the necessary characteristics.	The ESIA will assess the potential impacts related to both drilling fluids.
	4.5	Drill cuttings disposal methods	Options for drill cuttings disposal include discharge to sea; onshore disposal; and re-injection.	Drilling discharges will be disposed at sea. This is in line with most countries (including Namibia and South Africa) for early exploration and appraisal drilling phases. The rationale for this is based on the low density of drilling operations in the vast offshore area and the high energy marine environment. As such, BW Kudu proposes to use the "offshore treatment and disposal" option for their drilling campaign in Block 2814A. Drill cuttings modelling will be undertaken to confirm the extent of plume dispersion and will be used to assess impacts on marine habitats and species. Should significant impacts be identified alternative disposal methods may need to be considered.

MH	No.	Aspect	Description / Alternative	Consideration in ESIA
Minimisation	4.6	Helicopter flight paths	Helicopter flights between the aviation base and the drilling unit may impact on seabirds or seals on coastal rocky shores or islands during specific breeding seasons.	The ESIA will assess the risk of helicopter flights on seabirds or seals to confirm whether helicopter flight paths need to be rerouted to avoid certain sensitive areas. It will also consider additional mitigation such as minimum flight heights when flying over seal or bird islands or Marine Protected Areas (MPAs).
	4.7	Well abandonment	Based on the results of the drilling and logging, a decision would be made as to whether the well would be abandoned or suspended: • If abandoned, the wellhead(s) would be removed (with casings cut-off below the seafloor). • If suspended, the wellhead(s) would remain on the seafloor.	The ESIA will assess the potential impacts related to both well abandonment and suspension.

7.0 Description of the Receiving Environment

Block 2814A is located offshore the southern coast of Namibia close to the marine border with South Africa (see Figure 1-1). This chapter provides a description of the attributes of the physical, biological, socio-economic and cultural receiving environment of the licence area and region surrounding the licence block. An understanding of the environmental and social context and sensitivity within which the proposed activities would be located is important to understanding the potential impacts.

The descriptions of the physical and biological environments along the southern and central Namibian coast primarily cover the offshore area from Lüderitz in the north to the Orange River mouth in the south, although where appropriate reference is made to the entire Namibian coastline.

7.1 Area of Influence

The area of influence of the proposed appraisal well drilling activities defines the spatial extent of the baseline information and can be separated into the area of influence for normal operations and for unplanned events, summarised below:

- **The area of influence (normal operations)** (see Figure 7-1) will be re-confirmed based on the results of the underwater noise and drilling discharge modelling, as well as the marine ecology and fisheries assessments and includes:
    - Block 2814A within which appraisal activities will take place;
    - The Port of Walvis Bay (preferred location) or the Port of Lüderitz as the location for the onshore logistics base;
    - Marine traffic routes between Walvis Bay or Lüderitz and the drilling unit;
    - Airspace between airport (at Lüderitz or Oranjemund) and the drilling unit for helicopter-based crew changes; and
    - Areas where marine resources, such as commercial fishing stocks and marine mammals, are affected by the proposed activities, e.g. due to underwater noise and safety exclusion zones.
- **The extended area of influence in the case of any unplanned events occurring** will be confirmed based on the oil spill modelling results and may include coastal and nearshore areas that could be affected in the very unlikely event of a well blow-out.

7.2 Geophysical Characteristics

7.2.1 Bathymetry

The continental shelf along the Namibian coast varies in width and depth. Offshore of the Orange River mouth, the shelf is wide (230 km) and characterised by well-defined shelf breaks. Northwards, it reaches its narrowest point (90 km) off Chameis Bay, before widening again to 130 km off Lüderitz (Rogers 1977). For benthic ecosystem classifications, the continental shelf is divided into an inner shelf and an outer shelf at a depth of 150 m. The shelf edge extends to the shelf break at depths between 350 - 500 m. Beyond this, the slope is divided into upper and lower sections at 1 800 m, before forming the deep-sea abyss (>3 500 m) (Sink *et al.* 2012; Holness *et al.* 2014). **Block 2814A is located on the outer shelf, shelf edge and upper slope** (Figure 1-1).

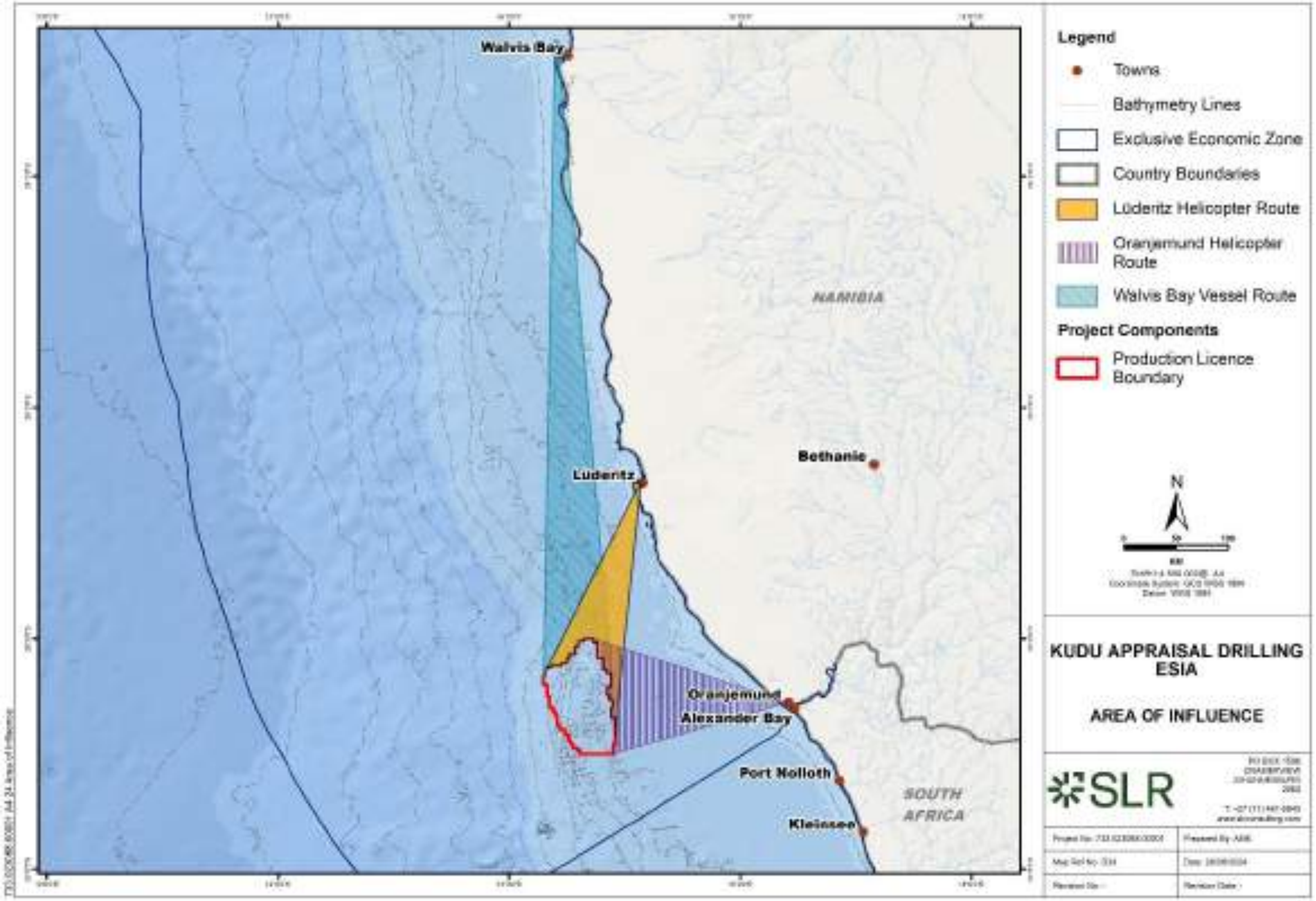

Figure 7-1: Expected Area of Influence.

The inner shelf has a relatively steep gradient to approximately 100 m depth, after which the gradient decreases and undulates to depths of approximately 200 m. North of Chameis Bay, the shelf edge and break is relatively deep (400 - 450 m). The variable topography of the shelf is important for near shore circulation and for fisheries (Shannon & O'Toole 1998).

Block 2814A is just offshore and to the north of the Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River. **Tripp Seamount, a geological feature situated approximately 300 km offshore in water depths of 1 000 m, is located 74 km south-west of Block 2814A.** It is a roughly circular feature with a flat apex at approximately 150 m depth that drops steeply on all sides.

7.2.2 Shelf Geology and Seabed Geomorphology

As part of the Marine Spatial Planning (MSP) process in Namibia, the marine geology of the Namibian continental shelf and geomorphic seafloor features within the EEZ were mapped (MFMR 2021) (Figure 7-2 and Figure 7-3). There is a canyon extending from the north-western corner of the block.

The inner shelf is underlain by Precambrian bedrock (also referred to as Pre-Mesozoic basement), whilst outer shelf area is composed of Cretaceous and Tertiary sediments (Dingle 1973; Birch *et al*. 1976; Rogers 1977; Rogers & Bremner 1991). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An approximately 500 km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the outer edge of the middle shelf between the Orange River and St Helena Bay in South Africa (Birch *et al*. 1976; Meadows *et al*. 1997, 2002; Herbert & Compton 2007). These biogenic muds contribute to the formation of low-oxygen waters and sulphur eruptions off central Namibia (see Section 7.3.9). Offshore of the mud belt, the composition changes to muddy sands, sands and gravels before changing back to mud-dominated seabed beyond the 500 m contour. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Photographic data recorded in Licence Block 2914A, immediately south of Block 2814A, shows that the substrate is unconsolidated sediment (SLR, 2024). **The seafloor in deeper regions of the Block 2914A was largely homogenous and classified as 'sandy mud', while the shallower regions were classified as 'sand' and 'muddy sand'.**

7.2.3 Sedimentary Phosphates

Phosphorite, sedimentary rock with 5%-20% phosphate content, is found in the marine environment as nodular hard ground or layers on continental shelves and slopes (Morant 2013). These deposits serve as a record of climate-linked palaeoceanographic changes in upwelling systems. The Benguela Upwelling System, one of the world's most productive, hosts significant phosphorite deposits over a 24 700 km^2 area on the Namibian shelf (Compton & Bergh 2016). It is estimated that the total resource is 7 800 million tonnes with an average grade of 19% per weight of P_2O_5 (Compton & Bergh 2016).

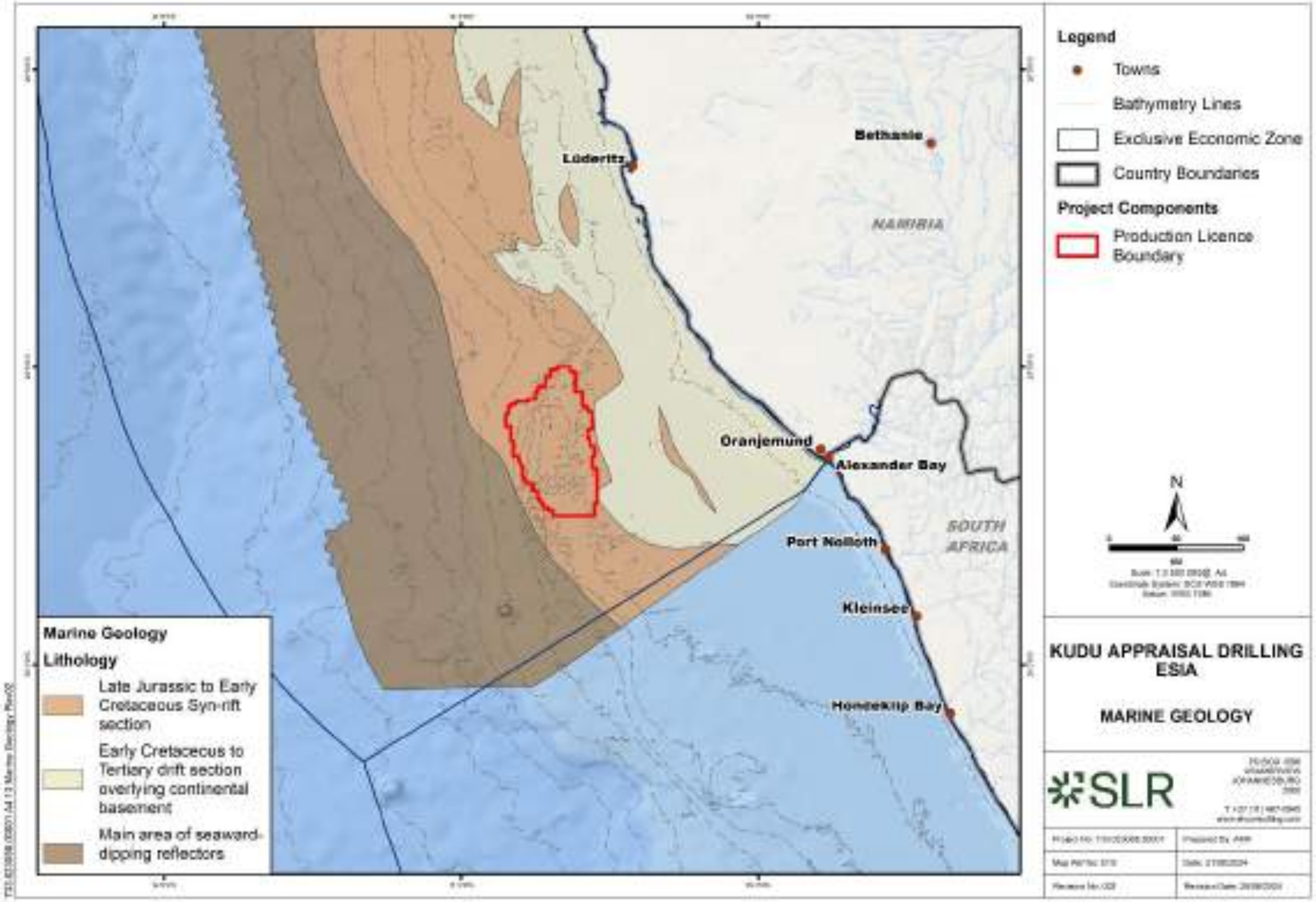

Figure 7-2: Block 2814A (red polygon) in relation to the marine geology of the southern Namibian continental shelf.

Source: Adapted from MFMR (2021).

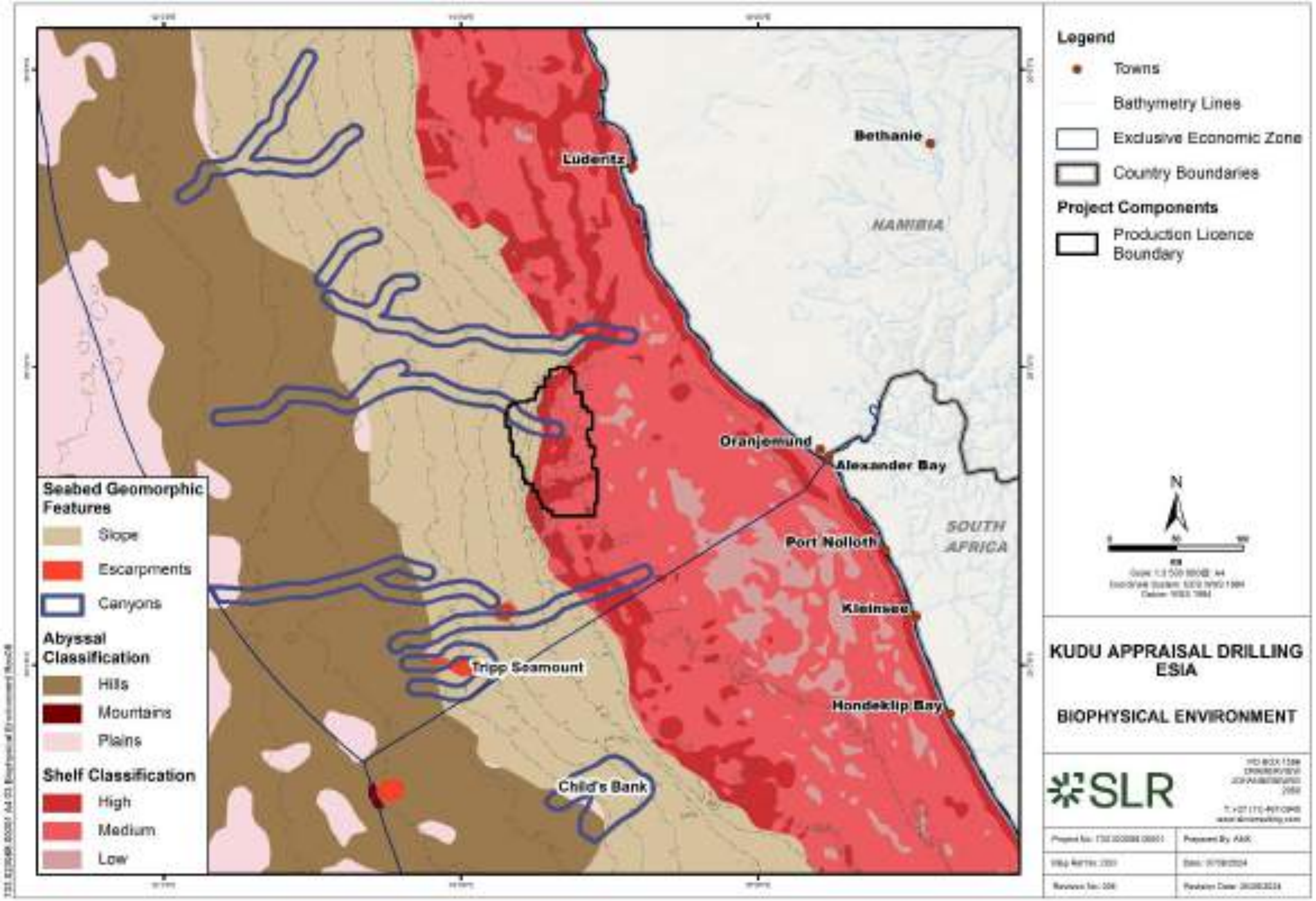

Figure 7-3: Block 2814A (black polygon) in relation to seabed geomorphic features off southern Namibia.

Source: Adapted from MFMR (2021).

The phosphorite deposits on the open shelf form when phosphate precipitates as calcium phosphate due to intense upwelling and temperature changes, which reduces phosphate solubility in oceanic waters. This precipitation occurs at the sediment-water interface, aided by the decay of siliceous phytoplankton. The resulting phosphates combine with calcium from calcareous foraminiferal and coccolithophorid debris, forming phosphatised lime-rich muds. These muds eventually solidify through secondary calcium phosphate replacement (francolite), creating a continuous layer of phosphate rock on the seafloor sediments (Birch 1990; Morant 2013).

Marine phosphates offshore of Namibia were first discovered and regionally mapped in the late 1960s and 1970s, with subsequent exploratory work undertaken in the 1990s and 2000s. Deposits occur as concretionary rock phosphorite and pelletal and glauconitized pelletal phosphorite, generally to depths of ~350 m. **Block 2814A is in water depths of 150 m to 750 m therefore the shallow regions of the block could contain pelletal and glauconitized pelletal phosphate deposits.**

7.2.4 Summary

Block 2814A is situated offshore on the lower shelf, shelf edge and upper slope, in water depths ranging from 150 m - 750 m. **The region's geological features include the Orange Bank, Tripp Seamount and shallow canyons**, which have been mapped for Marine Spatial Planning purposes. Block 2814A is 75 km north-east of Tripp seamount. **The shelf sediments range from sandy to muddy, with calcium carbonate deposits. Beyond the 500 m depth contour, the seabed composition is dominated by muds.** Photographic data from a nearby Licence Block showed that the **seafloor is unconsolidated sediment, ranging from sand, muddy sand and sandy mud in that area.**

Notably, Namibia's shelf hosts extensive phosphorite deposits, formed by upwelling-induced phosphate precipitation. **Regions of Block 2814A could contain pelletal and glauconitized pelletal phosphate deposits.**

7.3 Biophysical Characteristics

7.3.1 Climate

The Namibian coastline has hyper-arid conditions with low, unpredictable winter rains, and strong predominantly southerly or south-westerly winds. North of Lüderitz, summer rains prevail, and further out to sea, a south-easterly wind component is prominent. Winds reach a peak in the late afternoon and subside between midnight and sunrise.

Frequent fog occurs along the coast, about 50 - 75 days per year, mainly from February through May. The fog lies close to the coast extending about 20 nautical miles (~35 km) seawards (Olivier 1992, 1995). This fog bank is dense and hugs the shoreline, reducing visibility to less than 300 m.

Average annual precipitation is less than 15 mm. Mild temperatures prevail year-round, averaging around 16°C along the coast and increasing inland (Barnard 1998). In winter, hot easterly 'Berg' winds from the desert can cause significant daily temperature shifts, with temperatures reaching up to 30°C during such events (Shannon & O’Toole 1998).

7.3.2 Wind Patterns

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

The prevailing winds in the Benguela region are influenced by the South Atlantic subtropical anticyclone, eastward-moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure patterns over the subcontinent. The South Atlantic anticyclone strengthens and extends furthest south during the austral summer but weakens and moves north-westward in winter. This results in substantial differences between summer and winter wind patterns in the region.

During summer, wind is strongest with southerlies dominating most of the time, averaging 10-15 m/s and sometimes exceeding 30 m/s (Figure 7-4). These southerly winds bring cool, moist air to the coast and drive the large-scale upwelling of nutrient-rich bottom waters which defines the region in summer. These strong equatorward winds are interrupted by passing coastal lows which cause periods of calm or north/northwest wind conditions.

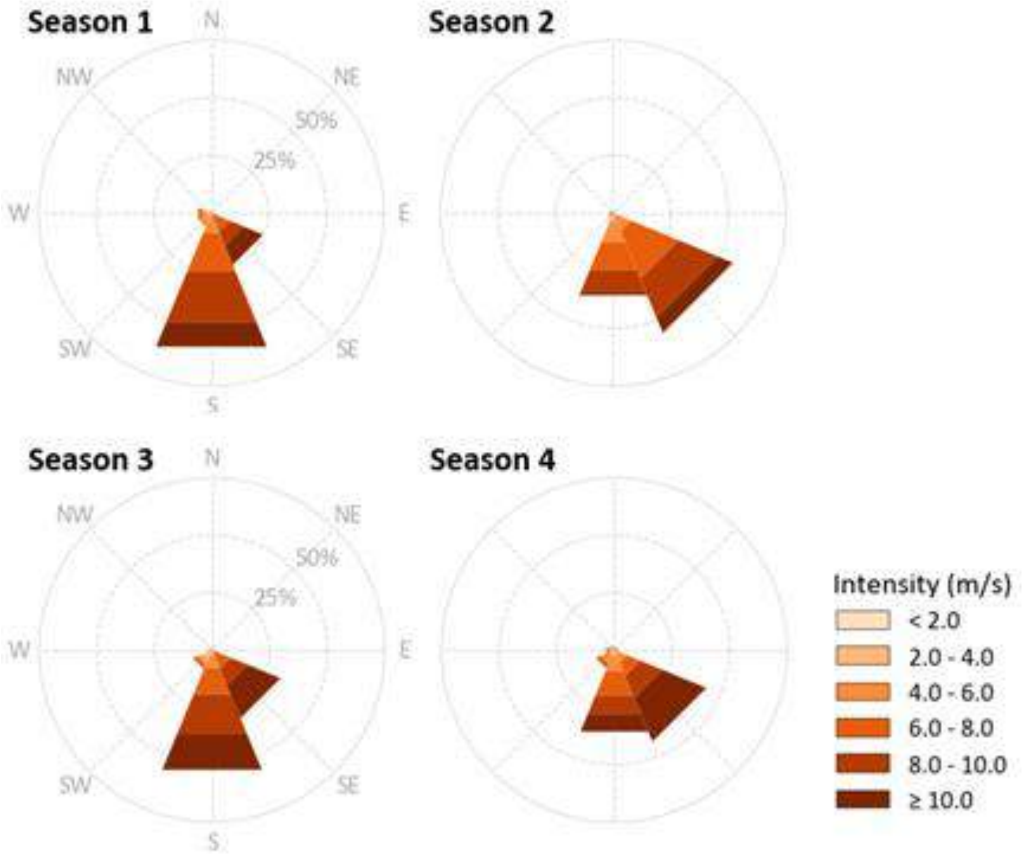

Figure 7-4: Wind data by season. Season 1: December to February, Season 2: March to May, Season 3: June to August, Season 4: September to November. Data from ERA5 project for years 2016-2020 for a grid point nearby Block 2814A.

Source: CLS Brasil, 2024.

Winter remains dominated by southerly winds, but the proximity of winter cold-front systems introduces a significant north-westerly component. This change in conditions results in a cessation of upwelling, movement of warmer mid-Atlantic water shoreward and a breakdown of the strong thermoclines which typically develop in summer. In winter, calms are more frequent and wind speeds generally don’t reach the summer’s maximum levels.

Larger swells occur in winter then the westerly winds align with the prevailing south-westerly swell direction.

In autumn and winter, strong offshore berg winds can occur. These easterly winds can exceed 13 m/s and create sandstorms, which severely limit visibility at sea and on land. These winds, though intermittent for about a week, play a major role in transporting sediment into the coastal marine environment, carrying sediment up to 150 km offshore (Tlhalerwa *et al.* 2012; Figure 7-5) (see also Section 7.3.8).

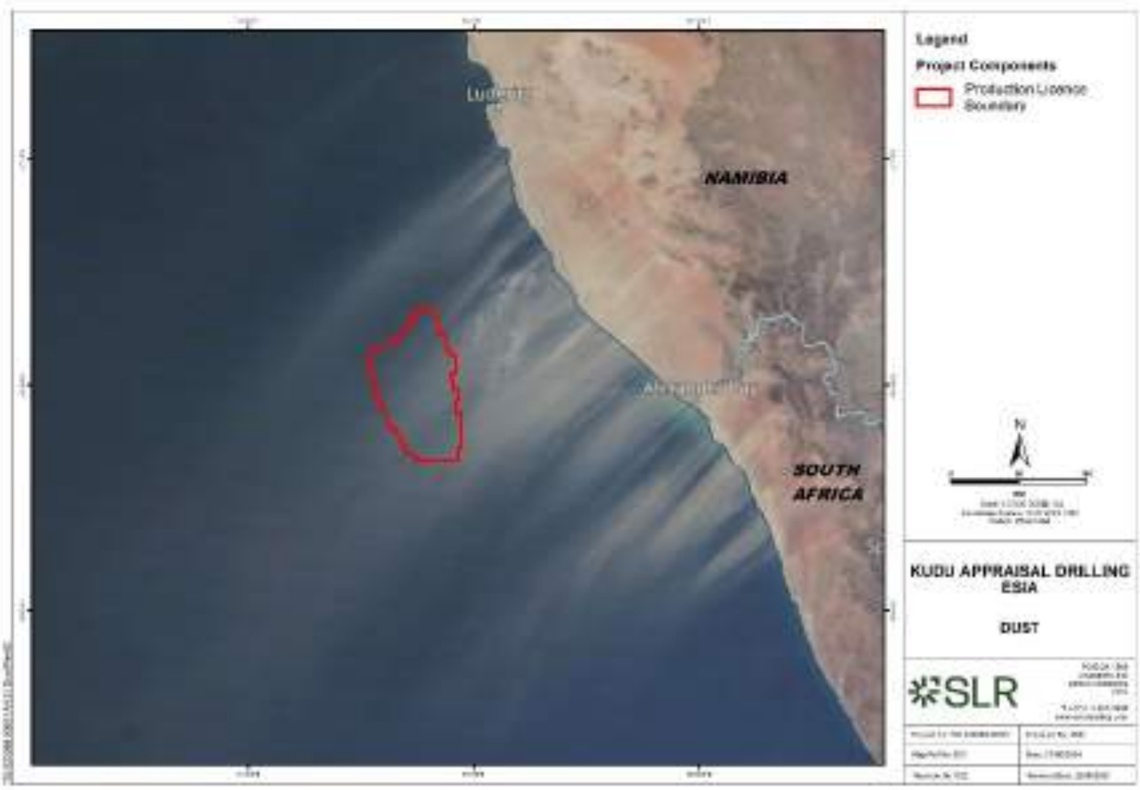

Figure 7-5: Satellite image showing aerosol plumes of sand and dust being blown offshore during a northeast 'berg' wind event along the southern Namibian coast. The estimated position of Block 2814A has been indicated.

Source: www.earthdata.nasa.gov/worldview/worldview-image-archive/dust-blows-off-coast-namibia-south-africa.

7.3.3 Large Scale Circulation and Currents

The Namibian coastline is heavily influenced by the Benguela Current. Current velocities on the continental shelf typically range between 10–30 cm/s (Boyd & Oberholster 1994). In the south, the Benguela Current spans 200 km in width, expanding rapidly northwards to 750 km. The barotropic current is primarily driven by wind and alternates between poleward and equatorward directions for short fluctuation periods (3-10 days) (Shillington *et al.* 1990; Nelson & Hutchings 1983; Hutchings *et al*. 2009) (Figure 7-6). However, the long-term flow average is approximately north-west alongshore (Figure 7-7). Near the bottom shelf, the flow is mainly poleward (Nelson 1989) with typically low velocities around 5 cm/s. The poleward flow becomes more consistent in the southern Benguela.

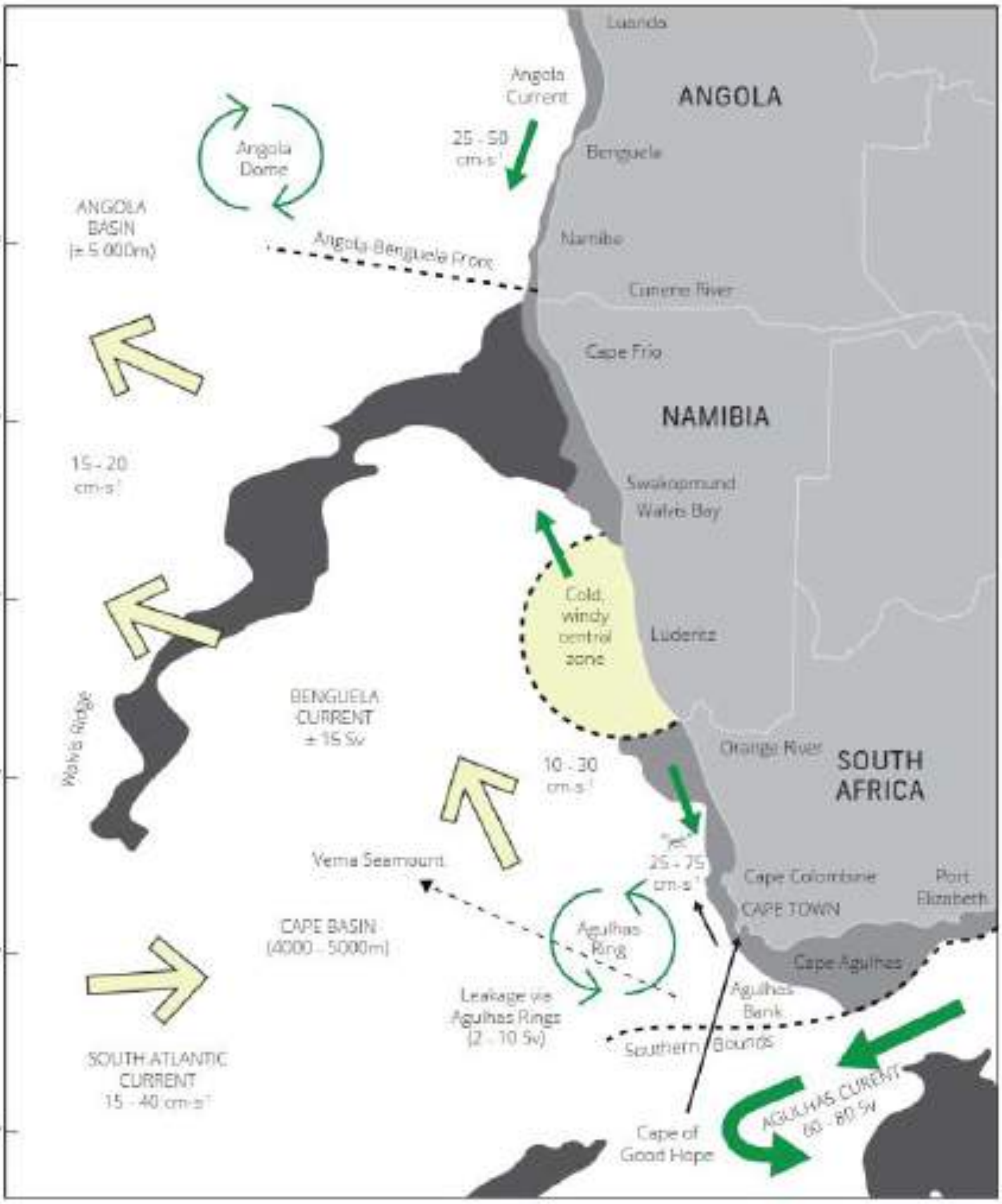

Figure 7-6: Major features of the predominant circulation patterns and volume flows in the Benguela System.

Source: Adapted from Shannon *et al.* (2006) and MFMR (2018).

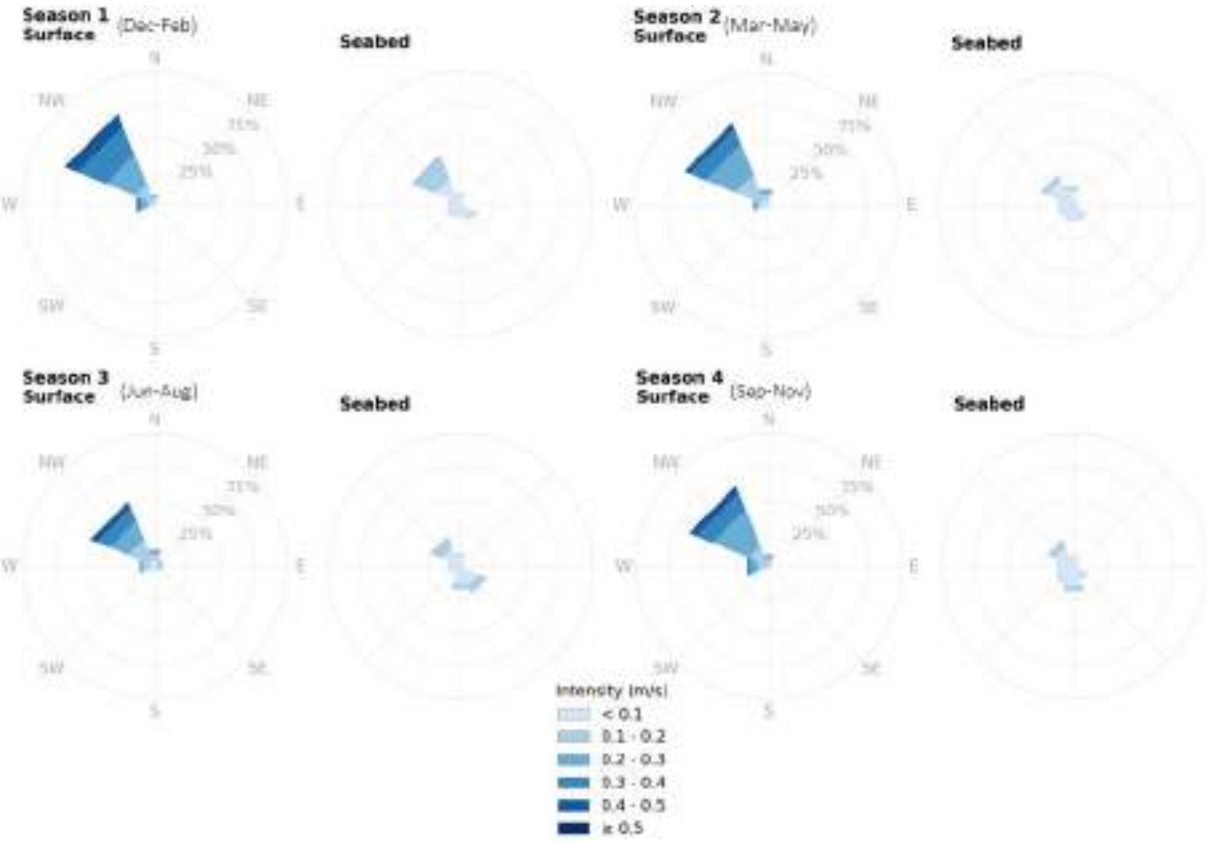

Figure 7-7: Surface and seabed current data by season. Season 1: December to February, Season 2: March to May, Season 3: June to August, Season 4: September to November. Data for years 2016-2020 a grid point nearby Block 2814A.

Source: CLS Brasil, 2024.

Measurements from adjacent blocks indicate that near-surface currents in Block 2814A are likely primarily from the south-southeast, with maximum speeds exceeding 60 cm/s during summer months (November to March). Current speeds decrease with depth to <20 cm/s near the seabed (SLR 2022).

The Benguela Current is characterised by coastal upwelling, which supplies nutrients to surface waters, resulting in high biological productivity and abundant fish stocks. Prevailing longshore winds move nearshore surface water offshore, causing colder, deeper water to upwell closer to the coast. Although upwelling intensity varies with seasonal wind patterns, the most intense upwelling occurring where the shelf is narrow, and winds are strong.

The Lüderitz upwelling cell is the most intense, extending seaward for nearly 300 km and drawing water from depths of 300-400 m (Longhurst 2006). Water mass analysis revealed discontinuities in central and intermediate layers along the shelf north and south of Lüderitz (Duncombe Rae 2005). This area forms a significant environmental barrier separating the northern and southern Benguela sub-systems (Ekau & Verheye 2005; Lett *et al*. 2007).

7.3.4 Waves and Tides

The Namibian coast is exposed to strong wave action, typically rated between 13-17 on a 20-point exposure scale (McLachlan 1980). These major swells are primarily generated in the roaring forties and locally driven by persistent southerly winds.

Throughout the year, the wave regime along the Namibian coast remains relatively consistent, predominantly coming from the south-west-south direction, with a slight increase in winter. The median significant wave heigh is 2.4 m, with the main peak wave energy period around 12 seconds. Longer period swells (11 to 15 seconds) generated by mid-latitude cyclones occur about 25-30 times annually, originating from the south-south-west sectors. The largest waves recorded along the Namibian coastline reach heights of 4-7 m during these events. In winter, heavy south-westerly storms can bring waves exceeding 10 m, often accompanied by wind speeds of up to 100 km/h. Generally, wave heights decrease with depth and alongshore distance.

In contrast, spring and summer swells are smaller, typically averaging around 2 m and lacking the extreme heights of winter swells. Summer also features a more pronounced southerly swell component, characterized by shorter wave periods (~8 seconds) and steeper profiles, primarily induced by wind (CSIR 1996). These southerly wind-induced waves, although less powerful, work in tandem with the strong southerly winds of summer to create northward-flowing nearshore surface currents. This combination of currents, wind, and waves results in significant nearshore sediment mobilisation and northward transport.

Based on measurements from blocks adjacent to Block 2814A, the majority of waves originate from the south to south-southwest direction, with maximum swell heights exceeding 0.6 m occurring during winter (June and July) (SLR 2022).

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of approximately 1.5 m at spring tide, but only 0.6 m during neap tide periods. **Tidal influence in the offshore regions of Block 2814A will be minimal.**

7.3.5 Water characteristics

South Atlantic Central Water (SACW) comprises the majority of the seawater in the area of interest, either in its pure form in deeper regions or when mixed with upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinity levels vary between 34.5 ppt and 35.5 ppt (Shannon 1985).

On the southern Benguela's continental shelf seawater temperatures typically vary between 6°C and 16°C. Well-developed thermal fronts mark the seaward boundary of the upwelled water. These fronts generate characteristic upwelling filaments, occurring as cold surface streamers, about 50 km wide and extending beyond the normal offshore limits of the upwelling cell. Such fronts usually persist for few days to several weeks, with the filamentous mixing zone extending up to 625 km offshore. Studies have shown changes in sea surface temperatures in large areas of the Benguela region over the last 30 years (Belkin, 2009; Roault *et al.* 2009), including warming of substantial areas off Namibia.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, particularly near the seafloor. SACW itself exhibits depressed oxygen concentrations (oligoxic: ~80% saturation value), with even lower levels (<40% saturation) and hypoxia occurring frequently (Bailey *et al.* 1985; Chapman & Shannon 1985, Montiero & van der Plas 2006; Montiero *et al.* 2006). Nutrient concentrations of upwelled water attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al.* 1985). The actual nutrient concentrations can vary widely, depending on phytoplankton uptake influenced by phytoplankton biomass and production rate. **The range of nutrient concentrations can thus be large but, in general, concentrations are high near the coast.**

7.3.6 Upwelling and Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman and Shannon 1985). During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

7.3.7 Turbidity

Turbidity is a measure of the level of suspended particulate matter in seawater, affecting water clarity and light penetration. Total Suspended Particulate Matter (TSPM) comprises Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM):

- POM includes detritus, bacteria, phytoplankton and zooplankton, and serving as food for filter-feeders. Coastal POM levels are influenced by seasonal microphyte production during upwelling events.
- PIM, mostly of geological origin consisting of fine sands, silts and clays. Off the Namibian coast, the coastal PIM load is strongly related to natural riverine inputs. Additionally, 'berg' winds can contribute sediment levels comparable to the annual Orange River inputs (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999).

Suspended particulate matter concentrations in shallow coastal waters vary spatially and temporally, ranging from a few mg/l to several tens of mg/l (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al*. 1992). Typical Benguela current system measurements suggest coastal and continental shelf sediment concentrations are generally <12 mg/l outside major flood events, showing significant longshore variation. However, under strong wave conditions, high tides, storms, or floods, higher PIM concentrations have been reported.

In the nearshore areas off the southern Namibian coast, turbidity primarily results from redistributing inner shelf sediments by long-period Southern Ocean swells. The Benguela Current velocities (10-30 cm/s) can resuspend and transport considerable quantities of sediment equatorward. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington *et al*. 1990; Rogers & Bremner 1991). The northward littoral drift of coarser bedload sediments, parallel to the coastline, occurs due to south-westerly swells and wind-induced waves. Longshore sediment transport is notably higher in the surf-zone due to breaking waves that suspend and mobilize sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, currents are insufficient to transport coarse sediments, and resuspension and shoreward movement mainly occurs during storm conditions (see also Drake *et al*. 1985; Ward 1985).

7.3.8 Organic Inputs

The coastal upwelling region in the Benguela current is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These blooms serve as the foundation for a diverse food chain, including pelagic baitfish (anchovy, pilchard, round-herring), predatory fish (snoek), mammals (mainly seals and dolphins), and seabirds (penguins, gannets, cormorants, terns). Balanced ecosystem models estimate that during the 1990s, the Benguela region sustained biomasses of 76.9 tonnes/km^2 of phytoplankton and 31.5 tonnes/km^2 of zooplankton alone (Shannon *et al.* 2003). Natural mortality affects these species, with approximately 36% of phytoplankton and 5% of zooplankton sinking to the seabed annually.

This annual influx of millions of tons of organic material onto the seabed significantly impacts the ecosystems of the Benguela Current. It supports the food requirements of benthic communities in sandy-mud habitats, contributing to the high organic content of the region's muds. As most of this organic detritus is not directly consumed, it enters the seabed decomposition cycle, leading to oxygen depletion in deeper waters.

The Benguela system is also known for red tides (dinoflagellate and/or ciliate blooms), commonly referred to as Harmful Algal Blooms (HABs) (see Shannon & Pillar 1985; Pitcher 1998). These red tides can grow to substantial sizes. Toxic dinoflagellate species can poison fish and shellfish, while the breakdown of organic-rich material from both toxic and non-toxic blooms results in subsurface water oxygen depletion. HABs are discussed further in Sections 7.3.9 and 7.4.3.1.

7.3.9 Low Oxygen and Hypoxic Events

The Benguela system's continental shelf waters consistently exhibit low oxygen levels, often falling below 40% saturation (e.g., Visser 1969; Bailey *et al.* 1985). The low oxygen concentrations are primarily attributed to remineralisation of nutrients in the bottom waters (Chapman & Shannon 1985), especially in areas with carbon-rich mud deposits. As the mud patches are unevenly distributed on the shelf, specific regions tend to experience lower oxygen levels. **The primary areas of low-oxygen water formation off southern Namibia are the Orange River Bight and off Walvis Bay** (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al.* 2000). The spatial distribution of oxygen-poor water in these regions can vary in the short and medium term.

Periodic low-oxygen events nearshore can have devastating effects on marine communities, leading to rock lobster strandings and mass mortalities of marine life and fish (Newman & Pollock 1971; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al.* 2000). These events result from the development of anoxic conditions due to the decomposition of large quantities of organic matter generated by algal blooms. These blooms typically occur during summer-autumn (February to April) but can also develop in winter during 'berg' wind periods when extended calm, warm, and windless conditions prevail.

Seafloor hypoxia, especially off central Namibia, is closely linked to the production of toxic hydrogen sulphide and methane within organically-rich, anoxic muds following the decay of expansive algal blooms. Under severe oxygen depletion, anaerobic bacteria in the anoxic seabed muds generate hydrogen sulphide (H_2S) gas (Brüchert *et al.* 2003). Periodically, this gas is released from the muds in 'sulphur eruptions,' leading to upwelling of anoxic water and the formation of surface slicks of sulphur-discoloured water (Emeis *et al*. 2004; Ohde *et al.* 2007).

7.3.10 Summary

The area of interest is located offshore of coastal upwelling cells, however during strong upwelling conditions low-oxygen, high nutrient and high-turbidity conditions may extend into the shallow regions of Block 2814A. **Swells throughout the year come predominantly from a south and south-south-west direction** with maximum swell heights exceeding 0.6 m occurring during winter.

Although more apparent closer to shore, **low-oxygen, high nutrient and high-turbidity conditions may extend into the shallow regions of Block 2814A**. **The deeper waters of Block 2814A are expected to be comparatively clear and nutrient poor.**

7.4 Biological Characteristics

The area of interest lies within the cold temperate Namaqua Bioregion, which stretches from Sylvia Hill, north of Lüderitz in Namibia, to Cape Columbine in South Africa (Emanuel *et al.* 1992; Lombard *et al.* 2004). **The majority of Block 2814A is situated within the marine Namaqua Biozone** (De Cauwer 2007), which stretches from the coast to the shelf edge in the southern coastal region of Namibia, with the north-eastern corner falling within the offshore Namib biozone (Figure 7-8). As discussed in Section 7.3.6, the dominant coastal, wind-driven upwelling along the Namibian coastline plays a pivotal role in shaping the marine ecology of the Benguela region.

Marine communities along the Namibian coast are widespread but vary based on substrate type and depth zone. These communities encompass hundreds of species and exhibit significant temporal and spatial fluctuations, even at small scales.

The typical biological communities found in the habitats represented in Block 2814A are briefly described below, highlighting dominant, commercially valuable, and conspicuous species, as well as potentially vulnerable species that may be impacted by the proposed appraisal well drilling.

7.4.1 Demersal (Seabed) Communities

The seabed communities in Block 2814A lie within the Namaqua outer shelf and Namaqua shelf edge benthic habitats. The benthic and coastal habitats of Namibia were mapped as part of the Benguela Current Commission’s Spatial Biodiversity Assessment (BCC-SBA) (Holness *et al.* 2014) to develop assessments of the ecosystem threat status and ecosystem protection level. Submarine canyons were also mapped as biodiversity features, although descriptions of their geographical situations were not sufficiently accurate for inclusion in the benthic habitat map[11] (Figure 7-9). The benthic habitats were subsequently assigned an ecosystem threat status based on their level of protection and ecological condition (Table 7-1, Figure 7-25). **Block 2814A overlaps with the Namib Upper Slope (Least Threatened), Namaqua Shelf Edge (Endangered) and Namaqua Outer Shelf (Least Threatened).**

[11] Possible marine canyons identified by the international Deep Ocean project mapped them as lines. The lines were buffered by 5 km to ensure that both the canyon and its associated adjacent ecosystems were included.

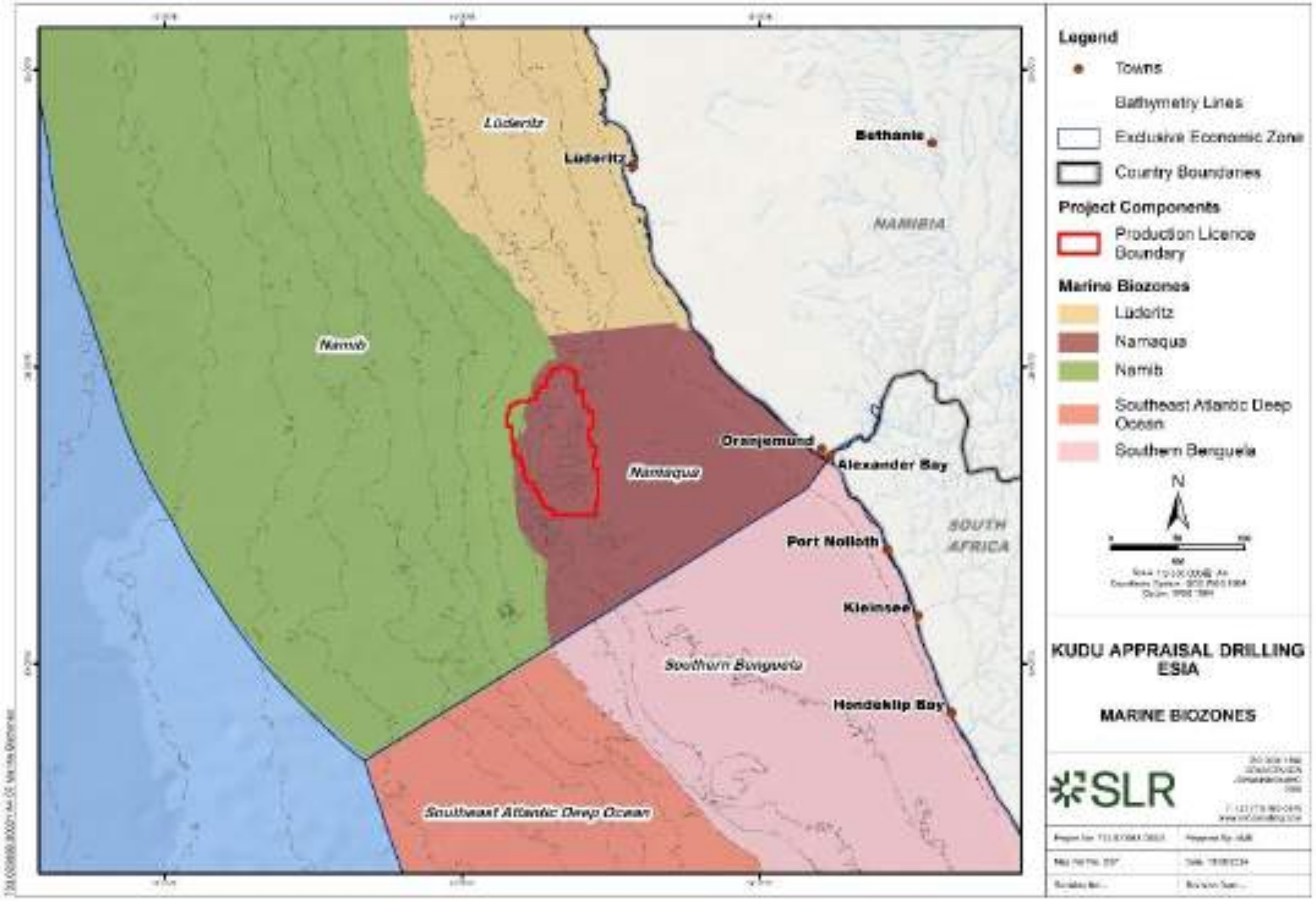

Figure 7-8: Block 2814A in relation to the Namibian marine biozones. The adjacent South African marine ecoregions are also shown.

Source: Adapted from De Cauwer (2007), MFMR (2021) and Sink *et al.* (2019).

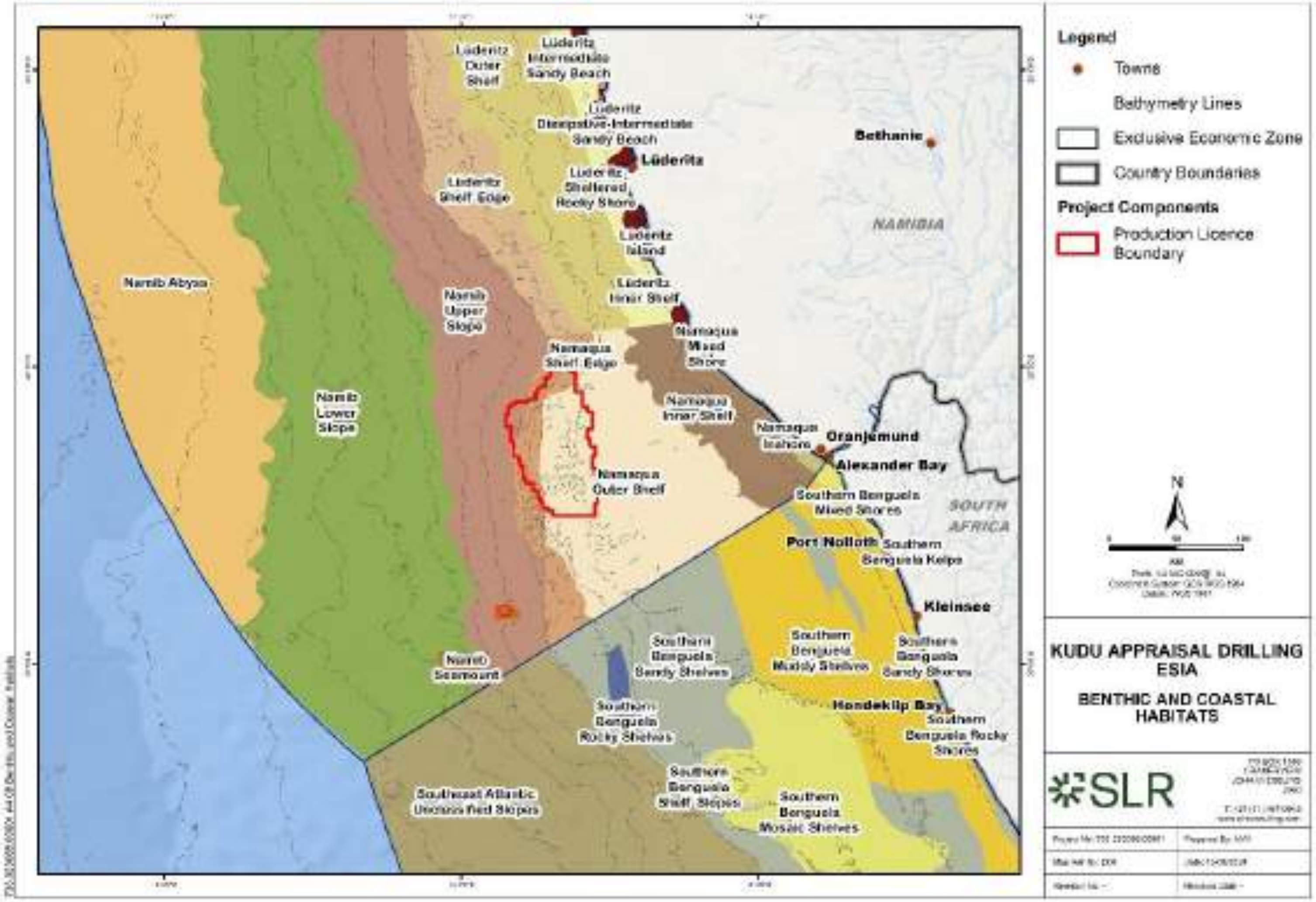

Figure 7-9: **Block 2814A in relation to the Namibian benthic and coastal habitats. The adjacent South African substratum types are also shown.**

Source: Adapted from Holness *et al.* (2014) and Sink *et al.* (2019).

Table 7-1: Ecosystem threat status for marine habitat types on the Namibian coast.

Habitat Type		Threat Status	Area (km^2)
1	Namib Abyss	Least Threatened	800.93
2	Namib Lower Slope	Least Threatened	1 380.13
3	**Namib Upper Slope**	**Least Threatened**	**590.66**
4	Namib Seamount	Least Threatened	26.83
5	**Namaqua Shelf Edge**	**Endangered**	**44.40**
6	**Namaqua Outer Shelf**	**Least Threatened**	**175.29**
7	Namaqua Inner Shelf	Least Threatened	69.48
8	Namaqua Inshore	Vulnerable	4.45
9	Lüderitz Shelf Edge	Critically Endangered	87.55
10	Lüderitz Outer Shelf	Vulnerable	184.70
11	Lüderitz Inner Shelf	Least Threatened	62.91
12	Lüderitz Islands	Least Threatened	13.32
13	Lüderitz Inshore	Least Threatened	3.56

Note: The habitats potentially affected by the proposed appraisal drilling are in **bold**.
Source: Adapted from Holness *et al.* (2014)

7.4.1.1 Benthic Invertebrate Macrofauna

The benthic biota of unconsolidated marine sediments includes invertebrates living on (epifauna) or within (infauna) the sediments, categorised as macrofauna (>1 mm) and meiofauna (<1 mm). Benthic macrofauna play crucial roles in ecological processes such as organic matter remineralisation, pollutant metabolism, and sediment stability. They are an important food source for commercially valuable fish species and other higher order consumers. As a result of their comparatively limited mobility and permanence over seasons, these animals provide an indication of historical environmental conditions and provide useful indices with which to measure environmental impacts (Gray 1974; Warwick 1993; Salas *et al.* 2006). Temperature, depth, hydrogen sulphide and dissolved oxygen seem to be significant forces shaping macrozoobenthic communities within the Namibian shelf (Amorim & Zettler 2023).

Numerous studies have been conducted to assess the continental shelf benthos offshore of South Africa and Namibia (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Field *et al.* 1996; Field & Parkins 1997; Parkins & Field 1997, 1998; Pulfrich & Penney 1999; Goosen *et al.* 2000; Savage *et al.* 2001; Steffani & Pulfrich 2004; 2007; Steffani 2007a; 2007b; Atkinson 2009; Steffani 2009a, 2009b, 2010a, 2010b, 2010c; Atkinson *et al.* 2011; Steffani 2011, 2012a, 2012b, 2014; Karenyi 2014; Steffani *et al.* 2015; Biccard & Clark 2016; Biccard *et al.* 2016; Duna *et al.* 2016; Karenyi *et al.* 2016; Biccard *et al.* 2017, 2018; Gihwala *et al.* 2018; Biccard *et al.*2019; Gihwala *et al.* 2019). These have been focused on mining, pollution or demersal trawling impacts on the continental shelf and in nearshore regions. Consequently, the benthic fauna in deeper regions (beyond ~450 m depth) are poorly known. This is also due to limited opportunities for sampling as well as the lack of access to Remote Operated Vehicles (ROVs) for visual sampling of hard substrata. For a review of the benthic macroinvertebrates present inshore of the 1 000 m depth contour in South Africa, the reader is referred to the comprehensive field guide compiled by Atkinson & Sink (2018).

Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast of southern Africa. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments (e.g. Kenny *et al.* 1998; Kendall & Widdicombe 1999; van Dalfsen *et al.* 2000; Zajac *et al.* 2000; Parry *et al.* 2003), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich 2004).

Karenyi *et al.* (2018) found that off Namaqualand, species richness increases from the inner-shelf across the mid-shelf and is influenced by sediment type. The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (±50 g/m^2 wet weight) and decreases across the mid-shelf averaging around 30 g/m^2 wet weight. This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those off the northern Namaqualand coast.

In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure. On the continental shelf slope and deeper regions, near-bottom conditions are oligoxic (Berg *et al*. 2015), with benthic communities characterised by greater stability and longer-lived species.

Amorim & Zettler (2023) provide a comprehensive study on the distribution of macrofaunal assemblages of the Oxygen Minimum Zone (OMZ) in the northern Benguela system off Namibia, using samples collected along three transects at depths between 25 m and 1 523 m. In general, the study reported high total biomass compared to OMZs worldwide. The assemblages on the shelf break (132 and 306 m) displayed intermediate diversity, abundance and biomass, and diversity was highest within the shallower and deeper assemblages. Biomass levels generally decreased offshore. The authors note that slope communities are likely distributed along a much wider latitudinal range and deeper depths than were sampled, and are similar to other upwelling slope areas.

The sediments observed during the ROV habitat survey in Licence Block 2914A, to the south of Block 2814A, predominantly comprised 'sandy mud' but there was some depth-driven variation in sediment type, with 'sand' and muddy sand' sediments reported from seven of the shallower stations surveyed (SLR 2024). The dominant taxa observed were brittlestars (Ophiuroidea), sea pens (Pennatuloidea) and sea cucumbers (Holothuroidea, including ?Benthothuria sp., ?Benthodytes sp. and Enypniastes eximia). Bioturbation, in the form of burrows, was present within all biotopes indicating the presence of infaunal taxa (Figure 7-10). As conditions in habitats of similar depths tend to be uniform, **similar infauna communities may be expected in Block 2814A if the benthic composition is similar.**

In terms of infauna, a deep-water benthic survey in another offshore licence block revealed consistent yet impoverished macrofauna dominated by polychaetes, molluscs, and crustaceans (SLR 2022). As found by Amorim & Zettler (2023), *Spiophanes* sp., a deposit-feeding polychaete, was the most abundant species, highlighting the prevalence of deposit feeders in soft sediments.

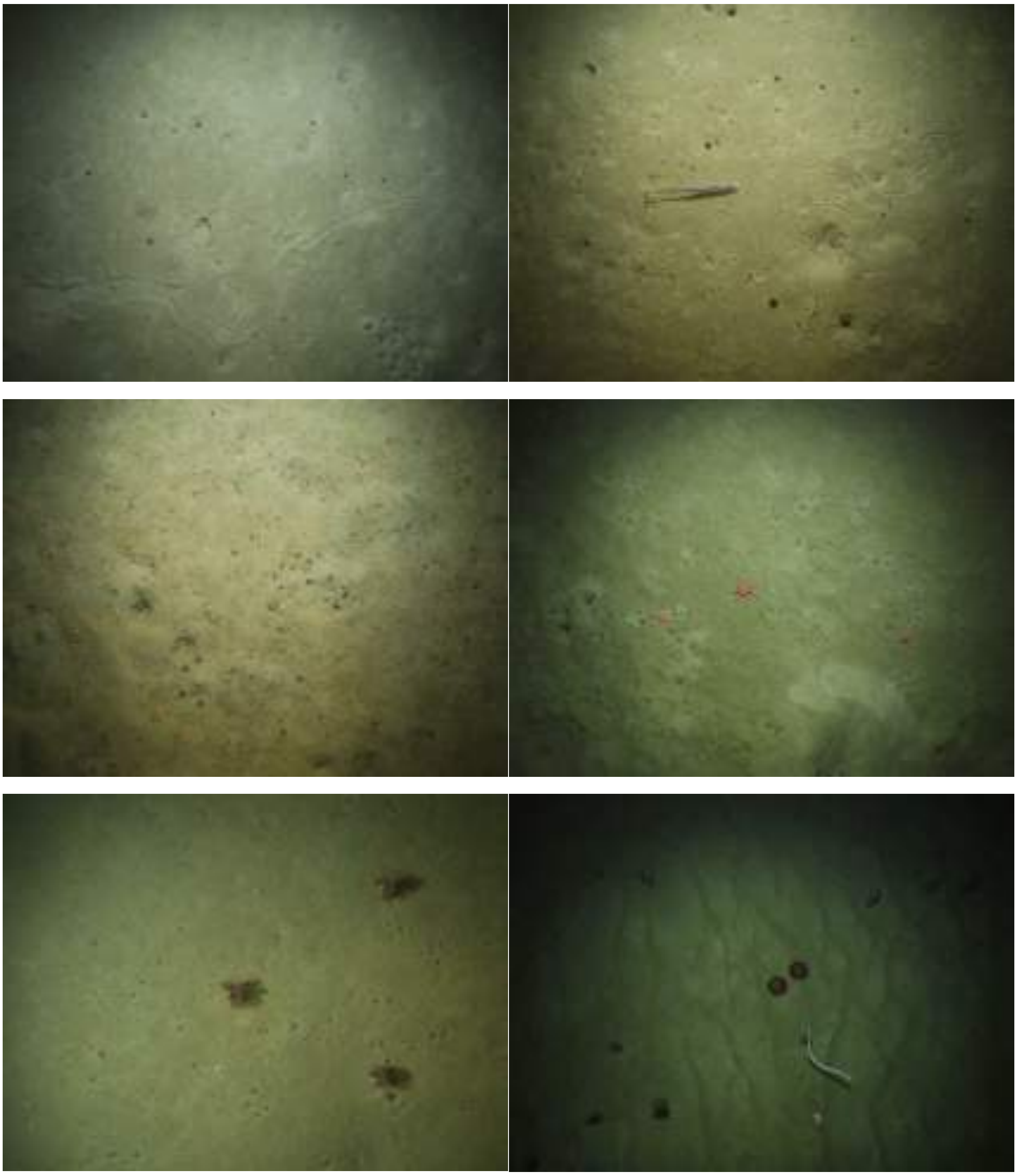

Figure 7-10: Examples of seafloor photographs taken within a nearby licence block.

Source: SLR, 2014

7.4.1.2 Deepwater Coral Communities

There has been increased interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders typically occur at depths exceeding 150 m, with some species recorded as deep as 3 000 m. They vary in size, forming either reefs or smaller solitary structures. Corals enhance biodiversity by adding structural complexity to otherwise uniform seabed habitats (Breeze *et al.* 1997; MacIssac *et al.* 2001). Deep-water corals thrive beneath the thermocline, where a consistent supply of concentrated particulate organic matter is maintained by strong currents and eddies formed over topographic features. Nutrient seepage from the substratum further promotes settlement (Hovland *et al.* 2002). The productive and substantial shelf areas in the Benguela region have potential to support rich, cold water, benthic, filter-feeding communities. Various species of scleractine and stylastrine corals have been reported from depths beyond 200 m in the Orange Basin. **Similar communities would also be expected near topographic features such as Tripp Seamount located 85 km to the south-west of Block 2814A, and potentially on hard substrate within the Block 2814A if present.**

During a habitat assessment in an adjacent Block 2914A, dead fragments of what was thought to be hard coral were identified from two of the shallower stations in the north-east of the survey area, but there was no evidence of living hard coral from these or other stations. Fossilised cold water coral reefs are known to occur on the Namibian shelf at water depths of between 160 m and 270 m; these are thought to have died in an extinction event approximately 4500 years ago, but fragments are still widespread within shelf sediments (Tamborrino et al., 2019). Similar fragments could be present in Block 2814A.

Sediment samples collected at the base of Norwegian cold-water coral reefs revealed high interstitial concentrations of light hydrocarbons (methane, propane, ethane and higher hydrocarbons C4+) (Hovland & Thomsen 1997), which are typically considered indicative of localised light hydrocarbon micro-seepage through the seabed. Bacteria and other micro-organisms thrive on such hydrocarbon pore-water seepages, thereby providing suspension-feeders, including corals and gorgonians, with a substantial nutrient source. It has been suggested that there is a correlation between the occurrence of deep-water coral reefs and elevated concentrations of light hydrocarbons (methane, ethane, propane and n-butane) in near-surface sediments (Hovland *et al.* 1998, Duncan & Roberts 2001, Hall-Spencer *et al.* 2002, Roberts & Gage 2003).

A study by January (2018) identified **hydrocarbon seeps and gas escape structures in the Orange Basin area. Large fluid seep/pockmark fields of varying morphologies were also reported in South African waters approximately 550 km south of Block 2814A** by Palan (2017). Further research is required to ascertain whether these features potentially host cold-water coral reefs. In the same region, benthic sampling up to a depth of 100 m was conducted in the vicinity of the Cape Canyon (Filander *et al*. 2022). Results indicate a homogenous benthic environment, with substrate type and depth collectively underpinning the sparse heterogeneity of the region.

7.4.1.3 Demersal Fish Species

Demersal fish are those species that live and feed on or near the seabed. As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf off southern Namibia (Roel 1987). Changes in fish communities occur both latitudinally (Shine 2006, 2008; Yemane *et al.* 2015) and with increasing depth (Roel 1987; Smale *et al.* 1993; Macpherson & Gordoa 1992; Bianchi *et al.* 2001; Atkinson 2009), with the most substantial change in species composition occurring in the shelf break region between depths of 300 m and 400 m (Roel 1987; Atkinson 2009).

The shelf community (<350 m) is dominated by the Cape hake (*Merluccuis capensis*), and includes jacopever (*Helicolenus dactylopterus*), Izak catshark (*Holohalaelurus regain*), soupfin shark (*Galeorhinus galeus*) and whitespotted houndshark (*Mustelus palumbes*). The more diverse deeper water community is dominated by the deepwater hake (*M. paradoxus*), monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*), bronze whiptail (*Lucigadus ori*) and hairy conger (*Bassanago albescens*) as well as cephalopod species (such as squid and cuttlefishes) and squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges shelf communities, with species such as the pelagic goby *Sufflogobius bibarbatus*, and West Coast sole *Austroglossus microlepis* occurring in shallow water during summer only. The deep-sea community was found to be homogenous both spatially and temporally. In a more recent study, however, Atkinson (2009) identified two long-term community shifts in demersal fish communities; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables (Sea Surface Temperatures and upwelling anomalies) (Howard *et al.* 2007) and with the eastward shifts observed in small pelagic fish species and rock lobster populations (Coetzee *et al.* 2008, Cockcroft *et al.* 2000).

The diversity and distribution of demersal cartilaginous fishes on the southern African west coast was discussed by Compagno *et al.* (1991). The species that may occur in the area of interest and on the continental shelf inshore thereof, and their approximate depth range, are listed in Table 7-2.

Information on demersal and cartilaginous fish species beyond the shelf break is lacking. Typical upper and mid slope fishes (200 to 2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus* species), notacanthids, halosaurs, chimaeras, skates, bythitids such as *Cataetyx* spp. and morids (deep-sea cods) (Smith & Heemstra 2003). Typical lower slope fishes include rattails, bythitids, liparidae (snail fishes) and notacanthids (*Polyacanthonotus* species and halosaurs) (see also Iwamoto & Anderson 1994; Jones 2014).

The most frequently observed fish in the video footage collected during the habitat assessment in an adjacent block were grenadiers (Macrouridae, including *Coryphaenoides* sp.), eel-like fish (Halosauridae/Synaphobranchidae) and deep-water hake *(?Merluccius paradoxus)*.

Table 7-2: Demersal cartilaginous species found on the continental slope along the southern African west coast, with approximate depth range at which the species occur (Compagno *et al*. 1991) and their International Union for the Conservation of Nature (IUCN) conservation status.

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Frilled shark	*Chlamydoselachus anguineus*	200-1 000	LC
Six gill cowshark	*Hexanchus griseus*	150-600	NT
Gulper shark	*Centrophorus granulosus*	480	EN
Leafscale gulper shark	*Centrophorus squamosus*	370-800	EN
Bramble shark	*Echinorhinus brucus*	55-285	EN
Black dogfish	*Centroscyllium fabricii*	>700	LC
Portuguese shark	*Centroscymnus coelolepis*	>700	NT
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700	NT
Birdbeak dogfish	*Deania calcea*	400-800	NT
Arrowhead dogfish	*Deania profundorum*	200-500	NT
Longsnout dogfish	*Deania quadrispinosa*	200-650	VU
Sculpted lanternshark	*Etmopterus brachyurus*	450-900	DD
Brown lanternshark	*Etmopterus compagnoi*	450-925	LC
Giant lanternshark	*Etmopterus granulosus*	>700	LC
Smooth lanternshark	*Etmopterus pusillus*	400-500	LC
Spotted spiny dogfish	*Squalus acanthias*	100-400	VU

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Shortnose spiny dogfish	*Squalus megalops*	75-460	LC
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600	EN
Sixgill sawshark	*Pliotrema warreni*	60-500	LC
Goblin shark	*Mitsukurina owstoni*	270-960	LC
Smalleye catshark	*Apristurus microps*	700-1 000	LC
Saldanha catshark	*Apristurus saldanha*	450-765	LC
“grey/black wonder” catsharks	*Apristurus* spp.	670-1 005	LC
Tiger catshark	*Halaelurus natalensis*	50-100	VU
Izak catshark	*Holohalaelurus regani*	100-500	LC
Yellowspotted catshark	*Scyliorhinus capensis*	150-500	NT
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300	CR
Common smoothhound/ Houndshark	*Mustelus mustelus*	<100	EN
Whitespot smoothhoundshark	*Mustelus palumbes*	>350	LC
Lesser guitarfish	*Acroteriobatus annulatus*	>100	VU
Atlantic electric ray	*Torpedo nobiliana*	120-450	LC
African softnose skate	*Bathyraja smithii*	400-1 020	LC
Smoothnose legskate	*Cruriraja durbanensis*	>1 000	DD
Roughnose/triangular legskate	*Cruriraja parcomaculata*	150-620	LC
African dwarf skate	*Neoraja stehmanni*	290-1 025	LC
Thorny skate	*Raja radiata*	50-600	VU
Bigmouth skate	*Raja robertsi*	>1 000	LC
Slime skate	*Dipturus pullopunctatus*	15-460	LC
Rough-belly skate	*Raja springeri*	85-500	LC
Yellowspot skate	*Raja wallacei*	70-500	VU
Roughskin skate	*Dipturus trachydermus*	1 000-1 350	EN
Biscuit skate	*Raja clavata*	25-500	NT
Munchkin skate	*Rajella caudaspinosa*	300-520	LC
Bigthorn skate	*Raja confundens*	100-800	LC
Ghost skate	*Rajella dissimilis*	420-1 005	LC
Leopard skate	*Rajella leopardus*	300-1 000	LC
Smoothback skate	*Rajella ravidula*	500-1 000	LC
Spearnose skate	*Rostroraja alba*	75-260	EN
St Joseph	*Callorhinchus capensis*	30-380	LC
Cape chimaera	*Chimaera notafricana*	680-1 000	LC
Brown chimaera	*Chimaera carophila*	420-850	LC
Spearnose chimaera	*Rhinochimaera atlantica*	650-960	LC

Notes: DD = Data Deficient, LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered.

7.4.2 Seamount Communities

Seamounts, including banks, knolls, and protruding underwater features interact with the surrounding water currents. There are several seamounts located outside of the Block 2814A, the closest being Tripp Seamount 85 km south-west of the block. These formations can cause upwelling of cool, nutrient-rich water amidst nutrient-poor surface water, resulting in higher productivity (Clark *et al.* 1999). This phenomenon shapes the distribution and occurrence of organisms in and around seamounts, causing diverse and abundant bottom-associated communities.

Seamounts serve as vital habitats for deep-sea commercial fish stocks such as orange roughy, oreos, alfonsino, and Patagonian toothfish, aggregating for spawning or feeding (Koslow 1996). They also attract a variety of predators like turtles, tunas, billfish, pelagic sharks, cetaceans, and seabirds, creating mid-ocean focal points for pelagic species (Hui 1985; Haney *et al.* 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for many species (SPRFMA 2007; Derville *et al.* 2020).

Seamounts, characterized by enhanced currents, steep slopes, and volcanic rocky substrata, support suspension feeders such as deep- and cold-water corals, barnacles, bryozoans, molluscs, and sponges, enriching benthic communities (Rogers 1994. reviewed in Rogers 2004). There are also associated mobile benthic fauna including echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994). Corals create refugia, adding structural complexity and fostering high biological diversity as discussed in Section 7.4.1.2.

Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant, and diverse fauna, with many species likely unidentified. Consequently, associated fauna is usually highly unique and may be restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers *et al.* 2008). As a result of conservative life histories (i.e., very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

However, it is not always the case that seamount habitats are VMEs, as some seamounts may not host sensitive communities or be associated with high levels of endemism. Evidence from video footage taken on hard-substrate habitats at depths of 100-120 m off southern Namibia (Figure 7-11) suggests that sensitive gorgonians, octocorals and reef-building sponges occur on the continental shelf. **Similar communities may thus be expected on Tripp Seamount, some 85 km to southwest of Block 2814A, and potentially on hard substrate within Block 2814A if present.**

Figure 7-11: Gorgonians and bryozoans communities recorded on reefs at depths of 100-120 m off the southern African West Coast.

Source: De Beers Marine

7.4.3 Pelagic (Water Column) Communities

In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the open water column. The pelagic communities are typically divided into plankton and fish, and their main predators: marine mammals (seals, dolphins, and whales), seabirds and turtles. These are discussed separately below.

As with seabed habitats, pelagic habitat types have been defined as 'Vulnerable', 'Endangered' or 'Critically Endangered' depending on their level of protection (Holness *et al.* 2014). **Pelagic ecosystems south of Walvis Bay have all been assigned a threat status of 'Least Threatened'**.

7.4.3.1 Plankton

Plankton is associated with the upwelling characteristic of the area and is, therefore, particularly abundant in the shelf waters off Namibia, within 100 km of the coast. Plankton range from single-celled bacteria to jellyfish of 2 m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton (Figure 7-12) (also see Sections 7.3.6 and 7.3.8).

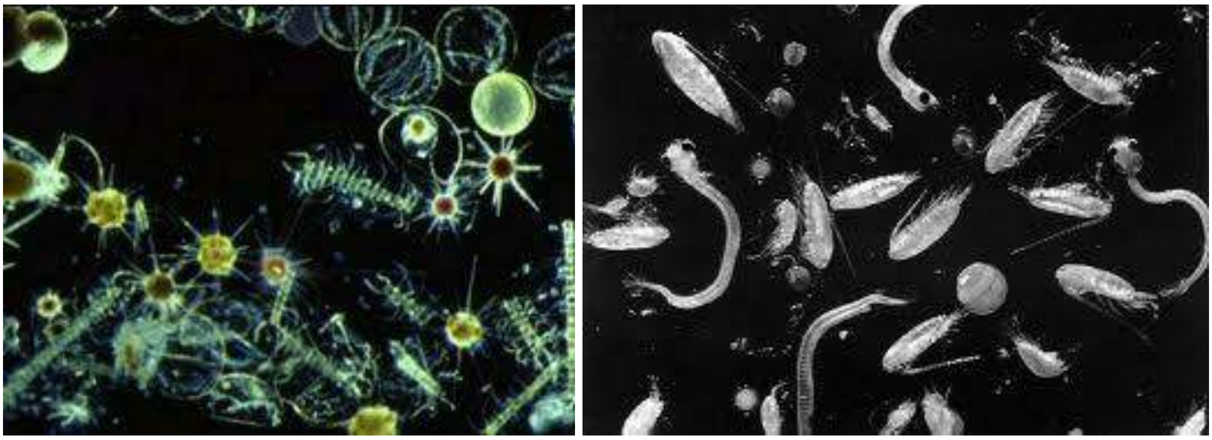

Figure 7-12: Phytoplankton (left) and zooplankton (right) associated with upwelling cells.

Source: hymagazine.com and mysciencebox.org

Off the Namibian coastline, phytoplankton are the principal primary producers with mean annual productivity at 2 g C/m^2/day (Barnard 1998). Diatoms dominate as they are adapted to the turbulent sea conditions. Diatom blooms occur after upwelling events, whereas dinoflagellate blooms more commonly occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Zooplankton abundance reaches a maximum further offshore than the phytoplankton maximum along the Namibian coastline. Samples collected over a full seasonal cycle (February to December) along a 10 to 90-nautical-miles transect offshore Walvis Bay showed that the mesozooplankton (<2 mm body width) community included egg, larval, juvenile and adult stages of copepods, cladocerans, euphausiids, decapods, chaetognaths, hydromedusae and salps, as well as protozoans and meroplankton larvae (Maartens 2003; Hansen *et al.* 2005). Copepods were the dominant group making up 70–85% of the zooplankton. The hydrography, phytoplankton, and zooplankton demonstrate close coupling, with zooplankton biomass tracking upwelling intensity and phytoplankton biomass. Following upwelling peaks, there is a lag time of 3-8 weeks when copepods respond the environmental conditions and increase in abundance (Hansen *et al.* 2005). Consistently higher biomass of zooplankton occurs offshore to the west and north-west of Walvis Bay (Barnard 1998).

Ichthyoplankton constitutes fish eggs and larvae. As the preferred spawning grounds of numerous commercially exploited fish species are located off central and northern Namibia (Figure 7-13), their eggs and larvae form an important contribution to the ichthyoplankton in the region. The Lüderitz upwelling cell - Orange River Cone (LUCORC) area, south of the Lüderitz upwelling cell between approximately 28°S – 31°S, is an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems (Hutchings *et al*. 2002, Lett *et al.* 2007). Areas of intense upwelling are considered unfavourable spawning habitats due to intense offshore advection and low phytoplankton levels. Despite good nutrient supply, phytoplankton levels are reduced in these regions due to high turbulence and deep mixing (Lett *et al.* 2007). Pelagic fish species, such as anchovy, redeye round herring, horse mackerel and shallow-water hake, spawn on either side of the LUCORC area, but not within it (Figure 7-13) (Lett *et al.* 2007). **Spawning levels near Block 2814A are expected to be low due to its proximity to the LUCORC area.**

Orange roughly aggregate and spawn at several discrete locations along the continental slope (Figure 7-13). The species has a short, intense spawning period of about a month from July to August (Boyer and Hampton, 2001). Spawning is thought to occur near Tripp seamount, 85 km south-east of in Block 2814A, and in the fishery's Quota Management Area, "Johnies", which overlaps with the north-west region of Block 2814A. Eggs are fertilised in the water column, and then drift upwards to a depth of approximately 200 m and remain planktonic until they lose buoyancy and hatch close to the bottom after approximately 10 days (Branch 2001). During the spawning period orange roughy eggs could drift into the pelagic waters of Block 2814A, however egg distribution is extremely patchy, decreasing over 10–15 km to just 0.1% of the density in spawning centres (Zeldis 1993; Branch 2001). The orange roughy fishery has been closed since 2007 due to overexploitation.

The abundance of phytoplankton, zooplankton and ichthyoplankton in Block 2814A, is unknown but expected to be low due to its proximity to the LUCORC area.

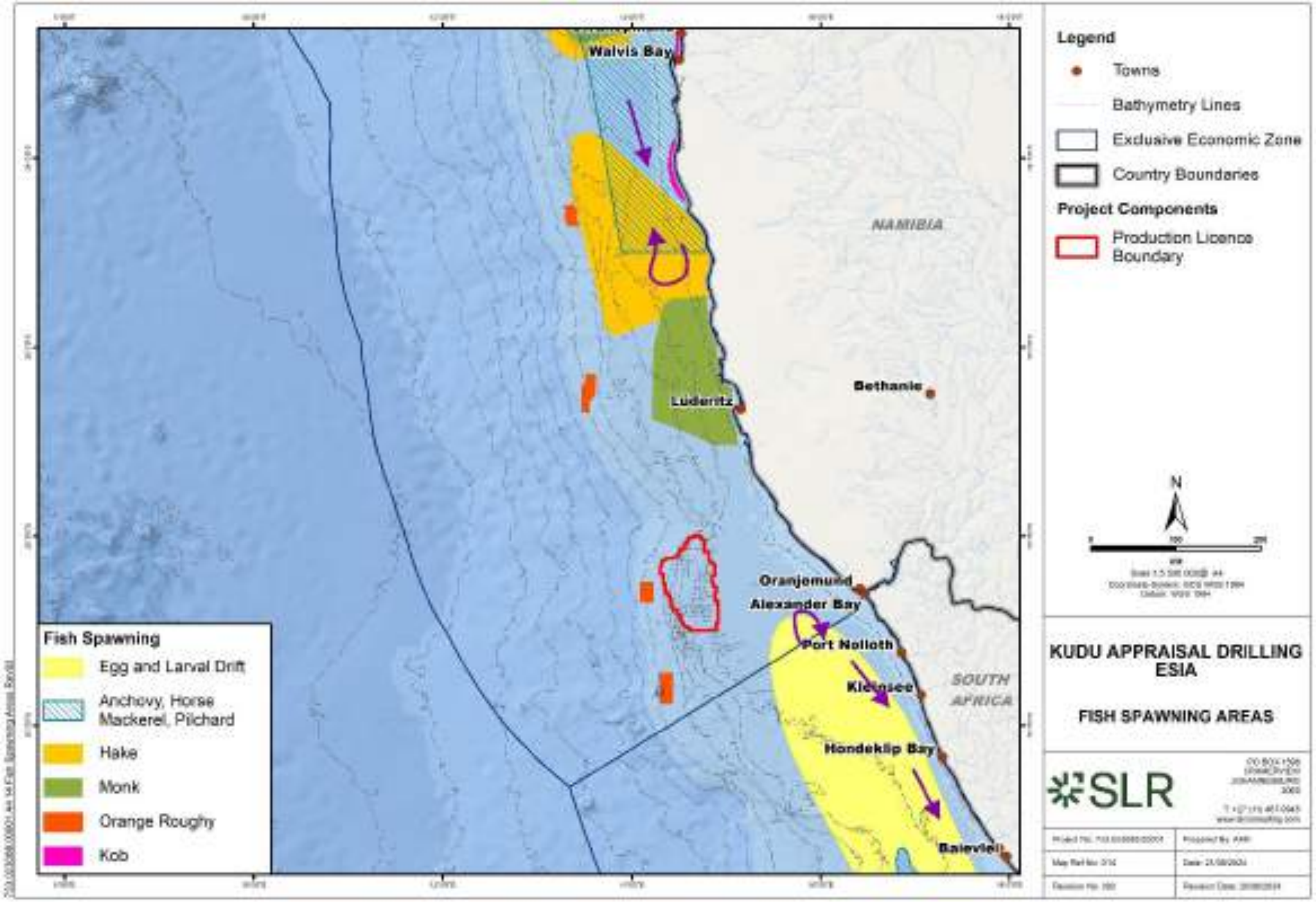

Figure 7-13: Block 2814A (red polygon) in relation to major spawning areas in the Benguela region.

Source: Adapted from Cruikshank (1990); Hampton (1992) and MFMR (2021).

7.4.3.2 Cephalopods

Fourteen species of cephalopods have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish (Lipinski 1992; Augustyn *et al.* 1995). Most of the cephalopod resource is distributed on the mid-shelf to depths of 500 m, with a higher biomass in summer months. Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

The colossal squid (*Mesonychoteuthis hamiltoni*) and the giant squid (*Architeuthis* sp) are rare deep-dwelling species, with the colossal squid distributed across the entire circum-Antarctic Southern Ocean, and the giant squid usually found near continental and island slopes worldwide. Growing to more than 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whales, pilot whales, elephant seals and sleeper sharks. Very little is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300-1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies. Occasionally, carcasses of giant squids have washed up on South African and Namibian beaches, with 60 specimens known. **While both species could occur in the pelagic habitat near Block 2814A, the likelihood of encounter in the area of interest is low.**

7.4.3.3 Fish

Small pelagic species include the **sardine/pilchard** (*Sardinops sagax ocellatus*) (Figure 7-14, left), **anchovy** (*Engraulis capensis*), **chub mackerel** (*Scomber japonicus*), **horse mackerel** (*Trachurus capensis*) (Figure 7-14, right) **and round herring** (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* 1987), and **generally occur within the 200 m contour, although they may often be found very close inshore, just beyond the surf zone.** Snoek (*Thyrsites atun)* and chub mackerel (*Scomber japonicas),* both rated as 'Least Concern' during the national assessment (Sink *et al.* 2019), migrate along the southern African west coast following the shoals of sardine and anchovy. Their appearance along the Namibian coast is highly seasonal. Adult snoek are found throughout their distribution range and longshore movements are random and without a seasonal basis (Griffiths 2002). Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast (Crawford & De Villiers 1985; Crawford *et al.* 1987), Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell (Griffiths 2003). On the West Coast, snoek move offshore to spawn and there is some southward dispersion as the spawning season progresses, with females on the West Coast moving inshore to feed between spawning events as spawning progresses. As they occur on the shelf mainly inside of the 500 m depth contour (Griffiths 2002) they could be seasonally encountered in Block 2814A. Snoek are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. The abundance and seasonal migrations of chub mackerel are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989).

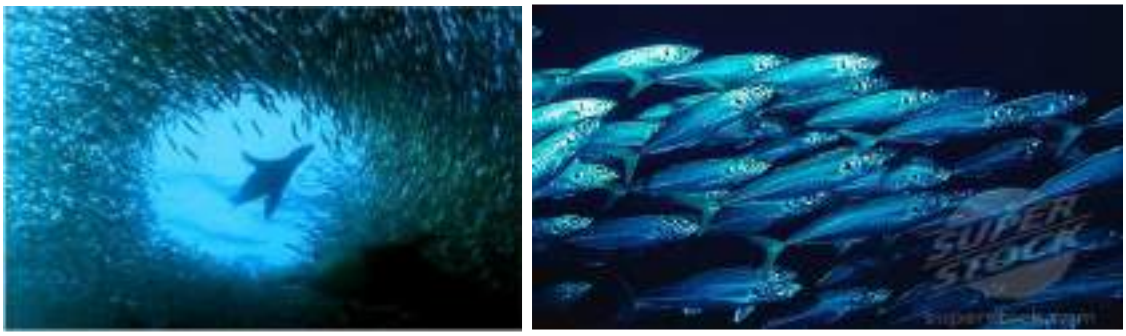

Figure 7-14: Cape fur seal preying on a shoal of sardine (left). School of horse mackerel (right).

Source: www.underwatervideo.co.za; www.delivery.superstock.com

The pelagic fish most likely to be encountered on the shelf, beyond the shelf break and further offshore are the large migratory species, including various tunas, billfish and sharks, many of which are considered Threatened by the IUCN, primarily due to overfishing (Table 7-3).

Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Off the southern African west coast, fishers typically follow the movement of longfin tuna from the southern Benguela waters northwards into southern and central Namibia. This movement occurs from mid to late summer (January to March) at which time aggregations may occur around or near oceanic features, in particular seamounts. Other species movements (e.g., yellowfin and bigeye tuna), which occur spatially and temporally throughout the southeast Atlantic have not been clearly defined, although their availability to the fisheries is believed to increase from later summer into winter (March through to July) (Lehodeya *et al.* 2006; Lan *et al.* 2011). Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, which are removed, and the remainder of the body discarded.

Table 7-3: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of Namibian waters and their Global IUCN Conservation Status.

Common Name	Species	IUCN Conservation Status
Tunas		
Southern Bluefin Tuna*	*Thunnus maccoyii*	Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Least concern
Yellowfin Tuna	*Thunnus albacares*	Least concern
Frigate Tuna	*Auxis thazard*	Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern
Billfish		
Black Marlin	*Istiompax indica*	Data deficient
Blue Marlin	*Makaira nigricans*	Vulnerable
Striped Marlin	*Kajikia audax*	Least Concern
Sailfish	*Istiophorus platypterus*	Vulnerable
Swordfish	*Xiphias gladius*	Near Threatened
Pelagic Sharks		

Common Name	Species	IUCN Conservation Status
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Critically Endangered
Dusky Shark	*Carcharhinus obscurus*	Endangered
Great White Shark	*Carcharodon carcharias*	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Endangered
Longfin Mako	*Isurus paucus*	Endangered
Whale Shark	*Rhincodon typus*	Endangered
Blue Shark	*Prionace glauca*	Near Threatened

*Until recently Southern Bluefin Tuna was globally assessed as 'Critically Endangered' by the IUCN. Although globally the stock remains at a low state, it is not considered overfished as there have been improvements since previous stock assessments. Consequently, the list of species changing IUCN Red List Status for 2020-2021 now list Southern Bluefin Tuna is globally 'Endangered'.

7.4.3.4 Turtles

Five turtle species occur in Namibian waters, namely Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*), Olive Ridley (*Lepidochelys olivacea*) and Leatherback (*Dermochelys coriacea*) (Bianchi *et al.* 1999). Observations of turtles in the area have been reported but are rare. Leatherbacks (Figure 7-15 left) are the only species that frequently inhabit deeper, offshore waters and are considered pelagic species, while the other species are primarily found in continental shelf and coastal waters. However, the Marine Mammal Observer (MMO) reports for adjacent Block PEL 83 have reported loggerhead turtle (Figure 7-15 right) sightings during seismic operations. Additionally, recent telemetry data recorded by the Two Oceans Aquarium, shows a green turtle and loggerhead turtle recently released on the Cape Peninsula remaining in West Coast waters before heading northwards into Namibian waters, suggesting that occurrence in Namibian waters does arise[12].

Figure 7-15: Leatherback (left) and loggerhead turtles (right) occur in Namibian waters.

Source: Ketos Ecology 2009; www.aquaworld-crete.com.

The Benguela ecosystem is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south-east Indian Ocean (South Africa) (Lambardi *et al.* 2008; Elwen & Leeney 2011). While hunting they may dive to over 600 m and remain submerged

[12] https://www.aquarium.co.za/foundation/news/tracking-our-turtles-the-first-update-of-2024

for up to 54 minutes (Hays *et al.* 2004). The Southwest Indian Ocean Leatherback subpopulation have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Figure 7-16; Lambardi *et al.* 2008; Harris *et al*. 2008).

Leatherback abundance in the area of interest is unknown but expected to be low. Although they tend to avoid nearshore areas, they may be encountered in Walvis Bay and off Swakopmund between October and April when prevailing north wind conditions result in elevated seawater temperatures (Figure 7-16). Entanglement and drowning of leatherback turtles in mariculture rafts in Lüderitz Lagoon have been reported (J. Kemper pers. obs.). Additionally, significant numbers of leatherback turtles have washed up on central Namibian shores recently, likely after mistakenly ingesting plastic pollution.

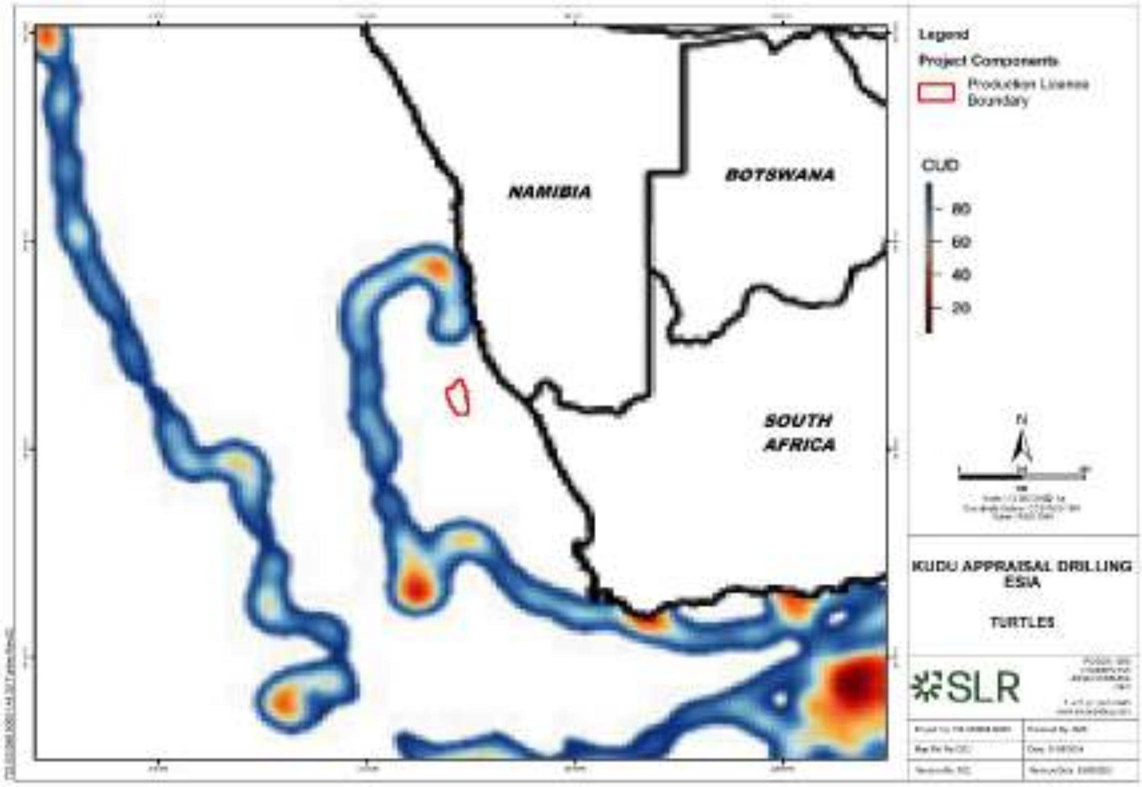

Figure 7-16: Block 2814A (red polygon) in relation to migration corridors of leatherback turtles in the south-western Indian Ocean. Relative use (CUD, cumulative utilization distribution) of corridors is shown through intensity of shading: light, low use; dark, high use.

Source: Harris *et al.* (2018)

Leatherback Turtles are listed as Vulnerable worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). Loggerhead and Olive Ridley turtles are globally listed as Vulnerable whereas Hawksbill are globally listed as Critically Endangered, and Green turtles as Endangered. The most recent conservation status, which assessed the species on a scale of Regional Management Units (RMU)[13], is provided in Figure 7-15. Leatherback and loggerhead turtles, the two species most likely to be encountered in the licence area, are rated as Critically Endangered and Near Threatened, respectively in the Southwest Indian RMU. Although not a signatory of CMS, Namibia has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. Namibia is thus committed to conserve these species at an international level.

Table 7-4: Global and regional conservation status of the turtles occurring off the southern African coastline showing variation depending on the listing used.

Listing	Leatherback	Loggerhead	Green	Hawksbill	Olive Ridley
IUCN Red List:					
Species (date)	V (2013)	V (2017)	E (2004)	CR (2008)	V (2008)
Population (RMU)	CR (2013)	NT (2017)	*	*	*
Sub-Regional/National (SA)					
NEMBA TOPS (2007)	CR	CR	E	CR	E
Hughes & Nel (2014)	E	V	NT	NT	DD

NT – Near Threatened, V – Vulnerable, E – Endangered, CR – Critically Endangered, DD – Data Deficient
* - Not yet assessed.
NEMBA TOPS: South African National Environmental Management: Biodiversity Act – List of Threatened or Protected Species (TOPS)

7.4.3.5 Seabirds

The Namibian coastline sustains large populations of breeding and foraging seabird and shorebird species, which require suitable foraging and breeding habitats for their survival. In total, 12 species of seabirds are known to breed along the southern Namibian coast (Table 7-5). Most seabirds breeding in Namibia are restricted to areas where they are safe from land predators, although some species are able to breed on the mainland coast, either cryptically on the open ground (e.g. Damara Tern) or in inaccessible places. In general, **most breed on the coastal islands off the southern Namibian coast, inshore of Block 2814A, or on the man-made guano platforms in Walvis Bay, Swakopmund and Cape Cross, well to the north of Block 2814A.** The southern Namibian islands and guano platforms therefore provide a vital breeding habitat to most species of seabirds that breed in Namibia. However, the number of successfully breeding birds at the particular breeding sites varies with local food abundance.

Most of the seabird species breeding in Namibia feed relatively close inshore (10-30 km), although exceptions occur (Ludynia *et al*. 2012), particularly when birds are forced to alter their dispersal patterns in response to environmental change (Sherley *et al.* 2017). Cape Gannets (Figure 7-17, left), however, are known to forage up to 140 km offshore (Dundee 2006; Ludynia 2007) (Figure 7-18). **The closest Cape Gannet colony to the area of interest is at Possession Island some 115 km to the northeast encounters with this species during appraisal drilling operations in Block 2814A are possible.**

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

African Penguins (Figure 7-17, right) have also been recorded as far as 60 km offshore (Ludynia *et al*. 2012). T**he closest African Penguin colonies are at Plumpudding, Sinclair, and Possession Islands, which lie some 80 km, 100 km and 115 km to the northeast, respectively. Encounters with this species during appraisal drilling operations in Block 2814A is unlikely.**

Table 7-5: Namibian breeding seabird species with their Namibian and global IUCN classification.

Species	Namibian	Global IUCN
*African Penguin *Spheniscus demersus*	Endangered	Endangered
*Bank Cormorant *Phalacrocorax neglectus*	Endangered	Endangered
*Cape Cormorant *Phalacrocorax capensis*	Endangered	Endangered
*Cape Gannet *Morus capensis*	Critically Endangered	Endangered
*Crowned Cormorant *Microcarbo coronatus*	Near Threatened	Near Threatened
*African Black Oystercatcher *Haematopus moquini*	Near Threatened	Near Threatened
White-breasted cormorant *Phalacrocorax lucidus*	Least Concern	Least Concern
Kelp Gull *Larus dominicanus*	Least Concern	Least Concern
*Hartlaub's Gull *Chroicocephalus hartlaubii*	Vulnerable	Least Concern
Caspian Tern *Hydroprogne caspia*	Vulnerable	Least Concern
*Greater Crested (Swift) Tern *Thallaseus bergii bergii*	Least Concern	Least Concern
*Damara Tern *Sternula balaenarum*	Near Threatened	Vulnerable

* denotes the species is endemic to southern Africa.
Differences between Namibia and global classifications are the result of local population size, and the extent and duration of declines locally.

Source: Kemper et al. 2007; Simmons et al. 2015; IUCN 2022

Figure 7-17: Cape Gannets *Morus capensis* (left) and African Penguins *Spheniscus demersus* (right) breed primarily on the offshore islands.

Source: J. Kemper, Klaus Jost

Among the non-breeding species present off Namibia's southern coast there are at least nine species of albatrosses, petrels and giant-petrels recorded (Boyer & Boyer 2015). Numbers foraging in Namibian waters are poorly known, although some tracking data are available (Figure 7-19). Forty-nine species of pelagic seabirds have been recorded in the broader project area, of which 14 are resident. Highest pelagic seabird densities occur offshore of the shelf-break in winter. Pelagic seabirds that have been encountered *enroute* to or within adjacent blocks near the area of interest are listed in Table 7-6.

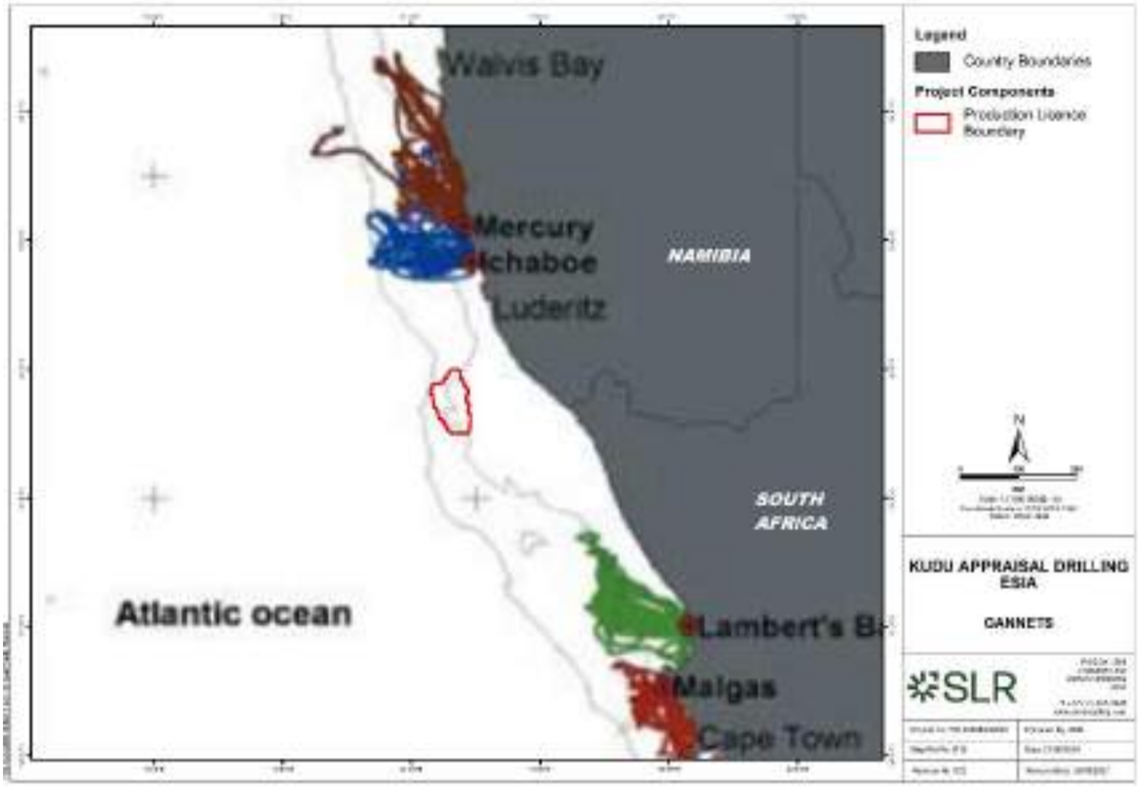

Figure 7-18: Block 2814A (red polygon) in relation to GPS tracks recorded for 93 Cape Gannets foraging off four breeding colonies in South Africa and Namibia.

Source: Grémillet *et al.* (2008)

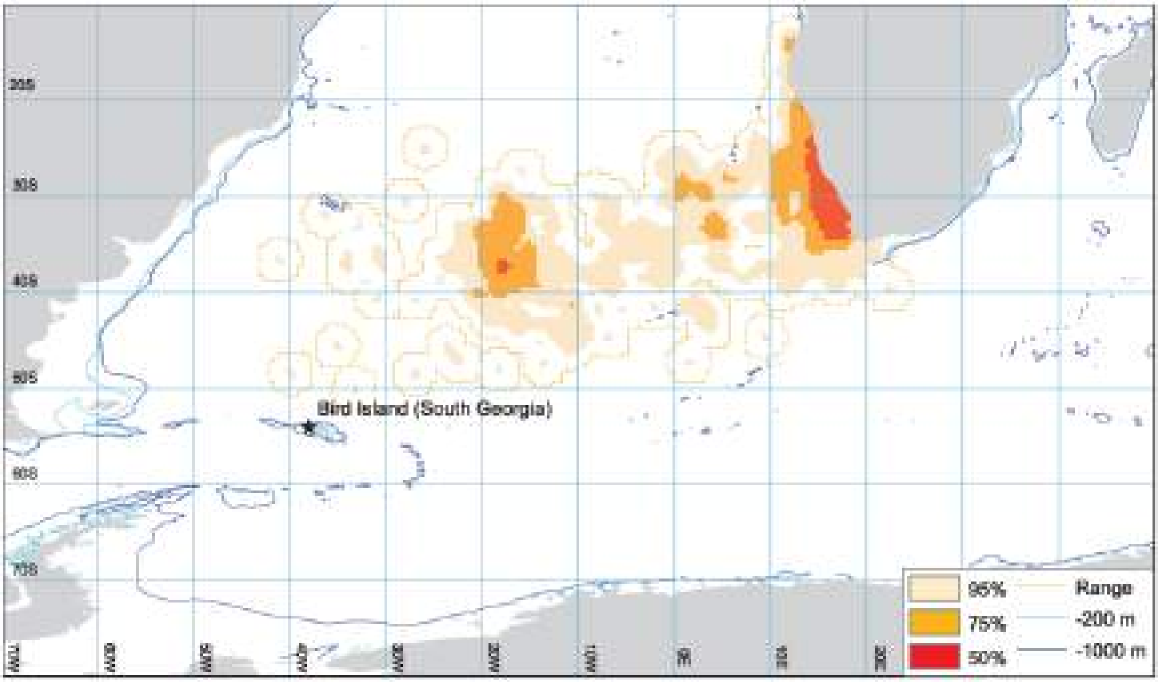

Figure 7-19: Utilisation distribution of incubating Black-browed Albatross from Bird Island, South Georgia (Birdlife Africa, 2004).

Source: Birdlife Africa (2004)

Table 7-6: Other bird species that occur in Namibia, with their Namibian and global IUCN classification (from Kemper *et al.* 2007; Simmons *et al.* 2015; IUCN 2023).

Species	Namibian Regional Assessment	IUCN Global Assessment
Tristan Albatross *Diomedea dabbenena*	Critically Endangered	Critically Endangered
Atlantic Yellow-nosed Albatross *Thalassarche chlororhynchos*	Endangered	Endangered
Black-browed Albatross *Thalassarche melanophrys*	Endangered	Least Concern
Wandering Albatross *Diomedea exulans*	Vulnerable	Vulnerable
Shy Albatross *Thalassarche cauta*	Near Threatened	Near Threatened
White-capped Albatross *Thalassarche sneadi*	Near Threatened	Near Threatened
Spectacled Petrel *Procellaria conspicillata*	Vulnerable	Vulnerable
Northern Giant-Petrel *Macronectes halli*	Near Threatened	Least Concern
Southern Giant-Petrel *Macronectes giganteus*	Not listed	Least Concern
Cape (Pintado) Petrel *Daption capense*	Not listed	Least Concern
Kerguelen Petrel *Aphrodroma brevirostris*	Not listed	Least Concern
Great-winged Petrel *Pterodroma macroptera*	Not listed	Least Concern
Soft-plumaged Petrel *Pterodroma mollis*	Not listed	Least Concern
White-chinned Petrel *Procellaria aequinoctialis*	Vulnerable	Vulnerable
Leach's Storm-Petrel *Oceanodroma leucorhoa*	Not listed	Vulnerable
Wilson's Storm-Petrel *Oceanites oceanicus*	Not listed	Least Concern
European Storm-Petrel *Hydrobates pelagicus*	Not listed	Least Concern
Sabine's Gull *Xema sabini*	Not listed	Least Concern
Arctic Tern *Sterna paradisaea*	Not listed	Least Concern
Red Phalarope *Phalaropus fulicarius*	Not listed	Least Concern

Species	Namibian Regional Assessment	IUCN Global Assessment
Brown (Sub-Antarctic) Skua *Catharacta antarctica*	Not listed	Least Concern
Pomarine Jaeger (Skua) *Stercorarius pomarinus*	Not listed	Least Concern
Antarctic Prion *Pachyptila desolata*	Not listed	Least Concern
Long-Tailed Jaeger (Skua) *Stercorarius longicaudus*	Not listed	Least Concern
Sooty Shearwater *Ardenna grisea*	Near Threatened	Near Threatened
Cory's Shearwater *Calonectris borealis*	Not listed	Least Concern
Scopoli's Shearwater *Calonectris diomedea*	Not listed	Least Concern
Manx Shearwater *Puffinus puffinus*	Not listed	Least Concern
Great Shearwater *Ardenna gravis*	Not listed	Least Concern

Differences between Namibia and global classifications are the result of local population size, and the extent and duration of declines locally.

7.4.3.6 Marine Mammals

Marine mammals occurring off the central Benguela ecosystem include cetaceans (whales and dolphins) and seals. The cetacean fauna of southern Namibia comprises 35 species of whales and dolphins known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (Table 7-7). Namibian waters host resident species such as the endemic Heaviside's dolphin, bottlenose and dusky dolphins, Namibia's and species that migrate between Antarctic feeding grounds and warmer low latitude breeding grounds, as well as species with a circum-global distribution.

The Namibian shelf and deeper waters have been poorly studied with most available information in deeper waters (>200 m) arising from historic whaling records. However, recent data from MMOs and passive acoustic monitoring is improving knowledge. Current information on the distribution, population sizes and trends of most cetacean species, especially smaller cetaceans, occurring in Namibian waters is lacking.

The distribution of cetaceans in Namibian waters can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found in the shelf edge area (200-1 000 m) making this the most species-rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging. **The most common species within the broader area (in terms of likely encounter rate not total population sizes) are likely to be the humpback whale and pilot whale.** Due to the warmer waters offshore of the Namibian coast, the area of interest may host some species associated with the more tropical and temperate parts of the Atlantic such as rough toothed dolphins, striped dolphins, pan-tropical spotted dolphins and short finned pilot whales.

Cetaceans comprise two basic taxonomic groups, the mysticetes (filter feeding whales with baleen) and the odontocetes (predatory whales and dolphins with teeth)[14]. Due to large differences in their size, sociality, communication abilities, ranging behaviour and principally, acoustic behaviour, these two groups are considered separately.

[14] The term 'whale' is used to describe cetaceans larger than approximately 4 m in length in both these groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontocetes and the family Delphinidae and are thus dolphins, not whales).

Table 7-7 lists the cetaceans likely to be found within the area of interest, while Table 7-8 shows the likely seasonality of key species, based on data sourced from: Findlay *et al.* (1992), Best (2007), Weir (2011), Dr J-P Roux, (MFMR pers comm) and unpublished records held by the Namibian Dolphin Project, which includes sightings from fisheries observers and MMOs working in the area (de Rock *et al.* 2019). From MMO sightings (Figure 7-20), **it is evident that many species do occur near Block 2814A, particularly sei whales, Bryde's whales, humpback whales and various dolphin species.** It is important to highlight that the extent of available data is dependent on the location of previous exploration activities utilising MMOs.

The South African red list of cetacean fauna was updated in 2016, with global reviews underway. These listings provide the most up to date assessments as the Namibian listings have been updated recently. Of the 33 species listed:

- Blue whale is considered Critically Endangered;
- Fin whale and Sei whale are considered Endangered;
- Sperm whale, Bryde's whale (inshore) and the Humpback B2 subpopulation[15] are considered Vulnerable; and
- 10 species are listed as Data Deficient underlining how little is known about cetaceans, their distributions and population trends in southern Africa.

A review of the distribution and seasonality of the key cetacean species likely to be found within the broader project area is provided below, based on information provided by the Sea Search - Namibian Dolphin Project (NDP), which has been conducting research in Namibian waters since 2008. The NDP holds the most up-to-date data of cetacean occurrence and distribution since whaling times, with the records including a total database of over 7 000 records with more than 1 000 sightings made by MMOs on seismic or mining vessels and fisheries observers operating in shelf or pelagic waters.

Mysticete (Baleen) whales

The majority of mysticete whales fall into the family Balaenidae. Those occurring in the study area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whale (see Table 7-7 for scientific names). Most of these species occur in pelagic waters with only the occasional visit to shelf waters. All these species show some degree of migration either to, or through the latitudes of Block 2814A when *en route* between higher latitude (Antarctic or Sub Antarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality in Namibian waters can be either unimodal, usually in winter months, or bimodal (e.g., May-July and October-November) reflecting a northward and southward migration through the area. Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below.

[15] The humpback population in the southern hemisphere is comprised of different breeding subpopulations. B2 is the subpopulation that breeds on the south-west coast of Africa (Rosenbaum *et al.* 2009).

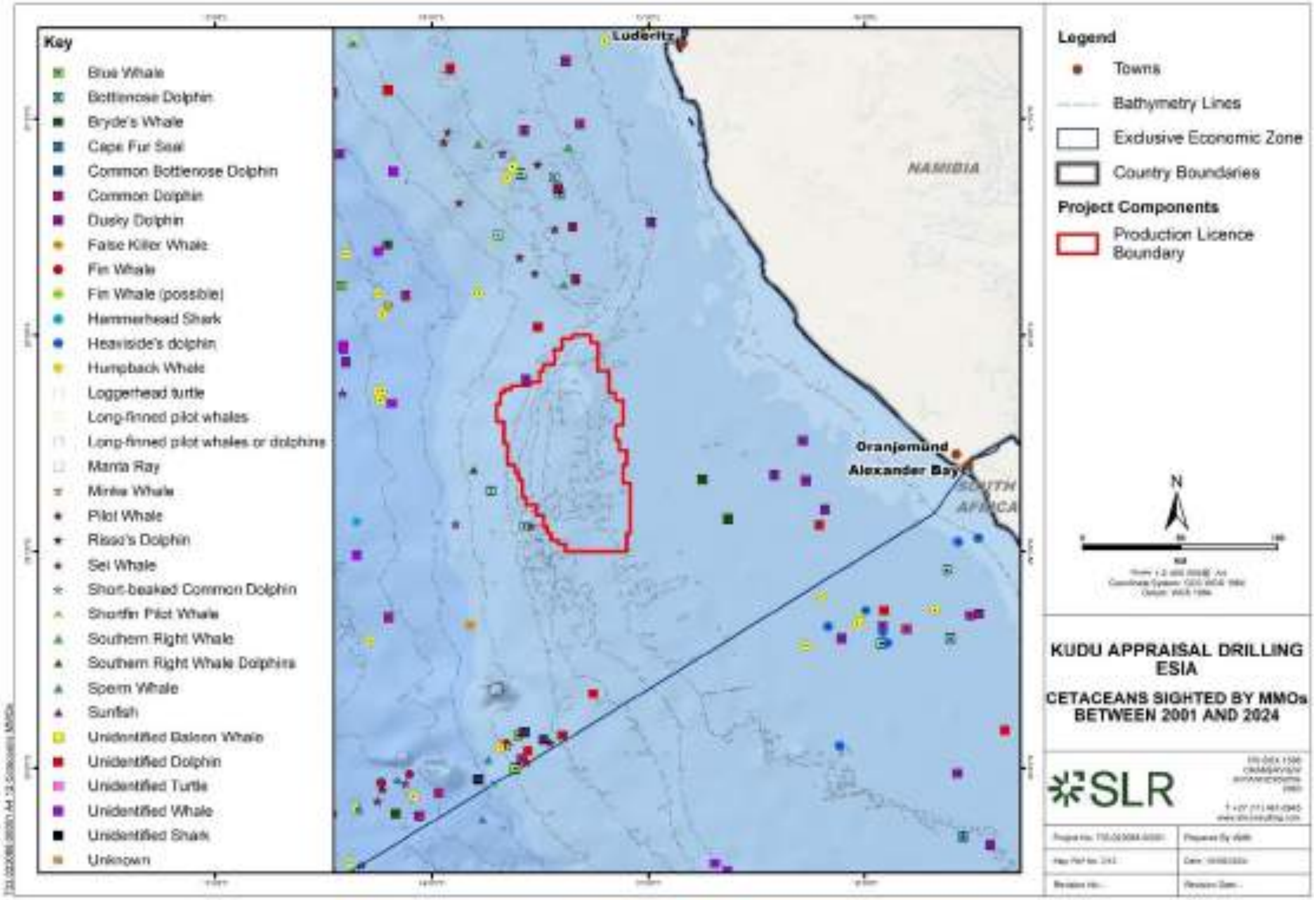

Figure 7-20: Block 2814A in relation to the distribution of cetaceans sighted by MMOs within the Namibian EEZ, collated between 2001 and 2024.

Source: SLR MMO database.

Table 7-7: Cetaceans occurrence off the southern Namibian Coast, their seasonality, likely encounter frequency in Block 2814A and South African (Child *et al*. 2016) and Global IUCN Red List conservation status.

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

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

Table 7-8: Seasonality of baleen whales in the broader project area based on data from multiple sources, predominantly commercial catches (Best 2007 and other sources) and data from stranding events (NDP unpubl data). Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species. For abundance / likely encounter rate within the broader project area, see Table 7-7.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's (inshore)	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's (offshore)	**H**	**H**	**H**	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	**H**	**H**	L	**H**	**H**	**H**	L	L
Fin	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Blue	L	L	L	L	L	**H**	**H**	**H**	L	M	L	L
Minke	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Humpback	M	M	L	L	L	**H**	**H**	M	M	L	M	**H**
Southern right	**H**	M	L	L	L	**H**	**H**	**H**	M	M	**H**	**H**
Pygmy right	**H**	**H**	**H**	M	L	L	L	L	L	L	M	M

<u>Sei whales</u>

There is very little information on sei whales in Namibian waters and most information on the species from the southern African sub-region originates from whaling data from 1958-1963. Sei whales spend time at high latitudes (40-50˚S) during summer months and migrate north through South African waters (where they were historically hunted in relatively high numbers) to unknown breeding grounds further north (Best 2007). As whaling catches were confirmed off both Congo and Angola, it is likely that they migrate through Namibian waters. Due to their migration pattern, densities in the area of interest are likely to show a bimodal peak with numbers predicted to be highest in May to June and August to October. All whales were historically caught in waters deeper than 200 m with most catches from deeper than 1 000 m (Best & Lockyer 2002). There is no current information on the abundance or distribution of this species in the region, but a sighting of a mother and calf in March 2012 (NDP unpublished data) and a stranding in Walvis Bay in July 2013 (NDP unpublished data) confirms their contemporary and probably year-round occurrence on the Namibian continental shelf and beyond. **Encounters in the area of interest are thus possible.**

<u>Bryde's whales</u>

Two genetically and morphologically distinct populations of Bryde's whales live off the west coast of southern Africa (Best 2001; Penry 2010). The "offshore population" occurs beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the west coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the area of interest from January to March. Several strandings of adult offshore Bryde's whales have occurred in central Namibia including in January 2012 and November 2017 near Walvis Bay, Namibia. The "inshore population" of Bryde's whales is unique amongst baleen whales in the region by being non-migratory. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the west coast with possible movements further north into the winter months (Best 2007). A live stranding of a calf of this population (population assigned genetically – G Penry pers. comm.) in Walvis Bay, Namibia confirms the current occurrence of this population in Namibian waters. An additional live sighting in the Namibian Islands Marine Protected Area (NIMPA) and a third stranding of a Bryde's whale adult in April 2013 have not been assigned to population but supports regular, year-round occurrence of both populations of the species in the central Benguela ecosystem. Sightings of Bryde's whales have been made *enroute* to and within nearby blocks (SLR 2022). **Encounters in the area of interest are thus possible.**

<u>Fin whales</u>

Fin whales were historically caught off the west coast of South Africa and Namibia. A bimodal peak in the catch data from South African shore-based stations suggests animals were migrating further north to breed (during May-June) before returning to Antarctic feeding grounds (during August-October). However, the location of the breeding ground (if any) and how far north it is remains unknown (Best 2007). Some juvenile animals may feed year-round in deeper waters off the shelf (Best 2007). Four strandings have occurred between Walvis Bay and the Kunene River in the last decade during January, April (2) and October (NDP unpubl. data). Groups of 5-8 animals have been seen on multiple occasions on the coast either side of Lüderitz in April, May of 2014 and January 2015 (NDP unpubl. data) confirming their contemporary occurrence in Namibian waters and potential use of the upwelling areas for feeding. To date, most sightings or strandings have occurred in late summer (April-May), supporting evidence from whaling data that this is a peak time of occurrence in southern Namibia. **Encounters in the area of interest are thus possible.**

<u>Blue whales</u>

Antarctic blue whales were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during July in Walvis Bay and Namibe suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Evidence of blue whale presence off Namibia is rapidly increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Thomisch *et al.* 2016) and in northern Namibia between May and July (Thomisch 2017) supporting observed timing from whaling records. Several recent (2014-2015) sightings of blue whales have occurred during seismic surveys off the southern part of Namibia in water >1 000 m deep confirming their current existence in the area and occurrence in Autumn months. **Encounters in the area of interest are thus unlikely.**

<u>Minke whales</u>

Two forms of minke whale occur in the Benguela, the Antarctic minke whale and the dwarf minke whale (Best 2007; NDP unpubl. data). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Regular sightings of semi-resident Antarctic minke whales in Lüderitz Bay, especially in summer months (December - March) and a stranding of a single animal in Walvis Bay (in February 2014) confirm the contemporary occurrence of the species in Namibia (NDP unpubl. data). Recent data from passive acoustic monitoring over a two-year period off the Walvis Ridge shows acoustic presence in June to August and November to December (Thomisch *et al.* 2016), supporting observations from whaling records. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minke whales have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean in summer months. Around southern Africa, dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa. **Both species are generally solitary, and densities are likely to be low in the area of interest, but encounters may occur.**

<u>Pygmy right whales</u>

The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult (Best 2007). The species is typically associated with cool temperate waters between 30°S and 55°S, with records from Namibia, south of Walvis Bay, providing the northern most for the species (Leeney *et al.* 2013).

<u>Southern right whales</u>

The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered to be a single population within this range (Roux *et al.* 2015). The most recent abundance estimate for this population is available for 2017 which estimated the population at ~6 100 individuals including all age and sex classes, which is increasing at ~6.5% per annum (Brandaõ *et al.* 2017). When the population numbers crashed in 1920, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Angola (Whitt *et al*. 2023), Namibia (Roux *et al.* 2001, 2015; de Rock *et al.*

2019) and Mozambique (Banks *et al.* 2011).

Southern right whales are one of the most abundant whales in the Benguela region, seen regularly in Namibian coastal waters (<3 km from shore), especially in the southern half of the Namibian coastline (Roux *et al.* 2001, 2011). Right whales have been recorded in Namibian waters in all months of the year (J-P Roux pers comm) but with numbers peaking in winter (June - August). A secondary peak in summer (November - January) also occurs, probably associated with animals feeding off the west coast of South Africa performing exploratory trips into southern Namibia (NDP unpubl. data). **Notably, all available records have been very close to shore with only a few out to 100 m depth, however they may be encountered in the shallower regions of the area of interest.**

<u>Humpback whales</u>

The majority of humpback whales passing through the Benguela are migrating to breeding grounds off tropical West Africa, between Angola and the Gulf of Guinea (Rosenbaum *et al.* 2009; Barendse *et al.* 2010). A recent synthesis of available humpback whale data from Namibia (Elwen *et al.* 2014) shows that in coastal waters, the northward migration stream is larger than the southward peak supporting earlier observations from whale catches (Best & Allison 2010). This supports previous suggestions that animals migrating north strike the coast at varying places, mostly north of St Helena Bay, resulting in increased whale density on shelf waters northwards towards Angola, but there is no clear migration 'corridor'. On the southward migration, there is evidence from satellite tagged animals and the smaller secondary peak in numbers in Walvis Bay, that many humpback whales follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs), possibly lingering in the feeding grounds off west South Africa in summer (Elwen *et al.* 2013, Rosenbaum *et al.* 2014). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse *et al.* 2010; Best & Allison 2010; Elwen *et al.* 2014). Regular sightings of humpback whales in spring and summer months in Namibia, especially in the Lüderitz area, suggest that summer feeding is occurring in Namibian waters as well, or that the foraging range extends into southern Namibia. Recent abundance estimates suggest that there were >9 000 individuals in the west African breeding population in 2005, with the population increasing by approximately 5% per annum (IWC 2012). **Humpback whales are thus likely to be the most frequently encountered baleen whale in Block 2814A, ranging from coastal waters to beyond the continental shelf. They have a year-round presence with numbers peaking in June and July (northern migration) and to a lesser degree in September to October (southern migration). Regular encounters occur until February associated with subsequent feeding in the Benguela ecosystem.**

In the first half of 2017 (when numbers are expected to be at their lowest) more than 10 humpback whales were reported stranded along the Namibian and west South African coasts. A similar event was recorded in late 2021-early 2022 when numerous strandings of young humpbacks were reported along the Western Cape Coast and in Namibia (Simon Elwen, Sea Search, pers. comm.). The cause of these deaths is not known, but similar events have been recorded off Brazil (2010) and the US Atlantic coast (2016 and 2022). The 2010 event was linked to possible infectious disease or malnutrition (Siciliano *et al.* 2013). The West African population may be undergoing similar stresses or responding to changes in their ecosystem (see for example Kershaw *et al.* 2021). It is not yet understood what may be driving these ecosystem changes and what the long-term effects to populations could potentially be.

Odontocete (toothed) whales

Odontocetes are a varied group of cetaceans including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Those in the region can range in size from 1.6 m long (Heaviside's dolphin) to 17 m (bull sperm whale).

<u>Sperm whales</u>

All information about sperm whales in the southern African subregion stems from data collected during commercial whaling activities, i.e., pre 1985 (Best 2007). Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They occur in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come into waters 500-200 m deep on the shelf (Best 2007). They are relatively abundant globally (Whitehead 2002), although no estimates are available for the southern African subregion. Seasonality of catches off west South Africa suggests that medium and large sized males are more abundant in winter months, while female groups are more abundant in autumn (March-April), although animals occur year-round (Best 2007). Sperm whales were one of the most frequently seen cetacean species from offshore seismic survey vessels operating between Angola and the Gulf of Guinea. All sightings were recorded in waters deeper than 780 m, and numbers peaked during April to June (Weir 2011). Multiple sightings of sperm whales have been recorded by MMOs operating around Tripp Sea Mount in the last decade (NDP Unpublished data, De Rock *et al.* 2019). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually. The regular echolocation clicks made by the species when diving, however, make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM). **Sperm whales in the area of interest are likely to be encountered in deeper waters (>500 m), predominantly in the winter months (April - October).** This has been confirmed by sightings of sperm whales *enroute* to nearby blocks (SLR 2022).

<u>Dwarf and pygmy sperm whales</u>

The genus *Kogia* contains two recognised species, the dwarf and pygmy sperm whales, both of which occur worldwide in pelagic and shelf edge waters, with few sighting records of live animals in their natural habitat (McAlpine 2018). Both species are deep water specialists living primarily off the shelf. There is preliminary evidence of species level genetic differentiation between dwarf sperm whale populations in the Indian and Atlantic Oceans (Chivers *et al.* 2004). Due to their small body size, cryptic behaviour and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. However, their narrow-band high frequency echolocation clicks make them detectable and identifiable (at least to the genus) using passive acoustic monitoring equipment. The majority of what is known about *Kogiid* whales in the southern African subregion results from studies of stranded specimens (e.g., Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013, but see also Moura *et al.* 2016). There are >30 records of pygmy sperm whales collected along the Namibian coastline with a peak in strandings in June and August. A single account of a dwarf sperm whale recorded in Walvis Bay in 2010, demonstrates that this species also occurs in Namibian waters (Elwen *et al.* 2014). *Kogia* species most frequently occur in pelagic and shelf edge waters, are **thus likely to occur in the area of interest at low levels**; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem (Best 2007) in waters deeper than ~1 000 m.

Killer whales

Killer whales have a circum-global distribution and are found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off western South Africa (Best *et al.* 2010), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.* 2010). Killer whales are found in all depths from the coast to deep open ocean environments and may **thus be encountered in the area of interest at low levels**.

False killer whales

False killer whales are recognised as a single species globally, although clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed (Best 2007). The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few close to shore as well (Findlay *et al.* 1992; NDP Unpubl. data). False killer whales usually occur in groups ranging in size from 1-100 animals (mean 20.2) (Best 2007), and are thus easily seen in most weather conditions. However, the strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, South Africa, all between St Helena Bay and Cape Agulhas (Kirkman *et al.* 2010). There is no information on population numbers of conservation status and no evidence of seasonality in the region (Best 2007). **Encounters within the area of interest may occur.**

Long- and short-finned pilot whales

Long- and short-finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or adjacent deep waters (Mate *et al.* 2005; Findlay *et al.* 1992; Weir 2011; Seakamela *et al*. 2022). They are regularly seen associated with the shelf edge by MMOs, fisheries observers and researchers operating in Namibian waters (NDP unpubl. data; De Rock *et al.* 2019). The distinction between long-finned and short finned pilot whales is difficult to make at sea. Short finned pilot whales are regarded as a more tropical species (Best 2007), and most sightings within the Benguela Ecosystem are thought to be long-finned pilot whales, however, due to the low latitude and offshore nature of the proposed activities, **it is likely that both could be encountered**. This was confirmed by the sighting of two short-finned pilot whales *enroute* to a nearby block in late 2018 (SLR 2022). There are many confirmed sightings of pilot whales along the shelf edge of South Africa and Namibia including within the area of interest since 2010 (de Rock *et al.* 2019; Sea Search unpublished data). Observed group sizes range from 8-100 individuals (Seakamela *et al*. 2022).

Dusky dolphins

Dusky dolphins (Figure 7-21, left) are frequently encountered in water less than 500 m deep. The species is very boat friendly and will often approach boats to bow-ride. This species is resident year-round throughout the Benguela ecosystem (Findlay *et al.* 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters off South Africa and Lüderitz, although encounters near-shore are rare along the central Namibian coast (Walvis Bay area), with most records coming from beyond 5 nautical miles from the coast (Elwen *et al.* 2010; NDP unpubl. data). In a recent survey of the

Namibian Islands Marine Protected Area (between latitudes of 24˚29’ S and 27˚57’ S and depths of 30-200 m) dusky dolphin were the most detected cetacean species with group sizes ranging from 1 to 70 individuals (NDP unpubl. data), although group sizes up to 800 have been reported in southern African waters (Findlay *et al.* 1992). Sightings of dusky dolphins have been made during trips to nearby blocks, as such **encounters within the area of interest may occur.**

Heaviside’s dolphins

Heaviside dolphins (Figure 7-21, right) are relatively abundant in both the southern and northern Benguela ecosystems with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen *et al.* 2009a) and several hundred animals living in the areas around Walvis Bay and Lüderitz. Heaviside’s dolphins are resident year-round. This species occupies waters from the coast to at least 200 m depth (Elwen *et al*. 2006; Best 2007) and may show a diurnal onshore-offshore movement pattern feeding offshore at night, although this varies throughout the range (Elwen *et al.* 2009b). This species occupies waters from the coast to at least 200 m depth (Elwen *et al.* 2006; Best 2007; Elwen *et al.* 2010). Since this species occur primarily inshore, they **may be encountered on the inshore boundary of the block.**

Figure 7-21: The dusky dolphin *Lagenorhynchus obscurus* (left) and endemic Heaviside’s dolphin *Cephalorhynchus heavisidii* (right).

Source: www.NamibianDolphinProject.com

Common dolphins

Common dolphins are known to occur offshore in Namibian waters (Findlay *et al.* 1992). Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay *et al.* 1992; Best 2007), although they are currently considered part of a single global species (Cunha *et al.* 2015). The long-beaked common dolphin lives on the continental shelf of South Africa rarely being observed north of St Helena Bay on the west coast or in waters more 500 m deep (Best 2007), although more recent sightings, including those from MMOs, suggest sightings regularly out to 1 000 m or more (SLR data, Sea Search data). A stranding in Lüderitz (May 2012, NDP unpublished data) and MMO reports have confirmed their occurrence in the region. Although group sizes can be large, averaging 267 (± *SD* 287) for the southern African region (Findlay *et al*. 1992), average sizes of 37 (± *SD* 31) have been reported for the Namibian region (NDP unpublished data). They are more frequently seen in the warmer waters offshore and to the north of the country, and all sightings to date have been in water deeper than 500 m. There is no evidence of seasonality. Far less is known about the short-beaked form, which is challenging to differentiate at sea from the long-beaked form. Group sizes are also typically large. It is likely that common dolphins encountered deeper than 2 000 m are of the short-beaked form. **Encounters in the area of interest may occur.**

Common bottlenose dolphins

Common bottlenose dolphins are widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. Within Nambian waters two populations of bottlenose dolphins occur. A small population of less than 100 individuals inhabits the very near shore coastal waters (mostly <15 m deep) of the central Namibian coastline from approximately Lüderitz in the south to at least Cape Cross in the north (Elwen *et al*. 2011). This group is considered to be of conservation concern, but **its nearshore habitat makes it unlikely to be impacted by the proposed activities.** An offshore 'form' of common bottlenose dolphins occurs around the coast of southern Africa including Namibia and Angola (Best 2007) with sightings restricted to the continental shelf edge and deeper. Offshore bottlenose dolphins frequently form mixed species groups, often with pilot whales or Risso's dolphins.

Beaked whales

There are almost no data available on the abundance, distribution, or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters (greater than 200 m) off the Namibian continental shelf (see Table 7-7). Beaked whales are all considered to be true deep-water species, usually recorded in waters in excess of 1 000-2 000 m (see various species accounts in Best 2007) and **thus they are unlikely to be encountered in the area of interest.**

Southern right whale dolphins

The cold waters of the Benguela region provide a northwards extension of the normally sub-Antarctic habitat of southern right whale dolphins (Best 2007). Most records in the region originate in a relatively restricted region between 26°S and 30°S roughly between Lüderitz and Tripp Seamount in water 100-2 000 m deep (Rose & Payne 1991; Best 2007; NDP Unpublished data). There was a live stranding of two individuals in Lüderitz Bay in December 2013. They are often seen in mixed species groups with other dolphins such as dusky dolphins. This small area where they are regularly seen does not overlap with the proposed project area. It is possible that the Namibian sightings represent a regionally unique and resident population (Findlay *et al.* 1992). **Encounters in the area of interest are therefore unlikely.**

Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) (Figure 7-22) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 7-23). Vagrant records from four other species of seal more usually associated with the sub-Antarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas),* sub Antarctic fur seal (*Arctocephalus tropicalis),* crabeater *(Lobodon carcinophagus)* and leopard seals (*Hydrurga leptonyx)* (David 1989).

Figure 7-22: Colony of Cape fur seals *Arctocephalus pusillus pusillus*

Source: Dirk Heinrich.

The southern colonies (Spencer Bay to Baker's Bay) historically contributed approximately 62% to the overall seal population in Namibia. However, since the distributional shift of the seal population northwards in response to environmental changes and altered prey distributions, the southern colonies comprise just less than a third of the total Namibian seal population (J-P Roux pers comm.). Population estimates fluctuate widely between years in terms of pup production, particularly since the mid-1990s (MFMR unpubl. Data; Kirkman *et al.* 2007). **The colonies closest to Block 2814A are at van Reenen Bay and Baker's Bay approximately 90 km inshore and to the north-east of the block, in the Tsau//Khaeb (Sperrgebiet) National Park**. These southern Namibian colonies have important conservation value since they are largely undisturbed at present, as public access to the southern Namibian coast is restricted.

Further colonies occur at Kleinzee (incorporating Robeiland), at Bucchu Twins near Alexander Bay, and Strandfontein Point (south of Hondeklipbaai) in South Africa. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African coast (Wickens 1994). The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status (M. Meÿer, SFRI, pers. comm.). **These colonies are over 150 km inshore and south-east of Block 2814A.**

The Cape fur seal population in the Benguela is regularly monitored by the South African and Namibian governments (e.g. Kirkman *et al.* 2012). Surveys of the full species range are periodically undertaken providing data on seal pup production (which can be translated to adult population size), thereby allowing for the generation of data on the population dynamics of this species. The population is considered to be healthy and stable in size although there has been a northward shift in the distribution of the breeding population (Kirkman *et al.* 2007; Skern-Mauritzen *et al.* 2009; Kirkman *et al.* 2012).

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles (~220 km) offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish.

Although Cape fur seals are primarily epipelagic foragers, some degree of geographic and temporal variation in resource and habitat use have been demonstrated (Botha *et al.* 2023). Benthic feeding to depths of up to 454 m has been recorded in females from the Kleinzee colony, with individual modal dive durations of 0.2 – 5.6 minutes (Kirkman *et al.* 2015; Kirkman *et al.* 2019). Botha *et al.* (2020) reported diel foraging patterns in females from the Kleinzee and False Bay colonies, with dive depth and benthic foraging increasing during daylight hours likely reflecting the vertical movements of prey species. The foraging area of tracked seals from Namibian colonies and the South African West Coast colonies was provided in Skern-Mauritzen *et al.* (2009) (Figure 7-23) and Harris *et al.* (2022) respectively. **The shallower regions of Block 2814A lie within foraging ranges from these colonies.**

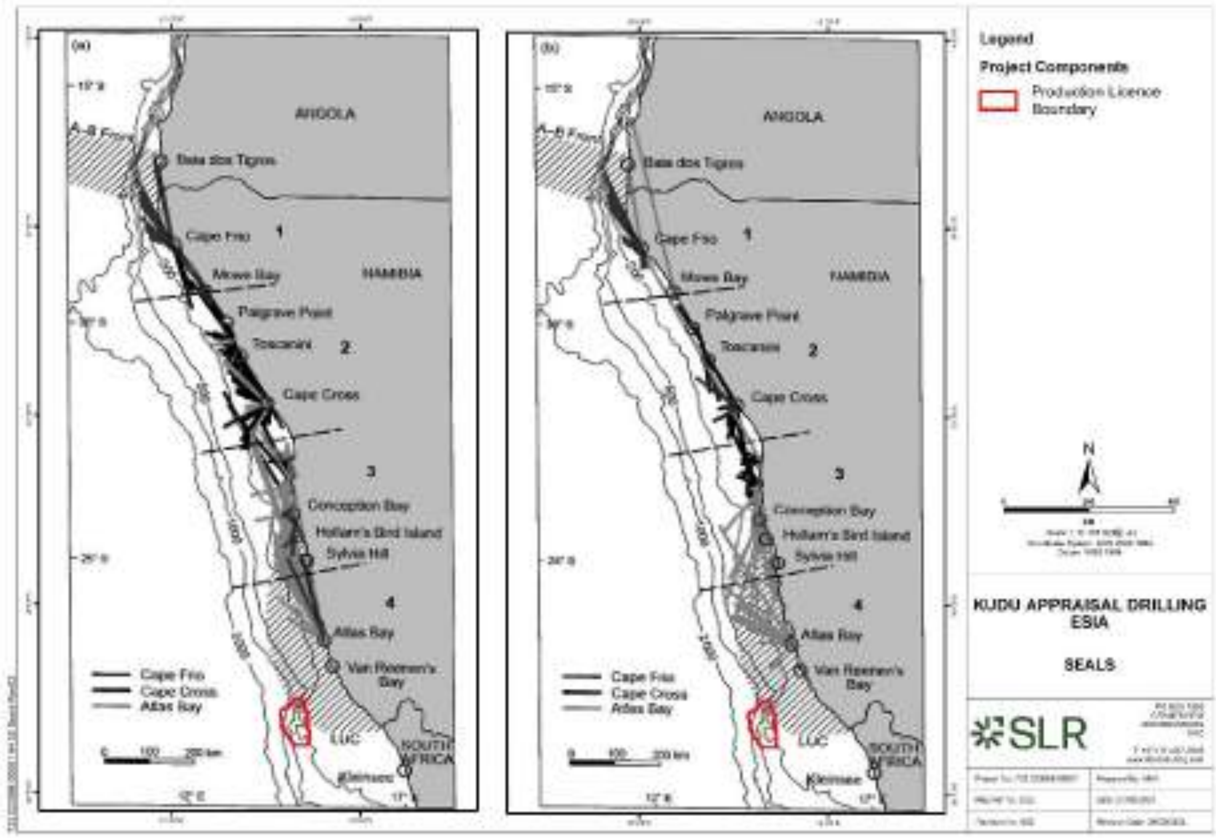

Figure 7-23: Block 2814A (red polygon) in relation to foraging trips of (a) females and (b) males of Cape fur seals at the Cape Frio, Cape Cross and Atlas Bay colonies. Trips are depicted as straight lines between the start location and the location where the seals spent most time during a trip.

Source: Skern-Mauritzen *et al.* (2009)

The timing of the annual breeding cycle is very regular, occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

There is a controlled annual quota, determined by government policy, for the harvesting of Cape fur seals on the Namibian coastline. The Total Allowable Catch (TAC) for 2020 and 2021 stands at 60 000 pups and 8 000 bulls, distributed among seven licence holders at Cape Cross and a further three in Lüderitz. The annual quotas are seldom filled with concessionaires typically only harvesting 50% of the bulls and 30% of the pups. The seals are exploited mainly for their pelts (pups), blubber and genitalia (bulls). The pups are clubbed, and the adults shot. These harvesting practices have raised concern among environmental and animal welfare organisations (Molloy & Reinikainen 2003).

In South Africa, an unprecedented mortality event was recorded between September and December 2021 at colonies around the West Coast Peninsula and north to Lambert's Bay and Elands Bay. Primarily pups and juveniles were affected. Post-mortem investigations revealed that seals died in a poor condition with reduced blubber reserves, and protein energy malnutrition was detected for aborted foetuses, for juveniles and subadults. Although no unusual environmental conditions were identified that may have triggered the die-off, or caused it indirectly (e.g., HABs), 2021 was a year of below average recruitment of anchovy and sardine, the main food source for seals. While a lack of food, as a result of possibly climate change and/or overfishing, has been predicted to be the cause of this mass mortality, the underlying causes of the mortality event remain uncertain (Seakamela *et al.* 2022). In Namibia, similar mortality events typically related to prey shortage occur periodically, the most recent being a large-scale abortion event in 2020, especially at the colonies in central Namibia (J-P. Roux, pers. comm.).

7.4.4 Summary

The area of interest is located on the continental slope, which can be seen as a transitional zone between the productive inner shelf areas and the outer continental shelf and abyss areas, which exhibit lower diversity and abundance of species.

Although upwelled nutrients may be high within Block 2814A, plankton levels and spawning are likely low due to the proximity to the LUCORC area. Substantial geological features such as seamounts, that can result in localised upwelling far offshore, are located approximately 75 km from the area of interest. **The distribution of small pelagic fish, which include many commercially important species such as sardine, anchovy, mackerel and herring, are located inshore of the area of interest. The shallower parts of Block 2814A are located within the foraging ranges of Cape fur seals and Cape gannets.**

Benthic fauna from beyond the shelf break are poorly known, but surveys in comparable environments showed that infauna were generally impoverished, which is typical for deep water sediments. These macrofaunal communities are usually dominated by polychaetes, with lower abundances of molluscs and crustaceans.

The benthic habitat at depths beyond 500 m have been assigned a threat status of 'Least Threatened', as they comprise large areas in the Namibian EEZ and experience limited impacts. **However, the continental shelf is considered 'Endangered' due to habitat degradation from trawling.**

The shelf community (<350 m) is dominated by the Cape hake, while the more diverse deeper water community is dominated by the deepwater hake, monkfish, kingklip, bronze whiptail and hairy conger as well as cephalopod species (such as squid and cuttlefishes) and squalid shark species. There is some degree of species overlap between the depth zones.

Small pelagic fish species usually occur in mixed shoals near within the 200 m depth contour, and thus are likely in the shallower regions of Block 2814A. Large migratory pelagic fish species, such as tunas, billfish and sharks, occur seasonally throughout the southern oceans; they may thus be encountered in the area of interest. Turtle

occurrence in the area of interest is also possible but abundances are similarly expected to be low.

Cetacean species most likely to be encountered in the area of interest are long-finned pilot, Bryde's and humpback whales, as well as various dolphin species (some often only detected acoustically). Beaked whales, although expected only in very low numbers in the area of interest, seem particularly susceptible to man-made sounds and specific precautions are required to avoid harm.

7.5 Sanctuaries, Marine Protected Areas and other Sensitive Areas

Numerous categories of sensitive areas and marine protected areas (MPA) exist along the southern Namibian coastline, which are discussed below.

7.5.1 Sanctuaries

Sanctuaries are considered a type of management area within Namibia's multi-purpose National Park and MPA network in which access and/or resource use is prohibited.

The **Lüderitz Bay and Ichaboe Island Rock-Lobster Sanctuaries** were proclaimed by South Africa in 1939 and 1951, respectively (Matthews & Smit 1979), and subsequently maintained as reserves by MFMR after Namibian independence. There is no restriction on other activities within these reserves. **These sanctuaries are 150 km north-east of Block 2814A.**

7.5.2 National Parks

Inshore of Block 2814A, the coastline of Namibia is part of a continuum of protected areas that stretch along the entire Namibian coastline, a distance of about 1 570 km, from Southern Angola into Namaqualand in South Africa. From north to south these comprise the Skeleton Coast National Park, the Dorob National Park, the Namib-Naukluft National Park and the Tsau//Khaeb (Sperrgebiet) National Park. In the south across the Orange River, it borders on the Richtersveld in South Africa, which comprises a protected area of about 1 600 km^2 within a multiple-use buffer zone of about 3 984 km^2. This whole area forms the Ai-Ais/Richtersveld Transfrontier Conservation Area under a formal co-operative agreement between the governments of Namibia and South Africa.

7.5.3 Marine Protected Areas

The Namibian MPA was launched on 2 July 2009 under the Namibian Marine Resources Act (No. 29 of 1992 and No. 27 of 2000), with the purpose of protecting sensitive ecosystems and breeding and foraging areas for seabirds and marine mammals, as well as protecting important spawning and nursery grounds for fish and other marine resources (such as rock lobster). The MPA comprises a coastal strip extending from Hollamsbird Island (24°38´S) in the north, to Chameis Bay (27°57´S) in the south, spanning approximately three degrees of latitude and an average width of 30 km, including 16 specified offshore islands, islets and rocks (; Currie *et al.* 2009). The Namibian Islands' Marine Protected Area (NIMPA) spans an area of 9 555 km^2 and includes a rock-lobster sanctuary constituting 478 km^2 between Chameis Bay and Prince of Wales Bay. The offshore islands, whose combined surface area amounts to only 2.35 km^2 have been given priority conservation and highest protection status (Figure 7-24; Currie *et al.* 2009). The area has been zoned into four degrees of incremental protection. These are detailed in Currie *et al.* (2009). **NIMPA is 65 km to the north-east of Block 2814A.**

The Orange Shelf Edge MPA is 75 km south of Block 2814A at its closest point, in South African waters. This offshore MPA covers depths of between 250 m and 1 500 m and was proclaimed in 2019. The area has not been trawled therefore provides a good reference for a healthy benthic environment.

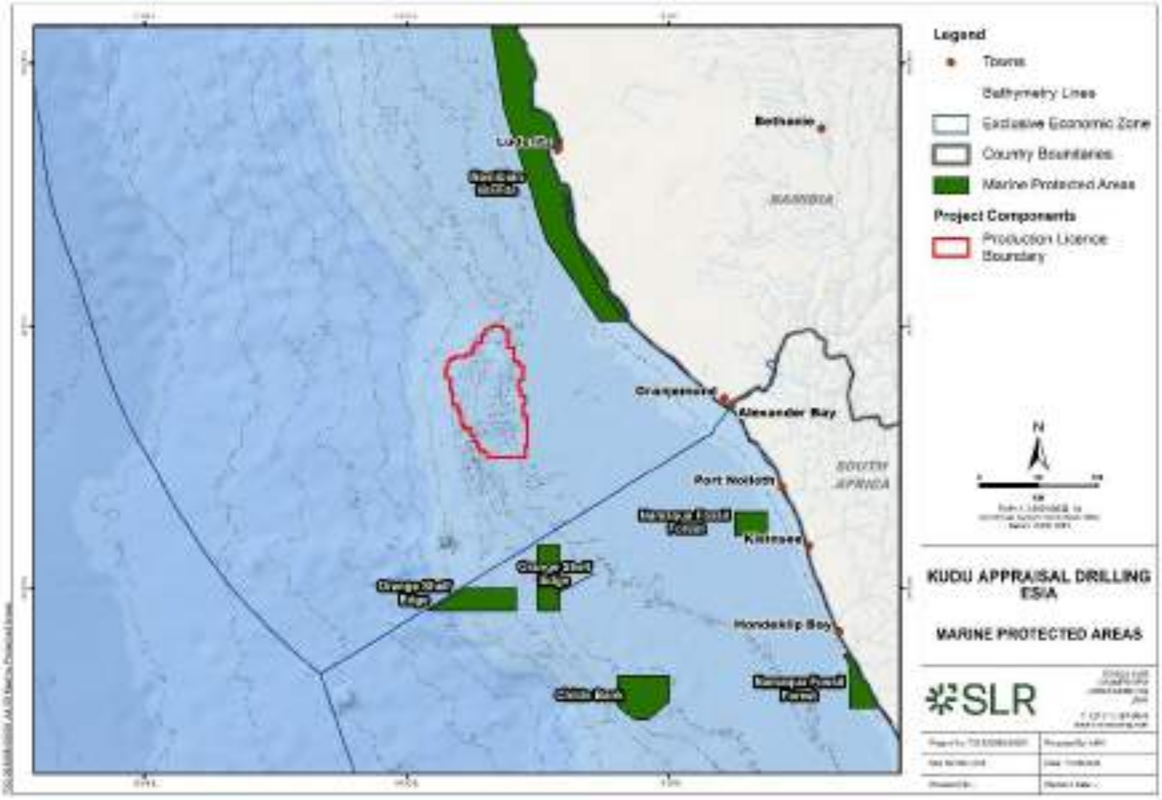

Figure 7-24: Block 2814A (red polygon) in relation to Marine Protected Areas in Namibia and South Africa.

7.5.4 Sensitive Areas

Benthic habitats along the shelf edge in southern Namibia (500 m depth contour) were classified as 'Endangered' by the BCC-SBA, largely due to the degraded habitat found in this area caused by trawling. The upper and lower shelf were considered 'Least Threatened'. The majority of the benthic habitat within Block 2814A is classified as 'Least Threatened', however the north-eastern region overlaps with the 'Endangered' trawled area on the shelf edge (Holness *et al*. 2014, Table 7-1, Figure 7-25).

Despite the development of the offshore Ecologically or Biologically Significant Marine Areas (EBSAs) a number of 'Vulnerable' ecosystem types in the broader project area are currently considered 'not well protected' or 'poorly protected' and further effort is needed to improve protection of these threatened ecosystem types (Holness *et al*. 2014) (Figure 7-25). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the upper and lower slope and abyss of the Namib biozone receives no protection at all, with the 'Endangered' and 'Critically Endangered' Namaqua Shelf Edge and Lüderitz Shelf edge being 'poorly protected' and 'moderately protected', respectively. **Block 2814A lies within an area receiving moderate protection (Figure 7-25).**

7.5.4.1 Ecologically or Biologically Significant Marine Areas

In the spatial marine biodiversity assessment undertaken for Namibia (Holness *et al.* 2014), several offshore and coastal areas were identified as being of high priority for place-based conservation measures. To this end, EBSAs spanning the coastline between Angola and South Africa were proposed and successfully submitted for international recognition to the Convention of Biological Diversity (CBD) in March 2020. The principal objective of the EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. The EBSAs are delineated to minimise conflict and avoid negative impacts with industries. In line with Namibia's National Development Plan 5, the EBSAs will be used to inform and enhance Marine Spatial Planning in the country's Economic Exclusive Zone (EEZ).

No specific management actions have been formulated for the EBSAs at this stage and they carry no legal status. Any future decisions in relation to management of the areas and possible restrictions of human activities are within the mandate of the responsible authorities. However, two biodiversity zones have recently been defined within each EBSA as part of the marine spatial planning process[16] (Figure 7-26). Although the proposed zonation of the EBSAs is still under discussion, the management objective in the zones marked for 'Conservation' is "*strict place-based biodiversity protection aimed at securing key biodiversity features in a natural or semi-natural state, or as near to this state as possible*". The management objective in the zones marked for 'Impact Management' is "*management of impacts on key biodiversity features in a mixed-use area to keep key biodiversity features in at least a functional state*". In the list of sea-use activities provided for Impact Management EBSAs, the marine spatial planning zone for petroleum activities recommends that non-destructive exploration (e.g., seismic acquisition) and localised destructive exploration (e.g., exploration or appraisal drilling) is conditionally permissible within the biodiversity conservation zone (or Critical Biodiversity Area, CBA). Conditional activities are defined as activities that "*are recommended to be managed as Consent activities, which are those that can continue in the zone subject to specific regulations and controls, e.g., to avoid unacceptable impacts on biodiversity features, or to avoid intensification or expansion of impact footprints of uses that are already occurring and where there are no realistic prospects of excluding these activities*" (MARISMA Project 2019).

[16] https://cmr.mandela.ac.za/EBSA-Portal/Namibia/Namibian-EBSA-Status-Assessment-Management

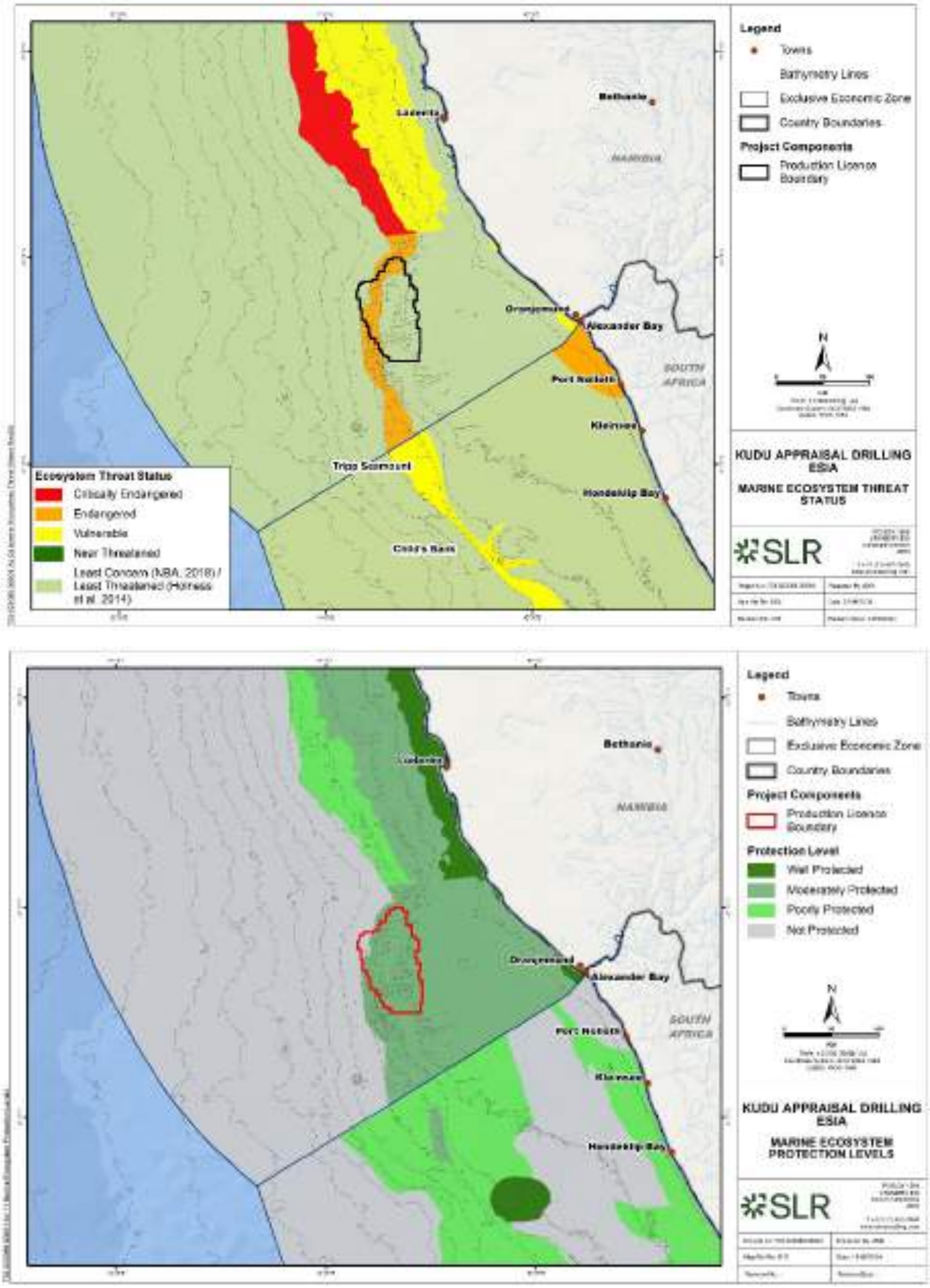

Figure 7-25: **Block 2814A (black and red polygon) in relation to ecosystem threat status (top) and protection levels (bottom) of benthic habitat types.**

Source: Adapted from Holness *et al.* (2014) and Sink *et al.* (2019).

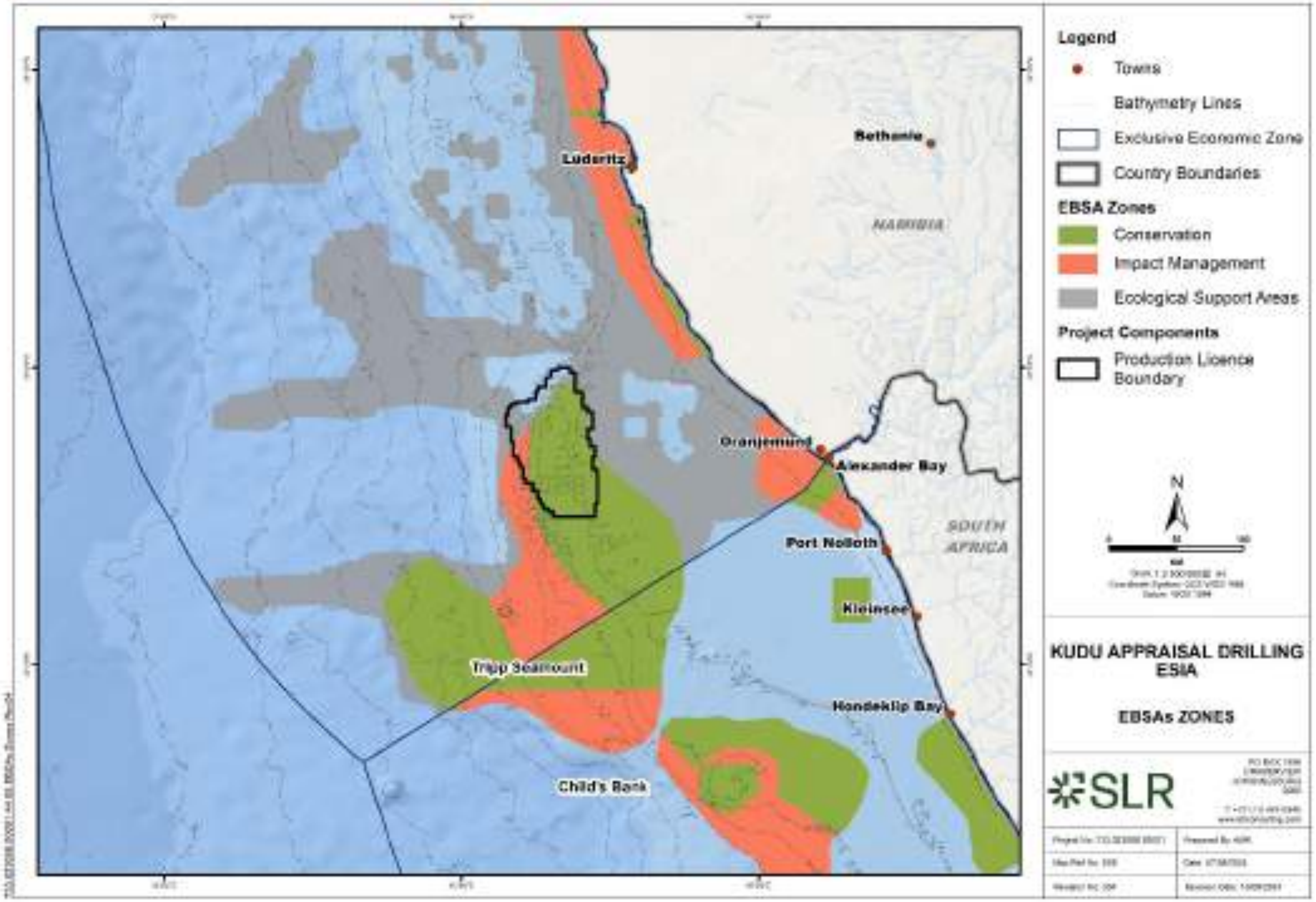

Figure 7-26: **Block 2814A (black polygon) in relation to Ecologically and Biologically Significant Areas (EBSAs) and the marine spatial planning zones within these. Ecological support areas (ESAs) also shown.**

Source: Adapted from MFMR (2021) and MARISMA.

Of the eight identified EBSAs off Namibia, two fall solely within Namibian national jurisdiction (Namib Flyway and Namibian Islands), while one is shared with Angola (Namibe) and two are shared with South Africa (Orange Shelf Edge and Orange Cone). The Benguela Upwelling System transboundary EBSA extends along the entire southern African West Coast from Cape Point to the Kunene River and includes a portion of the high seas beyond the Angolan EEZ. The following summaries are adapted from the MARISMA EBSA Workstream (2020):

- The **Namibian Islands** are located offshore of the central Namibian coastline and within the intensive Lüderitz upwelling cell. These islands and their surrounding waters are significant for life history stages of threatened seabird species as they serve as crucial seabird breeding sites within the existing Namibian Islands Marine Protected Area (NIMPA). The surrounding waters are also key foraging grounds for both seabirds and for 'Critically Endangered' leatherback turtles that nest along the northeastern coast of South Africa.
- The **Orange Seamount and Canyon Complex** occur at the western continental margin of southern Africa, spanning the border between South Africa and Namibia. On the Namibian side, it includes Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and shelf-edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are 'Threatened', one is 'Critically Endangered' and one 'Endangered'. The Orange Shelf Edge EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures (Sea Surface Temperature (SST) mean = 18.3°C) and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf. **Block 2814A is almost entirely located within the Orange Seamount and Canyon Complex transboundary EBSA.**
- The **Orange Cone** is a transboundary EBSA that spans the mouth of the Orange River. The estuary is biodiversity-rich but modified, and the coastal area includes many Critically Endangered, Endangered, and Vulnerable habitat types (with the area being particularly important for the Critically Endangered Namaqua Sandy Inshore, Namaqua Inshore Reef and Hard Grounds and Namaqua Intermediate and Reflective Sandy Beach habitat types). The marine environment experiences slow, but variable currents and weaker winds, making it potentially favourable for reproduction of pelagic species. An ecological dependence for of river outflow for fish recruitment on the inshore Orange Cone is also likely. The Orange River Mouth is a transboundary Ramsar site and falls within the Tsau//Khaeb (Sperrgebiet) National Park. It is also under consideration as a protected area by South Africa and is an Important Bird and Biodiversity Area. This area is thus highly relevant in terms of: 'Uniqueness or rarity', 'Importance for threatened, endangered or declining species and/or habitats' and 'Special importance for life history stages of species'.
- The **Benguela Upwelling System** is a transboundary EBSA is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems and is characterized by very high primary production (>1 000 mg $C.m^{-2}.day^{-1}$). It includes important spawning and nursery areas for fish as well as foraging areas for threatened vertebrates, such as sea- and shorebirds,

turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the Northern Benguela, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria.

- The **Namaqua Fossil Forest** EBSA, which lies inshore of the Deep Western Orange Basin block, is a small seabed outcrop composed of fossilized yellowwood trees at 136-140 m depth, approximately 30 km offshore on the west coast of South Africa. A portion of the EBSA comprised the Namaqua Fossil Forest MPA. The fossilized tree trunks form outcrops of laterally extensive slabs of rock have been colonised by fragile, habitat-forming scleractinian corals and a newly described habitat-forming sponge species. The EBSA thus encompasses a unique feature with substantial structural complexity that is highly vulnerable to benthic impacts.
- The **Childs Bank and Shelf Edge** EBSA, which lies to the east of the Deep Western Orange Basin block, is a unique submarine bank feature rising from 400 m to 180 m on the western continental margin on South Africa. This area includes five benthic habitat types, including the bank itself, the outer shelf and the shelf edge, supporting hard and unconsolidated habitat types. Childs Bank and associated habitats are known to support structurally complex cold-water corals, hydrocorals, gorgonians and glass sponges; species that are particularly fragile, sensitive and vulnerable to disturbance, and recover slowly.

7.5.4.2 Biodiversity Priority Areas and Marine Spatial Planning

In addition to EBSAs, Ecological Support Areas (ESAs) have been identified. Although these areas do not meet the EBSA criteria they reflect secondary priority conservation areas with special attributes that support a healthy and functioning marine ecosystem (Figure 7-26). **Block 2814A partially overlaps with an ESA bordering the Orange Seamount and Canyon Complex EBSA.**

Namibia recently embarked on a Marine Spatial Planning (MSP) process implemented as a development planning approach to organize the use of the country’s marine territory in such way that comprehensive, integrated, and complementary planning and management across sectors and for all ocean uses is enabled. MSP in Namibia is highly precautionary and forward-looking given the relatively low intensity of current uses, has a strong ecosystem-based perspective due to the pristine environment, is driven by a social equity and distributive justice agenda, and features a strong collaborative process governance (Finke *et al*. 2020a, 2020b). Although at this stage MSP lacks legislation and has only weak links to broader ocean governance, the MSP process has resulted in a clear framework for the development of the first marine plan (MFMR 2019), as it was linked to a systematic conservation planning process from the outset.

The objectives and principles for MSP, as well as the steps each planning process is expected to follow, is set out in the National MSP Framework (MFMR 2019). The Framework provides high-level direction to ensure consistent and coherent plan development, implementation and review across Namibia’s marine space and its three proposed planning areas: a northern, central and southern area. It also describes the background to MSP and its overarching objectives in Namibia and identifies relevant institutional structures, roles and responsibilities (MFMR 2022). The first MSP for Namibia is being developed for the central area, followed by the northern and the southern areas. Although all three areas have sites of high ecological sensitivity and importance, growing economic interests and increasingly overlapping human uses, particularly in the central and southern MSP areas call for improved management.

The Marine Spatial Plans in each of the three planning areas will translate the National Framework for MSP into integrated and strategic sustainable development plans that guide users, developers and regulators in their decision-making, setting out which activities should take place where, when and under what conditions. Any future licensing decisions would need to be in line with the provisions set out in the respective plans.

7.5.4.3 Ramsar Sites

A Ramsar site is wetland designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established by UNESCO in 1971. The Ramsar sites potentially in the Area of Influence are listed in Table 7-9. **Block 2814A lies offshore of these coastal sites.**

Table 7-9: List of coastal Ramsar sites inshore of. Block 2814A

Name	Size (ha)	Description
Walvis Bay Wetlands	10 550	Ramsar site no. 742. A tidal lagoon consisting of adjacent intertidal areas, Pelican Point, mudflats exposed at low tide, and sandbars serving as roosting sites. The site supports varying numbers of wetland birds (37 000 to 79 000 individuals); some species such as flamingos occur in impressive numbers. Eleven endangered bird species are regularly observed. Human activities consist of recreation and salt production. Residential development exists along the lagoon, and natural siltation may eventually lead to the infilling.
Sandwich Harbour	13 825	Ramsar site no. 743. Two distinct wetlands and associated mudflats. One is aquifer-fed and supports typical emergent vegetation but is slowly disappearing due to natural causes. The second, under tidal influence, consists of mudflats and raised shingle bars. One of Namibia's most important coastal wetlands, supporting eight endangered species among the large numbers of wading birds. Several archaeological sites dating back 1 000 years exist within the site. The site is used for scientific research, with surrounding areas used for tourism, recreation, and angling.
Orange River Mouth	2 000	Ramsar site no. 526. Transboundary area of extensive saltmarshes, freshwater lagoons and marshes, sand banks, and reedbeds shared by South Africa and Namibia. Important for resident birds and for staging locally migrant waterbirds. Following the collapse of the saltmarsh component of the estuary, the site was placed on the Montreux Record in 1995.

7.5.4.4 Important Bird Areas

The Important Bird Areas (IBAs) located along the Namibian coastline, as designated by BirdLife International in Namibia, include:

- 30-kilometre Beach: Walvis-Swakopmud
- Cape Cross Lagoon

- Ichaboe Island;
- Lüderitz Bay Islands;
- Mercury Island;
- Mile 4 saltworks;
- Namib-Naukuluft Park
- Possession Island;
- Sandwhich Harbour;
- Sperrgebiet; and
- Walvis Bay

Block 2814A lies well offshore of these coastal IBAs (Figure 7-27). Various marine IBAs have also been proposed in Namibian territorial waters, with a candidate trans-boundary marine IBA suggested off the Orange River mouth (Figure 7-27). The proposed Atlantic Southeast 21 marine IBA specifically targets the protection of Atlantic Yellow-nosed Albatross, Black-browed Albatross and White-chinned Petrels. **Block 2814A lies within this proposed marine IBA.**

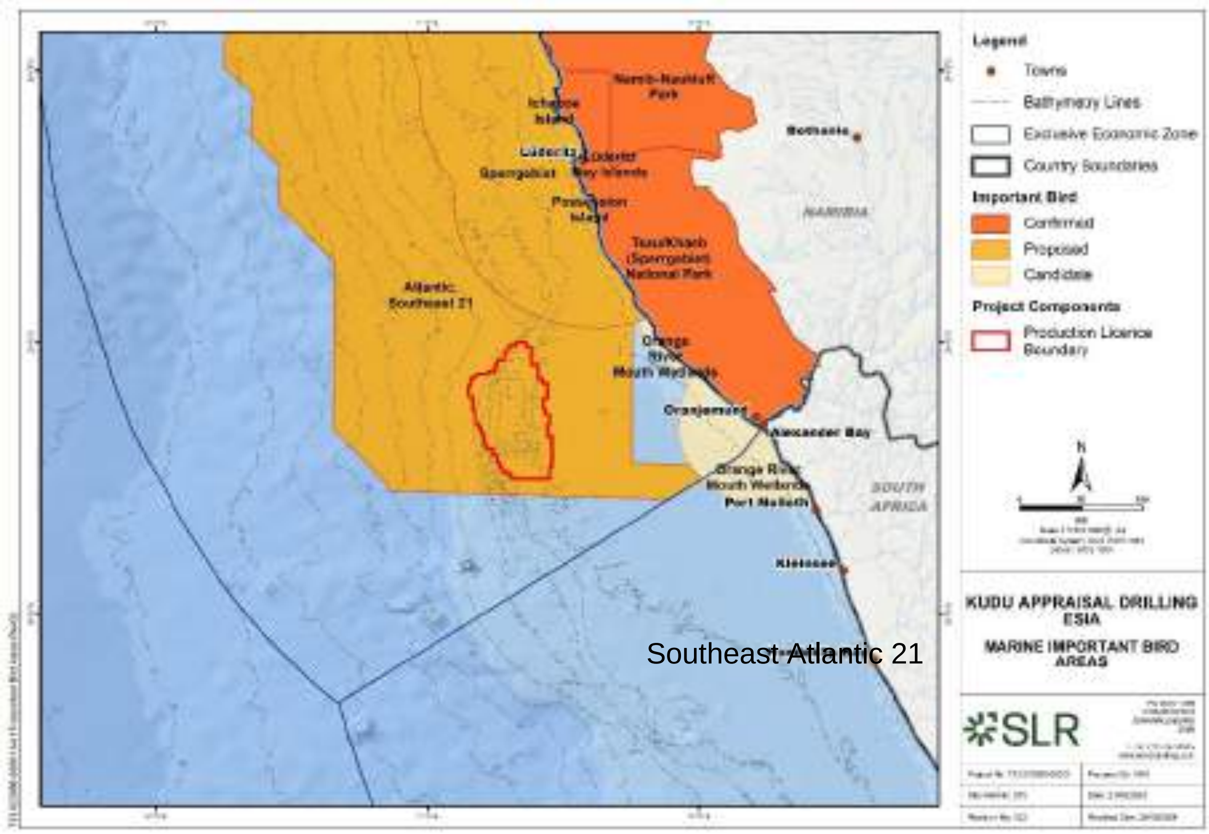

Figure 7-27: **Confirmed, proposed and candidate IBAs near Block 2814A.**

Source: https://maps.birdlife.org/marineIBAs/

7.5.4.5 Important Marine Mammal Areas

Important Marine Mammal Areas (IMMAs) were introduced by the IUCN Marine Mammal Protected Areas Task Force in 2016 to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle

activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.
The majority of the west coast of Africa has not yet been assessed with respect to its relevance as an IMMA. IMMAs in southern Africa include:

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

These all lie well to the south of Block 2814A.

7.5.5 Summary

Block 2814A is almost entirely located within the Orange Seamount and Canyon Complex transboundary EBSA. The area of interest does not overlap with any MPAs, IBAs, IMMAs or Ramsar sites.

The benthic habitat along 500 m depth contour in southern Namibia are considered 'Endangered', due to the degraded condition caused by trawling. Inshore and offshore of this, the benthic habitat is considered 'Least Threatened'. The area of interest covers a depth range of 150 to 750 m, incorporating these habitats.

7.6 Ecological Network Conceptual Model

Figure 7-28 provides a simplified conceptual model for the nearshore and offshore receiving environment in the southern Benguela illustrating key variables, processes, linkages, relationships, dependencies and feed-back-loops.

The upwelling of nutrients in the southern Benguela is the main driver that supports substantial seasonal phytoplankton production, which in turn serves as the basis for a rich food chain up through zooplankton, pelagic fish, cephalopods, and marine mammals, as well as demersal species and benthic fauna. High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters, resulting in a wind-related cycle of plankton production, mortality, sinking of detritus and eventual nutrient enrichment and remineralisation through the microbial loops active in the water column and on the seabed. The natural annual input of millions of tonnes of organic material onto the seabed provides most of the food requirements of the particulate and filter-feeding benthic communities, resulting in the high organic content of the muds in the region. Organic detritus not directly consumed enters the seabed decomposition cycle, potentially resulting in the depletion of oxygen in deeper waters and the formation of hydrogen sulphide by anaerobic bacteria.

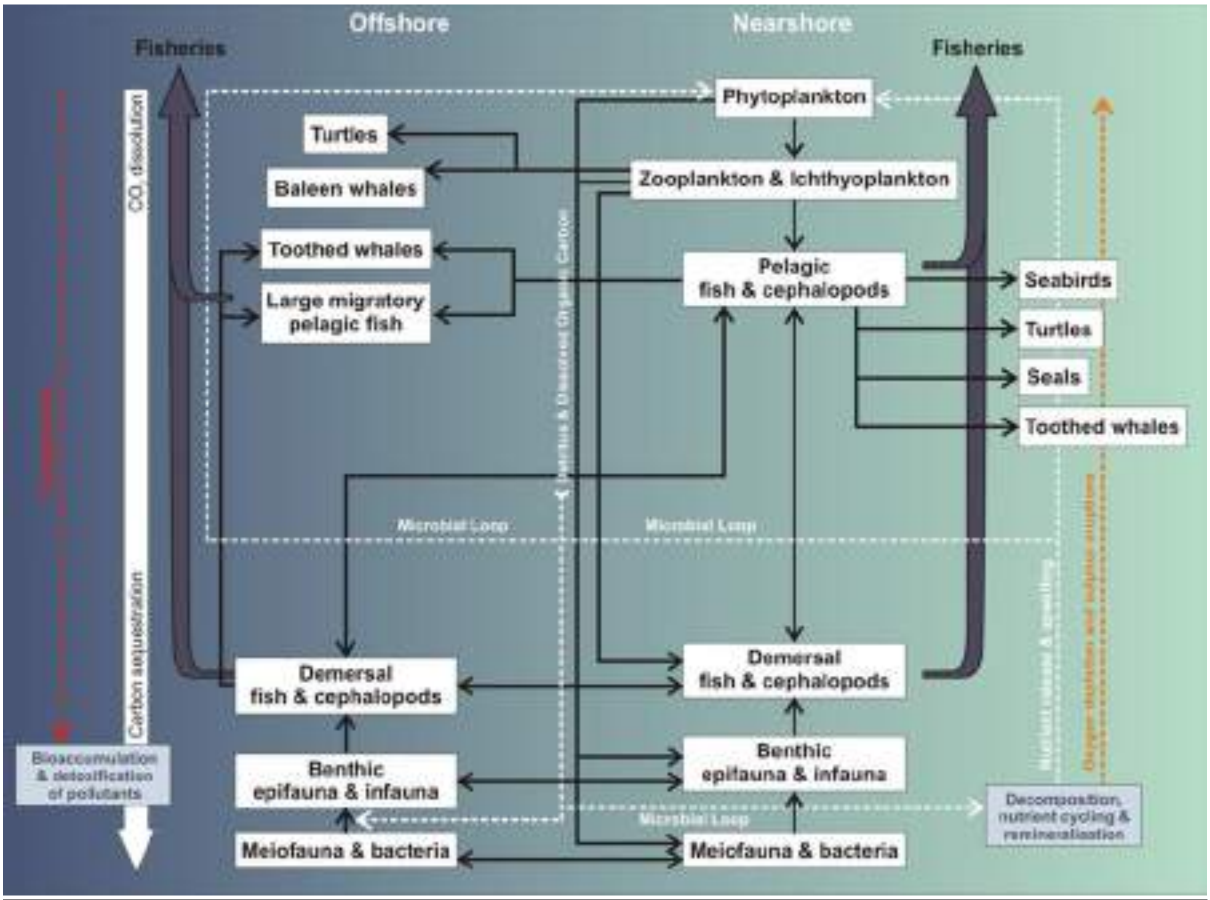

Figure 7-28: Simplified Network Diagram Indicating the Interaction Between the Key Ecosystem Components off the southern Benguela system.

Source: Pisces

In the offshore oceanic environment in the vicinity of a seamount, similar processes of decomposition and remineralisation, upwelling of nutrients and enhanced localised primary and secondary production would apply, thereby serving as focal points for higher order consumers. The cold-water corals typically associated with seamounts and canyons also add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity and the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts also provide an important habitat for commercial deep-water fish stocks.

Ecosystem functions of the offshore deep-water environment include the support of highly productive fisheries, the dissolution of CO_2 from the atmosphere and subsequent sequestering of carbon in seabed sediments, as well as waste absorption and detoxification.

The structure and function of these nearshore and offshore marine ecosystems is influenced both by natural environmental variation (e.g., El Niño Southern Oscillation (ENSO)) and multiple human uses, such as hydrocarbon developments and the harvest of marine living resources.

A brief discussion of potential population-level and ecosystem-wide effects of disturbance and the application of the integrated ecosystem assessment framework for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components is provided below.

Intense upwelling events, for example those associated with the Cape Canyon and the Lüderitz upwelling cell, provide highly productive surface waters, which power feeding grounds for fish, cetaceans and seabirds (DFFE 2018). Roman & McCarthy (2010) demonstrated the importance of marine mammal faecal matter in replenishing nutrients in the euphotic zone, thereby locally enhancing primary productivity in areas where whales and/or seals gather to feed (Kanwisher & Ridgeway 1983; Nicol *et al.* 2010). Surface excretion may also extend seasonal plankton productivity after a thermocline has formed, and where diving and surfacing of deep-feeding marine mammals (e.g. pilot whales, seals) transcends stratification, the vertical movement of these air-breathing predators may act as a pump bringing nutrients below the thermocline to the surface thereby potentially increasing the carrying capacity for other marine consumers, including commercial fish species (Roman & McCarthy, 2010). Behavioural avoidance of marine mammals from such seasonal feeding areas in response to increasing anthropogenic disturbance may thus alter the nutrient fluxes in these zones, with possible ecosystem repercussions.

Likewise, long-lived, slow-reproducing species play important stabilising roles in the marine ecosystem, especially through predation, as they play a vital role in balancing and structuring food webs, thereby maintaining their functioning and productivity. Should such predators be impacted by hydrocarbon exploration or appraisal at population level, and this have repercussions across multiple parts of a food web, top-down trophic cascades in the marine ecosystem could result (Ripple *et al.* 2016).

At the other end of the scale, significant impacts on plankton by anthropogenic sources can have significant bottom-up ripple effects on ocean ecosystem structure and health as phytoplankton and their zooplankton grazers underpin marine productivity. Healthy populations of fish, top predators and marine mammals are not possible without viable planktonic productivity. Furthermore, as a significant component of zooplankton communities comprises the egg and larval stages of many commercial fisheries species, large-scale disturbances (both natural and anthropogenic) on plankton communities can therefore have knock-on effects on ecosystem services across multiple levels of the food web.

Due to the difficulties in observing population-level and/or ecosystem impacts, numerical models are needed to provide information on the extent to which sound or other anthropogenic disturbances may affect the structure and functioning of populations and ecosystems. Attempts to model noise-induced changes in population parameters were first undertaken for marine mammals using the population consequences of acoustic disturbance (PCAD) or Population Consequences of Disturbance (PCoD) approach (NRC 2005). The PCAD/PCoD framework assesses how observed behavioural responses on the health of an individual translates into changes in critical life-history traits (e.g., growth, reproduction, and survival) to estimate population-level effects. Since then, various frameworks have been developed to enhance our understanding of the consequences of behavioural responses of individuals at a population level. This is typically done through development of bio-energetics models that quantify the reduction in bio-energy intake as a function of disturbance and assess this reduction against the bio-energetic need for critical life-history traits (Costa *et al*. 2016; Keen *et al*. 2021). The consequences of changes in life-history traits on the development of a population are then assessed through population modelling. These frameworks are usually complex and under continual development but have been successfully used to assess the population consequences and ecosystem effects of disturbance in real-life conditions both for marine mammals (Villegas-Amtmann, 2015, 2017; Costa *et al.* 2016; Ellison *et al.* 2016; McHuron *et al.* 2018; Pirotta *et al.* 2018; Dunlop *et al.*

2021), fish (Slabbekoorn & Halfwerk, 2009; Hawkins *et al.* 2014; Slabbekoorn *et al.* 2019) and invertebrates (Hubert *et al.* 2018). The PCAD/PCoD models use and synthesise data from behavioural monitoring programmes, ecological studies on animal movement, bio-energetics, prey availability and mitigation effectiveness to assess the population-level effects of multiple disturbances over time (Bröker, 2019).

Ecosystem-based management is a holistic living resource management approach that concurrently addresses multiple human uses and the effect such stressors may have on the ability of marine ecosystems to provide ecosystem services and processes (e.g., recreational opportunities, consumption of seafood, coastal developments) (Holsman *et al.* 2017; Spooner *et al.* 2021). Within complex marine ecosystems, the integrated ecosystem assessment framework, which incorporates ecosystem risk assessments, provides a method for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components (Levin *et al.* 2009, 2014; Holsman *et al.* 2017; Spooner *et al.* 2021). It, therefore, has the potential to address cumulative impacts and balance multiple, often conflicting, objectives across ocean management sectors and explicitly evaluate trade-offs. It has been repeatedly explored in fisheries management (Large *et al.* 2015) and more recently in marine spatial planning (Hammar *et al.* 2020; Carlucci *et al*. 2021; Jonsson *et al*. 2021; Harris *et al*. 2022).

However, due primarily to the multi-dimensional nature of both ecosystem pressures and ecosystem responses, quantifying ecosystem-based reference points or thresholds has proven difficult (Large *et al*. 2015). Ecosystem thresholds occur when a small change in a pressure causes either a large response or an abrupt change in the direction of ecosystem state or function. Complex numerical modelling that concurrently identifies thresholds for a suite of ecological indicator responses to multiple pressures is required to evaluate ecosystem reference points to support ecosystem-based management (Large *et al*. 2015).

The required data inputs into such models are currently limited in southern Africa. Slabbekoorn *et al* (2019) point out that in such cases expert elicitation would be a useful method to synthesise existing knowledge, potentially extending the reach of explicitly quantitative methods to data-poor situations.

7.7 Socio-Economic Environment

7.7.1 Overview of the study area

The Namibian southern and central coastline is sparsely populated and is dominated by the Namib-Naukluft National Park, the Tsau //Khaeb (Sperrgebiet) National Park and the Namibian Islands' MPA.

Lüderitz is the southern-most port town that supports fishing and mining sectors, with little other appreciable industrial development, besides support industries for the mentioned sectors (Section 7.7.5). Much of the town is comprised of residential neighbourhoods, made up of both formal housing concentrated around the port and informal or low-income settlements on the outskirts of the town.

Comparatively, Walvis Bay is located along the central coastline and is the third largest town in Namibia (after Windhoek and Rundu). The municipality has Namibia's largest commercial port, which handles container imports, exports and transhipments, as well as bulk commodities and supports current Oil and Gas operations. There is also notable industrial development that flanks the port operations and extends into the desert. The fisheries industry makes up a significant part of the town's economy (Section 7.7.5). Walvis Bay's residential suburbs are similarly structured to Lüderitz, with formalised (middle to high income) suburbs closer to the harbour and seafront and informal or low-income neighbourhoods north and east of the port, spreading into the desert.

7.7.2 Demographics

7.7.2.1 Population

The Population and Housing Census preliminary results show that in the 2023 the total population of Namibia was 3,022,401. Namibia's population has been increasing consistently from 1,409,920 at the time of the 1991 Census to 3,022,401 in 2023, representing an increase of 114.4% over a period of 32 years. Between 2011 and 2023 Namibia recorded an annual population growth rate of 3%. (Namibia Statistical Agency 2024) .

The 2023 census found a high proportion of the population (56.1%) was in the economically active age group of 15 – 59 years of age, however this was coupled with over one third of the population (37.04%) classified as young and thus dependent on the working population (Namibia Statistical Agency 2024).

The population for the //Karas Region was reported to be 109 893 people at the time of the 2023 Census. The !Nami‡Nûs Constituency accounts for 15.7% of the population within the region. The 2023 population for the town of Lüderitz in the //Karas Region as reported to be 16 125 at the time of the 2023 Census, with males accounting for 48.5% and females 51.5% respectively. (Namibia Statistical Agency 2024). The town of Lüderitz is the biggest settlement in the !Nami‡Nûs Constituency with 93.5% of the population within the constituency residing within Lüderitz.

Comparatively, the population within the Erongo Region is more than double the size with 240,206 people recorded to reside in the region in 2023. Walvis Bay accounted for 42.8% of the region's population with a total population of 102 704 persons, of which 51 618 were recorded in Walvis Bay Urban and 51 497 in Walvis Bay Rural. (Namibia Statistical Agency 2024).

7.7.2.2 Housing and Living Conditions

According to the Namibian Household Income and Expenditure Survey Report (NHIES, 2015/2016), the majority of households within both the //Karas and Erongo Regions residing in detached houses, albeit this figure was higher in the //Karas (62.4%) than the Erongo Region (39.4%). The second most common housing type in both regions was 'improvised housing' (i.e. informal housing), with one third of households (33%) in the Erongo Region and 18% of households in the //Karas Region residing in informal housing (Namibia Statistics Agency 2016) .

A similar trend is evident when looking at the !Nami≠nüs Constituency (where Lüderitz is located), located in the //Karas Region and the Walvis Bay Urban Constituency, located in the Erongo Region where 'detached house' is the most common household type while the second most common is 'improvised housing'. The high level of 'improvised housing; is likely the result of rural – urban with people moving to the urban centres of Lüderitz and Walvis Bay within the respective constituencies and residing on the urban fringe in informal housing. A breakdown of the different dwelling types at a regional and constituency level is provided in Table 7-10.

Table 7-10: Housing type by constituency

Type of Housing	Percentage of Households			
	//Karas Region (2015/2016	!Nami≠nüs Const (2011	Erongo Region (2015/2016)	WB (Urban) Const. (2011)
Detached house	62.4%	40.4%	39.4%	43.3%
Semi-Detached House	2.8%	9.4%	9.0%	9.9%
Apartment/Flat	5.6%	7.7%	9.2%	10.4%
Guest Flat	1.6%	0.9%	2.7%	1.6%
Part Commercial/Industrial	0.8%	0.5%	0.0%	0.3%
Mobile Home	0.6%	0.4%	0.0%	0.2%
Single Quarters	2.1%	6.2%	4.9%	2.5%
Traditional Dwelling	6.1%	0.1%	1.8%	0.3%
Improvised Housing Unit (Shack)	18.0%	34.4%	33.0%	31.5%
Total	**100%**	**100**%	**100**%	**100**%

Source: Namibian Statistics Agency, 2011, 2015/2016

7.7.2.3 Education

Data on education levels for the 2023 Census had not been released at the time of this baseline being compiled. Data from the 2011 census does however provide an indication of trends within the //Karas and Erongo regions.

At the time of the 2011 Census the majority of the population in both the //Karas (53.9%) and Erongo (44%) regions reported having a completed primary school as their highest level of education while a small portion of the population in both regions reported having tertiary education, 3.8% in the //Karas Region and 6.7% in the Erongo Region. Overall, the Erongo Region exhibits slightly better access to education with a higher proportion of the population over the age of 15 having completed secondary school as well as having obtained a tertiary education. This is indicative of the more urbanised nature of the Erongo Region compared to //Karas with centres such as Walvis Bay offering better access to facilities and services including education (Section 7.7.3). Figure 7-29 below illustrates the different levels of education within the //Karas Region and Erongo Region.

Despite the high proportion of the population over the age of 15 only reported to have a primary level of education literacy levels in both the //Karas Region and Erongo Region were high at 88.4% and 94.3% respectively (Namibia Statistics Agency 2014). As is the case with access to education, literacy levels are higher in the more urbanised Erongo Region.

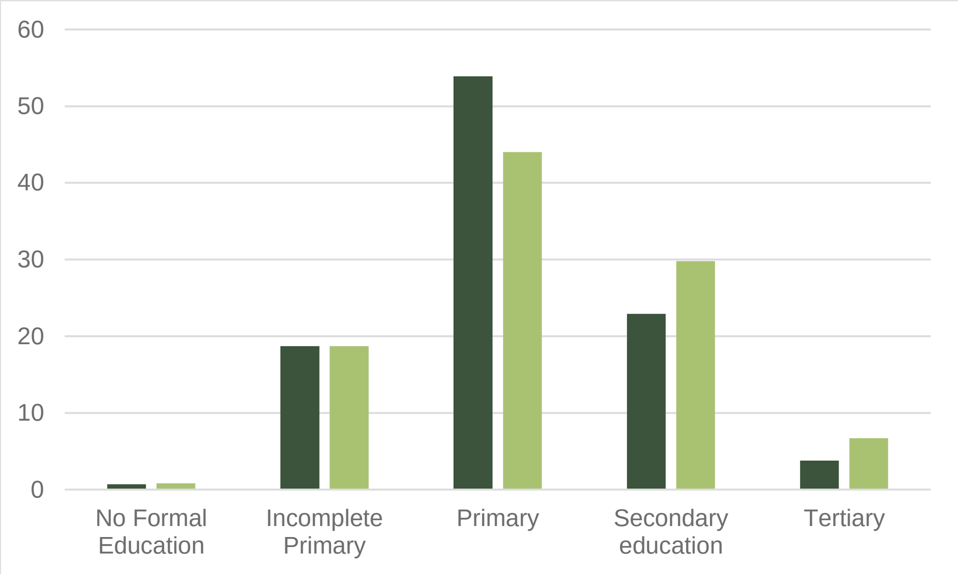

Figure 7-29: Highest level of education population over the age of 15

7.7.2.4 Employment and Occupations

More people aged between 15 and 65 years are active in Erongo's labour force than in any other region in Namibia: the labour force stood at 112 800 persons in 2018, with a labour force participation rate of 81% (86% among males and 75% among females) compared to the national average of 71%. The //Karas Region's participation rate was 74%, and ranked 4th highest out of Namibia's 14 regions (NSA, 2019, as cited in SLR 2024).

Namibia broadly defines all persons above the age of 15 being employable (i.e. economically active population). Of this total population, 56% and 60% were employed in 2011 in the !Nami≠nüs and Walvis Bay Urban Constituencies respectively (see Table 7-11**),** suggesting that employment levels are fairly equal in Lüderitz and Walvis Bay.

There is, however, a clear gender divide in terms of employment, as employment rates for women are 10% and 18% lower when compared to men in the two respective areas.

Table 7-11: Employment status of persons above 15 years of age.

Activity Status	Percentage of Total Population (2011)					
	!Nami≠nüs Constituency			Walvis Bay (Urban) Constituency		
	Male	Female	Total	Male	Female	Total
Economically Active	80.2	76.5	78.3	84.4	77.9	81.4
Employed	61.0	51.4	56.2	67.8	50.3	59.6
Unemployed	19.2	25.1	22.1	16.6	27.6	21.8
Economically Inactive	14.0	14.9	14.5	10.2	17.8	13.8
Don't Know	5.5	7.9	6.7	4.1	4.1	4.1

Source: Namibian Statistics Agency, 2014, as cited in SLR 2024

7.7.2.5 Poverty and Inequality

Namibia is defined as an upper middle-income country and it retained a Human Development Index (HDI) of 0.615 in 2021, which places it in the medium human development level, and at 139 out of 191 monitored countries and territories. (SLR 2024).

However, when the HDI is adjusted for inequality (IHDI) the score is reduced to 0.402. The loss of 34.6% from the HDI is strongly indicative of inequalities in Namibia, and such inequalities are generally recognised by the public, the national government, as well as international organisations (i.e. the World Bank). The IHDI places Namibia at 139 of 191 countries in terms of inequality alongside such countries as India, Guatemala and Tajikistan. (UNDP, 2021 as cited in SLR 2024).

While there has been a general positive trajectory in terms of improvement in the IHDI since Namibia's independence in 1990, the rate of decline in inequality is slowing down (Namibian Statistics Office, 2012 as cited in SLR 2024). In part, the endemic inequality is attributed to the exclusion of many households from the modern economy and associated benefits, despite the economy growing substantially since Namibia's independence in 1990 (Namibian Statistics Office, 2012 as cited in SLR 2024). This is notably apparent between administrative regions, as well as between urban and rural areas.

Due to stronger GDP growth in both 2022 and 2023, poverty is estimated to have decreased, but remains high at 17.8% based on the $2.15 per day international poverty line (IPL; 2017 PPP) (World Bank Group 2024).

Between 2009/10 and 2015/16, income inequality as measured by the Gini-coefficient declined from 0.59 to 0.57, however in 2022 inequality was reported to have increased with a reported Gini coefficient of 0.61 (African Development Bank Group 2024). A similar trend was evident with poverty levels during the same period (2009/10 to 2015/16) with the incidence of poverty decreasing from 19.5% to 17.4% and then increasing to 26.9% in 2022 (National Planning Commission 2021) and (African Development Bank Group 2024). This trend, i.e. increased inequality and poverty is likely due to COVID-19.

Despite the economic recovery following COVID-19, the socio-economic situation has not improved materially. Vulnerable households including female-headed households, those with lower levels of educated, larger families, children and the elderly, and labourers in subsistence farming, are particularly prone to poverty (World Bank Group 2024).

Poverty mapping undertaken in 2011 (National Planning Commission, n.d.) shows that the Erongo Region has the second lowest rates of poverty (2.4% of the total population being below a predetermined poverty limit) while //Karas is higher at 6.7%. This compares positively against the national poverty rate of approximately 19.5% during the same period.

At the Constituency level, Walvis Bay Urban is ranked the fifth least deprived constituency in the country while! Nami≠nüs is slightly more deprived but still ranked high at 10/107 constituencies (NPC, 2015 as cited in SLR 2024).

7.7.2.6 Health

Namibia recognises that health is a fundamental human right and is committed to achieving health for all Namibians. The main health and well-being issues for Namibia are child and maternal mortality, HIV, malaria- and TB-related deaths, Non-Communicable Diseases (NCDs), and road accident deaths (The Nambia Ministry of Health and Social Services (MoHSS) and ICF International 2014).

As specified in the United Nations General Assembly Special Session (UNGASS) on HIV and AIDS, young people in the 15-24 age range are an important group to monitor with regard to reductions in HIV incidence at the population level (UN General Assembly, 2001, as cited in (The Nambia Ministry of Health and Social Services (MoHSS) and ICF International 2014) .

In 2013 testing of women and men aged between 15 and 24 revealed an HIV positive infection rate of 4.1% in the Erongo Region and 2.8% in the Karas Region (The Nambia Ministry of Health and Social Services (MoHSS) and ICF International 2014).

The total HIV incidence per 1 000 uninfected (all ages) has decreased slightly from 3.31 in 2018 to 2.81 in 2020. The female and male incidences were 3.96 and 2.66 in 2018, respectively. In 2020, both female and male incidences declined to 3.70 and 2.25, respectively. (National Planning Commission 2021)

The number of HIV total infections in the 15-49 age category in 2018 was 7,190, while in 2020 it reduced to 6353. (National Planning Commission 2021).

TB incidence has recorded a constant decline on average from 524 in 2018 to 486 in 2019. Hepatitis B incidence cases were 191 and 95 in 2019 and 2020, respectively. The malaria incidence has recorded a significant decrease from 31.86% in 2018 to 2.84% in 2019 (National Planning Commission 2021).

7.7.3 Access to Services

Within Namibia as a whole, approximately 59% of households use electricity for lighting. Comparatively, within the Erongo Region 83.6% of households make use of electricity for lighting and in the //Karas Region 77.3% of households make use of electricity for lighting (Namibia Statistics Agency 2016).

The source of drinking water is an indicator of whether the households have access to safe water for drinking. At national level, 84.4% of households indicated having piped water as their main source of drinking water. Access to piped water within the Erongo Region is comparable to the //Kharas Region with 94% and 93% of households respectively reporting access to piped water (Namibia Statistics Agency 2016).

The majority of households in Erongo Region (86.5%) use flush toilets compared to 73.2% in the //Karas region. Better access to sanitation within the Erongo Region was also evident in that 9.8% of households reported no access while in the //Kharas Region 18.1% of households reported no access (Namibia Statistics Agency 2016).

In 2011, both the !Nami≠nüs (Lüderitz) and the Walvis Bay Urban Constituencies the majority of households, 77% and 99% respectively, reported access to electricity for lighting. The proportion of households using electricity on the Walvis Bay Urban Constituency is indicative of the urban setting while a reliance on candles in the !Nami≠nüs Constituency is likely indicative of informal settlement on the urban periphery lacking services (Namibia Statistics Agency 2014).

In 2011, both the !Nami≠nüs and the Walvis Bay Urban Constituencies provided good access to piped and treated water; however, the level of access to piped water varied by neighbourhood. Walvis Bay provided a higher level of services with 71.6% of households having piped water inside their property. Comparatively Lüderitz had poorer access, with 38.6% of households having access to piped water inside their property, while poorer households in surrounding informal or low-income settlements relied on water stands inside their property (31.7%) or communal standpipes (28.8%). Overall, however access to piped water within the both constituencies was higher than in the Erongo Region and //Karas Region (Namibia Statistics Agency 2014).

Access to sanitation also differed between the two constituencies with access in Walvis Bay was substantively more developed, with almost 60% of households having access to private toilets and 40% to shared flush toilets connected to water-borne sewage. In contrast, only 38% of households in Lüderitz had access to private toilets, while 45% of households used shared flush toilets and 14% used buckets or had no toilet facility (Namibia Statistics Agency 2014).

Most households in Lüderitz (77% of households) and Walvis Bay (95% of households) had their domestic waste regularity collected by the municipality. The level of service in Lüderitz was, however, lower and some households had only irregular collections (5.7% of house-holds) or rely on roadside dumping (4% of households) and burning (11% of households). Access to basic services at a regional and constituency level is provided in Table 7-12.

Table 7-12*:* **Basic services profile by constituency.**

Type of Basic Services	Percentage of Households			
	!Kharas Region (2015/2016)	!Nami≠nüs Const. (2011)	Erongo Region (2015/2016)	WB (Urban) Const (2011)
Source of Energy for Cooking				
Electricity from Mains	48.2%	45.9%	80.7%	97.3%
Gas	30.0%	48.8%	8.1%	2.3%
Other	21.8%	5.3%	11.2%	0.4%
Source of Energy for Lighting				
Electricity from Mains	77.3%	76.7%	83.6%	99.4%
Candles	11.6%	16.0%	8.2%	0.4%
Other	11.1%	7.3%	8.2%	0.2%
Source of Domestic Water				
Piped Water	93%	99.1%	94%	99.6%
Piped Water Inside House	-	38.6%	-	71.6%
Piped Water Outside House	-	31.7%	-	27.9%
Public Pipe	-	28.8%	-	0.1%
Other	7%	0.9%	6%	0.4%
Type of Sanitation				
Flush toilet	73.2%	83.1%	86.5%	99.4%
Bucket Toilet	1.4%	4.0%	0.3%	0.0%
No Toilet Facility	18.1%	9.5%	9.8%	0.1%
Other (including pit toilet)	7.3%	3.4%	3.3%	0.5%
Waste Disposal				
Regularly Collected	-	77.4%	-	95.7%
Irregularly Collected	-	5.7%	-	4.0%
Burning	-	1.8%	-	0.0%
Roadside Dumping	-	4.2%	-	0.2%
Rubbish Pit	-	10.7%	-	0.1%

7.7.4 Public and Private Facilities

Both Lüderitz and Walvis Bay provide good access to public and private facilities and services (see Table 7 10). Walvis Bay is a much larger settlement with a proportionately larger range of services, including a wider choice of banking, retail, public and private health facilities. Accommodation, restaurants and take-aways are numerous, as well as tourism and recreational facilities, that suggest that tourism is an important sector for Walvis Bay and there is a substantial local market for recreational activities. Most of these services and facilities are found in the residential and business areas of Walvis Bay, as well as in industrial areas that surround the Port.

Lüderitz has fewer public and private facilities or services (see Table 7-13) due to its smaller population. These services are primarily used by residents of Lüderitz and the Port's visitors, although there is provision for domestic and international tourism though accommodation (notably hotels, bed and breakfasts, back-backers etc.), as well as the expanded waterfront.

Table 7-13: Profile of private and public services and facilities.

Type of Facility / Service	Number of Facilities / Services	
	Lüderitz Town	Walvis Bay Town
Accommodation & Food	24	32
Cemetery	2	2
Education	7	22
Finance	3	12
Government Ministries	5	11
Health	3	5
Tourism and Recreation	10	40
Retail	4	7

Source: OpenStreetMap and GRN ministerial data

7.7.5 Economic Overview

Namibia's rich mineral base and small population of about 2.6 million gives it a World Bank classification of an upper-middle-income country. Political stability and social policies, such as public spending on pensions and welfare grants since Independence in 1990, have reduced poverty.

However, socio-economic inequalities inherited from the past apartheid system remain extremely high and structural constraints to growth have hampered job creation. Economic advantage remains in the hands of a relatively small segment of the population and the large disparities of income have led to a dual economy - a highly developed modern sector co-existing with an informal subsistence-oriented one. The duality of the labour market, combined with slow job creation and low primary-sector productivity, results in very high unemployment[17].

Poverty levels and the cost of living are high and thus the quality of life for many are not in unison with the country's macro-economic indicators. The economy grew between 2010 and 2015 by an average of 5.3% per annum, but since 2016, it has not come out of recession. COVID-19 negatively impacted commodity export markets, tourism and local consumption

[17] Namibia Overview: Development news, research, data | World Bank accessed on 4/10/2022

patterns and service industries and these resulted in a further 8.5% contraction of the economy in 2020 (IPPR, 2021). The World Bank predicts that the rebound will be slower than initially expected, with growth projected at 2.4% in 2022.

The size of the Namibian economy expanded from N$169 475 million in 2017 to N$177 020 million in 2018 (Namibian Statistics Agency, 2018. Tertiary industries have always been the most significant contributor to Namibia's GDP in recent years, contributing 58%, in 2019. These industries include the public sector, retail and wholesale, transport and services sectors. Secondary industries contributed 18% to GDP and include manufacturing such as meat and other food processing, beverages, mineral processing, electricity generation and construction. The primary industries, such as mining and agriculture, contributed 16% to GDP (NPC, 2020).

The country has good mineral resources, some remaining fish stocks, widespread livestock production, an increasingly urban population and high school attendance of both girls and boys up to Grade 11. However, the governing political party, South West Africa People's Organisation (SWAPO), is under more pressure than ever before to improve the lives of Namibians. There is widespread rural and urban poverty, low educational attainment, few technical skills, a major housing back-log and deepening unemployment.

7.7.5.1 Economy of Lüderitz

The Port of Lüderitz is the bedrock of the town as it serves the local fishing industry, the local diamond industry, the mines in the southern Namibia and north-western South Africa with imports and exports of mining commodities and handling general cargo for those regions. In 2018/19, the port handled over 362 000 tonnes of cargo, 5 355 containers and received over 700 vessel visits during that year[18]. The port is hampered by being only 8.75 metres deep so that it cannot accommodate average sized, economic bulk carriers that are used to transport bulk ore and other cargoes; it also has no direct rail connection into the harbour. Nevertheless, Namport and other service providers contribute to the local economy with marine engineering, shipping and logistics, freight storage, vessels, boat builders and repairs, employing several hundred people. Namdeb and two other small diamond companies operate out of Lüderitz.

The main employment sector in Lüderitz is the local commercial and subsistence fishing industry, which provides more than 80% of the employment (Lüderitz Town Council), even though the industry has been in steady decline as the larger vessels relocated to Walvis Bay. The lack of economic diversity has been identified as a key risk due to variations in fish stock and much of the national fishing fleet moving to the deeper harbour at Walvis Bay. There is, therefore, an increased focus towards tourism development and the logistics industry (Lüderitz Town Council, 2020). In addition, the town supports a range of secondary / service businesses including supermarkets, commercial banks, insurance, and hospitality amongst others.

Tourism to the town is recovering from the Covid-19 pandemic, as Lüderitz offers various attractions such as the Kolmanskop deserted diamond town, quaint old German architecture, a port for smaller passenger liners, the annual Crayfish Festival, the annual Lüderitz Speed Sailing Challenge and other events. It is one of four entry points into the access restricted Tsau //Khaeb (Sperrgebiet) National Park, a protected area of high biodiversity. Tourism will

[18] https://www.namport.com.na/files/files/Stats%20ended%20March%202019.pdf

always be a challenge as Lüderitz is far from Namibia's other main southern attractions of the Fish River Canyon and Sossusvlei.

7.7.5.2 Economy of Walvis Bay

The economy of the Erongo Region and the Walvis Bay Urban Constituency is more developed and diversified when compared to Lüderitz. The region is largely dependent on the primary sector: mining (notably uranium), commercial and small-scale fishing, and agriculture (mostly livestock farming).

The economy of Walvis Bay revolves around the Port of Walvis Bay which is Namibia's largest commercial port and received between 1 800 and 2 500 vessel calls each year and handled about 5 million tonnes of cargo, prior to the Covid-19 pandemic. The Namibia Ports Authority (Namport) handles container imports, exports and trans-shipments, as well as bulk and breakbulk volumes of various commodities. The port serves a wide range of industries such as mining, petroleum, salt, and fishing. Namport is a major employer in the region, employing most of its 965 staff in Walvis Bay (Namport, 2019). The expanded container harbour at the port was in response to growth in port related activity serving the SADC region. Unfortunately, the growth has not been sustained, partly due to the impact of Covid-19 on world trade and perhaps over-ambitious targets.

Walvis Bay supports a diverse economy including industrial development largely centred around the Namibian Export Processing Zone and secondary / service sector businesses (finance, retail, accommodation and food). The fishing industry is however considered a critical economic sector (Walvis Bay Municipality, 2020) and provides an estimate 8 000 local jobs.

The fishing sector is critical for both the economies of Walvis Bay and Lüderitz and warrants more consideration. The Food and Agriculture Organisation (FAO) recognises that Namibia has one of the most productive fishing grounds in the world, with 20 fish species that are commercially exploited (Food and Agriculture Organisation, 2020). Most catches are landed at either Walvis Bay or Lüderitz; however, because of its strategic location in the middle of the fishing grounds, most of the landings and processing plants are in Walvis Bay (Food and Agriculture Organisation, 2020). Both Walvis Bay and Lüderitz support businesses in both primary commercial fishing as well secondary fish processing.

In 2012 / 2013, a total of 256 vessels were licenced to operate in the Namibian Exclusive Economic Zone (Ministry of Fisheries and Marine Resources, n.d.), with the majority based at Walvis Bay.

7.7.6 Marine Cultural and Heritage Resources

There are a number of shipwrecks located along the Namibian coastline. In Namibian waters, wrecks older than 50 years are declared national monuments. The majority of identified shipwrecks occur close to the coastline (Turner, 1988) and are not likely to be present in the Block. However, because most of the sites described on the shipwreck list have been documented only through survivor accounts, archival descriptions and eyewitness reports, many remain uncharted and undiscovered. It is not, therefore, possible to provide accurate location data. **Although no wrecks are known to occur in Block 2814A based on available information, the possibility of identifying new shipwrecks remains, although of very low probability.**

7.7.7 Intangible Cultural Heritage

The overview of intangible cultural heritage is based on the study undertaken for the Block 2912 well drilling (SLR, 2023).

Intangible cultural heritage relates primarily to ritual and spiritual valuations and relations with the elements (wind, water, fire), ritual practices (ancestral veneration) and beliefs (natural-spiritual beliefs in the water sourcing / bearing deities). Intangible cultural heritages of Namibia are complex and influenced by ancient histories of the San peoples and their social-ecological relations with nature, the histories of the Ovahimba, Herero and Ovambo peoples, as well as those people coming into Namibia from Angola.

The small-scale fishers of Namibia come mostly from the coastal areas and have historically enjoyed either a leisure or livelihood relationship with the sea. However, increasingly, poverty in the northern region is leading to migration of peoples to the coast. This has resulted in what are known as Bicycle Fishermen in Swakopmund: men who fish for subsistence purposes in demarcated spots along the coast.

There are contestations between these groups, as well as tendency to cast identity as primordial (i.e., fixed, unchanging over time or to ignore cross-cultural connections and inter-marriages).

The deserts (Namib) are an important influence of concepts of time and space, human cultural engagement with the temporal and spatial aspects of cultural heritage practice and faunal/floral use for spiritual reasons.

Key intangible cultural heritage beliefs in Namibia can be summarised as follows:

- The ancestors reside in both water and wind but not in the sea.
- For the northern inhabitants of Ovambo and Ovaherero descent, the floodplains and rivers are sources of spiritual significance, since these may contain water spirits and specifically the water snake ‘deity’. Hoff (cited in Low, 2007) identified |Xam descendants who believed in a giant, water-bringing snake thought to live mainly in the sky alongside the Water Bull, but found very little evidence of this belief beyond Bushmanland. Hoff also observed that the Nama living around the Orange River had forgotten older ideas of a good and bad Water Snake and Water Bull in the sky, which symbolised the good and bad dimensions of rain, and only believed in a giant quasi-mythical and largely malign snake that lived in and near watercourses.
- Among the Damara and Haillom in the northern Namib, there is stronger belief / knowledge of the water snake and its associate, the crocodile. The beliefs suggest a deep social-ecological embedding and valuation of nature.
- For the San, the wind plays a critical role in shaping ritual practice (dance, drumming). Dance and drumming / music making are key to the expression of the self but also important for access to a trance/trans-dimensional state of being / alternative consciousness. San and Nama are known for their musical prowess. The music uses wind (flutes), guitar and harmonica (which involves inhalation/exhalation thereby invoking the power of the wind) to communicate with the community and ancestral world.
- There is an indication of some San cultural heritage with the ocean, but these have been largely severed by the process of forced removals from the coastal context under the colonial and apartheid regimes. San communities living inland (in places such as Tsumeb and Tsintsabis) still remember some of these rituals but are not able to revive them, due to distance from the coast.

- While the indigenous groups make use of waterways such as springs and rivers (when these are evident), there is rare connection with the ocean or sea. For example, in interviews with Himba communities, many expressed the view that they had never been to the sea and some said that they imagined it to be like a 'big river'.
- There were no rituals identified in respect of European settler groupings living along the coast.

7.7.8 Human Rights Profile

Fundamental human rights are recognised in the Namibian Constitution of 1990, and Namibia is a signatory to a range of United Nations Human Rights Conventions (see Table 7-14). The latest universal review undertaken by the United Nations in 2016 indicates that human rights are largely respected; however, the country still faces challenges with respect to addressing the root causes of poverty, hunger and to uplift the living conditions of the poor.

Table 7-14: Ratified Human Rights Treaties.

Treaty Description	Ratification Date
Convention against Torture and Other Cruel Inhuman or Degrading Treatment or Punishment	28 Nov 1994
Optional Protocol of the Convention against Torture	None
International Covenant on Civil and Political Rights	28 Nov 1994
Second Optional Protocol to the International Covenant on Civil and Political Rights	28 Nov 1994
Convention for the Protection of All Persons from Enforced Disappearance	None
Convention on the Elimination of All Forms of Discrimination against Women	23 Nov 1992
International Convention on the Elimination of All Forms of Racial Discrimination	11 Nov 1982
International Covenant on Economic, Social and Cultural Rights	28 Nov 1994
International Convention on the Protection of the Rights of All Migrant Workers and Their Families	None
Convention on the Rights of the Child	30 Sep 90
Optional Protocol to the Convention on the Rights of the Child (Armed Conflict)	16 Apr 02
Optional Protocol to the Convention on the Rights of the Child (Child Prostitution)	16 Apr 02
Convention on the Rights of Persons with Disabilities	04 Dec 07

7.7.9 Fisheries Activities

7.7.9.1 Overview

The Namibian fishing industry is a major contributor to the country's GDP, ranking among the top ten fishing countries globally (Food and Agricultural Organization (FAO), 2022). Supported by the high productivity of the Benguela upwelling ecosystem, abundant fish stocks have historically typified Namibian waters[19]. Fish stocks in the Benguela system

[19] Noting that in the International Commission for South East Atlantic Fisheries (ICSEAF) period these resources were over-exploited. The northern Benguela (Namibian waters) however remains a highly productive upwelling system resulting in proportionately (to many other countries) abundant commercial fish resources.

support intensive commercial fisheries. The main targeted species and gear types are demersal, small pelagic, large migratory pelagic fish, linefish and crustacean resources. The industry has only two major fishing ports, Walvis Bay and Lüderitz, and in 2023 had 163 Namibian-registered commercial fishing vessels (FAO, 2024), mostly demersal trawlers that fish year-round with the exception of a one month closed season in October. The midwater trawlers that target horse mackerel and the large pelagic tuna longline vessels are also significant. Licensed foreign fishing vessels in Namibian waters are limited, and licensed fishers must reflag under Namibia. Mariculture production is a developing industry based predominantly in Walvis Bay and Lüderitz Bay and surrounds.

The main commercial fisheries, targeted species and gear types are shown in Table 7-15 and recent Total Allowable Catches (TACs) are presented in Table 7-16 below. The management of fish stocks for commercial purposes is overseen by MFMR, which receives guidance from the National Marine Information and Research Centre (NatMIRC) in Swakopmund under the Ministry. TACs are set every year by the Minister based on recommendations from an advisory council. The Confederation of Namibian Fishing Industries represents commercial fisheries at the industry level, while sector-specific associations, such as the Namibian Hake Association and the Pelagic Fishing Association of Namibia, represent different fish species.

MFMR conducts regular research surveys to determine the biomass of demersal, midwater, and small pelagic species, covering the entire continental shelf from the Angolan to South African maritime borders. To preserve marine ecosystems, there is a strict prohibition on bottom trawling shallower than 200 m, enforced by Namibian regulations.

Table 7-15: List of fisheries that operate within Namibian waters, targeted species and gear types.

Sector	Gear Type	Target Species
Small pelagic	Purse-seine	Sardine (*Sardinops sagax*) Horse mackerel (*Trachurus capensis*)
Mid-water trawl	Mid-water trawl	Horse mackerel
Demersal trawl	Demersal trawl	Shallow water hake (*Merluccius capensis)* Deep-water hake *(M. paradoxus*) Monkfish (*Lophius vomerinus)*
Demersal longline	Demersal longline	Shallow water hake Deep-water hake
Large pelagic longline	Pelagic longline	Shark spp. Swordfish (*Xiphias gladius*) Bigeye tuna (*T. obesus*) Yellowfin tuna (*T. albacares*) Albacore tuna (*Thunnus alalunga*)
Pole-line	Pole and line	Albacore tuna Bigeye tuna
Deep-sea crab	Demersal longline trap	Red crab (*Chaceon maritae*)
Deep-water trawl	Demersal trawl	Orange roughy (*Hoplostethus atlanticus)* Alfonsino (*Beryx splendens*)
Rock Lobster	Demersal trap	Rock lobster (*Jasus lalandii*)

Sector	Gear Type	Target Species
Line-fish	Hand line	Silver kob (*Argyrosomus inodorus*) Dusky kob (*A. coronus*)
Mariculture	Longlines, rafts	Pacific oysters European oysters Black mussel Seaweed (Gracilaria sp.)

Table 7-16: Total Allowable Catches (tonnes) from 2009/10 to 2022/23 (MFMR, 2023).

Year	Sardine	Hake	Horse Mackerel	Crab	Rock Lobster	Monk
2009/10	17 000	149 000	230 000	2700	350	8 500
2010/11	25 000	140 000	247 000	2700	275	9 000
2011/12	25 000	180 000	310 000	2850	350	13 000
2012/13	31 000	170 000	310 000	3100	350	14 000
2013/14	25 000	140 000	350 000	3100	350	10 000
2014/15	25 000	210 000	350 000	3150	300	12 000
2015/16	15 000	140 000	335 000	3446	250	10 000
2016/17	14 000	154 000	340 000	3400	240	9 800
2017/18	0	154 000	340 000	3400	230	9 600
2018/19	0	154 000	349 000	3900	200	9 600
2020/21	0	154 000	349 000	3900	180	9 600
2021/22	0	154 000	330 000	4200	180	9 600
2022/23	0	154 000	290 000	4200	180	9 000

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

7.7.9.2 Stock Distribution, Spawning and Recruitment

Figure 7-13 shows the major spawning grounds in central and southern Namibian waters. The stock distribution, spawning and recruitment of key target species are discussed below.

As the preferred spawning grounds of numerous commercially exploited fish species are located off central and northern Namibia, their eggs and larvae form an important contribution to the ichthyoplankton in the region. However, as noted in Section 7.4.3.1, the LUCORC area, south of the Lüderitz upwelling cell, is an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems (Hutchings *et al*. 2002, Lett *et al.* 2007). Spawning levels near Block 2814A are thus expected to be low due to its proximity to the LUCORC area.

Sardine

The Namibian sardine stock is distributed inshore of the 200 m isobath, from the Lüderitz upwelling cell into southern Angola. There was a rapid decline in the sardine stock in the late 1960s, following intense exploitation, ecosystem change and variability, and poor recruitment (Crawford *et al.,* 1987; Boyer *et al.,* 2001; Erasmus *et al.,* 2021). The status remains overexploited with a low biomass estimate and a significantly contracted distribution pattern compared to historical levels. It is reported that the stock has reduced by 99.5%, from an estimated 11 million tonnes in the 1960s to 50 000 tonnes in 2015 (Erasmus *et al.,* 2021). The fishery is currently closed following a moratorium that was implemented in 2018.

Following the collapse of the sardine stock, two main spawning areas have been described in the northern Benguela, one off central Namibia in the Walvis Bay region (22°S and 25°S) and another further north near Palgrave Point (19°S and 21°S) (King, 1977). The spawning season is thought to be between August and April, with peaks in September/October and March. Spawning peaks 30-80 km offshore with larvae occurring slightly further offshore and recruits appearing close inshore (Hutchings *et al.,* 2002). Recruitment varies considerably between years, with environmental variability and conditions playing an important role (Kirchner *et al.,* 2009). During late summer the warm Angolan Current pushes southwards, which brings eggs and larvae into nursery grounds off central Namibia (Hutchings *et al.,* 2002).

Cape Horse Mackerel

Cape horse mackerel occurs predominantly north of 25°S, with juveniles present in the inshore pelagic regions up to the 200 m isobath and adult horse mackerel extending into waters up to 500 m deep. Concentrations are dense between Cape Cross and the Kunene River. Biomass estimates in this region are mostly low in summer, increasing in winter and early spring. Horse mackerel shoal in large numbers with a distinct diurnal vertical migration pattern, staying near the seabed during the day and rising in the water column to feed on zooplankton at night.

Horse mackerel spawn continuously from September to May, peaking from January and April (Klingelhoeffer, 1994). Spawning occurs between Cape Frio (18°S) and Cape Cross (22°S), with the highest spawning intensity taking place 50-100 km from the shore (O'Toole, 1977).

Large Pelagics

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

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

- Albacore tuna is a temperate species that prefers subtropical ocean waters between 16°C and 20°C but appears to be differentially distributed depending on their life-history stage. Spawning occurs in equatorial regions where water temperatures exceed 24°C (Manning, 1998). Bait boats using pole and line target albacore tuna primarily in southern Namibia from January to March. Aggregations of albacore tuna are known to occur in the vicinity of the Tripp Seamount (approximately 10 km south of the licence block) and the highest catch levels are recorded in this area.

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

- Bigeye tuna spawn across the east central Atlantic, North of 5°N in the warmest season when surface temperatures are above 24°C, and in the Gulf of Guinea (Manning, 1998).
- Yellowfin tuna are distributed between 10°S and 40°S in the south Atlantic, and spawn in the central Atlantic off Brazil in the austral summer (Penney *et al.* 1992). According to Crawford *et al.* (1987) juvenile and immature yellowfin tuna occur throughout the year in the Benguela system. After reaching sexual maturity they migrate (in summer) from feeding grounds off the West Coast of southern Africa to the spawning grounds in the central Atlantic.
- The availability of longfin tuna increases during the summer upwelling season due to the increased biological activity and bait fish (sardine and anchovy) abundance.
- Swordfish spawn in warm tropical and subtropical waters and migrate to colder temperate waters during summer and autumn months.

It is important to note that weather conditions play an important role in operations within the tuna fisheries (pole and line and longline). The high market price for tuna makes up for their relatively low catches off Namibia (Manning, 1998).

Hake

Hake is the most commercially important Namibian fishery. Two species of hake are caught in Namibian waters: shallow-water hake (*M. capensis*) and deepwater hake (*M. paradoxus*). These species display diurnal vertical migration, occurring in demersal waters in the daytime and moving to mid-water at night. Studies suggest that deepwater hake migrate to South Africa to spawn and do not spawn within Namibian waters. Spawning by shallow-water hake has been recorded along most of the Namibian coast, from about 27°S to 18°S, although areas of localized spawning appear to be focused off central Namibia (25°S to 20°S), and the exact location varies between years. This species displays variation in spawning, however spawning peaks during July to September along the shelf break off central Namibia (Jansen et al., 2015). The hake stocks extend along the entire Namibian shelf and slope approximately between the 100 m and 1000 m isobaths.

Monkfish

Monkfish are found along the entire extent of the Namibian coast, with the fishery concentrated between 17°15'S and 29°30'S on the deeper continental shelf and upper slope between depths of 200 m to 500 m. Cape monkfish spawn throughout the year with a peak between July and September (Erasmus 2021). Cape monkfish appear to spawn throughout Namibian waters, with evidence of hotspot spawning aggregation between 21º and 25ºS (Erasmus, 2021).

Deep-sea Red Crab

Deep-sea red crab stocks are distributed predominantly from 23°35'S northwards into Angolan waters, within a depth range of approximately 300 m to 1000 m. Highest densities occur along the northern range of its distribution, the Angolan border, to 18°S. Spawning takes place throughout the year (Le Roux 1997) in the shallower waters of the continental slope with adult females generally occurring at shallower depths to that of males.

Orange Roughy

Orange roughy has a discontinuous pattern of distribution along the continental slope. Aggregations of fish occur within four known spawning grounds (within designated Quota

Management Areas) within Namibian waters. The species has a short, intense spawning period of about a month from July to August (Boyer and Hampton 2001) during which individuals aggregate. As a result of overexploitation of the stock(s), the fishery (which only existed for four years) has been closed since 2007; however, the stock is currently being assessed and the viability of re-opening the fishery is under consideration.

Namibian Cape Rock Lobster

Namibian Cape Rock lobster is found from 25°S to 28°30'S at depths shallower than 100 m. The depth distribution of adults varies seasonally in response to changes in dissolved oxygen levels in the water. Adults moult during spring (males) and late autumn/early winter (females), with egg hatching peaking in October/November. Fishing activity is greatest over January and February with the number of active vessels declining towards the end of the fishing season in May.

7.7.9.3 Commercial Fishing Sectors

The commercial fisheries operating off southern Namibian are described below. Block 2814A, however, only overlaps directly with the following sectors:

- Large Pelagic Longline;
- Demersal Trawl;
- Demersal Longline; and
- Pole-line.

Large Pelagic Longline

This sector makes use of surface longlines to target migratory pelagic species including yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*), swordfish (*Xiphias gladius*) and various pelagic shark species. There is provision for up to 26 fishing rights and 40 vessels.

Namibia is a full member of the Regional Fisheries Management Organisation (RFMO) in the Southeast Atlantic, namely the International Commission for the Conservation of Atlantic Tuna (ICCAT). Since independence in 1990, Namibia has reported their catches of large pelagic species to ICCAT. The shark directed sector of this fishery targets two main species, blue shark (*Prionace glauca*) and mako shark (*Isurus oxyrinchus*). These catches augment the total catch of the large pelagic longline fishery and are included in the reports to ICCAT.

Catches of tuna species and shark species show interannual variation as shown in Figure 7-30 (ICCAT, 2023). Following independence, catches increased as Namibia systematically increased their fishing capacity. There was a peak in catches in 2005 (9 594 tonnes), however annual average catch has approximated 4 200 tonnes since. The reported catches for 2020 (8 555 tonnes) and 2021 (13 216 tonnes) were far higher than this average, with tuna spp. contributing the most to the annual catch in 2021.

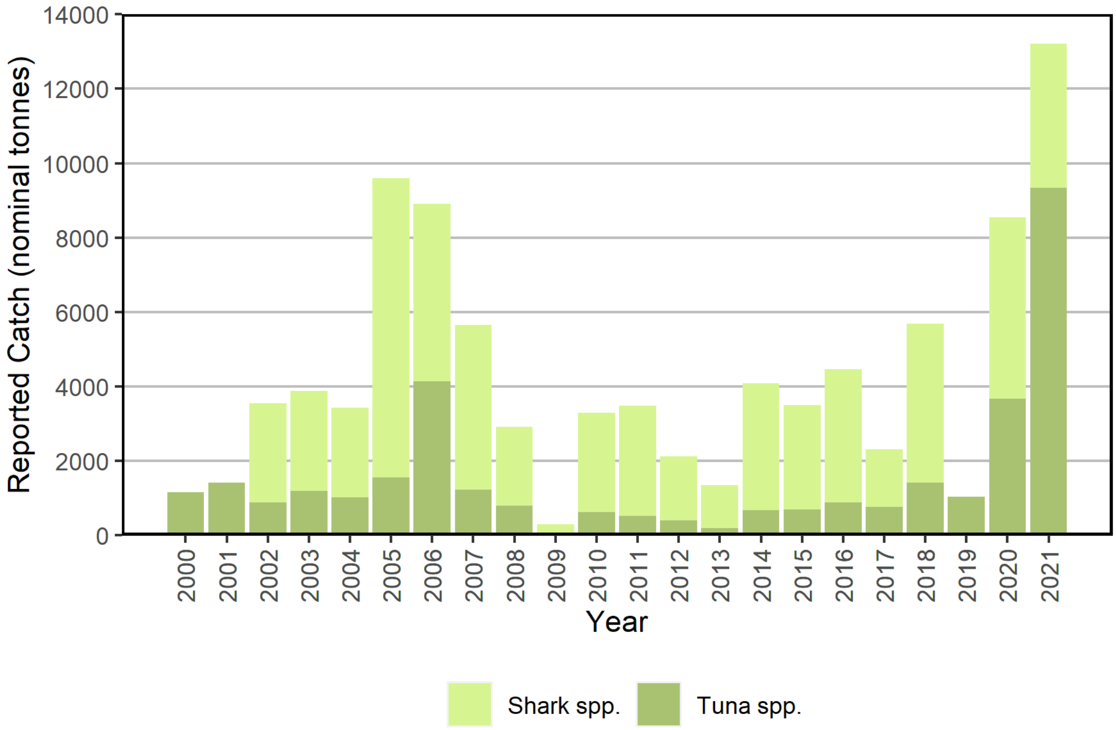

Figure 7-30: Annual longline catch (nominal tonnes) of large pelagic species reported to ICCAT by the Namibian longline fleet between 2000 and 2021.

Source: ICCAT Statistical Bulletin (2023).

Tuna are targeted at thermocline fronts, predominantly along and offshore of the shelf break. Pelagic longline vessels set a drifting mainline, up to 50-100 km in length, which is marked with radio beacons (Dahn) and float buoys along its length to facilitate later retrieval (see Figure 7-31). Various types of buoy combinations are used to keep the mainline near the surface and locate it should the line be cut or break for any reason. Between radio buoys the mainline is kept near the surface or at a certain depth by means of ridged hard-plastic buoys, (connected via “buoy-lines” of approximately 20 m to 30 m). The buoys are spaced approximately 500 m apart along the length of the mainline. Hooks are attached to the mainline on branch lines, (droppers), which are clipped to the mainline at intervals of 20 m to 30 m between the ridged buoys. The main line can consist of twisted tarred rope (6 mm to 8 mm diameter), nylon monofilament (5 mm to 7.5 mm diameter) or braided monofilament (~6 mm in diameter). A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. Refer to Figure 7-31 for a schematic diagram of pelagic longline gear.

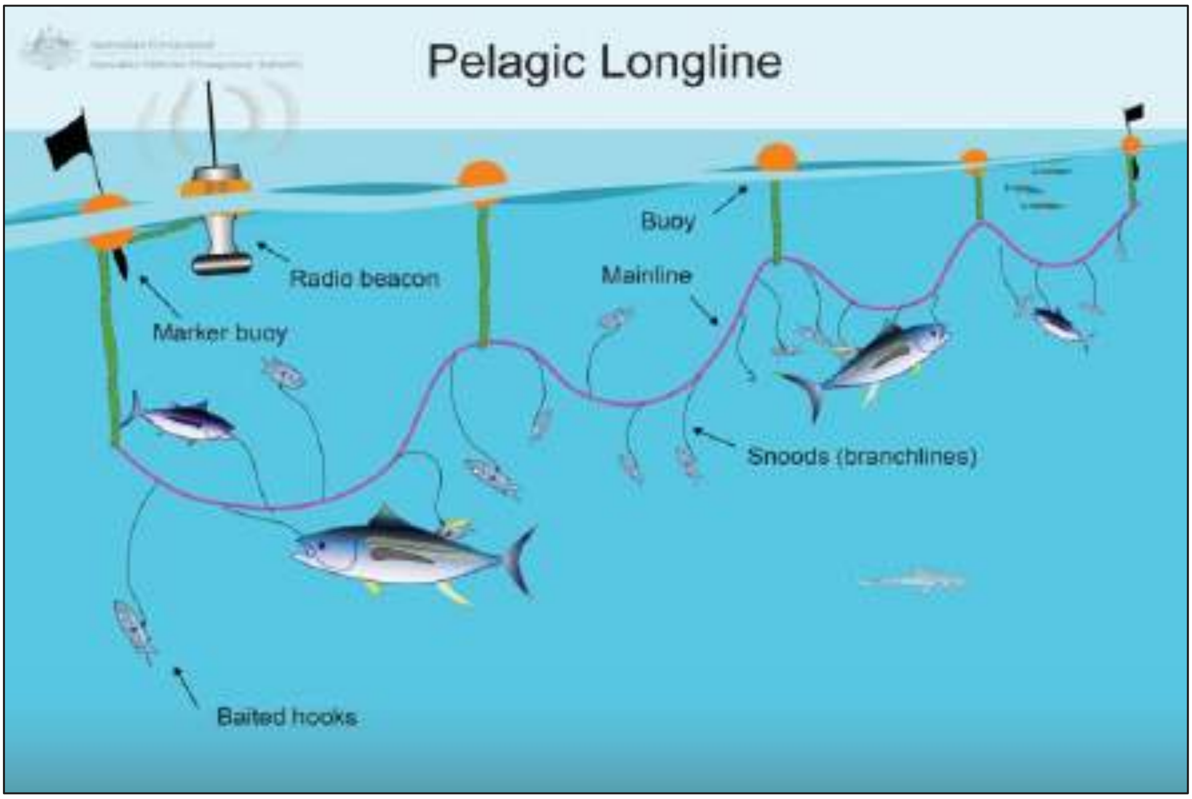

Figure 7-31: Schematic diagram of gear typically used by the pelagic longline fishery

Source: http://www.afma.gov.au/portfolio-item/longlining.

Longline vessels targeting pelagic tuna species and swordfish operate extensively around the entire coast along the shelf-break and into deeper waters. **The spatial distribution of fishing effort is widespread and may be expected predominantly along the shelf break (approximately along the 500 m isobath) and into deeper waters (2 000 m). Effort occurs year-round with peaks from March to May and December to a lesser degree** (Figure 7-32). This seasonality is also seen in catch data. Figure 7-33 shows the spatial distribution of annual average effort along the southern Namibian and South African West Coast over the period 2013 to 2023.

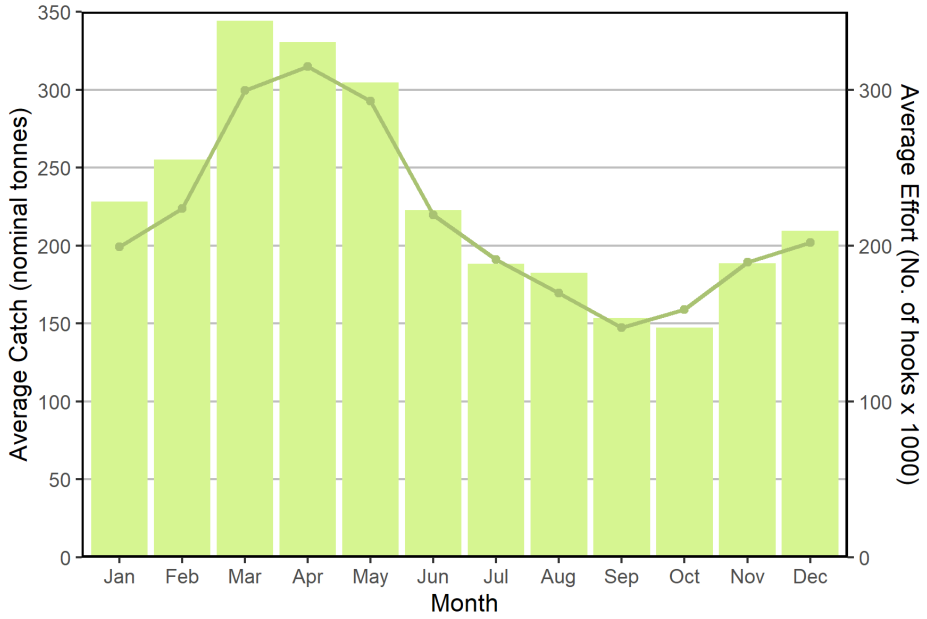

Figure 7-32: Monthly average catch (bars) and effort (line) recorded by the large pelagic longline sector within Namibian waters (2004 – 2019).

Source: Data provided by MFMR (2019)

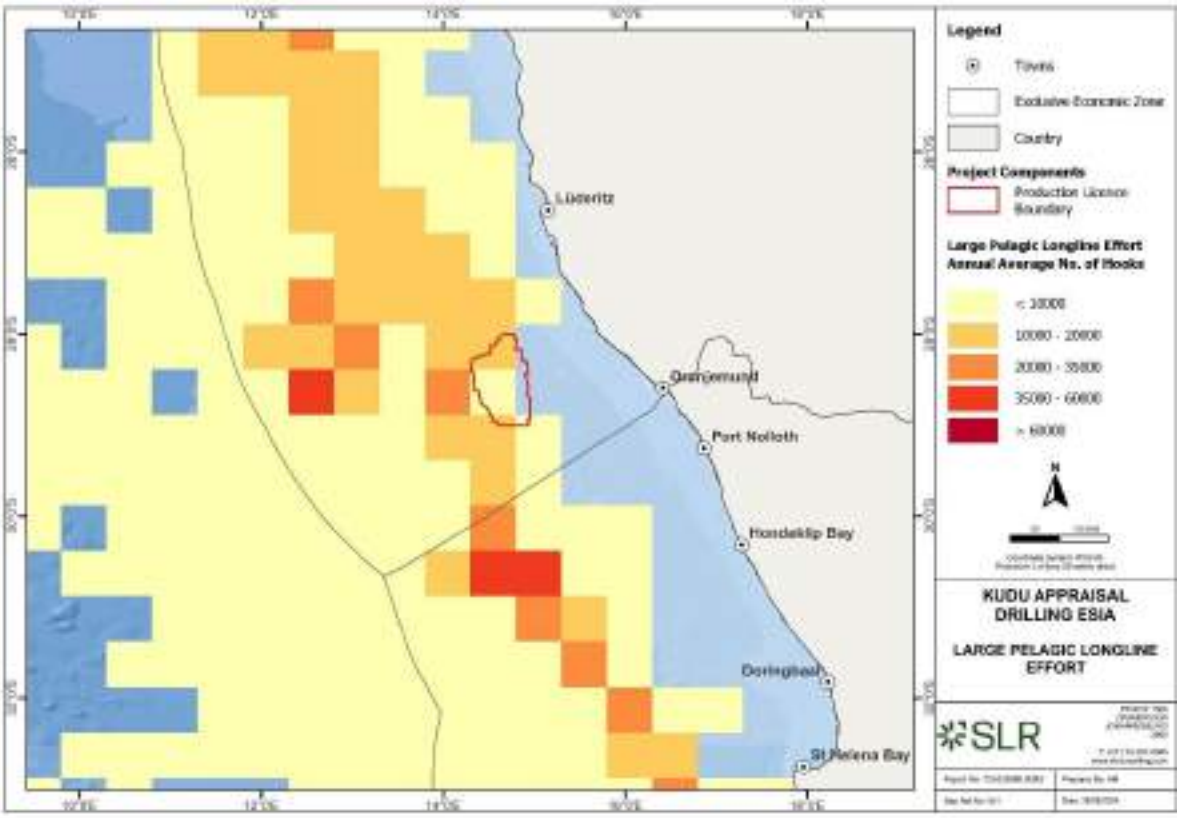

Figure 7-33: Spatial distribution of effort recorded by the large pelagic longline fishery in Namibia and South Africa in relation to Block 2814A.

Note: Annual average number of hooks is displayed on a 30 x 30 minute grid.
Source: Namibian data provided by MFMR (2014-2023), South African data provided by DFFE (2013-2022).

Demersal Trawl

Namibia's fishing industry is largely driven by the shallow-water hake (*M. capensis*) and the deep-water hake (*M. paradoxus*), which are managed as a single sector. At the peak of exploitation in the mid-1970s, catches of hake in Namibian waters reached almost 1 million tonnes, although some believe that this figure was underestimated. The directed hake trawl fishery is Namibia's most valuable fishery, with a current annual TAC of 154 000 tonnes. The fleet of 71 demersal trawlers licensed to operate within the fishery primarily targets hake in deeper waters, while smaller trawlers fish inshore for monkfish, sole, and kingklip.

The deep-sea fleet is divided into wetfish and freezer vessels, with a prescribed 70:30 ratio. Freezer vessels process fish offshore, while wetfish vessels land fish at factories ashore for processing. Wetfish vessels are smaller, with an average length of 45 m, and can only remain in an area for about a week before returning to port, whereas freezer vessels can work in an area for up to a month at a time. Most trawlers operate from the port of Walvis Bay, with fewer vessels operating from Lüderitz.

Fishing effort is relatively constant throughout the year except for a closure for the month of October and lower levels of effort expended during November and December. Demersal trawling is prohibited in waters shallower than 200 m[20].

Fishing grounds extend along the entire coastline following the distribution of hake and monkfish along the continental shelf at a depth range of 200 m to 850 m. Figure 7-34 shows the spatial distribution of average commercial catches in the vicinity of Block 2814A over the period 2014-2023.

Demersal Longline

Similar to the demersal trawl fishery the target species of the demersal longline fishery is Cape hake, with a small non-targeted commercial by-catch that includes kingklip. **Longline vessels fish in similar areas as the hake-directed trawling fleet, in a broad area extending along the full length of the Namibian coastline at depths between 200 m to 650 m.** Some 18 vessels operate within the sector. Those based in Lüderitz mostly work South of 26°S towards the South Africa border while those based in Walvis Bay operate between 23°S and 26°S and North of 23°S. **The fishery effort is highest offshore of Walvis Bay.**

Figure 7-35 shows the spatial distribution of average effort in the vicinity of Block 2814A. Similar to the demersal trawl fishery, effort is concentrated along the shelf edge and western region of Block 2814A.

[20] Namibia has a designated area closed to most “offshore” fishing activities under 200 m water depth to protect potential spawning areas as well as areas of high juvenile abundance for most demersal species, including hake. Demersal trawling is prohibited in waters shallower than 200 m.

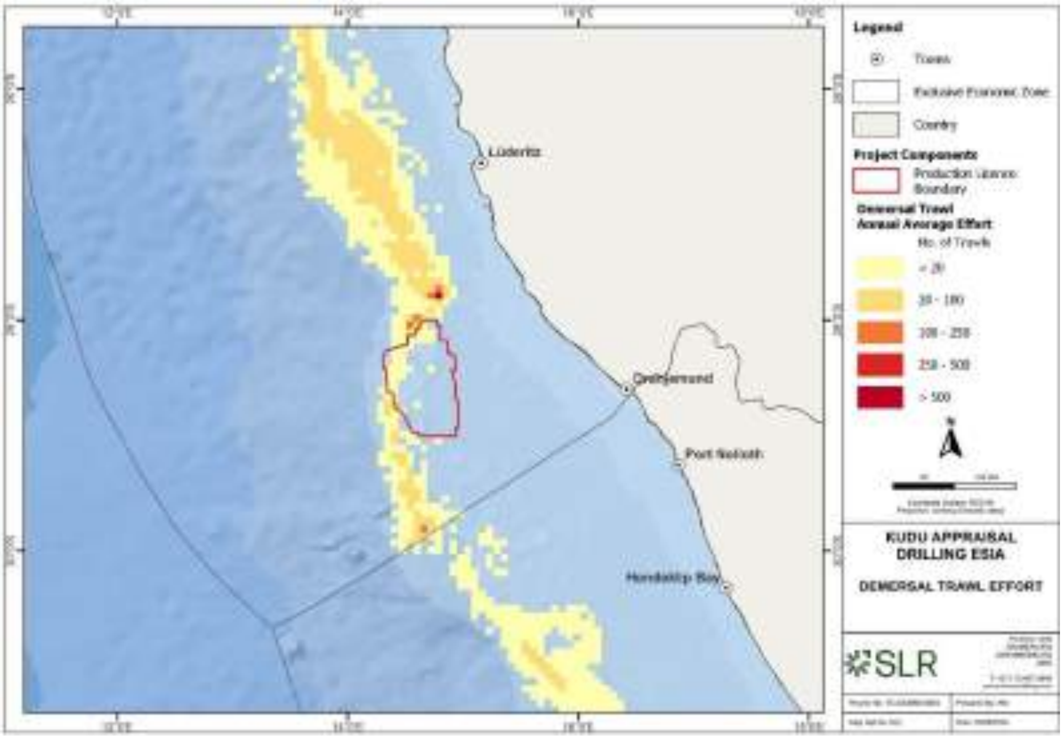

Figure 7-34: Spatial distribution of effort recorded by the demersal trawl fishery in Namibia and South Africa in relation to Block 2814A.

Note: Average annual effort (number of trawls) over the period 2012 to 2021 is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2012-2021), South African data provided by DFFE (2012-2021).

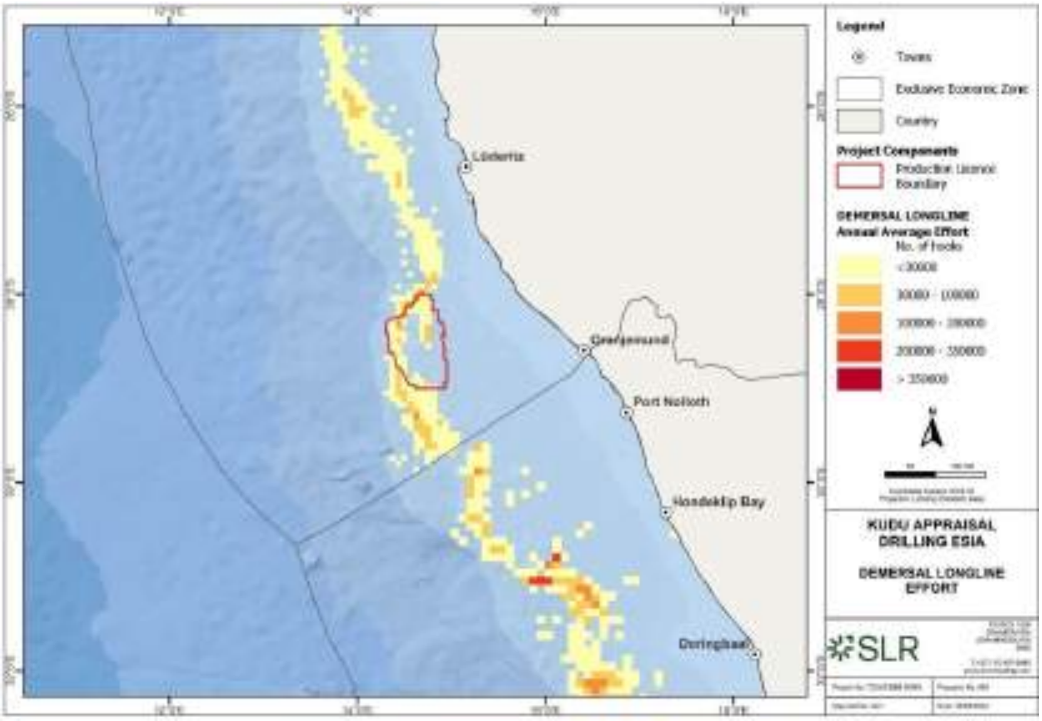

Figure 7-35: Spatial distribution of effort recorded by the demersal longline fishery in Namibia and South Africa in relation to Block 2814A.

Note: Average annual effort (number of hooks set) is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2014-2023), South African data provided by DFFE (2018-2020).

Pole-line

Poling for tuna is predominantly based on the southern Atlantic albacore (longfin tuna) stock (*T. alalunga*) and a small amount of skipjack tuna (*Katsumonus pelamis*), yellowfin tuna and bigeye tuna. Commercial landings of large pelagic species are variable and Namibian-reported catches reported by the pole sector (also referred to as "baitboat") are shown in Figure 7-36.

Namibia's quota for tuna and swordfish is allocated by the International Commission for Conservation of Atlantic Tunas (ICCAT), of which Namibia is a member. The Tuna-Pole fishery catches albacore using long poles that have lines attached to them, with hooks and bait at the end. The poles are manually lowered into the water and raised to retrieve the catch.

Historically, South African pole and line vessels were allowed to operate in Namibian waters under arrangements with Namibian right holders each year. However, recently the activity has been restricted only to Namibian-registered vessels. **The fishery is seasonal with vessel activity mostly between December and May and peak catches in March and April.** Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. As such the fishery is dependent on window periods of favourable conditions relating to catch availability.

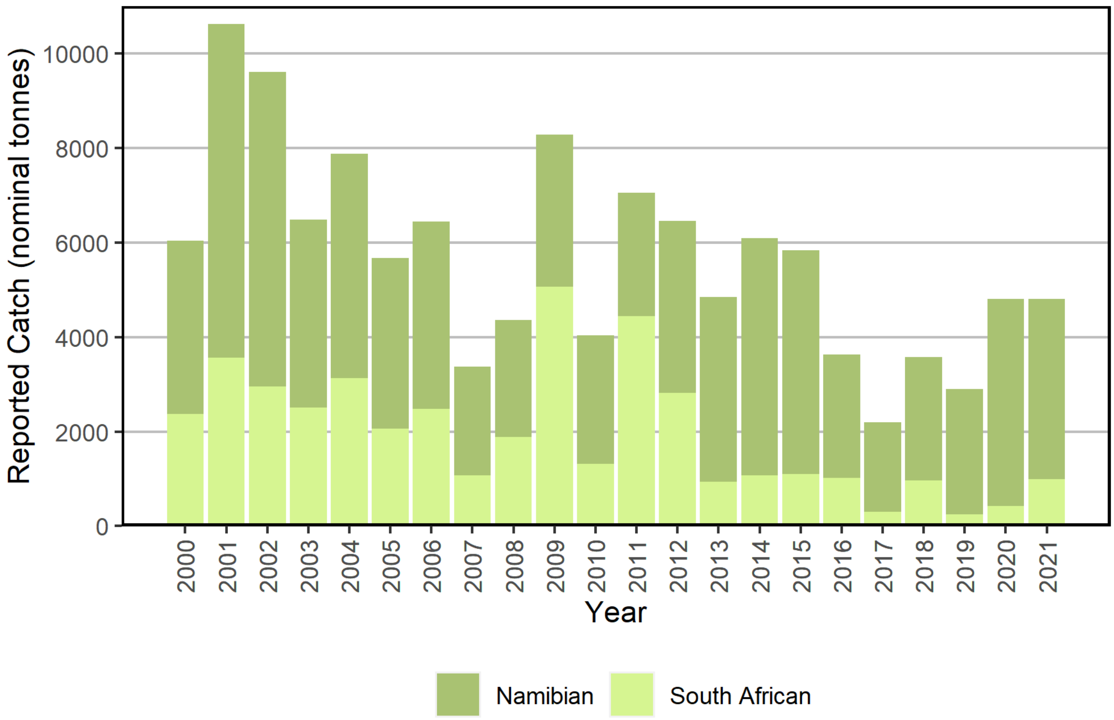

Figure 7-36: Total nominal pole-line catch (tonnes) reported by South African and Namibian flagged vessels from 2000 to 2021.

Source: ICCAT Statistical Bulletin (2023).

Aggregations of albacore tuna occur in specific areas, in particular Tripp Seamount which is situated just north of the South Africa/ Namibia maritime border. Catches in this area are variable from year to year, although boats will frequent the area knowing that albacore aggregate around the seamount after migrating through South African waters. The movement of albacore between South Africa and Namibia is not clear although it is believed that the fish move northwards following bathymetric features and generally stay beyond the 200 m depth contour. Figure 7-37 shows the spatial distribution of reported catches in relation to Block 2814A. **The highest catch is over Tripp seamount, 75 km south-west of Block 2814A.**

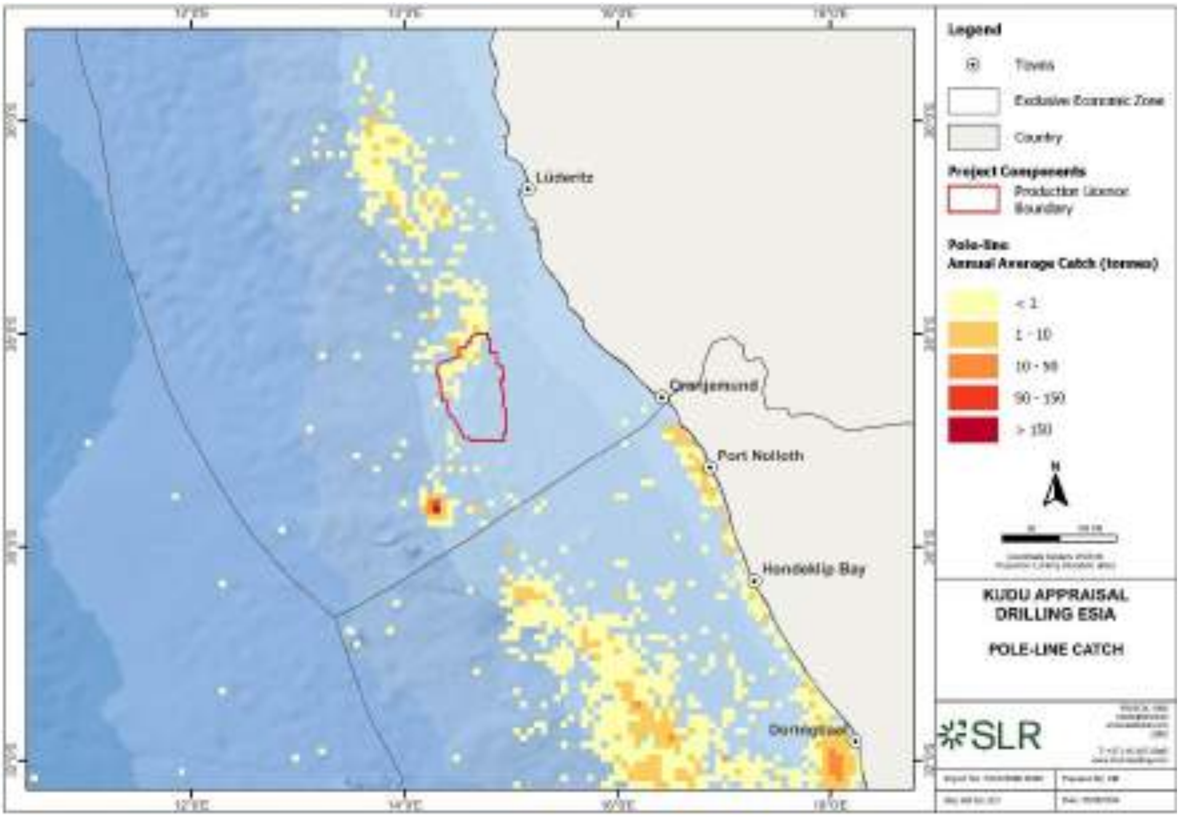

Figure 7-37: Spatial distribution of catch recorded by the pole-line fishery in Namibia and South Africa in relation to Block 2814A.

Note: Average annual catch (tonnes) over the period 2013 to 2022 is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2013-2022), South African data provided by DFFE (2013-2022).

Small Pelagic Purse-Seine

The pelagic purse-seine landings comprise Benguela sardine (*Sardinops sagax*) (also regionally referred to as pilchard), and small quantities of juvenile horse mackerel. A moratorium was implemented on 01 January 2018 due to a significant population reduction. **This fishery remains closed at present** (2024). Prior to the stock collapse, the stock distribution extended throughout the Benguela system, however a contracted distribution is currently apparent. Recent biomass surveys have shown small aggregations of the stock mostly located inshore of the 200 m isobath. Commercial fishing activity occurred primarily inshore of 200 m, northwards of 25°S to the Angolan border (Figure 7-38) with the main commercial fishing grounds situated at least 300 km northward of the licence area.
There was historically marginal overlap of fishing activity within Block 2814A, however the fishery is currently closed.

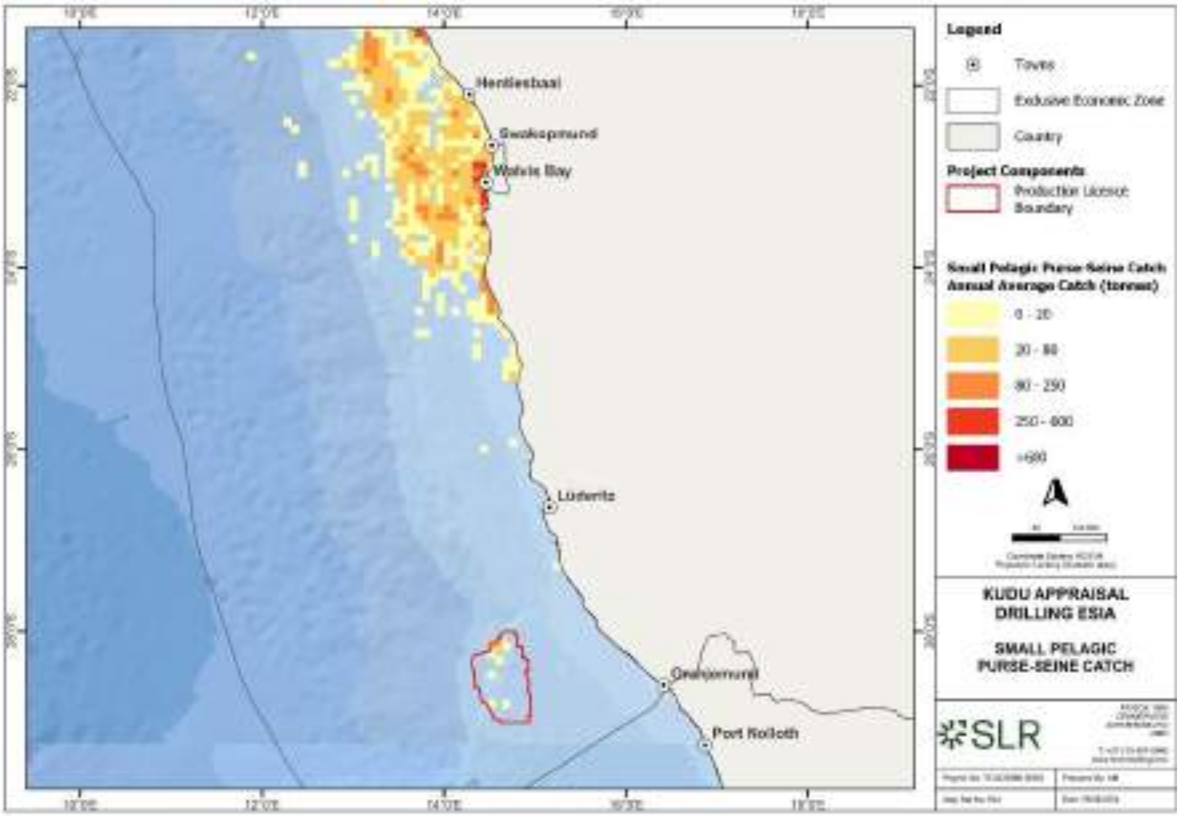

Figure 7-38: Spatial distribution of catch recorded by the small pelagic purse-seine fishery in Namibia in relation to Block 2814A.

Note: Average annual catch (tonnes) over the period 2000 to 2017 is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2000-2017).

Mid-water Trawl

The Namibian fishery for Cape horse mackerel (*Trachurus capensis*) is the largest contributor by volume and second highest contributor by value to the industry. The stock is caught by the mid-water trawl fishery (targeting adult horse mackerel) and pelagic purse-seine fishery (smaller quantities of juvenile horse mackerel). The midwater fishery operates using trawls within the water column to catch schools of adult horse mackerel.

The fishery operates year-round with relatively constant catch and effort values by month. The mid-water trawl fleet operates exclusively out of the port of Walvis Bay and fishing grounds extend north of 25ºS to the border of Angola. Juvenile Cape horse mackerel move into deeper water when mature and are fished mostly between the 200 m and 500 m isobaths towards the shelf break. **The main commercial fishing grounds are situated approximately 280 km northward of Block 2814A, however incidental catches to the north-east of the block have been recorded** (Figure 7-39).

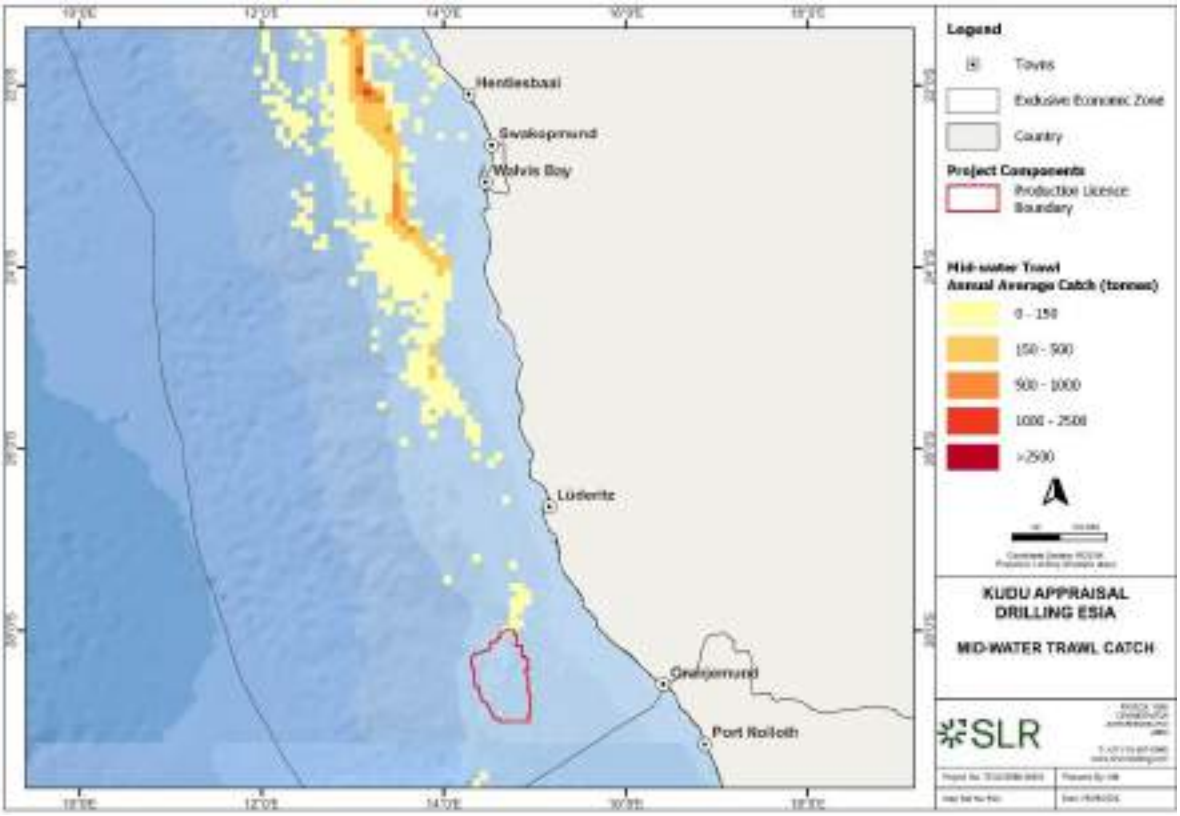

Figure 7-39: Spatial distribution of catch recorded by the mid-water trawl fishery in relation to Block 2814A.

Note: Average annual catch (tonnes) over the period 2000 to 2022 is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2000-2017).

Linefish

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

The sector operates inshore of the 200 m depth contour with incidental reports of fishing in deeper waters. The closest fishing activity taking place from Lüderitz, at least 150 km north-east of Block 2814A and off Oranjemund at least 140 km east of the block. There is no spatial overlap of fishing activity with the block, however there are incidental catch records 20 km inshore (Figure 7-40).

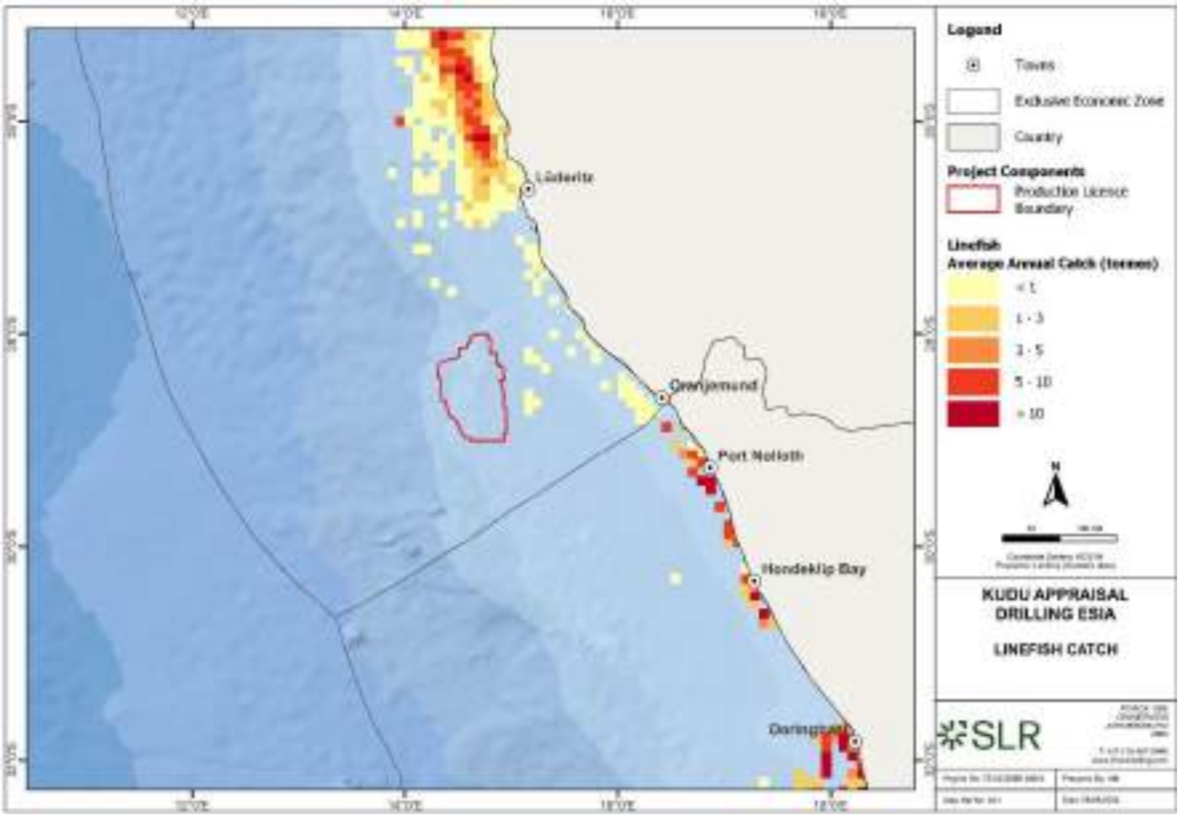

Figure 7-40: Spatial distribution of catch recorded by the linefish fishery in Namibia and South Africa in relation to Block 2814A.

Note: Average annual catch (tonnes) is displayed on a 5 x 5 minute grid.
Source: Namibian data provided by MFMR (2007-2020), South African data provided by DFFE (2017-2019).

Deep-Sea Crab

The Namibian deep-sea crab fishery is based on two species of crab namely spider crab (*Lithodes ferox*) and red crab (*Chaceon maritae*).

The distribution of red crab extends from ~5°S to just South of Walvis Bay and the commercial fishery operates in grounds extending northwards of 23°S and into Angolan waters. There is a minimum operational depth of 400 m set for the fishery, which sets traps at depths of up to 1 200 m. The fishery is small, with only two vessels currently operating from the port of Walvis Bay. Vessels are active year-round but with relatively low fishing effort from November to February. **Fishing grounds are located at least 650 km to the north of Block 2814A and there is, therefore, no spatial overlap.**

Deep-Water Trawl

The deep-water trawl fishery is a small, but lucrative fishing sector directed at the outer Namibian shelf from 400 m to 1 500 m water depth targeting orange roughy (*Hoplostethus atlanticus*) and alfonsino (*Beryx splendens*). Both species are extremely long-lived and form dense aggregations, leading to high catch rates. General aggregations of the stock occur between June and August. Fishable aggregations are usually found on hard grounds on features such as seamounts, drop-off features or canyons (Branch 2001). Off Namibia, orange roughy has a restricted spawning period of less than a month in late July, when spawning takes place in dense aggregations close to the bottom in small areas typically between 10 and 100 km^2 in extent (Boyer and Hampton 2001).

The fishery is split into four Quota Management Areas (QMAs) referred to as “Hotspot”, “Rix”, “Frankies” and “Johnies” and TACs are set for each specific QMA (see Figure 7-41). **The north-western corner of Block 2814A overlaps with “Johnies”, which is the largest QMA.**

In 2009, a three-year moratorium on orange roughy was enforced in Namibia and the fishery has not been re-opened yet.

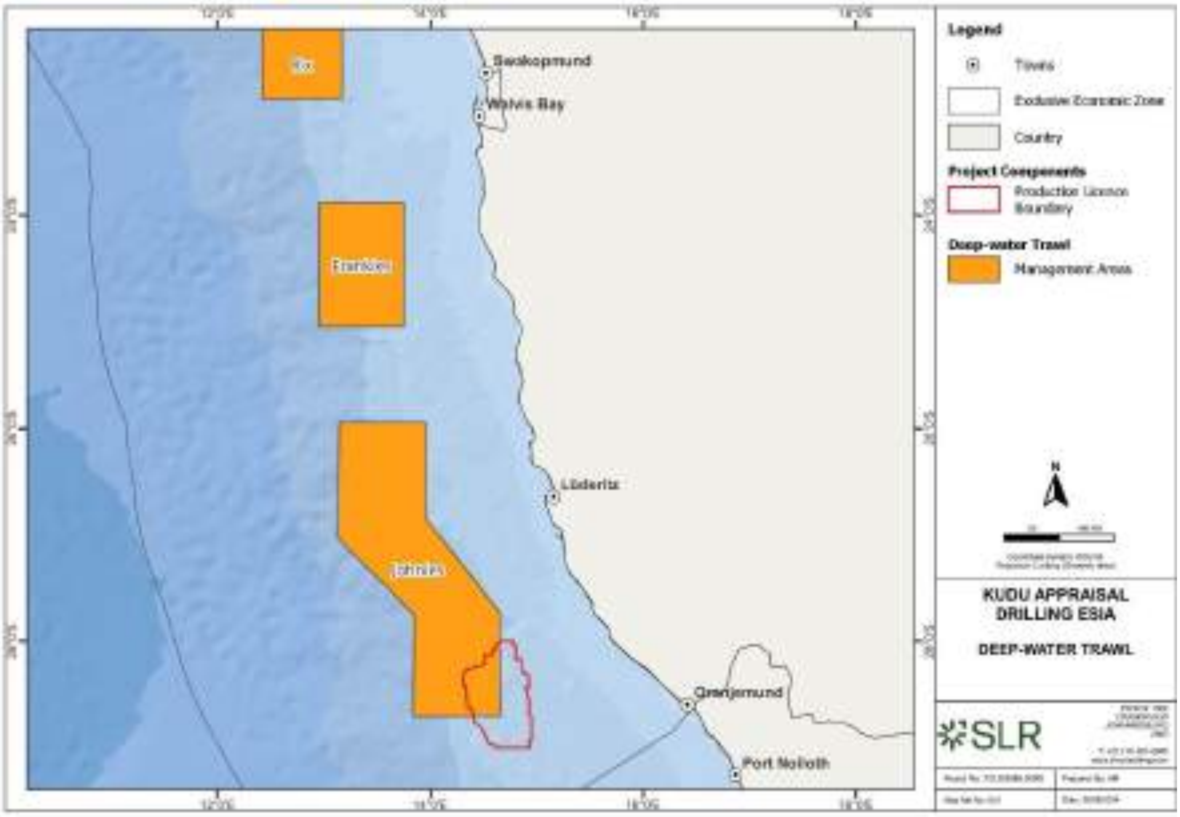

Figure 7-41: Deepwater trawl QMAs in relation to Block 2814A.

Rock Lobster

The small but valuable fishery of rock lobster (*Jasus lalandii*) is based exclusively in the port of Lüderitz. The catch season is a six-month period with a closed period extending from 1 May to 31 October and highest activity levels are experienced over January and February. A total of 18 vessels participated in the 2021-22 rock lobster fishing season.

The sector operates in water depths of between 10 and 80 m. Within Namibian waters, the lobster stock is commercially exploited between the Orange River border in the south to Easter Cliffs/Sylvia Hill north of Mercury Island (approximately 25°S). The fishery is spatially managed through the demarcation of catch grounds by management area. **Block 2814A is located at least 65 km from the outer depth at which rock lobster is caught and therefore there is no spatial overlap between the licence area and fishing grounds.**

7.7.9.4 Fisheries Research

MFMR conducts regular research (biomass) surveys for demersal, mid-water and small pelagic species. These surveys typically follow fixed transects, are spaced 20-25 nm apart, and are designed to statistically optimize the number of stations. In some years the Benguela Current Commission may conduct "transboundary" surveys.

Swept-area biomass surveys for hake are conducted annually to obtain an index of abundance, determine the geographical distribution and collect biological information of the stock. These surveys are normally carried out over the period of one month during January and February and cover the entire continental shelf from the Angolan to the South African maritime border. **The method of abundance estimation from these surveys is based on depth stratification and trawls range in depth from 100 m to 600 m; thus, overlap could be expected with Block 2814A**. During trawling the vessel tows the net for a period of 30 minutes at a speed of approximately 3 knots.

Scientific acoustic surveys are carried out between February and March each year to estimate the biomass of small pelagic species (using the survey vessel F/V Welwitchia). The vessel surveys along pre-determined transects that run perpendicular to depth contours (east-west / west-east direction). **These surveys cover the Namibian shelf from the coastline to the 500 m depth contour (and up to the 2 000 m contour northwards of 18°30´S), thus, overlap could be expected in the deeper regions of Block 2814A**.

7.7.10 Other Human Uses

7.7.10.1 Marine Traffic and Transport

There are various international shipping routes along the Namibian coastline. The majority of the international shipping traffic is located on the outer edge of the continental shelf. Traffic inshore of the continental shelf largely comprises fishing and mining vessels, especially off the coast of Oranjemund, which is inshore of Block 2814A. The block overlaps the main traffic route that passes around southern Africa (see Figure 7-42).

The two main ports in Namibia are:

- Port of Walvis Bay: Walvis Bay is Namibia's largest commercial port and is a key port for regional and international shipping trade. It offers direct access to principal shipping routes and is a natural gateway for international trade. It has a sheltered deep water harbour which benefits from a temperate climate. The port is operated by Namport and receives approximately 3 000 vessel calls each year and handles over 5.3 million tons of cargo.
- Port of Lüderitz: Lüderitz Port is historically Namibia's second largest port, functioning mainly as a fishing port. It has expanded in recent years to ship cargo from the mining industry and to support and service offshore petroleum exploration and diamond mining activities. Lüderitz is closest Namibian port to Block 2814A, approximately 260 km to the north-east.

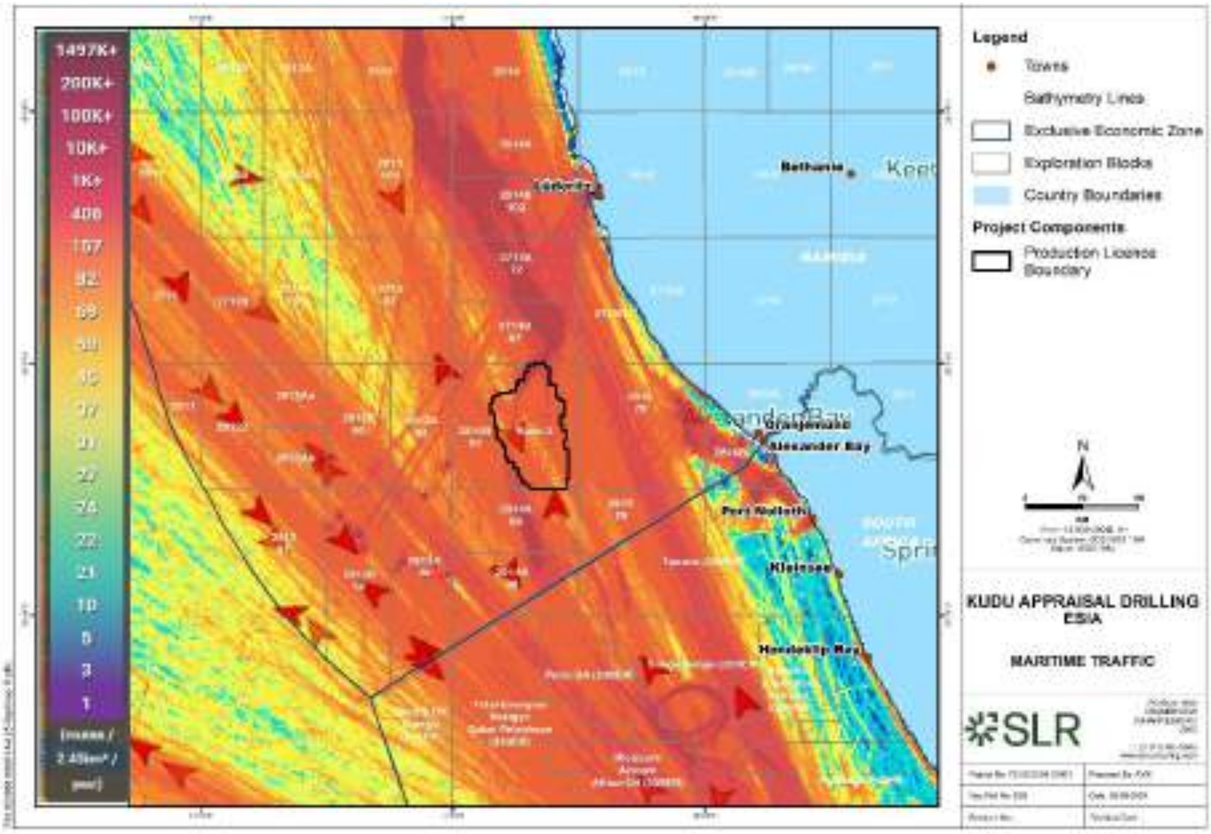

Figure 7-42: Block 2814A in relation to shipping density around southern Africa.

Adapted from: http://www.marinetraffic.com/

7.7.10.2 Oil and Gas Exploration / Production and Mineral Prospecting / Mining

Oil and gas exploration and production

A summary of the oil and gas industry in Namibia is provided in Section 5.2.

The collection of survey, seismic and aeromagnetic data has contributed to a substantial geological and geophysical database for the country and has revealed the existence of four offshore frontier basins of interest to explorers: the Orange, Lüderitz, Walvis and Namibe basins. Figure 7-43 shows the extent of 2D seismic surveys undertaken in Namibia's offshore EEZ. More than 20 additional infill 3D surveys have been completed (Figure 7-44).

Recent and current exploration well drilling activity nearby Block 2814A includes those in Blocks 2813A/B (Galp - Mopane wells), 2912 (TEEPNA - Nara well), 2913B (TEEPNA - Mangetti and Venus wells), 2913A (Shell - Cullinan, Jonkers, Lesedi and Graff wells), and 2914B (Shell - La Rona well). A number of historic wells were also drilled in Block 2814A (Kudu) (see Figure 7-45). An application is also underway for exploration well drilling in Block 2813B (Harmattan / Chevron) and 2914A (Rhino). A number of seismic surveys were undertaken in the southern Namibian offshore from 2022 to 2024, including seismic acquisition across Block 2913B in 2023/24.

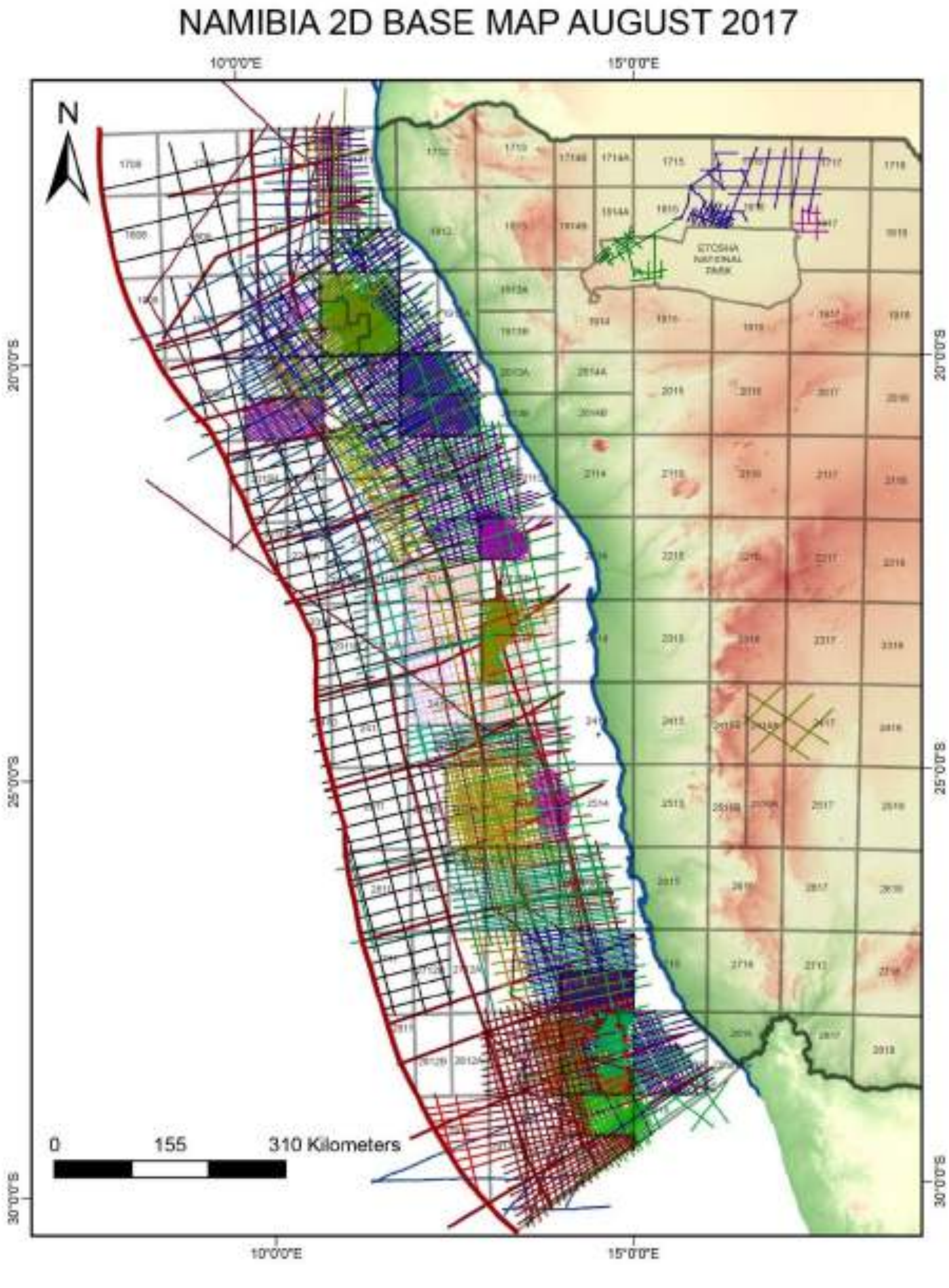

Figure 7-43: 2D seismic surveys undertaken in Namibia's offshore EEZ.

Source: https://www.mme.gov.na/maps/

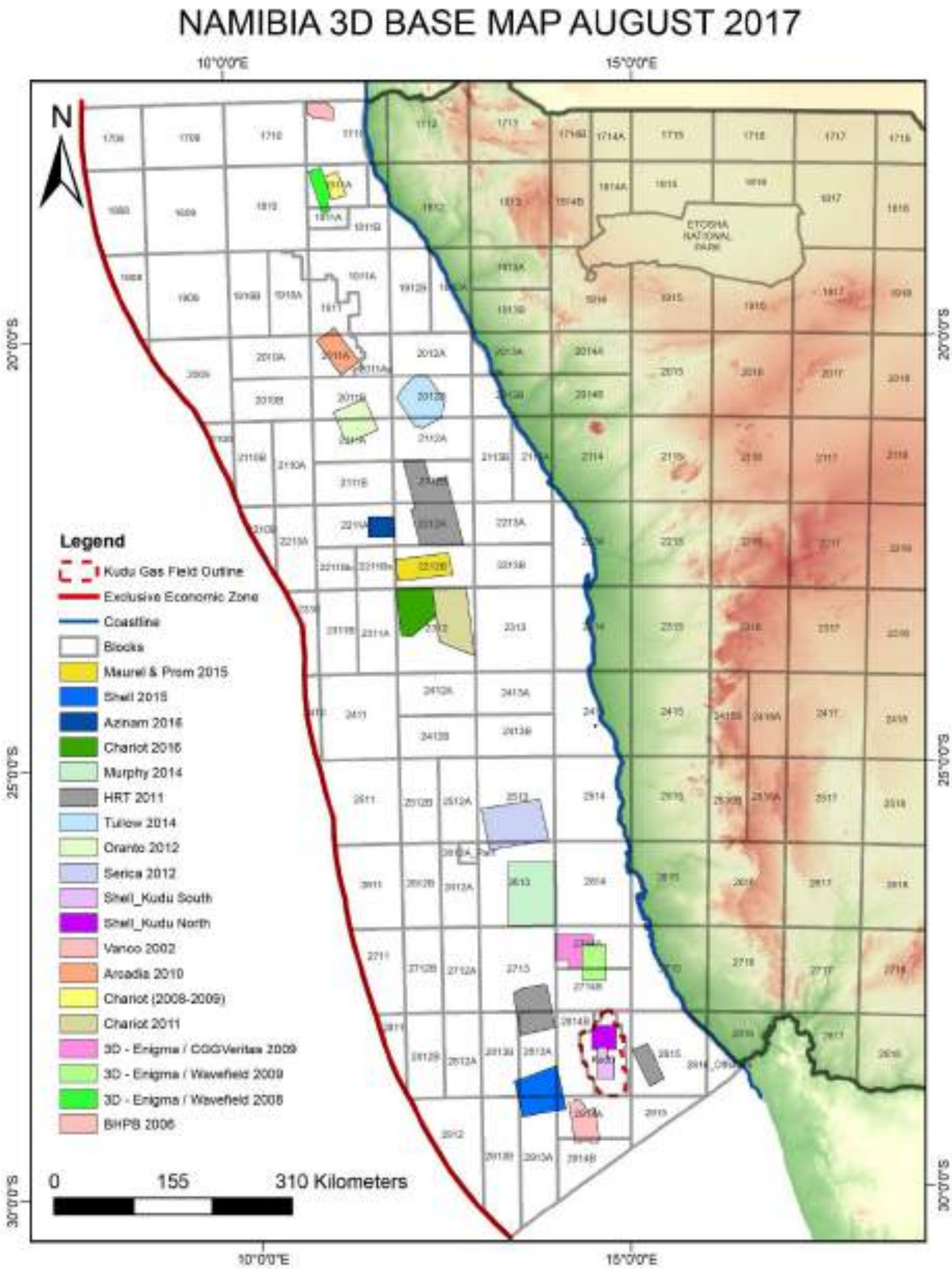

Figure 7-44: 3D seismic surveys undertaken in Namibia's offshore EEZ.

Source: https://www.mme.gov.na/maps/

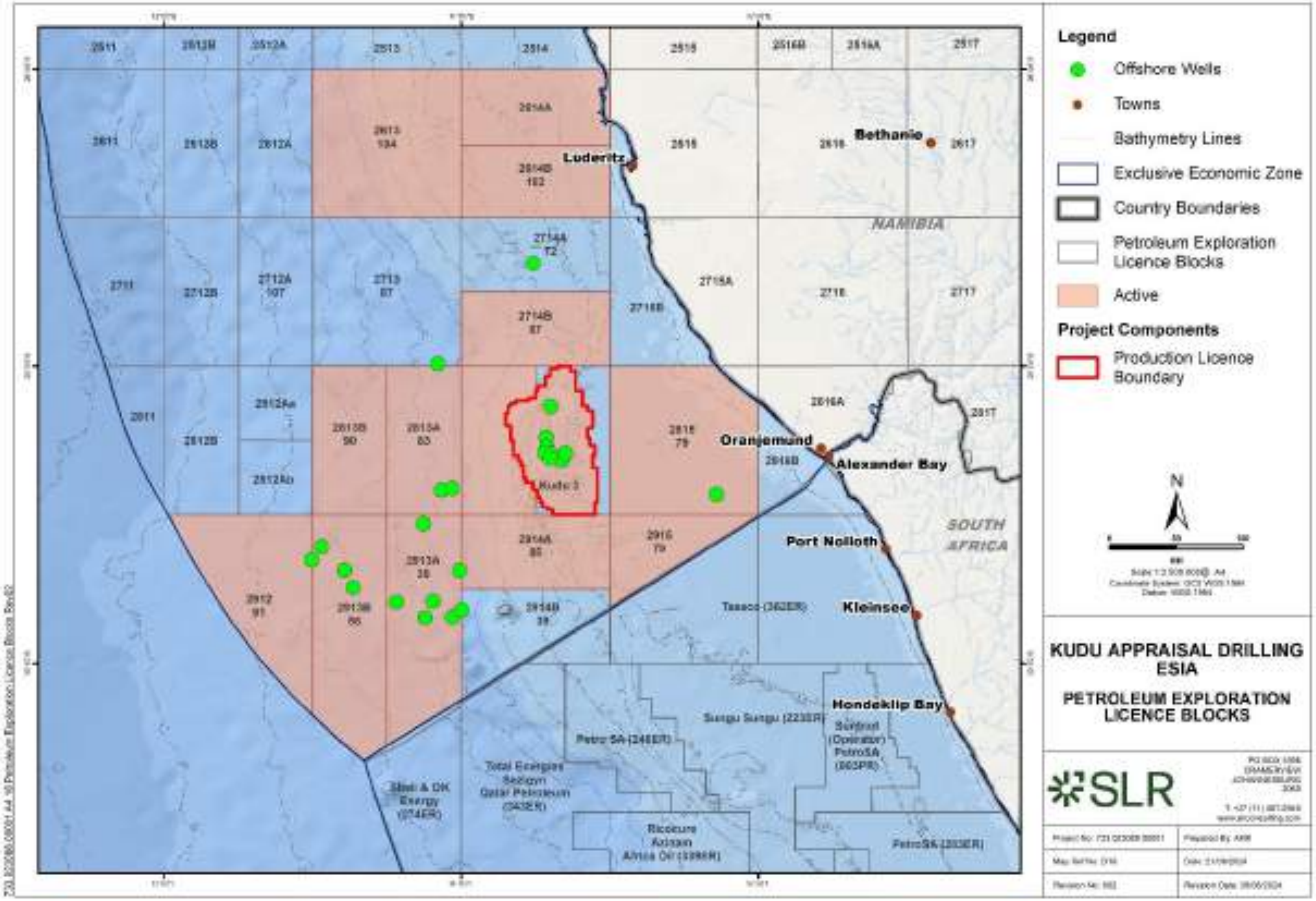

Figure 7-45: Block 2814A in relation to Petroleum Exploration and Production Licence Blocks.

Diamond prospecting and mining

Marine diamonds are mined along the Southern African West Coast from the Olifants River mouth northwards to Walvis Bay. Diamonds are mined either in:

- Shallow waters (less than 30 m depths) by shore-based divers or small vessel-based divers who employ suction pipes to deliver gravel to land for sorting;
- Midwater (30 - 70 m depth) region, where remote operated tools are used; or
- Deep waters (more than 75 m), where custom mining equipment (undersea crawlers and large rotating drills) and high pressure airlift suction is used.

Marine diamond mining is currently limited to the southern half of the Namibian offshore. Diamond Mining Licence (ML) Areas are shown in Figure 7-46. Current diamond mining activities are minimal to non-existent, with the only active operations being in ML-47 (Atlantic 1) held by Debmarine Namibia. Deep-water diamond mining operations in the Atlantic 1 Mining Licence Area are typically conducted to depths of 150 m. Thus, **Block 2814A does not overlap with any diamond mining activities. However, the shallow regions of the block overlaps with a number of Exclusive Prospecting Licences (EPLs).**

Phosphate prospecting and mining

Phosphate deposits off Namibia were delineated during regional studies in the 1970's, but have remained undeveloped to date. The deposits occur as unconsolidated seafloor sediments, which can be efficiently mined by applying currently available dredging technology. Preliminary reconnaissance sampling by Bonaparte Diamond Mines NL during 2007 demonstrated potential for enrichment to commercial grades (up to 35% P2O5) (Mining Review Africa, 2008).

In 2011, the MME granted mining licences to two companies Namibian Marine Phosphate (NMP) and LL Namibia Phosphates for licence areas located south-west of Walvis Bay[21]. Strong opposition to the granting of these rights resulted in the Namibian government establishing a moratorium on offshore phosphate mining. A condition of the moratorium was that an independent and comprehensive EIA must be conducted. In 2016, NMP was awarded an ECC to mine offshore phosphates. Legal action against the issuing of the certificate was taken resulting in the High Court setting aside the ECC on concerns relating to the local fishing industry (specifically monk fish) and the environment (Perks, 2016). However, in May 2018 NMP received a further High Court judgment winning back its Environmental Clearance Certificate for its marine phosphate EIA. Further legal action has since been ongoing regarding the validity of the mining licence (Russell, 2018). **Block 2814A does not overlap with any proposed phosphate mining activities.**

7.7.10.3 Recreational Use

Traditional recreational coastal pursuits are less popular in this region than in many other coastal areas because of the cold water and generally cool, foggy climate. Coastal recreation may be either consumptive or non-consumptive. Due to access restrictions along the coastline between Lüderitz and Oranjemund (part of the Namdeb mining area) no recreational activities occur within this area. **Block 2814A, being over 144 km offshore at the closet point, does not overlap with any recreational activities.**

[21] https://cer.org.za/wp-content/uploads/2016/06/CER_Factsheet3_web.pdf

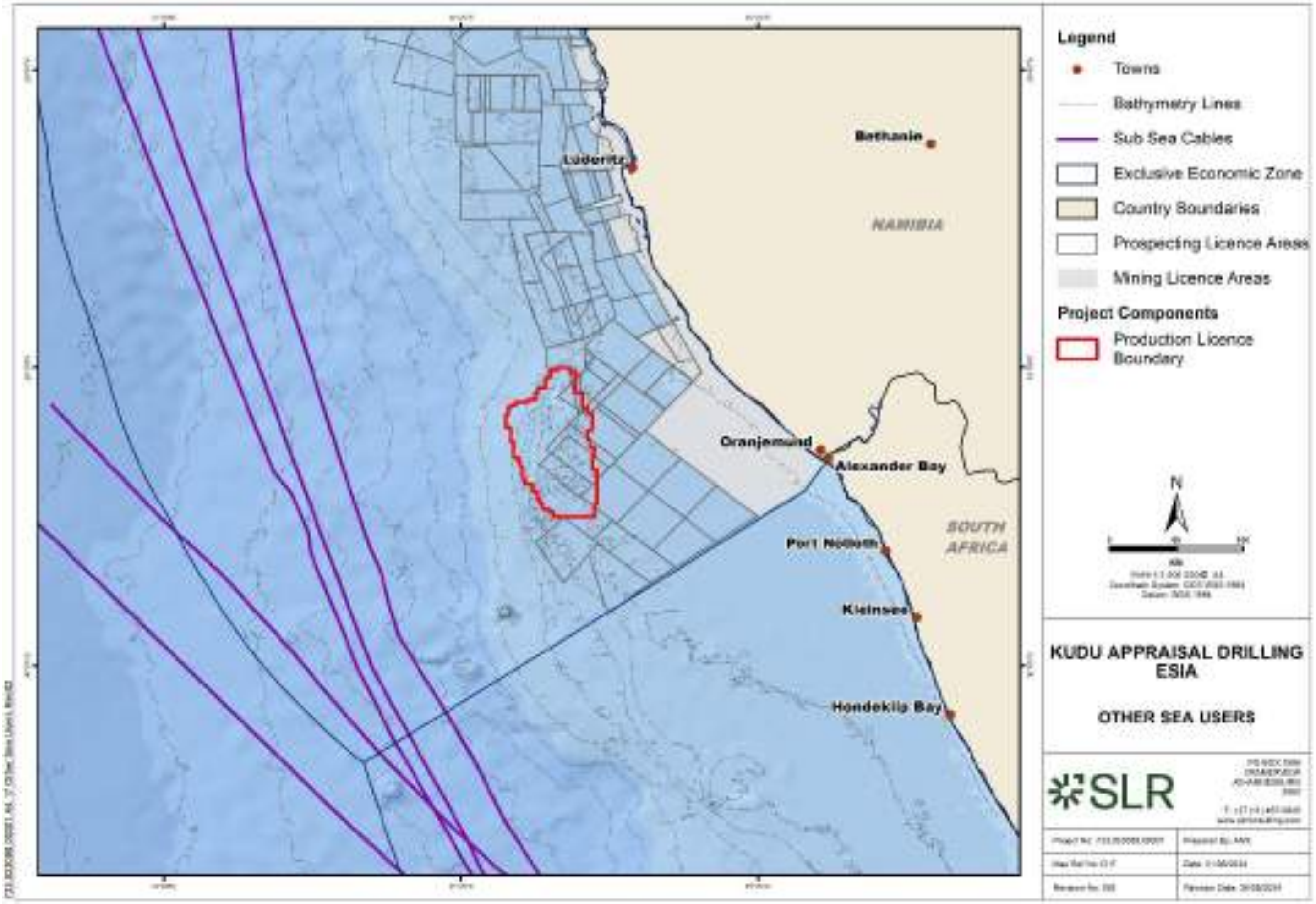

Figure 7-46: Block 2814A (red polygon) in relation to activity - environment interaction points on the Namibian coast, illustrating the active marine diamond mining concessions (shaded) and Exclusive Prospecting Licences, and telecommunications cables.

Source: Adapted from MFMR (2021).

Closer inshore, the ports of Lüderitz and Walvis Bay are fully operational and already supports existing commercial vessels. Thus, certified recreational and pleasure crafts have and continue to operate around the port and alongside existing commercial vessels.

Consumptive recreational uses involve collection of material from the sea for personal use. Recreational anglers (Brouwer *et al.,* 1997) and divers target line-fish from either a boat or the shore, with shore-based divers also targeting West Coast rock lobsters. Rock lobsters are also exploited recreationally from boats with the use of hoop nets. Consumptive recreational use is carried out more regularly near coastal settlements (e.g. Henties Bay), although is of a limited nature off the coast of Namibia, largely due to access restrictions imposed by diamond mining concessions.

Tourism, a *non-consumptive recreational use,* is a major contributor (14.5%) to Namibia's GDP, creating approximately 18% of all employment (directly or indirectly). Offshore recreational and tourist activities which take place in the areas around Walvis Bay and Lüderitz include recreational boating, boat tours (including whale watching) and recreational angling. **Since Block 2814A is located approximately 150 km south-west of Lüderitz, these activities occur well inshore and would not be impacted by proposed appraisal operations.**

7.7.10.4 Undersea Cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 7-46), four of which land pass though Namibian waters, namely the African Coast to Europe (ACE), the West Africa Cable System (WACS), Eastern Africa Submarine Cable System (EASSy) and South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE). Both the ACE and WACS have cable landings and connections at Swakopmund. **Block 2814A does not overlap with these submarine cables.**

7.7.10.5 Guano Harvesting

There is limited guano harvesting on guano platforms off the coast of Namibia. A 1.7 ha wooden platform is located approximately 200 m offshore between Swakopmund and Walvis Bay. North of Swakopmund at the Salt Pans and at Cape Cross, a further two platforms (4 ha each) have been erected (ref. http://www.namibweb.com/guano.htm, 6 Feb 23017). **These sites are located well to the north-east of the Block 2814A and would not be affected by the proposed appraisal activities.**

7.7.11 Summary

Block 2814A overlaps directly with the large pelagic longline, demersal trawl, demersal longline and pole-line sectors. Namibia promotes mariculture, particularly in Lüderitz's nutrient-rich waters, with allocated plots for various seafood cultivation. **The block overlaps the main traffic route that passes around southern Africa.** The coastal region south of Lüderitz is a restricted diamond mining area, which limits public access. Current **diamond mining operations exist to depths of 150 m, and as such there is no overlap with Block 2814A. Block 2814A does not overlap with these submarine cables.**

8.0 Environmental and Socio-Economic Screening of Key Impacts

This chapter provides a high-level screening of the interaction between the proposed activities and the receiving environment and an activity-specific Aspects and Impacts Register to ensure that all environmental and social aspects of the proposed operation and the associated impacts are identified. Key potential impacts were identified by the ESIA project team on this basis, and reviewed by I&APs during the DSR comment period (see Section 4.2). No additional issues were identified by I&APs during the DSR comment period. Specialists will, however, be required to confirm these potential impacts, as well as identify any others, and assess the significance thereof.

8.1 Environmental and Socio-Economic Interaction Matrix

Potential impacts have been identified by examining the possible interactions of all proposed activities and associated aspects (described in Chapter 6.0) with the broad physical characteristics of the area of influence (described in Chapter 7.0), through which potential impacts on biological and social receptors (or features) in the area of interest could arise. The identified possible interactions are shown in the environmental and social interaction matrix in Table 8-1. Shaded cells indicate where a proposed activities may interact with a certain physical characteristic and, in turn, biological or socio-economic receptor. Interactions are broadly grouped into minor interactions and potentially significant interactions (which need to be confirmed by specialist assessments). Key considerations that inform the potential interactions are the far offshore location of the area of interest (located 144 km offshore at its closest point) and the short duration of the proposed activities (approximately three months for drilling and testing of each well).

During normal operations, the biological receptors that may be most affected by proposed activities include benthic communities, fish and marine mammals (although other receptors are also considered). Socio-economic receptors (or activities or resources) that may be most affected by proposed activities include fishing, income / livelihoods, maritime shipping, cultural heritage, public health and safety, and GHG levels.

Potential interactions with receptors in the event of **unplanned events**, associated with potential activity risks such as vessel collisions, minor hydrocarbon spills, loss of drilling-related equipment, blow-out during well drilling or a leak from a plugged well, were also considered to ensure a comprehensive assessment. These unplanned events are unlikely to occur and measures are in place to actively prevent them in line with Industry Best Practice.

8.2 Aspects and Impacts Register

The activity-specific Aspects and Impacts Register in Table 8-2 identifies potential impacts[22] for each proposed activity and associated aspect[23] based on the interactions identified in Table 8-1. This systematic approach allowed for the planning of the scope of the specialist studies.

[22] An "impact" is any change to the environment, whether adverse or beneficial, wholly or partially resulting from the organisation's activities, products or services.

[23] An "aspect" is the element of an organisation's activities, products or services that can interact with the environment.

Table 8-1: Environmental and Social Interaction Matrix.

See legend at the end of the table.

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment																
										Biological receptors / resources								Socio-economic receptors / resources								
			Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air quality / GHG	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Coastal / seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income loss	Employment / Procurement	Maritime / cultural heritage	GHG levels	Visual / sense of place	Services availability	Public health and safety
1. Normal Operations																										
Mobilisation	Establishment of onshore logistics base and mobilisation of staff	Procurement of facilities and services																								
		Employment of staff																								
	Transit of drilling unit and support / survey vessels to site	Vessel presence																								
		Underwater noise from manoeuvring																								
		Vessel air emissions																								
		Vessel lighting																								
		Routine discharges to sea																								
		Discharge of ballast water																								
Operation	Operation of drilling unit and support / survey vessels	Underwater noise from manoeuvring and dynamic positioning																								
		Vessel / drill unit air emissions																								
		Vessel / drill unit lighting																								
		Routine discharges to sea																								
		Implementation of safety zone																								
		Supply vessel transit																								
		Procurement of facilities and services																								
		Employment of staff																								
	Coring, well drilling and installation of well infrastructure	Underwater noise from drilling																								
		Seabed disturbance																								
		Discharge of drill cuttings, mud and residual cement																								
		Treatment and/or disposal at a landfill																								
	VSP	Impulsive underwater noise																								
	ROV operation	Sediment dislodging																								
	Well (flow) testing	Flaring of gas and liquid hydrocarbons																								
		Discharge of treated produced water																								

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Physical characteristics potentially affected, which may affect sensitive receptors							Potentially affected sensitive receptors in the receiving environment																
										Biological receptors / resources								Socio-economic receptors / resources								
			Seabed characteristics	Water quality and turbidity	Underwater noise	Underwater light	Air quality / GHG	Atmospheric noise	Atmospheric light	Benthic communities	Plankton	Fish	Coastal / seabirds	Turtles	Marine mammals	Nearshore habitats and communities	Protected /designated sensitive areas	Fishing	Commercial shipping	Livelihoods / Income loss	Employment / Procurement	Maritime / cultural heritage	GHG levels	Visual / sense of place	Services availability	Public health and safety
	Operation of helicopters	Atmospheric and underwater noise																								
Demobilisation	Abandonment of well	Discharge of residual cement to seabed																								
		Infrastructure on seabed																								
	Demobilisation of drilling unit and support vessels	Vessel presence																								
		Underwater noise from manoeuvring																								
		Vessel air emissions																								
		Vessel lighting																								
		Routine discharges to sea																								
	Demobilisation of logistics base and work force	End of procurement																								
		Release of staff																								
2. Unplanned Events																										
Unplanned	Operation of drilling unit and support vessels	Vessel collision with marine fauna																								
		Minor oil spill caused by vessel or equipment failure and refuelling																								
	Well drilling and installation of well infrastructure	Loss of equipment at sea																								
		Loss of well control / Blow-out																								
	Well abandonment	Hydrocarbon leak from plugged well																								

Legend

	No significant interaction		Interaction of aspects with key physical characteristics in the area of influence		Potentially minor interaction screened out as described in Section 8.3		Potentially significant negative interaction to be assessed in ESIA		Potentially significant positive interaction to be assessed in ESIA

Table 8-2: Aspects and Impacts Register.

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study
1. Normal Operations				
Mobilisation	Establishment of onshore logistics base and mobilisation of staff	Procurement of facilities and services	Income from local procurement and spending	Socio-economic
			State income from taxes and levies	Socio-economic
			Availability of services (port services)	Minor – Screened out
		Employment of staff	Income and skills training for workers	Socio-economic
			Deterioration of shore-based community health and safety	Socio-economic
	Transit of drilling unit and support / survey vessels to site	Vessel presence	Displacement of fishing vessels	Fisheries
			Displacement of shipping vessels	Minor – Screened out
			Alteration of sense of place due to drilling activities and additional vessels	Minor – Screened out
		Underwater noise from manoeuvring	Behavioural disturbance of marine fauna	Marine ecology
			Injury to marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Vessel air emissions	Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change
		Vessel lighting	Behavioural disturbance of marine fauna	Marine ecology
		Routine discharges to sea	Ecological effects	Minor – Screened out
			Deterioration of cultural heritage links to the sea	Cultural heritage
		Discharge of ballast water	Alteration of ecological composition due to introduction of invasive aliens	Minor – Screened out
			Reduction in cultural heritage links to the sea	Cultural heritage
Operation	Operation of drilling unit and support / survey vessels	Underwater noise from manoeuvring and dynamic positioning	Behavioural disturbance of marine fauna	Marine ecology
			Injury to marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Vessel / drill unit air emissions	Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change
		Vessel / drill unit lighting	Behavioural disturbance of marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Routine discharges to sea	Ecological effects	Minor – Screened out

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study
			Deterioration of cultural heritage links to the sea	Cultural heritage
Operation	Operation of drilling unit and support / survey vessels	Implementation of safety zone	Displacement of fishing vessels	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
			Displacement of shipping vessels	Minor – Screened out
		Supply vessel presence (transit)	Displacement of fishing vessels	Minor – Screened out
			Displacement of shipping vessels	Minor – Screened out
			Alteration of sense of place due to drilling activities and additional vessels	Minor – Screened out
		Procurement of facilities and services	Income from local procurement and spending	Socio-economic
			State income from taxes and levies	Socio-economic
		Employment of staff	Income and skills training for workers	Socio-economic
			Deterioration of shore-based community health and safety	Socio-economic
	Well drilling and installation of well infrastructure	Underwater noise from drilling	Behavioural disturbance of marine fauna	Marine ecology
			Injury to marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
	Coring, well drilling, installation of well infrastructure and seabed sampling	Seabed disturbance	Smothering and disturbance of benthic fauna (in well footprint)	Marine ecology
			Deterioration of cultural heritage links to the sea	Cultural heritage
			Disturbance of archaeological material	Minor – Screened out
		Discharge of drill cuttings, mud and residual cement	Smothering and disturbance of benthic fauna (in discharge footprint)	Marine ecology
			Ecological effects from pollutants in water column	Marine ecology
			Release of radioactive materials	Minor – Screened out
			Reduction in cultural heritage links to the sea	Cultural heritage
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Treatment and/or disposal at a landfill	Reduction in available services (landfill capacity)	Minor – Screened out
	VSP	Impulsive underwater noise	Behavioural disturbance of marine fauna	Marine ecology
			Injury to marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
			Reduction in cultural heritage links to the sea	Cultural heritage
	ROV operation	Sediment dislodging	Smothering and disturbance of benthic fauna	Minor – Screened out

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study
Operation	Well (flow) testing	Flaring of gas and liquid hydrocarbons	Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change
			Ecological effects (due to hydrocarbon 'drop out')	Marine ecology
		Discharge of treated produced water	Ecological effects	Marine ecology
			Deterioration of cultural heritage links to the sea	Cultural heritage
	Operation of helicopters	Atmospheric and underwater noise	Behavioural disturbance of marine fauna	Marine ecology
			Alteration of sense of place due to additional helicopter activity	Minor – Screened out
Demobilisation	Abandonment of well	Discharge of residual cement to seabed	Smothering and disturbance of benthic fauna (in discharge footprint)	Marine ecology
		Infrastructure on seabed	Modification of benthic habitat through additional hard substrate	Marine ecology
			Reduction in cultural heritage links to the sea	Cultural heritage
			Displacement of fishing vessels	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
	Demobilisation of drilling unit and support vessels	Vessel presence	Displacement of fishing vessels	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
			Displacement of shipping vessels	Minor – Screened out
			Alteration of sense of place due to additional vessels	Minor – Screened out
		Underwater noise from manoeuvring	Behavioural disturbance of marine fauna	Marine ecology
			Injury to marine fauna	Marine ecology
			Changes in catch due to behavioural change in fish	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Vessel air emissions	Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change
		Vessel lighting	Behavioural disturbance of marine fauna	Marine ecology
		Routine discharges to sea	Ecological effects	Minor – Screened out
			Deterioration of cultural heritage links to the sea	Cultural heritage
	Demobilisation of logistics base and work force	End of procurement	Income from local procurement and spending	Socio-economic
			State income from taxes and levies	Socio-economic
			Availability of services (port services)	Minor – Screened out
		Release of staff	Income and skills training for workers	Socio-economic
			Deterioration of shore-based community health and safety	Socio-economic

Phase	Proposed Activities	Aspects associated with activities that can cause impacts	Potential impact	Proposed Specialist Study
2. Unplanned Events				
Unplanned	Operation of drilling unit and support vessels	Vessel collision with marine fauna	Injury of marine fauna	Marine ecology
		Minor oil spill caused by vessel or equipment failure and refuelling	Ecological effects from pollutants in water column	Marine ecology
			Displacement of fishing vessels and target species from polluted areas	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
	Well drilling and installation of well infrastructure	Loss of equipment	Entanglement of fishing gear	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
		Loss of well control / blow-out	Ecological effects from pollutants in water column	Marine ecology
			Displacement of fishing vessels and target species from polluted areas	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
			Displacement of shipping vessels from polluted areas	Socio-economic
			Ecological effects from pollutants on the shore	Marine ecology
			Reduction of income from coastal livelihoods and recreation	Socio-economic
			Reduction in cultural heritage links to the sea	Cultural heritage
			Alteration of sense of place	Socio-economic
			Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change
	Well abandonment	Hydrocarbon leak from plugged well	Ecological effects from pollutants in water column	Marine ecology
			Displacement of fishing vessels and target species from polluted areas	Fisheries
			Loss of income from any disruption of fisheries	Socio-economic
			Displacement of shipping vessels from polluted areas	Socio-economic
			Ecological effects from pollutants on the shore	Marine ecology
			Reduction of income from coastal livelihoods and recreation	Socio-economic
			Reduction in cultural heritage links to the sea	Socio-economic
			Alteration of sense of place	Socio-economic
			Health impacts from atmospheric pollution	Air quality
			Contribution to GHG emissions and increased carbon concentration in atmosphere	Climate change

8.3 Minor Screened Out Impacts

A number of potential impacts identified during the screening described in Sections 8.1 and 8.2 are deemed to be minor and not significant in the larger context of the proposed activities. This includes impacts that are commonplace in the marine environment, where existing legal requirements impose adequate management requirements, and/or where impacts are of a negligible intensity in relation to receiving environment before implantation of mitigation. These impacts have thus been screened out as discussed below and will not be formally assessed in the ESIA.

8.3.1 Introduction of Invasive Aliens due to Ballast Water Discharge

As noted in Section 6.4.5.2, ballast water is routinely used by offshore vessels to maintain safe operations. In this process, ballast water may be pumped into or out of the ballast water tanks of the vessel during a journey. Ballast water taken onboard will contain small marine organisms, some of which can survive the ballast water tanks. The discharge of ballast water in areas that are different from those where it was taken onboard can thus result in the release of marine organisms that are alien to the region where they are released. If these organisms are able to survive and proliferate in the new environment where they are released, they could then compete with native species and change the composition of the native ecosystem.

Such discharges are common to ocean-going vessels and are regulated by international conventions, such as the International Convention for the Control and Management of Ships' Ballast Water and Sediments (see Sections 2.4 and 6.4.5.2). The Convention requires that all ships using ballast water exchange will do so at least 50 nm (± 93 km) from the nearest land and wherever possible 200 nm (~370 km) from the nearest land in waters at least 200 m deep when arriving from a different marine region, to minimise the chances of fauna carried in the ballast water surviving.

For the proposed drilling activities, ballast water will be taken on and discharged by the drill unit and potentially the supply vessels, and the potential concern around the introduction of alien invasive species occurs particularly as vessels mobilise to Namibia from other regions, i.e. once off, as the vessels are expected to remain within the area of interest until the appraisal is complete. The area of interest is located 144 km offshore, which is offshore of the minimum discharge distance requirement of the Convention. The area of interest is, however, closer to the coast than the preferred discharge distance, and ballast water should be exchanged, where possible *en route* to the area of interest.

Ballast water discharges from the "project" vessels are not considered to pose a higher risk than those from a multitude of other vessels traversing Namibian waters daily on the major commercial shipping routes. Drilling units are highly specialised international vessels that are expected to fully implement standard international discharge management measures.

The following management measures must be implemented:

- Compile and implement a Ballast Water Management Plan that complies with the International Convention for the Control and Management of Ships' Ballast Water and Sediments standards.
- Aim to exchange ballast water *en route* to the area of interest, in line with the preferred 200 nm distance from the coast.

8.3.2 Ecological Effects from Routine Discharges to Sea

Routine discharges considered in this section include bilge water from vessel machinery spaces, deck drainage, brine generated from onboard desalination plant, sewage, food wastes, and detergents from deck cleaning. The discharge of such substances can in principle have a number of impacts, including physiological effects on marine fauna from pollutants contained in the discharge and attracting marine fauna and associated predator species to the vessel area (see Section 6.4.5.2).

Such discharges are common to all ocean-going vessels and are regulated by national law and international conventions, such as MARPOL (see Section 2.4).

Discharge volumes are directly proportional to the size of the vessel and crew (including drilling unit). While support vessels are mobile and comparable in size to other offshore vessels, the drilling unit has a larger crew complement and will remain in one place for longer.

However, the area of interest is located 144 km from the coast at its closest point; and particularly the drilling unit which will account for the largest proportion of discharges it is thus far removed from any coastal receptors and within the deep-water open ocean environment, where marine fauna density is considerably lower than in nearer-shore areas. The dominant current direction will move discharges mainly in a north-westerly direction, away from the coast into deeper offshore waters.

Discharges are expected to disperse rapidly to undetectable concentrations and are unlikely to have an impact on more sensitive coastal receptors or water quality. Discharges are not considered more significant than those from a multitude of other vessels cruising offshore. Drilling units are highly specialised international vessels that are expected to fully implement standard international discharge management measures.

The following management measures must be implemented:

- Compile and implement a Waste and Discharge Management Plan that complies with MARPOL standards.
- Monitor and audit appropriate implementation of the Waste and Discharge Management Plan and MARPOL standards.

8.3.3 Sediment and Benthic Habitat Disturbance from ROV Operation

Prior drilling or spudding the well, a ROV will be deployed to obtain video footage of the seabed at the proposed well location. This video footage be used to finalise the well position based on the presence of any seafloor obstacles.

Although the standard operating procedure is not to settle or rest the ROV on the seabed, the ROVs thrusters may stir up the soft or silty sediments when operating close to the seabed. This resuspension of fine sediments will result in localised increases turbidity and could temporarily disturb seabed communities. However, in most cases sub-lethal or lethal responses would occur only at concentrations well in excess of those anticipated due to resuspension of sediments by ROV thrusters (low intensity). Any turbidity effects would be transient only as sediments would redeposit after the ROV has departed the area. Any impacts would thus persist over the short-term (hours) only.

The following management measures must be implemented:

- Ensure the ROV does not land or rest on the seabed as part of normal operations. Limit the area directly affected by physical contact with infrastructure to the smallest area required.

8.3.4 Availability of Services Supplying the Proposed Activities

Namibia has existing ports and facilities (including Walvis Bat and Lüderitz) and operators which service the Oil and Gas industry. The proposed operations are largely similar to existing operations serviced by Namibian ports and service providers.

As offshore activities and associated demand for services increases, it is expected that more service providers will enter the market. Providers of non-specialised goods or services (e.g., accommodation or land-based transportation) may be able to expand faster than providers of fixed facilities (e.g., berthing space) or specialised goods and services (e.g., drilling muds and aerial transportation). However, there is no indication of supply shortages materially affecting offshore activities to date, or that the volume of existing good and services cannot be expanded to meet increased market demand over time. In addition, certain services could, where necessary, be sourced from suppliers in neighbouring South Africa or Angola where there are currently various exploration activities being undertaken.

Solid wastes generated during the appraisal drilling activities will be transported to shore for further treatment, depending on the location of the onshore logistics base. This waste will be segregated, segregated, packed, labelled and transported under a manifest to shore for disposal at a licenced waste management facility approved by the operator.

The services of an appropriately licenced waste contractor will be used to collect and transport all operational waste for recycling, treatment or disposal. The volumes of waste generated and requiring onshore management are expected to be relatively small, as it is understood that surplus drilling muds will be returned to the provider for processing and re-use. The recycling, treatment and/or disposal of waste onshore will be fully traceable to ensure it is disposed at appropriately licenced waste facilities.

None of the required logistics / support operations are of such a nature, frequency or duration that they would place undue pressure on local infrastructure that also supplies other users.

8.3.5 Displacement of Shipping Vessels

As noted in Section 7.7.10.1, international shipping routes run along the outer edge of the continental shelf offshore Namibia. Block 2814A lies in an area likely to experience high vessel traffic (see Figure 7-42).

A drilling unit is considered an “offshore installation” and during drilling, there would be a minimum safety zone of 500 m around drilling unit (0.79 km^2), which need to be increased if the drilling unit is anchored. All unauthorised vessels would be excluded from entering this safety zone for the duration of the drilling operation. Navigational warnings (issued via IMO/IHO approved broadcast systems) would request that all vessels provide at least a 500 m safety clearance zone around the drilling unit position. Thus, other vessels must potentially amend their route to avoid the drilling unit and its safety zone.

The overall extent of the safety zone is very small compared to the extent of the offshore environment. The drilling unit will be in position for a relatively short period (three months per well), but during that time it will be stationery (and hence predictable), with its position broadcast to passing vessels. Any alterations to vessels' routes, if required at all, will be minimal and not result in material changes in required vessel fuel or transit time.

Support vessels will also be required to utilise, and traverse, these main shipping routes. Support vessels would, however, adhere to maritime traffic safety protocols and vessels travelling to the port will follow charted navigational channels and standard harbour and safety controls. Thus, the risk of collisions and accidents as it is assumed to be low.

The following management measures must be implemented:

- Request, in writing, the South African Navy Hydrographic Office (SANHO) to broadcast a navigational warning via Navigational Telex (Navtext) and Channel 16 VHF for the duration of the well drilling operation.
- Use Notices to Mariners to warn other users of the sea of the presence of the drilling unit.
- Use standard communication (constant bridge watch and radio contact) and navigation systems (lighting and signalling systems) on the drill unit and support vessels.

8.3.6 Alteration of the Sense of Place

Block 2814A is located 144 km from the coast at its closest point. The temporary presence of a drilling unit in these far offshore waters will not be visible to coastal residents and visitors or recreational water users, who will stay well inshore of the area of interest.

Commercial (e.g., freight) vessels traverse large parts of the ocean and are not deemed to be sensitive to an alteration in the particular offshore sense of place in Namibia.

The supply vessels travelling between the drilling rig and the coast are few in number and largely congruent with other vessels in the offshore area and not expected to affect the general sense of place in the offshore, near-shore and (working) port environment.

The increased use of aircraft, such as helicopters and small fixed wing aircraft, to transport crew to and from the drilling unit adds to an existing presence of such aircraft operating from existing bases in Luderitz or Oranjemund. The sense of place impacts are thus expected to be very limited.

Due to the significant distance from the coast, the limited number of vessels and temporary nature of the operation it is not expected to materially affect the sense of place.

8.3.7 Disturbance of Archaeological Material

As noted in Section 7.7.6, no wrecks are known to occur or have been identified within Block 2814A. Nevertheless, the possibility of identifying new shipwrecks or maritime debris remains, although of very low probability given the Block's offshore location.

Well locations will be identified based on several factors, including an analysis of existing seismic data and the geological target. Prior to spudding, an ROV will be used to finalise the well position based on the presence of any seafloor obstacles that may be observed (see Section 6.4.3.1). During such a survey any visible wrecks would more than likely be detected and, if detected, would be avoided as the drilling area should be free of obstacles to ensure optimal operations. The likelihood of finding and disturbing a shipwreck in this deep-water offshore environment is very small considering the vast size of the Namibian offshore area.

Should a wreck or ship remains be discovered, this would contribute to archaeological knowledge.

The following management measures must be implemented:

- Adjust the well location to avoid any marine underwater cultural heritage (shipwrecks) identified in pre-drilling environmental baseline survey or pre-spudding survey.
- If any historic shipwreck objects are found during the pre-spudding seafloor survey or after drilling commencement, which could potentially be impacted by the activity, work in the directly affected area should cease (if identified after drilling commencement) until the Namibian Heritage Authority has been notified and the operator has complied with any additional mitigation as specified by the Authority, including any recommended buffer.

8.3.8 Release of Radioactive Material

The target resources are not expected to be naturally radioactive. Thus, drill cuttings are not expected to be radioactive.

If any radioactive materials are utilised in well drilling or testing tools, they would be of minimal volumes, contained and managed in line with the relevant legislation and guidelines for the management of radioactive sources. Contractors with the necessary accreditation and certification will handle radioactive sources and they will comply with necessary regulations for the transport, storage, and handling of radioactive devices. The testing does not generate radioactive wastes.

8.4 Summary of Key Potential Impacts for Assessment

A summary of key potential impacts related to normal operations and / or those likely to be of public concern is summarised in Sections 8.4.1 to 8.4.5, as well as in Table 8-3 below, together with preliminary mitigation measures.

Table 8-3 essentially inverts Table 8-2 and summarises all identified impacts and the respective activity aspects that can cause impacts (for the normal operations) per specialist discipline. This allows for the holistic assessment of impacts on each receptor from all proposed activity aspects that will interact with the receptor during implementation of the proposed activities. There is currently insufficient information available for the assessment of impacts. Thus, these will be formally assessed by the specialists during the Impact Assessment Phase based on the technical modelling studies and their expertise using the Impact Assessment methodology presented in Section 9.2.

For unplanned events impacts are assessed per event (and not per receptor), as each event is unlikely to occur, and as such these events would not all impact on receptors concurrently. These unplanned events (including vessel collisions, loss of equipment, spills, and well blow-out) are also summarised in Table 8-3 and will also be assessed by specialists.

Table 8-3: Summary of Identified Impacts related to Normal Operations and Preliminary Mitigation / Project Controls.

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls	Report section
1	**Minor screened out impacts**			
1.1	Introduction of invasive aliens due to ballast water discharge	• Discharge of ballast water (Mobilisation)	• Compliance with requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments.	Section 8.3.1
1.2	Ecological effects from routine discharges to sea	• Routine discharges to sea (Mobilisation, Operation, Decommissioning)	• Compliance with MARPOL standards for discharges to sea. • Implementation of Waste & Discharge / Maintenance management plans.	Section 8.3.2
1.3	Sediment and benthic habitat disturbance from ROV operation	• Sediment dislodging from ROV operation (Operation)	• Ensure the ROV does not land or rest on the seabed as part of normal operations.	Section 8.3.3
1.4	Availability of services	• Procurement of facilities and services (port services) (Mobilisation, Decommissioning) • Treatment and/or disposal at a landfill (landfill capacity) (Operation)	• N/A	Section 8.3.4
1.5	Displacement of shipping vessels	• Vessel presence (Mobilisation, Operation, Demobilisation) • Implementation of safety zone (Operation)	• Request, in writing, the SANHO to broadcast a navigational warning for the duration of the well drilling operation. • Use Notices to Mariners to warn other users of the sea of the presence of the drilling unit. • Use standard communication and navigation systems on the drill unit and support vessels.	Section 8.3.5
1.6	Alteration of sense of place due to drilling activities and additional vessels	• Vessel presence (Mobilisation, Operation, Demobilisation) • Helicopter atmospheric and underwater noise (Operation)	• N/A	Section 8.3.6
1.7	Disturbance of archaeological material	• Seabed disturbance from seabed sampling, anchoring and drilling (Operation)	• Adjust the well location to avoid any marine underwater cultural heritage (shipwrecks) identified in pre-drilling environmental baseline survey or pre-spudding survey. • If any historic shipwreck objects are found during the pre-spudding seafloor survey or after drilling commencement, which could potentially be impacted by the activity, work in the directly affected area	Section 8.3.7

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls	Report section
			should cease (if identified after drilling commencement) until the Namibian Heritage Authority has been notified and the operator has complied with any additional mitigation as specified by the Authority, including any recommended buffer.	
1.8	Release of radioactive materials	• Discharge of drill cuttings and mud and residual cement to the seabed (Operation)	• N/A	Section 8.3.8
2	**Marine Ecology**			
2.1	Smothering and disturbance of benthic fauna	• Seabed disturbance from seabed sampling, anchoring and drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • Discharge of residual cement to seabed (Demobilisation)	• Pre-drilling environmental baseline survey or pre-spudding site survey (video footage) to implement buffers around sensitive hardgrounds and vulnerable habitats if present. • Monitor discharges.	Section 8.4.1
2.2	Modification of benthic habitat through additional hard substrate	• Infrastructure on seabed (Demobilisation)	• N/A	
2.3	Turbidity, bioaccumulation, toxicity and hypoxic effects on marine fauna	• Discharge of drill cuttings, mud and residual cement (Operation) • Flaring of gas and liquid hydrocarbons (due to ‘drop out’) (Operation) • Discharge of treated produced water (Operation)	• Drilling discharges: o Usage of low-toxicity drilling fluids and cement. o Monitor discharges. • Flaring: o Optimise well test programme to reduce flaring as much as possible. o Use a high-efficiency burner when flaring to maximise combustion of the hydrocarbons. • Produced water: o Onboard treatment of hydrocarbon component to <30 mg/l or ship to shore.	
2.4	Behavioural disturbance of marine fauna	• Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Vessel / drill unit lighting (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Underwater noise from drilling (Operation) • VSP impulsive underwater noise (Operation)	• Vessel operations: o Reduce the lighting on the “project” vessels to a minimum compatible with safe operations whenever and wherever possible. o Control vessel transit speed between the drill site and port. • VSP operations: o Pre-shoot watch by Marine Mammal Observer, including Passive Acoustic Monitoring.	

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls	Report section
		• Helicopter atmospheric and underwater noise (Operation)	o Implement 'soft start' to VSP activities for slow ramp up of power output. o "Soft-start" procedures. o Shut-downs for animals in mitigation zone. • Helicopter operations: o Minimum flying heights and flight paths to avoid sensitive habitats.	
2.5	Injury of marine fauna	• Underwater noise from vessel and drilling operations (Mobilisation, Operation, Decommissioning) • VSP impulsive underwater noise (Operation)	• Refer to VSP operations above.	
3	**Fisheries**			
3.1	Displacement of fishing vessels	• Vessel presence (Mobilisation, Operation, Demobilisation) • Implementation of safety zone (Operation)	• Stakeholder engagement and notification. • Navigational warning. • Fisheries Liaison Officer. • Survey and accurately charted wellheads with the SANHO. • Grievance management.	Section 8.4.2
3.2	Reduced fishing grounds	• Infrastructure on seabed (Demobilisation)		
3.3	Changes in catch due to behavioural change in fish	• Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Vessel / drill unit lighting (Operation) • Underwater noise from drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation)		
3.4	Loss of income from any disruption of fisheries (large pelagic longline)	• Vessel presence (Mobilisation, Operation, Demobilisation) • Implementation of safety zone (Operation) • Underwater noise from manoeuvring (Mobilisation, Operation, Decommissioning) • Underwater noise from dynamic positioning (Operation) • Vessel / drill unit lighting (Operation) • Underwater noise from drilling (Operation)		Section 8.4.3

No.	Potential impact	Aspects potentially resulting in impact	Preliminary Mitigation Measures / Project Controls	Report section
		• Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation) • Infrastructure on seabed (Decommissioning)		
4	**Other Socio-economic**			
4.1	Income and skills training for workers	• Employment of staff (Mobilisation, Operation, Decommissioning)	• Appointment of local service providers as far as possible. • Operator's local content policy. • Manage community expectations. • Stakeholder engagement.	Section 8.4.3
4.2	Income from local procurement and spending	• Procurement of facilities and services (Mobilisation, Operation, Decommissioning)		
4.3	State income from taxes and levies	• Procurement of facilities and services (Mobilisation, Operation, Decommissioning)	• N/A	
4.4	Deterioration of shore-based community health and safety	• Employment of staff (Mobilisation, Operation, Demobilisation)	• Implement Code of Conduct policy.	
4.5	Deterioration of cultural heritage links to the sea	• Routine discharges to sea (Mobilisation, Operation, Decommissioning) • Discharge of ballast water (Mobilisation) • Seabed disturbance from seabed sampling, anchoring and drilling (Operation) • Discharge of drill cuttings, mud and residual cement (Operation) • VSP impulsive underwater noise (Operation) • Infrastructure on seabed (Demobilisation)	• Stakeholder engagement and notification. • Implement, where necessary, a ritual event/s. • Grievance management.	Section 8.4.4
4.6	Increase in Atmospheric Pollutants and associated Health Risks	• Vessel / drill unit air emissions (Mobilisation, Operation, Decommissioning) • Flaring of gas and liquid hydrocarbons (Operation)	• Optimise rig positioning, rig movement, support / survey vessel routes and the logistics (number of trips required to and from the onshore logistics base) in order to lower fuel consumption. • Optimise well test programme to reduce flaring as much as possible. • Use a high-efficiency burner when flaring to maximise combustion of the hydrocarbons.	Section 8.4.5
4.7	Contribution to GHG emissions			Section 8.4.5
5	**Unplanned Events**			
5.1	Injury of marine fauna	• Vessel collision with marine fauna (Mobilisation, Operation, Decommissioning)	• Control vessel transit speed between the drill site and port.	Section 8.4.1

<table>
<tr><th>No.</th><th>Potential impact</th><th>Aspects potentially resulting in impact</th><th>Preliminary Mitigation Measures / Project Controls</th><th>Report section</th></tr>
<tr><td>5.2</td><td>Potential disturbance and damage to seabed habitats and associated fauna</td><td rowspan="2">• Loss of equipment (Operation)</td><td>• Post drilling ROV survey.
• Retrieve of lost objects / equipment, where practicable.</td><td>Section 8.4.1</td></tr>
<tr><td>5.3</td><td>Collision hazards for other vessels</td><td>• Retrieve of lost objects / equipment, where practicable.
• Notify SANHO.</td><td>Section 8.4.3</td></tr>
<tr><td>5.4</td><td>Ecological effects from pollutants in water column and on the surface</td><td rowspan="6">• Vessel or equipment failure and refuelling (Mobilisation, Operation, Decommissioning)
• Loss of well control / blow-out (Operation)</td><td rowspan="6">• Spill training and clean-up equipment.
• Design and Technical Integrity.
• Detailed Technical Risk Analysis.
• Blow-out Preventer.
• Well-specific response strategy and plans (Oil Spill Contingency Plan, Emergency Response Plan, Shipboard Oil Pollution Emergency Plan).
• Capping and Containment Equipment.
• Well-specific oil spill modelling.
• Surface and subsea response.
• Deploy and/or pre-mobilise shoreline response equipment.
• Refuelling procedure.
• Stakeholder engagement.
• Grievance management.</td><td>Section 8.4.1</td></tr>
<tr><td>5.5</td><td>Displacement of fishing vessels and target species</td><td>Section 8.4.2</td></tr>
<tr><td>5.6</td><td>Loss of income from any disruption of fisheries and other secondary and tertiary sectors that support tourism, recreational, and other coastal economies</td><td>Section 8.4.3</td></tr>
<tr><td>5.7</td><td>Deterioration of cultural heritage links to the sea and coast</td><td>Section 8.4.4</td></tr>
<tr><td>5.8</td><td>Increase in Atmospheric Pollutants and associated Health Risks</td><td>Section 8.4.5</td></tr>
<tr><td>5.9</td><td>Contribution to GHG emissions</td><td>Section 8.4.5</td></tr>
</table>

8.4.1 Potential Impacts on Marine and Coastal Ecology

One of the potentially most significant impacts associated with the proposed appraisal drilling (normal operations) relates to the physical disturbance and / or smothering of vulnerable or sensitive hardground benthic communities during spudding and the discharge of drill cuttings. In addition to the smothering impact, benthic and pelagic fauna may also suffer indirect toxicity and bioaccumulation effects due to leaching of potentially toxic additives from the drilling fluids. The discharge of produced water, as well as hydrocarbon ‘drop out’ from inefficient combustion of hydrocarbons during flaring, can also add to these toxic effects on marine fauna.

Underwater noise generated by the “project” vessels and drilling (non-impulsive noise), as well as VSP operations (impulsive noise), could further impact marine fauna in number of different ways, including physiological injury (permanent or temporary), disturbance and / or behavioural changes. Operational lighting, as well as the intense lighting from flaring, would increase ambient lighting in offshore areas at night, which may also disturb and disorientate marine fauna in the area.

Helicopters operations between the drilling unit and the onshore helicopter base may fly over or be in proximity to sensitive coastal receptors, such as key faunal breeding/feeding areas, and bird or seal colonies. Although exposure will be limited and be of a temporary nature while the helicopter passes overhead (site specific), indiscriminate or direct low altitude flying over seabird and seal colonies or breeding cetaceans could impact fauna behaviour and breeding success.

Further to the potential impacts related to normal operations, various unplanned events will be assessed. The greatest environmental threat from offshore drilling operations, although highly unlikely, is a major spill of crude oil and/or natural gas occurring either from a loss of well control or well blow-out, which could severely impact the offshore and coastal environments.

How the potential impacts will be addressed in the ESIA:

A *marine ecology impact assessment* will be commissioned to assess the potential impacts on the marine and coastal environment during normal drilling operations and upset conditions (faunal strikes, small accidental spills and large blow-out). This study will not only consider the potential impacts on the various faunal groups and sensitive marine areas, but will also consider potential ecosystem-wide effects of the proposed appraisal drilling. The terms of reference for this assessment are presented in Section 9.1.2.

Outputs from the *technical modelling studies* (see Section 9.1.1) will be used to assess the potential impacts related to the discharge of drill cuttings and associated muds, increased underwater noise (zones of impact related to non-impulsive and impulsive noise), and a large oil spill associated with a well blow-out on the marine ecosystem and biota.

The drilling discharges modelling study will use the available metocean data to model the dispersion and concentration of drilling cuttings and associated mud discharges to determine the thickness, extent and toxicity of deposited material on the seabed and in the water column. These outputs will then be used to determine the potential overlap of the deposition footprint and sediment plume with marine receptors, including sensitive marine areas.

The underwater noise modelling study will aim to, *inter alia*, describe the likely background noise levels, determine noise transmission loss with distance from the drill site, and zones of impact for relevant faunal groups relating to injury (permanent or temporary) and behavioural disturbance. These zones of impact represent the worst-case consideration and will reduce logarithmically with decreased exposure time.

Considering the impacts related to an unlikely oil spill, various oil spill scenarios will be modelled for the appraisal drilling activities, considering a worst-case scenario of crude oil (although both gas condensate and/or oil could be encountered). The modelling will compute the fate and weathering of oil and gas, its potential surface extent and probability of shoreline oiling. This modelling will also provide a preliminary indication of the effectiveness of both surface and subsea response, which will guide the final response strategy and associated resources.

8.4.2 Potential Impacts on Commercial and Small-Scale Fisheries

The implementation of the 500 m safety zone around the drilling unit (or larger if drilling unit is anchored) will effectively exclude fishing from a relatively small area around the drilling unit (up to three months per well). Considering the historical fishing effort and catch of all fisheries operating off Namibia, four sectors directly overlap with Block 2814A and thus may be impacted by the implementation of the safety zone is the large pelagic longline fishery (see Section 7.7.9.3). No other sectors (including small-scale fishing) have historically shown to have operated in the area. In addition to the potential exclusion impact, the sediment plume from drilling discharges and elevated noise levels from drilling activities could result in behavioural changes causing fish to be displaced from known fishing grounds, potentially resulting in reduced catch and/or increased fishing effort. The fishing sectors potentially impacted by the sediment plume and increased underwater noise would depend on the extent of behavioural disturbance, which would need to be determined through the technical modelling studies.

The potential impacts of an unlikely oil spill on fishing will be assessed in the ESIA. Crude oil spilled in the marine environment will have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality of marine fauna or affecting faunal health. An oil spill can also result in several indirect impacts on fishing, including:

- Exclusion of fisheries from polluted areas and displacement of targeted species from normal feeding / fishing areas, both of which could potentially result in a loss of catch and / or increased fishing effort;
- Mortality of animals (including eggs and larvae) leading to reduced recruitment and loss of stock (e.g., mariculture); and
- Gear damage due to oil contamination.

How the potential impacts will be addressed in the ESIA:

A *fisheries impact assessment* will be commissioned to, *inter alia,* confirm the historical fishing effort and catch off south Namibia within the area of influence and to assess the impact of the proposed activities on these sectors, with input from the technical modelling studies. The terms of reference for the fisheries impact assessment are presented in Section 9.1.2.2. As noted for the marine ecology assessment above, outputs from the *technical modelling studies* will be used to inform the fisheries assessment (see Section 9.1.1).

In addition, a *socio-economic impact assessment* will be undertaken, which will assess the impacted related to any disruption of fisheries. The terms of reference for the socio-economic impact assessment are presented in Section 9.1.2.4. The level of information given to the economic aspects of potential impacts and benefits on environmental and social receptors is considered adequate to inform the assessment of impacts and to inform decision-making in this regard.

8.4.3 Potential Impacts on the Socio-Economic Environment

The proposed activities would result in some temporary socio-economic benefits associated with the procurement of local goods and services, employment of some local staff and contractors and State income from taxes and levies.

Potential socio-economic impacts could be associated with any reduction in income if fishing is materially affected, any impacts on the social fabric from the presence of “project” staff travelling to and from site and the logistics base. In the unlikely event of a major spill, socio-economic impacts could be associated with a reduction in livelihoods and income, should these be affected.

How the potential impacts will be addressed in the ESIA:

A *socio-economic impact assessment* will be commissioned to, *inter alia*, provide an overview of the social context of the proposed activities and determine the potential socio-economic impacts and benefits associated with the proposed appraisal drilling activities, including unplanned events. This assessment will draw on information provided by the related *technical modelling and specialist studies*. The terms of reference for the socio-economic impact assessment are presented in Section 9.1.2.4.

8.4.4 Potential Impacts on Cultural Heritage

Intangible cultural heritage relates primarily to ritual and spiritual valuations and relations with the elements (wind, water, fire), ritual practices (ancestral veneration) and beliefs (natural-spiritual beliefs in the water sourcing / bearing deities). Intangible cultural heritages of Namibia are complex and influenced by ancient histories of the San peoples and their social-ecological relations with nature, the histories of the Ovahimba, Herero and Ovambo peoples, as well as those people coming into Namibia from Angola.

Well drilling will result in some disturbance of physical elements, such as drilling on portions of the seafloor (which are small relative to the overall block or offshore area), discharges to the water column (including cuttings and drilling fluids) and underwater noise, which could potentially affect peoples’ spiritual connectivity with those elements and associated aspects, such as ancestral connections, which in turn may affect peoples’ customs, sense of place, wellbeing or rituals.

How the potential impacts will be addressed in the ESIA:

The potential impacts on indigenous people’s rights and their religious and ritual connections to the coast and sea during normal drilling operations and upset conditions (well blow-out) will be assessed in the ESIA. This assessment will be based on the findings of a recent study to assess potential cultural heritage impacts of the proposed activities. A standalone study will not be undertaken.

8.4.5 Potential Impacts on Air Quality and Climate Change

The proposed well drilling activities will generate air emissions through the operation of the drilling unit, movement of vessels and helicopters, and flaring during well testing (if a hydrocarbon resource is found). The release of gaseous pollutants (principally nitrogen oxides, sulphur oxides, carbon monoxide, particulate matter and non-methane volatile organic compounds) from related activities has the potential to impact local air quality close to the emissions source, which may in turn have negative effects on human health (e.g., respiratory effects).

In addition, some of the gaseous pollutants (mainly carbon dioxide, methane and nitrous oxide) contribute to global GHG emissions, which are the primary driver of changes in the global climate system (increased temperatures, changing weather patterns and sea level rise).

Further to the potential emissions related to normal operations, there would also be fugitive emissions in the unlikely event of a well blow-out. Natural gas (predominantly methane) could be released during a well blow-out, in addition to the combustion emissions related to any response efforts (vessels and helicopters).

How the potential impacts will be addressed in the ESIA:

An *air emissions impact assessment* will be undertaken to establish an emissions inventory of key emission sources (including fuel combustion and flaring during normal operations) and determine the ground-level impacts of emissions using dispersion modelling. On completion of the dispersion modelling, the impact of particulate and gaseous emissions on the receiving environment will be assessed through comparison of calculated ambient concentrations with national standards and international guidelines, as applicable. This assessment will also establish an emissions inventory of an unplanned event and assess the potential impact thereof. The terms of reference for this study are presented in Section 9.1.2.5.

Further to the above, a *climate change risk assessment* will be commissioned for the proposed appraisal drilling (not production). The aim of this study will be to quantify the annual GHG emissions generated during normal operations and an unplanned event and assess (i) the potential risk of a changing climate to the proposed activities, (ii) the potential implications of climate change for “project-affected” communities and natural ecosystems, and (iii) the potential of the proposed activities to contribute to the build-up of GHGs in the atmosphere. The terms of reference for this study are presented in Section 9.1.2.6.

9.0 Terms of Reference for Detailed Assessment

An overview of the ESIA and public consultation process, highlighting each phase and corresponding activities, is provided in Chapter 3.0 and 4.0, respectively. An outline of the planned specialist investigations is included in Section 9.1 below.

The specialist findings, mitigation, recommendations and other relevant information will be integrated into an ESIA Report and ESMP. The ESMP will provide recommendations on how to establish, operate, maintain and close the proposed activities throughout all relevant phases of the activities. The aim of the ESMP will be to ensure that the proposed activities are managed to avoid or reduce potential negative environmental impacts and enhance potential positive environmental impacts. The ESMP will detail the impact management objectives, outcomes and actions as required, the responsibility for implementation and the schedule and timeframe. Requirements for monitoring of environmental aspects, as well as compliance monitoring and reporting, will also be detailed.

Future consultations that will be undertaken during the Impact Assessment Phase is summarised in Section 4.3.

9.1 Technical and Specialist Studies to be Undertaken

The terms of reference for the technical modelling studies and the specialist studies are presented in Section 9.1.1 and 9.1.2 below. These terms of reference have been designed to address all the issues that have been identified by the ESIA project team.

The technical modelling studies (noise, drilling discharges and oil spill) will not assess any potential impacts as such, but rather provide supporting information for use in the other specialist studies, which will review and interpret data relevant to identifying and assessing environmental and social impacts that might occur as a result of the proposed appraisal activities in their particular field of expertise.

The specialist studies will provide baseline information, and identify and assess impacts according to predefined impact assessment criteria (see Section 9.2). Specialists will apply the mitigation hierarchy by identifying and recommending actions in sequential order of priority by first seeking to avoid impacts and where avoidance is not possible suggest ways in which negative impacts could be mitigated and benefits could be enhanced.

The results of the technical modelling and specialist studies will be integrated into the Draft ESIA Report. Three technical modelling studies and five specialist studies will be commissioned to address the key issues that require further investigation and detailed assessment.

9.1.1 Technical Modelling Studies

9.1.1.1 Drilling Discharges Modelling

The specific terms of reference for the underwater oil drilling discharges study are as follows:

- Provide a description of the metocean conditions, such as winds and ocean currents in Block 2814A.
- Model the transport, dispersion and bottom deposition of drill cuttings and associated mud discharged during drilling operations based on two drill discharge locations at varying depths using the DREAM (Dose-related Risk and Exposure Assessment

Model)[24] and PARTRACK[25] model. The following criteria will be considered for the selection of discharge locations (release locations for the modelling study) leading to worst case scenarios:
    - Distance from the coast;
    - Water depth;
    - Proximity of protected areas (including MPAs and EBSAs); and
    - Metocean dataset.
- Modelling parameters should include aspects such as type and quantity of drilling fluids used and constituents, depth of discharge and volume of cuttings.
- Present results in relation to the drilling area and include the assumptions, modelling parameters and any limitations of the modelling exercise. Modelling output to include:
    - Cumulative risk of drilling operations throughout the water column;
    - Main contributors to the risk of drilling operations in the water column and sediments;
    - Maximum discharge concentrations for main contributors and cuttings in the water column and sediments; and
    - Potential risk, cumulative thickness deposit, grain size change, contaminant concentration in sediments.

Details on the relevant parameters and assumptions used in the drilling discharges modelling study will be provided in the Assessment Phase.

9.1.1.2 Oil Spill Modelling

The specific terms of reference for the underwater oil spill modelling study are as follows:

- Provide a description of the metocean conditions, such as winds and ocean currents in Block 2814A.
- Model the trajectory and fate of a 30-day gas and crude oil blow-out (stochastic and deterministic) for a 90-day period based on two spill locations (one gas and one oil) at varying depths using the Oil Spill Contingency and Response (OSCAR)[26] modelling tool. The following criteria will be considered for the selection of discharge locations (release location for the modelling study) leading to worst case scenarios:
    - Distance from the coast;
    - Water depth;
    - Proximity of sensitive areas (including MPAs and EBSAs); and
    - Metocean dataset.

[24] DREAM calculates the physical/chemical fates of the various compounds in the discharge in three dimensions plus time. The model includes processes like near-field mixing, dilution in the sea due to currents and turbulence, and biodegradation of organic compounds in the discharge. The model can include hundreds compounds simultaneously in the discharge and multiple release locations.

[25] PARTRACK is a model that simulates the release of drilling muds, cuttings, and chemicals from offshore drilling units. Given model inputs such as ambient currents and densities, chemical and physical properties of the effluent, and details of the release scenario, PARTRACK simulates the release and spreading of the effluent within a 3D ocean grid.

[26] OSCAR computes the fate and weathering of oil, in order to simulate the oil's drift, concentration and extent, on the sea surface and/or the shoreline. This tool offers the means to quantify potential environmental impacts caused by hydrocarbons spills and to identify the appropriate spill response strategy (dispersants, containment and mechanical recovery). OSCAR uses surface spreading, advection, entrainment, emulsification, and volatilization algorithms to determine the transport and fate of the oil on the surface.

- Model two spill scenarios (with and without spill response) over four seasons (with 5 years representative metocean dataset) to be modelled for each drill location.
- Present modelled surface and shoreline oiling results as graphical outputs in relation to the drilling area and include the assumptions, modelling parameters and any limitations of the modelling exercise. Modelling output to include:
    - Surface and shoreline oiling probability.
    - Surface minimum arrival time (days).
    - Shoreline concentration after 60 days.
    - Water column contamination probability.
    - Oil fate comparison graphs / diagrams of different oil spill responses.

Details on the relevant parameters and assumptions used in the oil spill modelling study will be provided in the Assessment Phase.

9.1.1.3 Underwater Noise Modelling

The specific terms of reference for the underwater noise modelling study are as follows:

- Identify significant sources of underwater noise in relation to those operation activities and quantify the typical noise characteristics of these sources (such as the source level, the frequency content and the temporal characteristics, etc.).
- Investigate the baseline underwater noise environment based on a review of available baseline noise data for the area of interest, or relevant metocean data (e.g., current, wind, etc.) when the noise measurement data are not available.
- Establish noise exposure assessment criteria for the identified marine fauna species to be assessed, based on applicable guidelines or regulatory requirements.
- Undertake detailed marine noise modelling predictions for two well locations (worst-case shallow water and deep water locations) as outlined below:
    - For the VSP airgun array, the source levels are proposed to be modelled using the Gundalf Designer software package, including the far-field signatures, directivities and beam patterns;
    - For the drilling operations, the source levels for the proposed drilling rig and supporting vessels are proposed to be derived using empirical formula based on the detailed specifications of the drilling rig and supporting vessels.
    - For broadband noise propagation, transmission loss is proposed to be modelled using the fluid parabolic equation modelling algorithm RAMGeo at one-third octave band central frequencies;
    - The received levels as a function of range, depth and frequency are then to be obtained via combination of source spectral levels and transmission loss modelling results; and
    - Cumulative sound exposure level (SELcum) modelling prediction is to be performed considering relevant cumulative operational characteristics (such as exposure duration, VSP discharges, etc.), in line with the “Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area” guidelines.
- Undertake post-processing and analysis of the above modelling results to derive relevant zones of impact, which are to be used for further noise impact assessment.
- Details on the relevant parameters and assumptions used in the underwater noise modelling study will be provided in the Impact Assessment Phase.

9.1.2 Specialist Studies

9.1.2.1 General Terms of Reference for the Specialist Studies

The following general terms of reference will apply to the specialist studies:

- Describe the receiving environment and baseline conditions that exist in the study area and identify any sensitive areas that will need special consideration.
- Review the Scoping Comments and Responses Report to ensure that all relevant issues and concerns relevant to fields of expertise are addressed.
- Identify and assess potential impacts of the proposed activities and infrastructure, including any associated cumulative impacts.
- Describe the legal, permit, policy and planning requirements.
- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts.
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty).
- Where necessary apply the precautionary principle to the assessment of impacts.
- Identify management and mitigation actions using the Mitigation Hierarchy by recommending actions in order of sequential priority. Avoid first, then reduce/minimise, then rectify and then lastly offset.
- Identify alternatives that could avoid or minimise impacts.
- Determine significance thresholds for limits of acceptable change.
- Where applicable, specialists shall use the assessment method for impact prediction and assigning significance (see Section 9.2).

9.1.2.2 Marine Ecology Impact Assessment

The terms of reference for the marine fauna impact assessment are as follows:

- Provide a general description of the benthic environment in the Benguela System along the central and southern Namibian coast, based on current available literature.
- Describe the coastal and offshore habitats that are likely to be affected by appraisal activities.
- Identify sensitive habitats and species that may be potentially affected by the proposed appraisal activities.
- Describe seasonal and migratory occurrences of key marine fauna.
- Identify, describe and assess the significance of potential impacts of the proposed appraisal programme on the local marine fauna, focussing particularly on the benthic environment, but including generic effects on cetaceans, turtles, seals, fish and pelagic invertebrates. The assessment is to consider both planned activities (normal operation) and unplanned events.
- Identify practicable mitigation measures to reduce the significance of any negative impacts and indicate how these can be implemented during the execution of appraisal programme.

9.1.2.3 Fisheries Impact Assessment

The terms of reference for the commercial fisheries impact assessment are as follows:

- Provide a description of the fisheries sectors operating in southern Namibian coastal waters, focusing on the area of influence.
- Undertake a spatial and temporal assessment of recent and historical fishing effort and catch in the licence area.
- Use available data to describe natural variability in historical trends and check monthly catches for seasonality.
- Assess the risk of impact of the appraisal activities on specific commercial fish species and the consequential implications for fish catch by the different fishing sectors.
- Assess the potential impacts of normal operations and upset conditions (small accidental spills and large blow-out) on the fishing activities in terms of estimated catch and effort loss.
- Identify practicable mitigation measures to reduce any negative impacts on the fishing industry.

9.1.2.4 Socio-economic Impact Assessment

The specific terms of reference for the socio-economic impact assessment are as follows:

- Provide a social and economic baseline for the areas potentially affected by the proposed land-based activities (e.g., possible logistics bases which may be used for the proposed activities) using available data. This should be tailored to the extent of potential linkages and impacts of the proposed activities with the local population and nearby communities.
- Identify and assess the likely socio-economic impacts and benefits associated with the proposed appraisal drilling activities (normal operations) and an unplanned event (well blow-out), including direct, indirect and induced impacts. Quantify potential benefits and impacts of the proposed activities on the wider economy and specific relevant sectors.
- Provide practical and reasonable mitigation measures to reduce predicted social impacts, as well as recommendations for the enhancement of social benefits.

The level of information given to the economic aspects of potential impacts and benefits on environmental and social receptors is considered adequate to inform the assessment of impacts and to inform decision-making in this regard.

9.1.2.5 Air Emissions Impact Assessment

The specific terms of reference for the GHG emissions assessment and air emissions estimation and dispersion modelling are as follows:

- Undertake a desktop review of the relevant local air quality legislation and international guidelines.
- Establish an emissions inventory from key emissions sources, including fuel combustion and non-routine flaring, as well as an unplanned event (well blow-out), using published emission factors. The pollutants of focus include sulphur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), non-methane volatile organic compounds (NMVOC) and particulate matter (PM).

- Undertake dispersion modelling for a single flaring scenario (worst-case) using the SCREEN3 model[27] to simulate downwind impacts of the pollutants list above. Based on estimated air emissions, predict concentrations of criteria pollutants at closest shoreline.
- Assess the potential impact of particulate and gaseous emissions of normal operations and an unplanned event (well blow-out) on the receiving environment through comparison of calculated ambient concentrations with national standards and international guidelines, as applicable.
- Identify practicable air quality management and mitigation measures to reduce any negative impacts.

9.1.2.6 Climate Change Risk Assessment

The specific terms of reference for the climate change risk assessment are as follows:

- Provide a broad overview of the relevant Namibian legislation, international guidelines and standards. This review will highlight any references to offshore oil and gas in the relevant climate-related policies and legislation.
- Provide a brief overview of the latest climate data to identify climate-related natural hazards, such as cyclones, which could adversely affect the proposed activities, as well as the observed and projected changes in climate. The climate variables that will be considered in the assessment include mean near surface air temperature, precipitation, mean temperature of the sea surface level, sea currents, and mean sea level.
- Provide a brief overview of Namibia’s national GHG inventory, Nationally Determined Contribution, and Biennial Update Report to understand the country’s current and future contribution to the build-up of GHGs in the atmosphere. This review will highlight Namibia’s national climate change commitments with respect to GHG emissions reductions.
- Quantify the GHG emissions, including material sources of direct (mobile combustion, stationary combustion, and venting) and indirect emissions (i.e., purchased energy) generated during the construction and operational phases. The quantification will include the GHG emissions from mobile combustion (i.e., drilling unit, supply vessels, helicopter), venting (i.e., gases entrained in drilling fluids), flaring (i.e., combustion of oil and gas), and well blow-out (i.e., unplanned event).
- Provide a qualitative assessment of the physical (i.e., related to physical impacts of climate change) and transitional risks (i.e., impacts related to the transition to a lower-carbon economy) to the proposed activities, as well as the opportunities that may arise from the transition to a lower carbon economy. The climate risks to the proposed activities will be assessed in terms of impact and likelihood. The impact of the GHG emissions generated will be assessed in terms of pre-defined thresholds and the contribution to Namibia’s national GHG emissions.
- Provision of high-level adaptation measures to mitigate the risks of climate change to the proposed activities, as well as high-level measures for mitigating the potential GHG emissions.

[27] SCREEN3 is the US EPA’s screening level dispersion model that estimates worst-case impacts of ground-level concentrations for a single emission source. SCREEN3 is recognised by South Africa’s Modelling Regulations as a Level 1 screening tool to examine a full range of meteorological conditions, including standard stability classes and wind speeds, to determine maximum ambient impacts.

9.2 Proposed Method for Assessing Impact Significance

This section sets out the approach and method for the assessment of impacts for the Project and defines the terminology applied and the steps used to evaluate impact significance.

9.2.1 Approach to Impact Assessment

The identification and assessment of environmental and social impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental and social impacts associated with a proposed activities. Impacts are identified throughout the ESIA process by independent environmental and social assessment practitioners, from specialist studies and public participation, and refined using available baseline information, modelling data and design information.

For potentially significant impacts or those of stakeholder concern, the impact identification and evaluation process involves the following main steps:

Step 1: Define the Area of Influence

The area of influence associated with the proposed activities is defined as a basis for defining the boundaries for baseline data gathering by taking into consideration the spatial extent of potential direct and indirect impacts of the proposed activities. Direct impacts of the proposed activities are typically located within a smaller area around the proposed activities (i.e. in the direct area of influence), while indirect impacts typically extend across a wider area and often relate to the socio-economic sphere of influence. The area of influence will possibly be reassessed in the Impact Assessment Phase based on the oil spill modelling results.

Step 2: Identification of Potential Impacts

Potential impacts (both positive and negative) of a proposed activities are identified through a process of examining the potential for interactions between proposed activities and environmental and social receptors (or features). This requires consideration of the range of proposed activities across different phases of the "project" (planning, exploration / appraisal, construction, operation and decommissioning) and the potential for interactions on each of the environmental receptors, features or aspects occurring in the area of influence. The results are then presented in an 'environmental and social interaction matrix' format (see Table 8-1). For each proposed activity, the degree of interaction is rated through colour coding the level and type of interaction in the matrix. This matrix approach to impact identification is designed to highlight where interactions may occur as a way of focussing the impact assessment.

Step 3: Compile Impacts – Aspects Register

An impacts-aspects register (see Table 8-2) is typically prepared during the Scoping Phase as a basis for further elaborating the potential impacts identified through the initial impact identification stage. For each of the proposed activities, different aspects associated with the activity and their potential impacts are tabulated. This systematic approach provides a basis for planning the scope of specialist studies to ensure the correct information is obtained to conduct a detailed assessment of the potential impacts. It also enables identification of the linkages between different specialist scopes and overlapping impacts, and where there are interdependencies on data and reporting to enable an integrated impact assessment. For instance, social specialists are typically reliant on other specialists for inputs such as water quality, air quality or noise effects and this needs to be factored into work scopes and scheduling. The presentation of an Impacts-Aspects Register further provides stakeholders with a degree of confidence that the specialists and environmental assessment practitioners have adequately identified potential impacts at an early stage.

Step 4: Impact Evaluation

Evaluation of impact significance follows a stepwise process as set out below. Part A (Table 9-6) provides the definition for determining impact consequence (combining intensity, extent, and duration) and impact significance (combining consequence and probability). Impact consequence and significance are determined from Part B (Table 9-2) and Part C (Table 9-3), respectively. The interpretation of the impact significance is given in Part D (Table 9-4). This methodology is utilised to assess both the potential incremental and cumulative related impacts.

Table 9-1: Criteria and Definitions for Determining Consequence and Significance

PART A: DEFINITIONS AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, extent, and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VL**	• Negligible change, disturbance, or nuisance with very minor consequences or deterioration. • Targets, limits, and thresholds of concern never exceeded. • Species or habitats with negligible importance.
	L	• Minor (Slight) change, disturbance, or nuisance with minor consequences or deterioration. • Targets, limits, and thresholds of concern rarely exceeded. • Habitats and ecosystems which are degraded and modified.
	M	• Moderate change, disturbance, or discomfort with real but not substantial consequences. • Targets, limits, and thresholds of concern may occasionally be exceeded. • Habitats or ecosystems with important functional value in maintaining biotic integrity.
	H	• Prominent change, disturbance, or degradation with real and substantial consequences. • May result in illness or injury. • Targets, limits, and thresholds of concern regularly exceeded. • Habitats or ecosystems which are important for meeting national/provincial conservation targets.
	VH	• Severe change, disturbance, or degradation with severe consequences. • May result in severe illness, injury, or death. • Targets, limits, and thresholds of concern are continually exceeded. • Habitats or ecosystems of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds.
	VL+	• Negligible change or improvement. • Almost no benefits. • Change not measurable/will remain in the current range.
	L+	• Minor change or improvement.

PART A: DEFINITIONS AND CRITERIA		
		• Minor benefits. • Change not measurable/will remain in the current range.
	M+	• Moderate change or improvement. • Real but not substantial benefits. • Will be within or marginally better than the current conditions.
	H+	• Prominent change or improvement. • Real and substantial benefits. • Will be better than current conditions.
	VH+	• Substantial, large-scale change or improvement. • Considerable and widespread benefit. • Will be much better than the current conditions.
Criteria for ranking the DURATION of impacts	**Very Short term**	Very short, always less than a year or may be intermittent (less than 1 year). Quickly reversible.
	Short term	Short term occurs for more than 1 but less than 5 years. Reversible over time.
	Medium term	Medium-term, 5 to 10 years.
	Long term	Long term, between 10 and 20 years. Likely to cease at the end of the operational life of the activity or because of natural processes or by human intervention.
	Permanent	Very long, permanent, +20 years. Irreversible. Beyond closure or where recovery is not possible either by natural processes or by human intervention.
Criteria for ranking the EXTENT of impacts	**Within/ near site**	The impact is limited to the immediate footprint of the activity and the nearby vicinity.
	Local	The impact goes beyond the site footprint but is confined to a localised area / project surroundings / remains within a habitat or vegetation type or local (municipal) administrative boundary.
	Regional	The impact goes well beyond the site footprint and is regional but remains within an ecosystem or regional (district/province) administrative boundary.
	Inter-regional	The impact affects several regions, e.g. several ecosystems or regional administrative units.
	National/ International	The impact extends to a national scale and/or beyond.

Table 9-2: Determining Consequence

PART B: DETERMINING CONSEQUENCE – APPLIES TO POTENTIAL POSITIVE OR ADVERSE IMPACTS						
		EXTENT				
		Within/near site	Local	Regional	Inter-regional	National/ International
INTENSITY = VL						
DURATION	Very short term	Very Low	Very Low	Very Low	Low	Low
	Short term	Very Low	Very Low	Low	Low	Medium
	Medium term	Very Low	Low	Low	Medium	Medium
	Long term	Low	Low	Medium	Medium	Medium
	Very long term/permanent	Low	Medium	Medium	Medium	High
INTENSITY = L						
DURATION	Very short term	Very Low	Very Low	Low	Low	Medium
	Short term	Very Low	Low	Low	Medium	Medium
	Medium term	Low	Low	Medium	Medium	Medium
	Long term	Low	Medium	Medium	Medium	High
	Very long term/permanent	Medium	Medium	Medium	High	High
INTENSITY = M						
DURATION	Very short term	Very Low	Low	Low	Medium	Medium
	Short term	Low	Low	Medium	Medium	Medium
	Medium term	Low	Medium	Medium	Medium	High
	Long term	Medium	Medium	Medium	High	High
	Very long term/permanent	Medium	Medium	High	High	High
INTENSITY = H						
DURATION	Very short term	Low	Low	Medium	Medium	Medium
	Short term	Low	Medium	Medium	Medium	High
	Medium term	Medium	Medium	Medium	High	High
	Long term	Medium	Medium	High	High	High
	Very long term/permanent	Medium	High	High	High	Very High
INTENSITY = VH						
DURATION	Very short term	Low	Medium	Medium	Medium	High
	Short term	Medium	Medium	Medium	High	High
	Medium term	Medium	Medium	High	High	High
	Long term	Medium	High	High	High	Very High
	Very long term/permanent	High	High	High	Very High	Very High

Table 9-3: Determining Significance

PART C: DETERMINING SIGNIFICANCE - APPLIES TO POSITIVE OR ADVERSE IMPACTS						
		CONSEQUENCE				
		Very Low	**Low**	**Medium**	**High**	**Very High**
PROBABILITY (of exposure to impacts)	**Unlikely**	Insignificant	Insignificant	Very Low	Low	Medium
	Conceivable	Insignificant	Very Low	Low	Medium	High
	Possible/ frequent	Insignificant	Very Low	Low	Medium	High
	Probable/ likely	Very Low	Low	Medium	High	Very High
	Highly likely/ definite/ continuous	Very Low	Low	Medium	High	Very High

Table 9-4: Interpretation of Significance

PART D: INTERPRETATION OF SIGNIFICANCE		
Significance		**Decision guideline**
Insignificant		Inconsequential, not requiring any consideration.
Very Low	**Very Low +**	These beneficial or adverse impacts will not influence the decision. In the case of adverse impacts, mitigation is not required.
Low	**Low +**	These beneficial or adverse impacts are unlikely to influence the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Medium	**Medium +**	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.
High	**High +**	These beneficial or adverse impacts are considered to be very important considerations and must influence the decision. In the case of adverse impacts, substantial mitigation will be required.
Very High	**Very High +**	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.

9.2.2 Additional Assessment Criteria

Additional criteria that are taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process include:

- the degree to which impacts may cause irreplaceable loss of resources;
- the degree to which impacts can be avoided;
- the degree to which impacts can be reversed;
- the degree to which the impacts can be mitigated; and
- the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects

Definitions for these supporting criteria are indicated in Table 9-5 below.

Table 9-5: Categorisation and Description of Additional Assessment Criteria

Criteria	Rating	Description
Criteria for DEGREE TO WHICH AN IMPACT CAN BE REVERSED	**FULLY REVERSIBLE**	Where the impact can be completely reversed.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary.
	IRREVERSIBLE	Where the impact cannot be reversed and is permanent.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**NONE**	It will not cause irreplaceable loss.
	LOW	Where the activity results in a marginal effect on an irreplaceable resource.
	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for DEGREE TO WHICH IMPACT CAN BE AVOIDED	**HIGH**	The impact can be avoided through the implementation of preventative mitigation measures.
	MEDIUM	The impact cannot be avoided, but mitigation measures can reduce the significance.
	LOW	The impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
	NONE	The impact cannot be avoided, and consideration should be given to compensation and offsets.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**HIGH**	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
	MEDIUM	Mitigation is feasible and will may reduce the impact significance rating.
	LOW	Some mitigation is possible but will have a marginal effect in reducing the impact significance rating.
	NONE	No mitigation is possible, or mitigation, even if applied, would not change the impact.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS	**UNLIKELY**	There is a low likelihood of cumulative impacts arising.
	POSSIBLE	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects, either through interaction or in combination, can be expected.

9.2.3 Application of the Mitigation Hierarchy

A key component of this ESIA process is to explore practical ways of avoiding or reducing potentially significant impacts of the proposed activities. These are commonly referred to as mitigation measures and are incorporated into the “project” as part of the ESMP. Mitigation is aimed at preventing, minimising or managing significant negative impacts to as low as reasonably practicable and optimising and maximising any potential benefits of the proposed activities. The mitigation measures are established through the consideration of legal requirements, best practice industry standards and specialist input from the ESIA team.

The mitigation hierarchy, as specified in IFC Performance Standard 1, which is widely regarded as a best practice approach to managing risks, is based on a hierarchy of decisions and measures, as presented in Figure 9-1 and described in Table 9-6. This is aimed at ensuring that wherever possible potential impacts are mitigated at source rather than mitigated through restoration after the impact has occurred. Any remaining significant residual impacts are then highlighted, and additional actions are proposed.

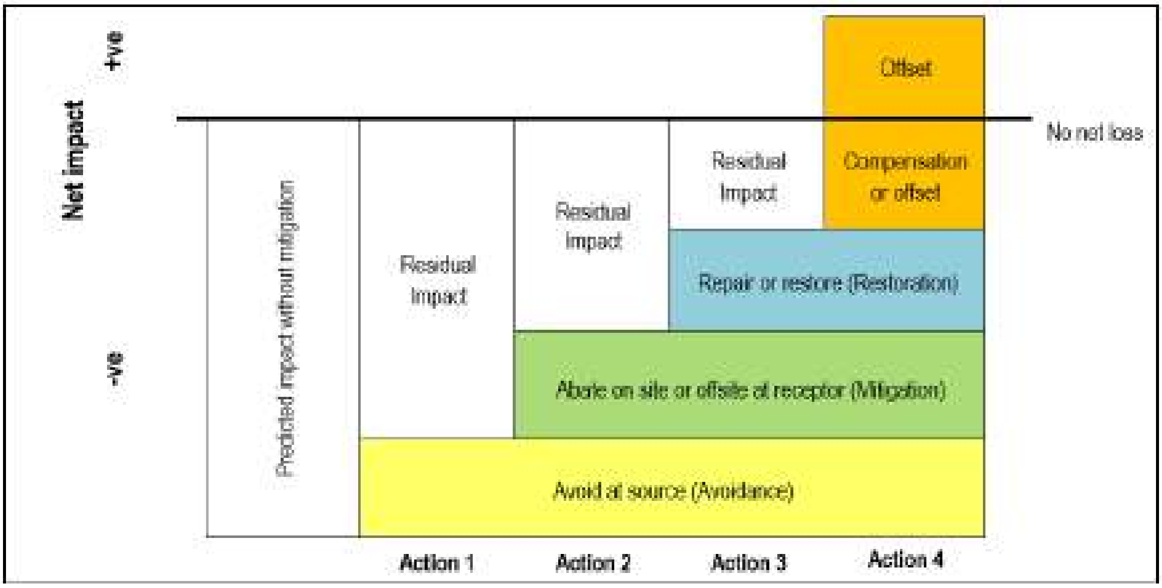

Figure 9-1: Mitigation Hierarchy

Adapted from: www.thebiodiversityconsultancy.com

Table 9-6: Sequential Application of the Mitigation Hierarchy

Avoid at Source	Avoiding or reducing at source is essentially 'designing' the Project so that a feature causing an impact is designed out (e.g., a waste stream is eliminated).
Abate on Site	This involves adding something to the basic design or procedures to abate the impact (often called 'end-of-pipe') or altered (e.g., reduced waste volume) and is referred to as minimisation Pollution controls fall within this category.
Abate Offsite/at Receptor	If an impact cannot be abated on-site, then measures can be implemented off-site – an example disposing of waste generated on-board at a proper waste facility onshore. Measures may also be taken to protect the receptor.
Repair or Restore	Some impacts involve unavoidable damage to a resource, e.g., shoreline pollution arising from an oil spill. Repair essentially involves restoration and reinstatement type measures, such as clean-up of the shoreline.
Compensate or Offset	Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate. An example could be compensation for loss of earnings if fisheries were to be permanently impacted by a Project activity.

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Appendix A Curricula Vitae of the SLR ESIA Project Team

Final Scoping Report

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Appendix B Public Participation Process Documents

Final Scoping Report

SLR

B.1 Stakeholder Database

B.2 Advertisements

B.3 Site Notices

B.4 IAP Notification Letters and emails

B.5 Non-Technical Summaries

B.6 Public Meeting Presentation

B.7 Meeting Minutes and Photographs of Public Meetings

B.8 I&AP correspondence received during the DSR comment period

B.9 Comments and Responses Report

Making Sustainability Happen