ESIA for Exploration Well Drilling in Block Deep Water Orange Basin off the West Coast of South Africa

Draft Scoping Report

Licence Block Deep Water Orange Basin, offshore West Coast, South Africa

Prepared for: TotalEnergies EP South Africa B.V.

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EXECUTIVE SUMMARY

1. INTRODUCTION

This Executive Summary provides a synopsis of the draft Scoping Report (DSR) prepared as part of the Environmental and Social Impact Assessment (ESIA) process that is being undertaken for an application to undertake exploration well drilling in Block Deep Water Orange Basin (DWOB) off the West Coast of South Africa (see Figure 1).

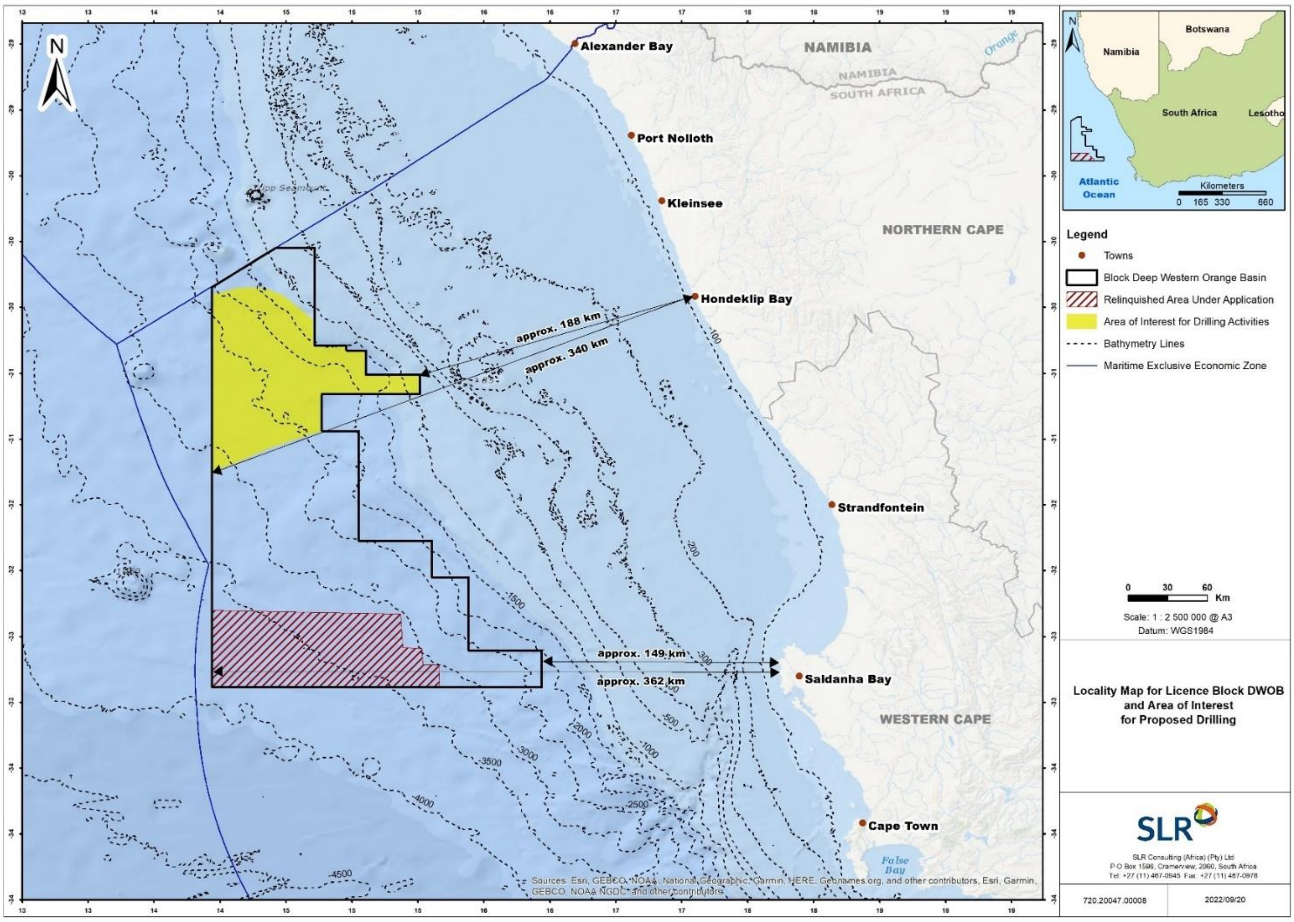

FIGURE 1: LOCALITY OF BLOCK DWOB AND THE AREA OF INTEREST FOR PROPOSED EXPLORATION DRILLING OFF THE WEST COAST

1.1 PROJECT BACKGROUND AND LOCATION

TotalEnergies EP South Africa B.V. (TEEPSA) and its partners hold an Exploration Right for the Deep Western Orange Basin (DWOB) Licence Block (12/3/343 ER), located off the West Coast of South Africa. TEEPSA is proposing to undertake various exploration activities within the DWOB Licence Block, including:

- Sonar bathymetry surveys throughout the year;
- Drop core sampling; and
- Exploration well drilling (including vertical seismic profiling).

TEEPSA proposes to drill one exploration well, and success dependent, up to nine additional wells in total within an Area of Interest within the Block (i.e., up to ten wells in total). The Area of Interest for exploration drilling is 9 711.21 km^2 in extent and is located offshore roughly between Port Nolloth and Hondeklip Bay, approximately 188 km from the coast at its closest point and 340 km at its furthest, in water depths between 1000 m and 3000 m. The DWOB Licence Block itself, however, is located in water depths between 400 m and 3 900 m (see Figure 1).

The proposed project triggers a number of listed activities in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), and as such requires an Environmental Authorisation before such activities can commence. TEEPSA, as the Operator of the Block, is the applicant for the Environmental Authorisation.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed as the independent Environmental Assessment Practitioner to undertake a full Scoping and EIA process for the proposed additional exploration activities (hereafter collectively referred to as "Environmental and Social Impact Assessment" or "ESIA" process).

1.2 OPPORTUNITY TO COMMENT AND ATTEND PUBLIC INFORMATION-SHARING MEETINGS

This draft Scoping Report is distributed for a 30-day comment period from **4 November to 5 December 2022**. It provides an opportunity for Interested and Affected Parties (I&APs) to comment on any aspect of the proposed project and the potential impacts identified for further investigation in the Assessment Phase.

Copies of the full report are available for review on the SLR website (**https://www.slrconsulting.com/en/public-documents/TEEPSA-DWOB**), a data free website (**https://slrpublicdocs.datafree.co/en/public-documents/TEEPSA-DWOB**) and at various locations (refer to specific details in the I&AP notification letter). In addition, the Non-technical Summary is available for collection at various locations (refer to the I&AP notification letter). The Non-technical Summary are also available on the above-mentioned websites as a document and audio recording. Any comments should be sent to SLR at the address, WhatsApp / SMS numbers or e-mail shown below. For comments to be included in the final Scoping Report, comments should reach SLR by **no later than 5 December 2022**.

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Stakeholders are also invited to attend public information-sharing meetings. Specific details of these meetings are provided in the I&AP notification letter.

2 ESIA PROCESS

In terms of the EIA Regulations 2014 (as amended), the proposed project requires Environmental Authorisation as it triggers the following listed activities:

- Listing Notice 1 (R.983 of 2014 as amended): 14, 17, 19A.
- Listing Notice 2 (R.984 of 2014 as amended): 4, 6, 7, 14, 18.

The ESIA process will thus be undertaken in compliance with the requirements of the National Environmental Management Act (No. 107 of 1998) and the EIA Regulations 2014 (as amended). The Department of Mineral Resources and Energy (DMRE) is the competent authority that is responsible for the granting or refusing of an Environmental Authorisation, while the Department of Forestry, Fisheries and Environment (DFFE) remains the appeal authority for such an authorisation. In terms of Section 70 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (as amended), various duties pertaining to petroleum exploration and production have been designated to Petroleum Agency of South Africa (PASA), as such PASA will review the ESIA documents and make a recommendation to DMRE.

The overall ESIA Process consists of two phases, namely the Scoping Phase and Impact Assessment Phase.

2.1 SCOPING PHASE

The purpose of the Scoping Phase is to communicate the scope of the proposed project to I&APs, to consider project alternatives, to identify the environmental and social aspects, potential impacts and their mitigation for further investigation and assessment, and to develop the plan of study for the Impact Assessment Phase, including technical / specialist studies to be conducted.

Key steps (excluding public consultation) that were undertaken during the Scoping Phase are summarised below:

- A pre-application meeting was held with PASA on 6 September 2022 to inform them of TEEPSA's proposed project and application for Environmental Authorisation, as well as to obtain agreement on the ESIA process.
- An Application Form for Environmental Authorisation and DFFE National Screening Tool were compiled and submitted to PASA.
- Specialist inputs into the description of the receiving (baseline) environment were provided by a marine ecologist, fisheries specialist and a social scientist.
- Preparation of this draft Scoping Report in fulfilment of Appendix 2 of the EIA Regulations 2014 (as amended), which presents detailed information on the proposed project and the receiving environment, identifies potential impacts and mitigation, describes the impact assessment approach and outlines the plan of study for the ESIA, including scope of the technical / specialist studies.
- Completion of the Scoping Phase will involve:
  - o An update of the draft Scoping Report to final version with stakeholder comments appended in a Comments and Responses Report; and
  - o Submission of the final Scoping Report to PASA for consideration and review. PASA will then make a recommendation on the acceptance or rejection of the report to DMRE, who will make the final decision. If the report is accepted, the project will proceed to the Impact Assessment Phase.

2.2 IMPACT ASSESSMENT PHASE

In fulfilment of Appendix 3 of the EIA Regulations 2014 (as amended), the tasks that will be undertaken during this phase are summarised below:

- *Technical Modelling and Specialist Studies*: Three technical and five specialist studies will be commissioned to assess the key potential impacts and identify mitigation measures. These include:
  - Technical Modelling Studies:
    - Drilling Discharges Modelling.
    - Oil Spill Modelling.
    - Underwater Noise Modelling.
  - Specialist Studies:
    - Marine Ecology Impact Assessment.
    - Fisheries Impact Assessment.
    - Socio-Economic Impact Assessment.
    - Cultural Heritage Impact Assessment.
    - Climate Change and Air Emissions Impact Assessment.

  In addition to those listed above, an independent peer review of the Drilling Discharges and Oil Spill Modelling studies will be undertaken.
- *Compilation of ESIA Report*: An ESIA Report, including an Environmental and Social Management Programme (ESMP) will be compiled based on the technical / specialist findings and other relevant information. The draft ESIA Report will be released for a 30-day review and comment period, including I&AP information feedback sessions.
- All registered I&APs will be notified of all public participation opportunities. All comments received will be incorporated and responded to in a Comments and Responses Report. The final ESIA Report will be submitted to PASA for consideration and review.
- *Decision and Appeal Period*: After review of the final ESIA, PASA will provide a recommendation to DMRE on whether or not to grant an Environmental Authorisation. After DMRE issues its decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision. A statutory appeal period in terms of the National Appeal Regulations, 2014 (GN No. R993) will follow the issuing of the decision, which allows for any registered I&AP to submit an appeal within 20 days of the date of notification of the decision.

3 PUBLIC PARTICIPATION

The requirements of the public participation process are set out in Chapter 6 of the EIA Regulations 2014 (as amended) and will be, as a minimum, adhered to during the current ESIA process. In addition, the public participation process will follow the public participation guidelines in terms of EIA Regulations (DEA 2017). The public participation steps that were undertaken during the Scoping Phase are summarised below:

- *Stakeholder Identification:* A preliminary I&AP database was compiled based on TEEPSA's existing databases for its South African offshore licence blocks, input from the Fisheries Specialist, DFFE and Civil Society Organisations, and additions from the Cultural Heritage baseline data collection.

- *Pre-Application Meeting with PASA:* A meeting was held with PASA on 6 September 2022 to provide notification of the proposed project and TEEPSA's intent to submit an application for Environmental Authorisation, as well as to consult on the ESIA process and PASA requirements.
- *Notification and Registration Letters*: All I&APs included on the initial project database were notified of the proposed project, application for Environmental Authorisation and ESIA process by means of a notification / registration letter (available in English, Afrikaans, IsiXhosa and Setswana).
- *Advertising:* Newspaper advertisements were placed in various local and regional newspapers in English, Afrikaans, IsiXhosa and Setswana.
- *Site notices*: Site notices (in English, Afrikaans, isiXhosa and Setswana) are to be placed at various locations in coastal towns /cities between Port Nolloth and Cape Town. The placement of the site notices are to target locations used for small-scale and recreational fishing and coastal tourism.
- Radio Announcements: Radio adverts will be aired to notify coastal users, including vulnerable and disadvantaged communities, of the proposed project, ESIA process, availability of the Draft Scoping Report and planned public meetings.
- *Availability of Scoping Report*: The draft Scoping Report has been released for a 30-day review and comment period from 4 November to 5 December 2022.
  - Reports have been made available on the SLR website, data free website (no data costs) and at various public venues.
  - Notification letters via e-mail were sent to all I&APs registered on the database with the Non-technical Summary (in English). The Non-technical Summary is also available in Afrikaans, isiXhosa and Setswana. Locations where the draft Scoping Report and Non-technical Summary have been placed for review are indicated in the I&AP notification letter.
  - In order to facilitate engagement during the Scoping phase and access to the draft Scoping Report, a cell phone number has been provided in all notifications indicating that SLR can be contacted via SMS or WhatsApp messaging.
- *Information-sharing Meetings: Various meetings (focus group and public) are planned during the draft Scoping Report disclosure period.*
- *I&AP comments and responses*: all issues raised by I&APs during the public participation process will be consolidated into a Comments and Responses Report which will be attached as an appendix to the final Scoping Report.

4 NEED AND DESIRABILITY

South Africa, like the rest of the world, is vulnerable to the climate change. There is thus global concern of the need to reduce Greenhouse Gas (GHG) emissions and achieve carbon neutrality by 2050. South Africa has a high dependency on fossil fuels and, as one of the top 20 global GHG emitters, will need to make substantial emission cuts. However, the rapid transition to carbon neutrality presents a potential risk to economic growth and sustainable development if not managed properly. South Africa is committed to a "just" transition to a net-zero carbon economy and climate resilient society (as per South Africa's Low-Emission Development Strategy and draft Nationally Determined Contribution), whereby the need to reduce emissions is balanced with the need to grow the economy, create jobs and develop skills, so that the needs of vulnerable groups are addressed.

The COVID-19 pandemic has deepened the economic crisis in South Africa and as a result, inequality is expected to widen and poverty to deepen. There is a drive from National Government to stimulate development and grow the economy of South Africa with a strong focus on job creation in all sectors, whilst protecting the environment. In order to facilitate this economic growth and reduce dependency on imported fuel products, there is a critical need to ensure that there is sufficient, stable capacity in the country’s energy supply by diversifying the primary energy sources within South Africa. In this regard, South Africa needs to balance the three core dimensions of what has been defined as the "energy trilemma": (1) affordability and accessibility, (2) energy security, and (3) environmental sustainability. In weighing up these core dimensions, the South African Government policy currently supports exploration for indigenous oil and gas resources and currently promotes the use of natural gas as part of the energy mix in the short- to medium-term up to 2030 (as per the Integrated Resource Plan (IRP) 2019).

The use of fossil fuels is, however, not aligned with other National and International policies and plans, which identify the need to reduce the reliance on fossil fuels for South Africa (and worldwide) to reduce its GHG emissions and meet its commitments in this regard. Notwithstanding the above, natural gas is included in the energy mix of the country to serve as a transition or bridge on the path to carbon-neutrality from 2050 onwards (as per the Paris Agreement) and provide the flexibility required to complement renewable energy sources (as per the IRP 2019). The "Just Transition and Climate Pathways Study" (NBI, 2021) concludes that a lack of gas supply threatens South Africa's decarbonisation strategy because the synfuels, power and industrial sectors would rely on carbon-intensive fuels (e.g., coal and diesel) for longer. In addition to the use of natural gas for electricity generation, the many other uses (e.g., transportation fuels, asphalt, and feedstocks for making chemicals, polyurethane, solvents, plastics, and other synthetic materials) will also need to see adaptation and mitigation during this transition period.

It is acknowledged that the proposed exploration project would not result in the production of oil and gas, but rather the generation of information on possible indigenous resources. By gaining a better understanding of the extent, nature and economic feasibility of extracting these potential resources, the viability of developing indigenous gas resources would be better understood. The proposed exploration project, as contemplated (i.e. not considering possible production), has no direct influence on South Africa’s reliance on fossil fuels and whether consumers use more or less oil or gas, nor on which types of fossil fuels contribute to the country's energy mix. The proposed exploration project will not necessarily change how fossil fuels are used in South Africa and has no direct influence on GHG emissions that would arise from the consumption of fossil fuels. These aspects are influenced by South Africa’s energy and climate change related policies, the financial costs of the various energy sources, and consumer choices in this regard.

The proposed exploration project will potentially lead to South Africa optimising its own indigenous resources to provide its identified oil and gas needs until the 2050 deadline to achieve carbon neutrality, rather than having to mainly import, as at present. It won’t necessarily change how fossil fuels are used in the short- to medium-term in the transition towards the goal of carbon neutrality by 2050. These National strategic policy issues relating to energy and climate change fall beyond the scope of this exploration project ESIA.

5 PROJECT DESCRIPTION

5.1 OVERVIEW OF PROPOSED PROJECT ACTIVITIES

The key components and activities of the proposed exploration activities are summarised in Table 1. Additional details regarding the proposed activities are provided in subsequent sections.

TABLE 1: SUMMARY OF KEY PROJECT COMPONENTS

Licence Block No.:	Deep Western Orange Basin (DWOB) Licence Block
Exploration Right No.:	12/3/343 ER
Exploration and Appraisal Well Drilling	
Number of exploration and appraisal wells	10 wells
Size of Area of Interest for proposed exploration drilling	9 711.21 km^2
Well depth (below seafloor)	Variable depending on depth of resource which is not currently known. A notional well depth of 3 500 m is assumed for the ESIA
Water depth range	• Water depth range of area of interest: 500 m to 3 500 m • Water depth range of most probable prospect(s): 1 000 m to 3 000 m
Duration to drill each well	• Mobilisation phase: up to 45 days • Drilling phase: o Exploration well: Up to three months o Appraisal well: Up to four months • Well plugging and abandonment: up to 15 days • Demobilisation phase: up to 10 days
Commencement of drilling and anticipated timing	Commencement is not confirmed, but possibly between first quarter of 2024 (Q1 2024) and fourth quarter of 2024 (Q4 2024) to drill first well.
Proposed drilling fluids (muds)	Water-based Muds (WBM) will be used during the first (riserless) drilling stage and Non-Aqueous Drilling Fluid (NADF) during the second (risered) drilling stage.
Drilling and support vessels	• Semi-submersible drilling unit or drillship • Three support vessels during mobilisation, riserless and demobilisation periods. Two during the risered phase. These vessels will be on standby at the drilling site, as well as moving equipment and materials between the drilling unit and the onshore base.
Operational safety zone	Minimum 500 m around drilling unit
Flaring[1]	Possibly, if hydrocarbons are discovered– up to 2 Drill Stem Tests (DST) per appraisal well, with each test taking up 2 days to flow and flare, 24-hours a day
Logistics base	Port of Cape Town, but alternatively at the Port of Saldanha

1 In the petroleum industry, flaring occurs during well testing to dispose of oil or gas in a safe and reliable manner through combustion in an open flame.

Logistics base components	Office facilities, laydown area, mud plant
Support facilities	Crew accommodation in Cape Town
Staff requirements:	• Specialised drilling staff supplied as part of the hire of drilling unit • Additional specialised international and local staff at logistics base
Staff changes	Rotation of staff every three to four weeks with transfer by helicopter to shore
Drop core sampling	
Purpose	Sampling of seabed sediment
Method	• Piston core • Box core
Number	20 cores
Duration	4 weeks
Location	Water depth < 3 500 m (no specific target identified)
Safety Zone	500 m
Sonar Surveys	
Purpose	Investigate the structure if the ocean bed sediments
Method	• Multi beam echo-sounder (70-100 kHz) • Single beam echo-sounder (38-200 kHz) • Sub-bottom profiler (2-16 kHz)
Duration/Extent	4 weeks/approximately 15 000 km^2
Location	Not confirmed but localised areas within the whole block
Safety zone	500 m

5.2 PRE-DRILLING SURVEYS

Pre-drilling surveys may be undertaken prior to drilling in order to confirm baseline conditions at the drill site and to identify and delineate any geo-hazards that may impact the proposed exploration drilling operations. Pre-drilling surveys may involve sonar surveys and sediment sampling.

5.2.1 SEABED CORING

Coring is undertaken to collect sediment samples in order to characterise the structure of the seafloor and for laboratory geochemical analyses. One of the main objectives is to determine if there is any naturally occurring hydrocarbon seepage at the seabed. TEEPSA is proposing to undertake coring within the Licence Block in water depths of less than 3 500 m. The duration of the sampling programme would be approximately 4 weeks and up to 20 samples would be taken.

5.2.2 SONAR SURVEYS

There are a number of different sonar surveying tools used for investigating the structure of the ocean bed sediment layers. For the planned sonar surveys, TEEPSA intend to use a multi beam echo-sounder, a single beam echo-sounder and/or a sub bottom profiler.

The selected equipment would be hull mounted on the survey vessel to image the seabed and the near surface geology. Although this type of survey typically does not require the vessel to tow any cables, it is "restricted in its ability to manoeuvre" due to the operational nature of this work.

Typical multi-beam echo sounders emit a fan of acoustic beams from a transducer at frequencies ranging from 40 kHz to 100 kHz and typically produces sound levels in the order of 230 dB re 1 µPa at 1 m. A typical sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 2 kHz to 16 kHz (38 to 200 kHz for a single beam echo-sounder).

The proposed sonar surveys would be undertaken in specific areas across the Licence Block with a cumulative footprint of approximately 15 000 km². It is anticipated that the data acquisition operation would take in the order of four weeks to complete.

5.3 EXPLORATION AND APPRAISAL WELL DRILLING

5.3.1 LOCATION, TIMING AND DURATION

- *Location:* The Area of Interest has been selected based on the analysis of available data. This area is 9 711.21 km^2 in extent and is located offshore roughly between Port Nolloth and Hondeklip Bay, approximately 188 km from the coast at its closest point and 340 km at its furthest, in water depths between 1 000 m and 3 000 m (see Figure 1).
- *Anticipated timing:* Commencement is not confirmed, but possibly between the first quarter of 2024 (Q1 2024) and third quarter of 2024 (Q3 2024) to drill first well.
- *Drilling duration:* It is expected that it would take approximately three to four months to complete the physical drilling and testing of each well (excluding mobilisation and demobilisation).

5.3.2 DRILL UNIT, VESSEL SUPPORT AND ONSHORE LOGISTICS BASE

- *Drilling Unit*: TEEPSA is proposing to utilise a semi-submersible drilling unit or a drill-ship, both with dynamic positioning system suitable for the deep-water harsh marine environment. A temporary 500 m safety zone 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 and helicopter transfers between the drilling unit and Cape Town International Airport.
- *Logistics base:* The primary onshore logistics base will most likely be located at the Port of Cape Town (preferred option), or alternatively at the Port of Saldanha.

5.3.3 DRILLING OPERATION

- *Final Drilling Site Selection:* Site selection will be based on further detailed analysis of the seismic and 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.

- *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 wellbore), 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 (see Figure 2).
    - *Initial (riserless) drilling stage:* At the start of drilling, a 36 or 42 inch hole will be drilled approximately 70 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 inches to a depth of approximately 1 070 m. These initial hole sections 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 wellbore.
    - *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 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, 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 and discharged overboard.

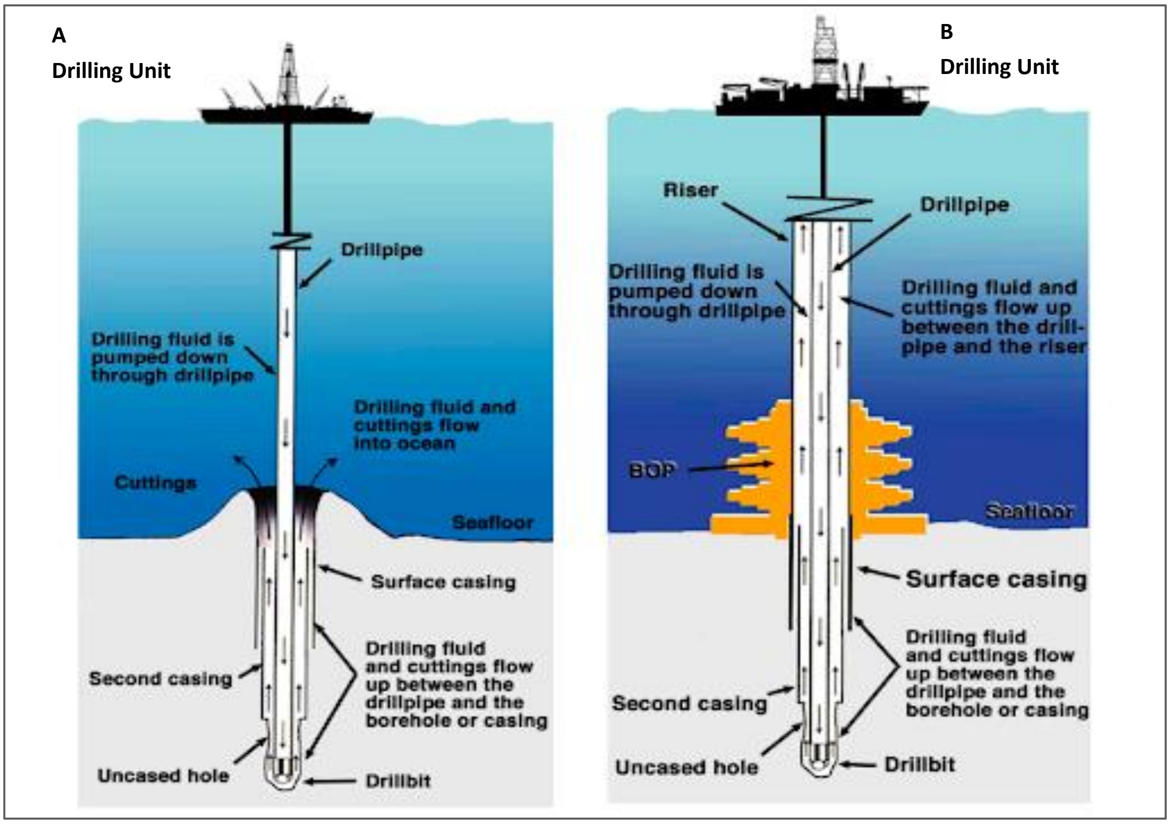

FIGURE 2: DRILLING STAGES: (A) RISERLESS DRILLING STAGE; AND (B) RISERED DRILLING STAGE

- *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 rocks. 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 and for forward planning of the drill bit during drilling. 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.
- *Well (flow) testing*: This is undertaken to determine the economic potential of any discovery before the well is abandoned or suspended. One test would be undertaken per exploration well if a resource is discovered and up to two tests per appraisal well. Each test may take up to seven days to complete (5 days of build-up and 2 days of flowing and flaring). 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 discharged overboard or transferred to shore for treatment and disposal.
- *Well Sealing and Plugging*: Once drilling and logging are completed, the exploration well(s) will be sealed with cement plugs, tested for integrity and abandoned according to international best practices.
- *Demobilisation:* The intention is to abandon the wellheads on the seafloor if deemed safe to do so based on a risk assessment. Where it is deemed to be safe, the wellhead will be left and fitted with an over-trawlable abandonment cap. Monitoring gauges to monitor pressure and temperature may be installed under the over-trawlable cap on wells where TEEPSA will return in the future for appraisal / production purposes. 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.

5.3.4 EMERGENCY RESPONSE

TEEPSA has contract agreements with global response companies to use globally advanced capping stacks in the event of a well blow-out. Capping stacks are designed to shut-in an uncontrolled subsea well in the unlikely event of a blow-out. One capping stack is located in Saldanha and others in the UK and Singapore. The mobilisation of these and other incident response equipment and services will be contained in TEEPSA's Oil Spill Contingency Plan (OSCP) and Blow-Out Contingency Plan (BOCP).

6. RECEIVING ENVIRONMENT

6.1 GEOPHYSICAL CHARACTERISTICS

The water depths in Block DWOB range from approximately 400 m to 3 900 m, whereas within the Area of Interest for proposed exploration drilling water depths range from 1 000 m to 3 000 m. Offshore sediments in Block DWOB are dominated by muds and sandy muds. However, the occurrence of hard grounds is likely.

Major bathymetric features on the continental shelf of the West Coast includes (Figure 3): Orange River Cone (or Shelf) and Child's Bank, situated approximately 150 km offshore at about 31°S, and approximately 75 km east of the licence block. The closest seamount to Block DWOB is Tripp Seamount, a geological feature approximately 25 km to the north of the licence block, which rises from the seabed at 1 000 mbsl to a depth of 150 mbsl. It is a roughly circular feature with a flat apex that drops steeply on all sides.

6.2 BIOPHYSICAL CHARACTERISTICS

Winds are one of the main physical drivers of the nearshore Benguela Region. Most winds in summer come from the south to south-south-east. Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component. Most of the West Coast is classified as exposed, experiencing strong wave action. Winter swells are strongly dominated by those from the south and south-south-west. During the summer there is a slightly more pronounced southerly swell component and swells tend to be smaller on average.

Block DWOB is primarily located within the Southern Benguela system with the North East Portion infringing on the Bottom Poleward Current. A major feature of the Benguela Current is coastal upwelling, however, Block DWOB is located well offshore of these upwelling events. This upwelling is associated with extremely high seasonal production of phytoplankton and zooplankton, and can result in low-oxygen water moving up onto the inner shelf and into nearshore waters.

6.3 BIOLOGICAL OCEANOGRAPHY

The seabed communities in Block DWOB lie within the within the Namaqua sub-photic and continental slope biozon, and is characterised by a limited variety of ecosystem types. The majority of Block DWOB is characterised by Southeast Atlantic Lower Slope habitat, with some representation by Southeast Atlantic Mid and Upper Slope, and Cape Basin Abyss habitats. The Area of Interest for proposed exploration drilling is dominated by ecosystems rated as 'Least Concern' (Figure 4).

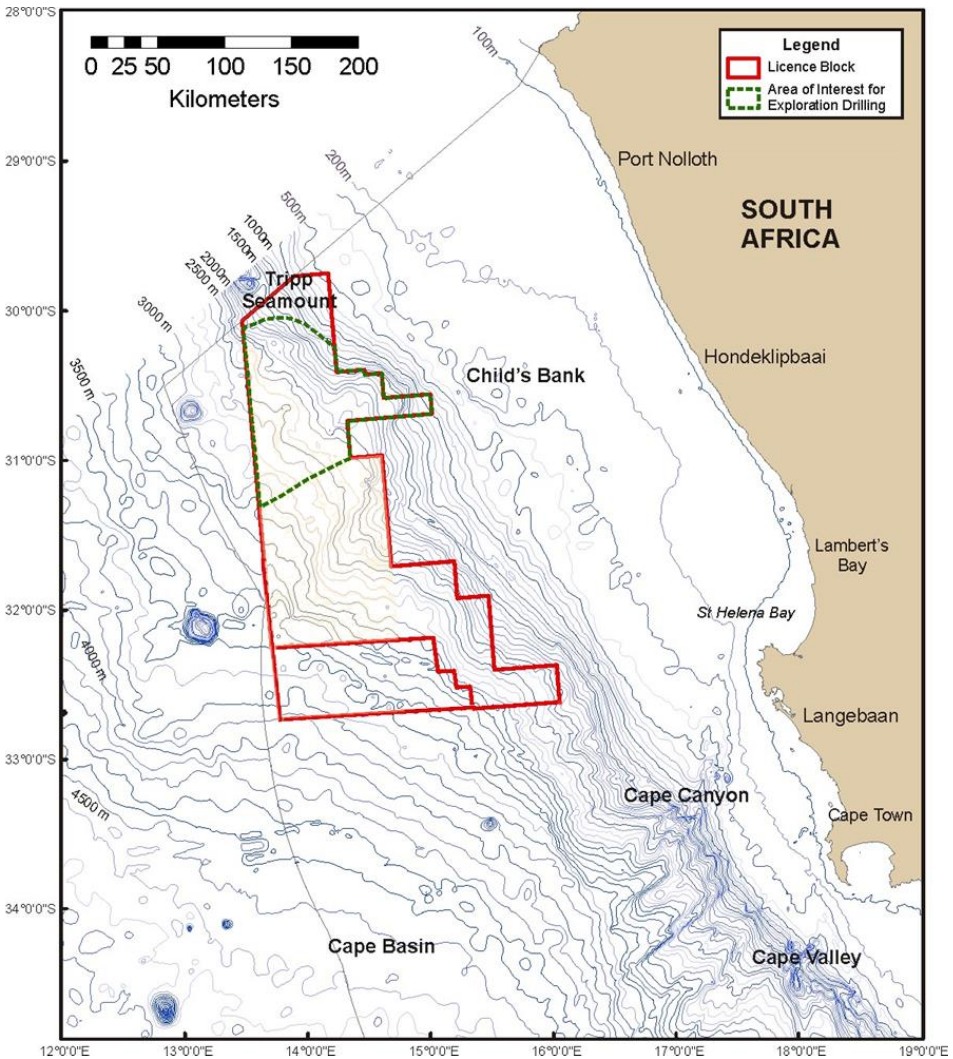

FIGURE 3: MAP INDICATING LOCATION OF THE DWOB LICENCE AREA IN RELATION TO BATHYMETRIC FEATURES OFF THE WEST COAST.

Source: Pisces

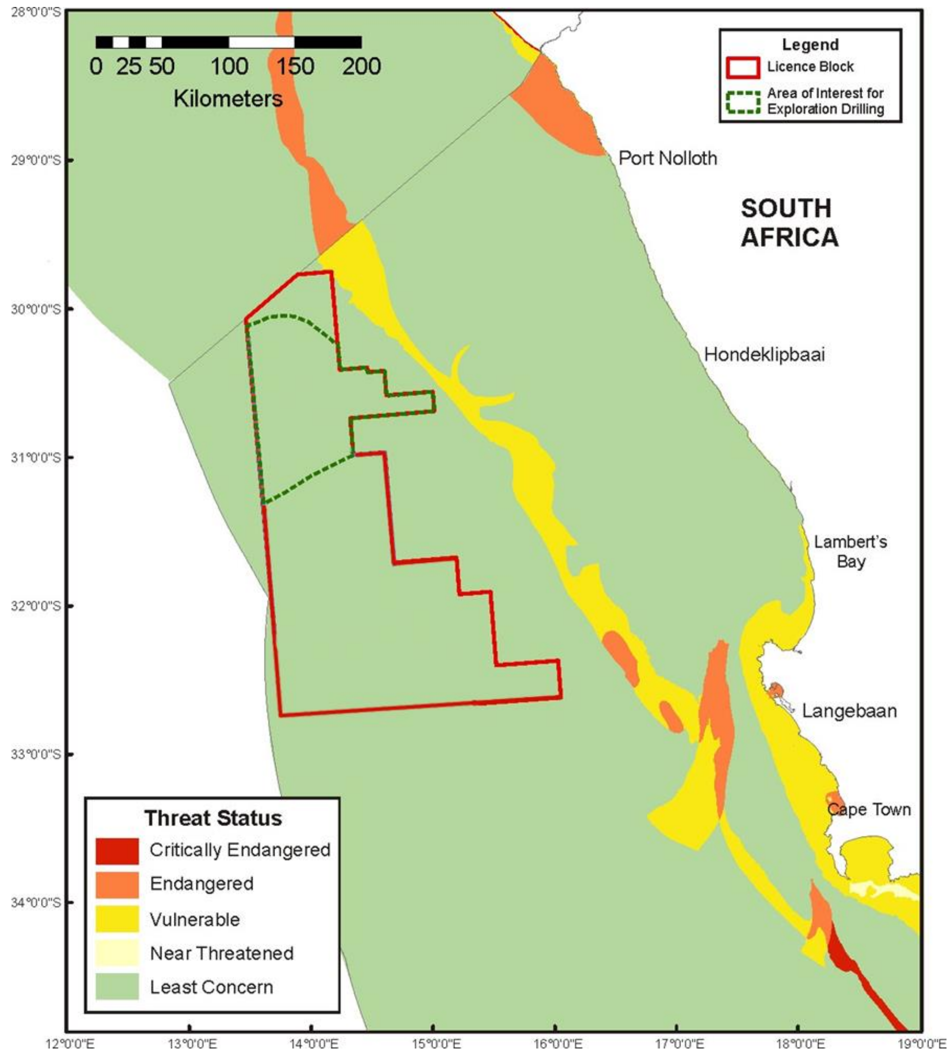

FIGURE 4: DWOB BLOCK AND THE AREA OF INTEREST IN RELATION TO ECOSYSTEM THREAT STATUS FOR COASTAL AND OFFSHORE BENTHIC AND PELAGIC HABITAT TYPES ON THE WEST COAST.

Adapted from Sink *et al.* 2019

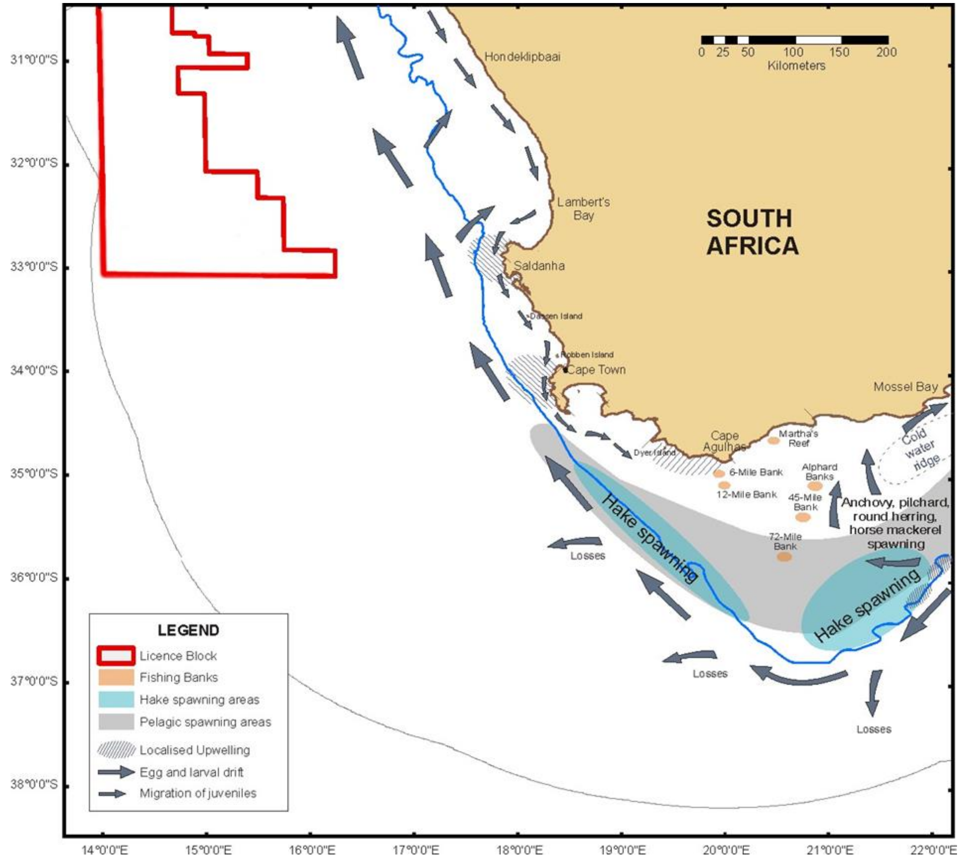

FIGURE 5: DWOB (RED POLYGON) IN RELATION TO MAJOR SPAWNING, RECRUITMENT AND NURSERY AREAS IN THE SOUTHERN BENGUELA REGION.

Adapted from Crawford et al. 1987; Hutchings 1994; Hutchings et al. 2002

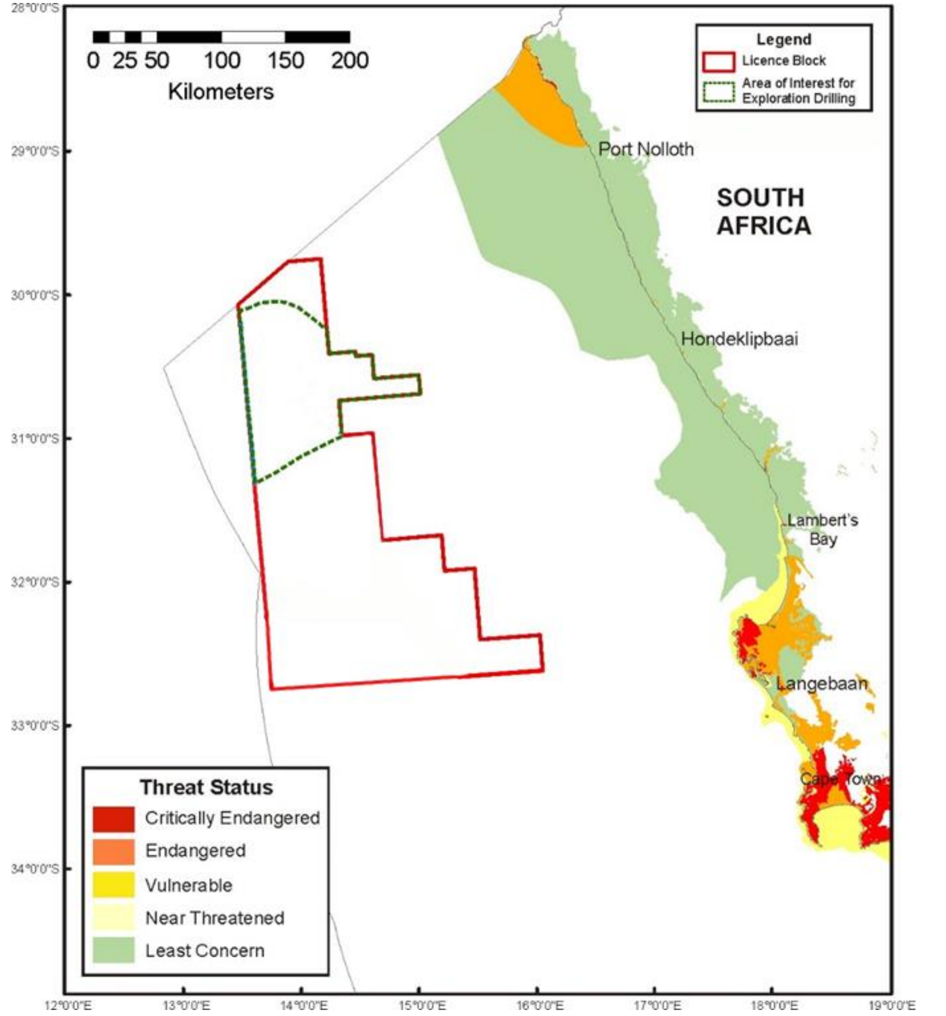

FIGURE 6: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF THREATENED COASTAL ECOSYSTEM TYPES ALONG THE WEST COAST

Adapted from Harris et al. 2019

Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela (see Figure 5). Ichthyoplankton abundance in the offshore waters of the Area of Interest for proposed exploration drilling are, however, expected to be low.

Small pelagic species include the sardine/pilchard, anchovy, chub mackerel, horse mackerel and round herring. These shoaling species generally occur within the 200 m contour and thus unlikely to be encountered within the Area of Interest for proposed exploration drilling. The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Area of Interest for drilling are the large migratory pelagic species, including various tunas, billfish and sharks.

Three species of turtle occur along the South-West Coast, with the Leatherback being the most likely to be encountered in the offshore waters of west South Africa. Their abundance in the study area is unknown but expected to be low. Loggerhead and Green turtles are expected to occur only as occasional visitors.

Most of the pelagic seabird species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), and are therefore likely to occur in the proposed Area of Interest for proposed exploration drilling, with highest population levels during their non-breeding season (winter). Fifteen species of seabirds breed in southern Africa, including Cape Gannet, African Penguin, African Black Oystercatcher, four species of Cormorant, White Pelican, three Gull and four Tern species. The closest breeding islands to the Area of Interest for proposed exploration drilling Bird Island in Lambert's Bay, the Saldanha Bay islands, Dassen Island, Robben Island and Seal Island approximately 200 km, 150 km, 175 km, 200 km and 250 km to the east and southeast of the southern section of the Deep Western Orange Basin Block, respectively.

Thirty-five species or sub-species/populations of cetaceans (whales and dolphins) are known or likely to occur in the waters of the South-West Coast. The most common species within Block DWOB are likely to be the long-finned pilot whale, common dolphin, sperm whale and humpback whale.

The Cape fur seal is the only species of seal resident along the West Coast. The closest breeding colonies to the Area of Interest for the proposed exploration drilling are at Bucchu Twins, Cliff Point, Kleinzee, Strandfontein Point and Cape Columbine located between 150 km and 250 km inshore of Block DWOB.

The coastline of the project's Area of Influence is characterised by a mixture of intertidal sandy beaches and rocky shores, but also estuaries and rocky subtidal habitats and kelp beds. The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone. Biological communities of the rocky sublittoral habitat can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora, and an offshore zone below 10 m depth dominated by fauna. Along the West Coast, rainfall is relatively high, and this contributes to a higher density of estuarine systems along this portion of the coastline. The spatial distribution of threatened coastal ecosystem types in the broader project area is illustrated in Figure 6.

6.4 MARINE PROTECTED AREAS AND OTHER CONSERVATION AREAS

Although Block DWOB overlaps with Orange Shelf Edge MPA (MPA), the Area of Interest for proposed exploration drilling avoids the MPA (Figure 7). Block DWOB also overlaps with one Ecologically or Biologically Significant Area (EBSA) (namely the Orange Seamount and Canyon Complex EBSA) but the Area of Interest for proposed exploration drilling also avoids this area.

Building on from the EBSAs, the National Coastal and Marine Spatial Biodiversity Plan identifies Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. **The Area of Interest for proposed exploration drilling does not overlap with mapped CBA 1 and CBA 2 areas** (Figure 7).

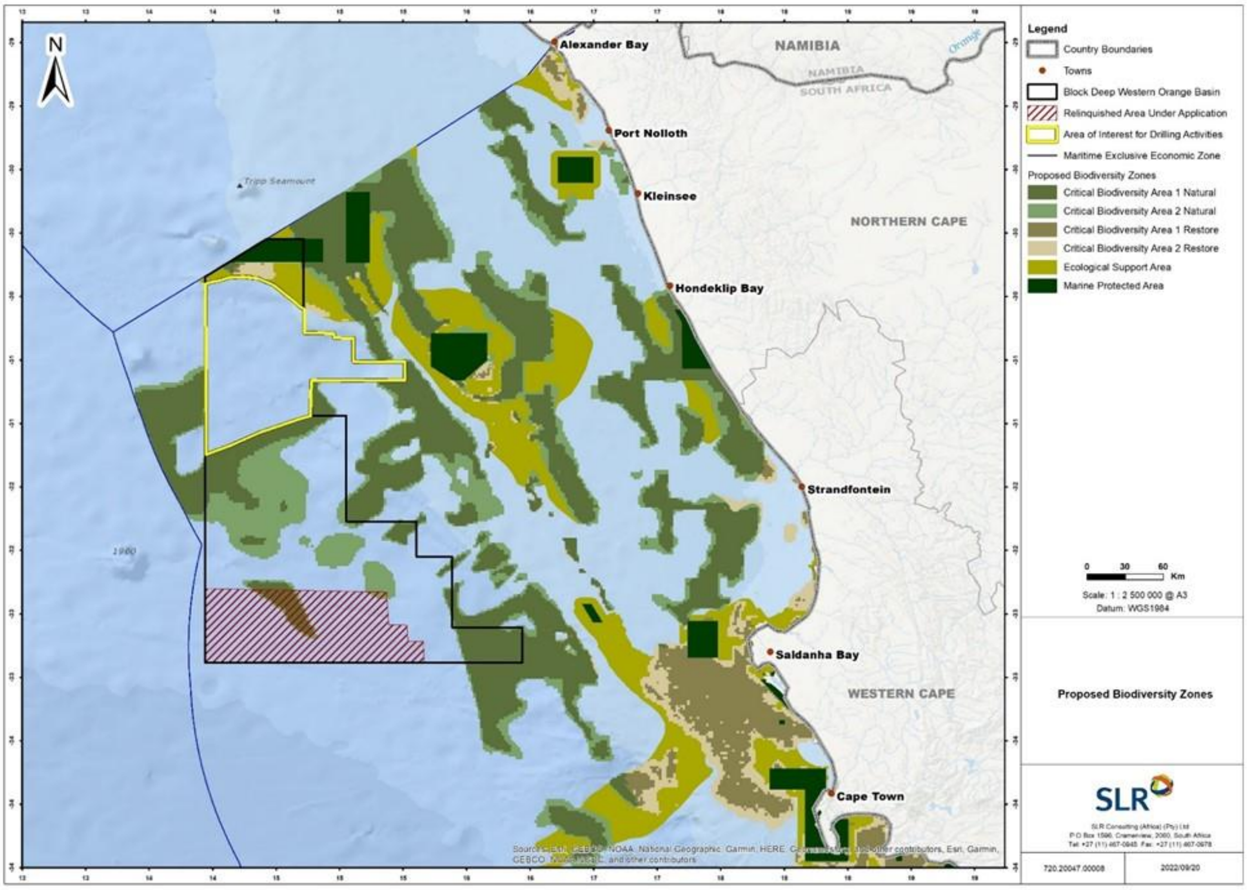

FIGURE 7: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAS).

Adapted: Harris et al. 2022

Block DWOB does not overlap with any current or proposed coastal and marine Important Bird Areas (IBA). Five RAMSAR sites occur within the Project's indirect area of influence. Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an Important Marine Mammal Areas (IMMAs), the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs, none of which overlap with the area of interest for proposed exploration drilling.

6.5 SOCIO ECONOMIC ENVIRONMENT

The project's area of influence encompasses the entire approximate coastline that extends between Cape Town, Western Cape and extends into the Northern Cape. The significant key populated areas include the City of Cape Town Municipality and Saldanha Bay. The Namakwa District Municipality is located further from major metropolitan areas or major towns and is sparsely populated with much smaller coastal towns. Tourism is a central economic activity for the Western Cape playing an important role in the economy of many of the towns along this coastal area. However, tourism market in the Northern Cape Province is less developed.

Information on the spatial distribution and catch effort of the commercial fishing sectors that operate off the West Coast are given below. Of these fisheries, only one overlaps with the proposed Area of Interest, namely the large pelagic longline fishery.

Figure 8 shows the spatial extent of pelagic longline fishing grounds in relation to the licence block and Area of Interest for proposed exploration drilling. Over the period 2017 to 2019 (cumulative local and foreign fleets), an average of 149 lines per year were set within DWOB yielding 191 tonnes of catch. This is equivalent to 7.14% of the overall catch and 8.36% of the overall effort reported nationally by the sector. Fishing activity takes place over the entire Area of Interest for proposed exploration drilling but is concentrated towards the shelf break. Over the period 2017 to 2019, an average of 68 lines per year were set within the area of Intrest yielding 84 tonnes of catch. This is equivalent to 3.14% and 3.84% of the overall catch and effort, respectively.

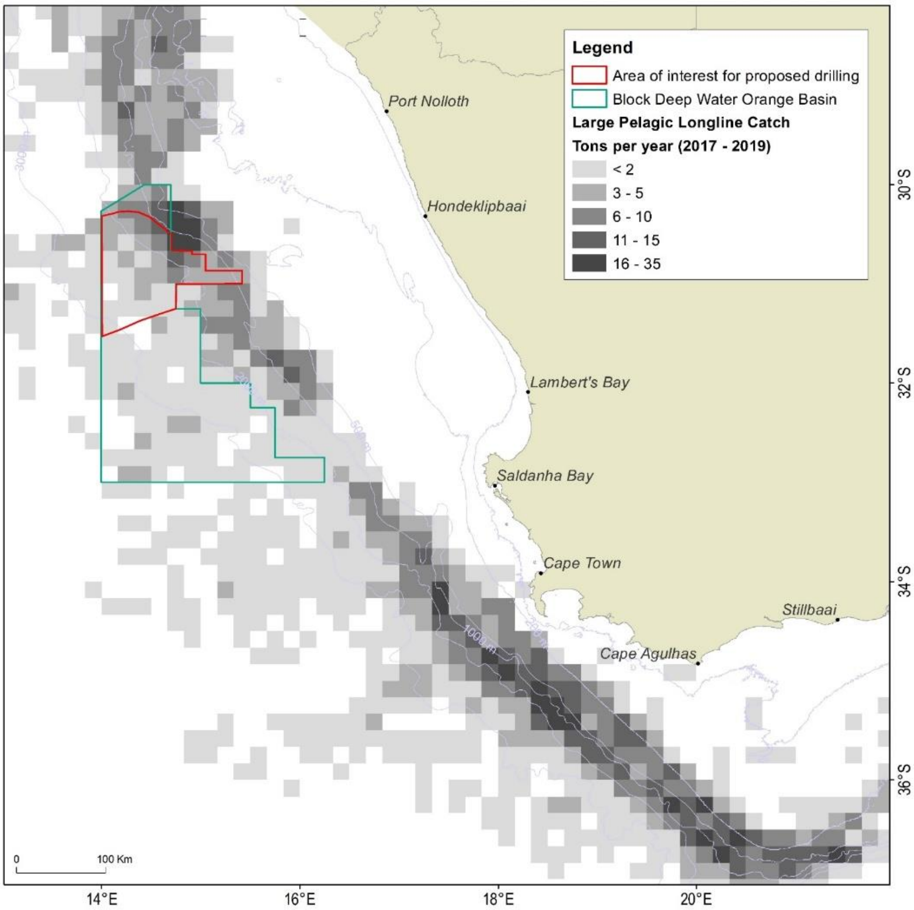

FIGURE 8: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF PELAGIC LONGLINE CATCH (2017-2019)

Source: CapMarine

South Africa has also embarked on a process of developing a Small-Scale Fisheries (SSF) sector aimed in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. SSF resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner. The SSF is to be implemented along the coast in series of community co-operatives. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations and show a historical dependence on deriving the major part of their livelihood from traditional fishing operations. In the Northern Cape, communities are grouped into the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities and there are 103 registered fishers in the province. Between Saldanha Bay and Cape Agulhas, 68 communities have been registered for small-scale fishing rights, these co-operatives comprise a total of 2 031 fishers. These communities are unlikely to range beyond 3 nautical miles (5.6 km) from the coastline, well in shore of the Area of Interest.

There are various mariculture, aquaculture, ranching and coastal harvesting operations relating to a number of different species that occur off the West Coast (including white mussels, oysters, abalone and seaweed). These all occur along the coast inshore of the Area of Interest for proposed exploration drilling. Demersal research trawls and pelagic research surveys have previously been undertaken in the proposed Area of Interest for proposed exploration drilling.

A significant amount of ship traffic can be expected to pass through the inshore portion of Block DWOB. Figure 9 shows Block DWOB and Area of Interest in relation to existing wells (exploration, appraisal and production), submarine cables and offshore ammunition dumps. No ammunition dumps occur within Block DWOB. Four submarine cables pass through the Block DWOB; although only three pass through the Area of Interest for proposed exploration drilling. No wells have been previously drilled within Block DWOB.

7 ENVIRONMENTAL AND SOCIO-ECONOMIC SCREENING AND KEY IMPACTS

7.1 ENVIRONMENTAL AND SOCIAL INTERACTION MATRIX

The environmental and social interaction matrix prepared for the proposed project is presented in Table 2.
The matrix provides a list of the project activities and allows for easy checking of interaction against components of the receiving environment.
For a more detailed review of project activities and potential impact refer to the Aspects and Impacts Register in Section 8.2 of the main report.

7.2 KEY ENVIRONMENTAL AND SOCIAL IMPACTS

The significant issues identified during the Scoping Phase that will be assessed by specialists are described below.

7.2.1 Impacts on Marine and Coastal Ecology

The proposed exploration activities could result in the following potential impacts on marine and coastal ecology:

- Localised reduction in air quality due to emissions from the combustion of diesel fuel for generators and other machinery used to power the drilling operations and support vessels, aviation fuel for aircrafts and helicopters, and well flow testing (flaring);

TABLE 2: ENVIRONMENTAL AND SOCIAL INTERACTION MATRIX

Project Phase	Project Activities / Resource / Receptors	Sensitive receptors in the receiving environment																	
		Physical and Biological											Socio-Economic						
		Water Column (incl. Water Quality, Noise and Turbidity)	Atmosphere (including Air Emissions, Noise, Lighting)	Seabed Sediment and Profile	Fish & Plankton Communities	Benthic Habitats and Communities	Coastal/marine birds	Turtles and Marine Mammals	Seabed Features and Seamounts	Nearshore Habitats and Communities	Designated sensitive areas	Alien marine species	Fishing	Maritime Heritage / Cultural Heritage	Marine Traffic / Navigation	Public Health and Safety	Infrastructure and Services	Settlements, Tourism, Recreation, Sense of Place	Employment & Income
Planned Activities (Normal Operation)																			
Mobilisation	Onshore logistics base (including liquid mud plant)																		
	Appointment of specialist service providers and staff																		
	Procurement, importation and transportation equipment & materials																		
	Accommodation rental and local spend (e.g., food and supplies)																		
	Transit of drilling unit and supply vessels to drill site																		
	Discharge or exchange of ballast water																		
Operation	Presence and operation of drilling unit and support vessels (including waste management, water intake, air emissions and routine discharges to sea)															SO	SO	SO	
	Lighting from drill vessel																		
	Operation of helicopters																		
	Drop-core sampling operations, including the deployment of sampling tools																		
	Well drilling (including ROV site selection, installation of conductor pipes; wellhead, BOP and riser system, well logging and plugging)													SO		SO			
	Discharge of drill cuttings and drilling fluid and residual cement																		
	Vertical Seismic Profiling (VSP)/sonar acquisition																		
	Well (flow) testing and flaring including the possible discharge of treated produced water																		
Demobilisation	Abandonment of well on sea floor																		
	Demobilisation of drill unit & supply vessels															SO			
	Demobilisation of logistics base, services and work force																		
Unplanned Activities (Emergency Event)																			
All	Faunal strike / collisions																		
	Accidental hydrocarbon spills / releases (minor) (e.g., vessel accident, bunkering and pipe rupture)															SO			
Operation	Dropped objects / lost equipment																		
	Loss of well control / Blow-out																		

Key:

No Interaction	Minor Negative Interaction	Moderate-/ High Negative Interaction	Positive	SO Screened Out

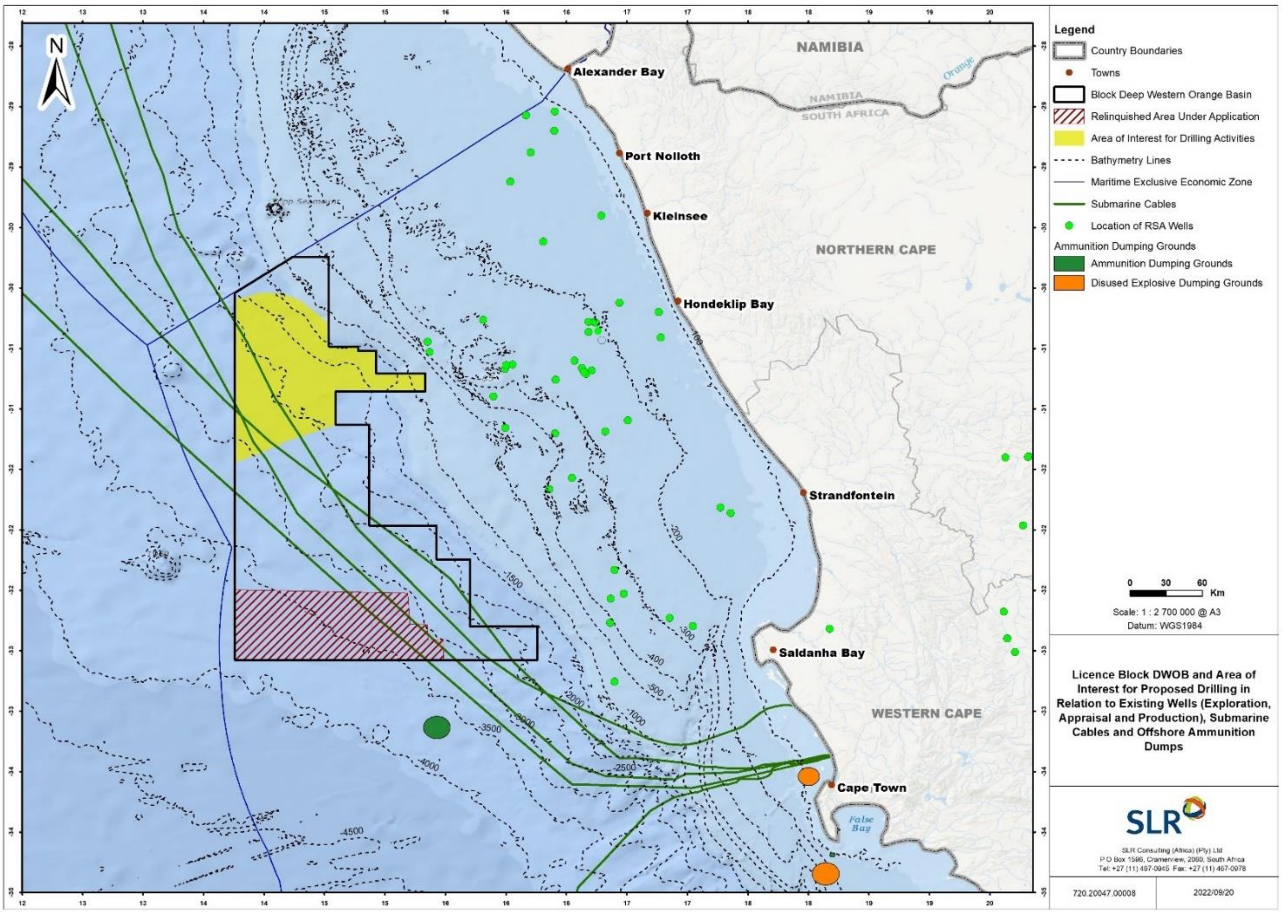

FIGURE 9: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO MARINE INFRASTRUCTURE ALONG THE WEST COAST.

- Localised reduction in water quality due to drilling discharges;
- Localised reduction in water quality due to normal discharges, as per the International Convention for the Prevention of Pollution from Ships (MARPOL) requirements, to the marine environment from a variety of sources, including deck drainage, machinery space drainage, sewage and galley wastes from the drilling unit and support vessels;
- Localised disturbance of and / or behavioural changes to marine and coastal fauna due to increased ambient noise and lighting from the exploration vessels/drilling unit, support vessels and helicopter operations;
- Localised disturbance of and / or behavioural changes to marine fauna due to increased underwater noise from vessels, drilling, sonar and VSP;
- Sediment disturbance due to drilling activities and placement of infrastructure on the seafloor;
- Smothering and biochemical effects (e.g., direct toxicity and bioaccumulation) on relatively immobile or sedentary benthic species due to the discharge of cuttings, drilling fluid and cement during well drilling;
- Increased biodiversity and biomass on wellhead due to hard substrate habitat available for colonisation by benthic organisms;
- Introduction of alien invasive marine species through international vessels and equipment transfer and ballast water discharge; and

- Local and regional impacts on water quality, marine fauna and oiling of coastal habitats (including MPAs) and seabirds due to accidental oil spills during the proposed exploration drilling (normal operations, e.g., bunkering at sea), as well as the unlikely event of a large blow-out.

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 (including large blow-out). Input obtained from the technical modelling studies (refer to Section 2.2 above) will be used to assess the potential impacts related to increased underwater noise, the discharge of drill cuttings and associated muds, as well as accidental oil spills on the marine ecosystem and biota.

The drilling discharges and oil spill modelling studies will use the available metocean data to model the following:
- 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; and
- The trajectory, extent and fate of an unlikely large oil spill due to a well blow-out.

The underwater noise modelling study will aim to, inter alia, describe the likely background noise levels, determine noise transmission loss with distance from the survey area, and zones of impact relating to permanent or temporary injury and behavioural disturbance.

7.2.2 Impacts on Commercial and Small-Scale Fisheries

During normal operations, the proposed exploration activities could potentially affect fishing activities, as a result of fishing exclusion from the 500 m operational safety zones around the drilling unit; increased underwater noise disturbance during drilling, coring, sonar and VSP activities, the abandonment of the wellheads on the seafloor. These activities could have an impact on commercial fisheries that operate in the area through the reduction in catch rates and/or an increase in fishing effort.
An oil spill can also result in several impacts on fishing (unplanned event), 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, determine the fishing effort and catch of all fisheries operating off the coast of South Africa within the Project's area of influence. It will also assess the impact that the proposed project will have on these sectors during normal drilling operations and upset conditions (small accidental spills and large blow-out) with input from the technical modelling studies.
The fisheries impact assessment includes consideration of broad economic risks and impacts of the proposed exploration operations on key fishing sectors. The level of information that will provided on the economic aspects of potential impacts of normal operations on key fishing sector receptors is considered to be adequate to inform the assessment of impacts and to inform decision making in this regard.

7.2.3 Impacts on the Socio-Economic Environment

The proposed exploration activities could potentially result in some limited socio-economic positive impacts. Given the isolated nature of the exploration area and short duration, the potential for direct socio-economic negative impacts from normal operations is considered negligible outside of the short-term disruption of commercial fisheries. More direct localised impacts are possible in relation to: (i) onshore operations at either the Port of Cape Town or Saldanha, (ii) movement of support vessels and helicopters from the logistics base to the drilling site, as well as (3) in the unlikely event of a well blow-out or vessel collision:

Possible negative socio-economic impacts may include:

- Alteration in sense of place and cultural / spiritual reliance on the sea. Exploration operations may be perceived to result in changes to the natural environment and/or the local sense of place, as well as links to area or items of cultural, spiritual or ritual significance.
- Pressure on local services and facilities. The use of local service providers and suppliers, while considered an economic benefit, may also result in increased pressure on local providers or facilities if they do not have sufficient capacity to support the exploration or other activities. This may include both public services (hospitals, clinics, and emergency responses), as well as private services (accommodation, transport and others), but also consumption of products (i.e. food, consumables, etc.).
- Reduction in income and livelihood related to short-term disruption of commercial fisheries.
- Impact on local tourism, recreation and recreational fishing, and commercial shipping. The implementation of the safe operational zone around the drilling unit, as well as movement of the support vessel between the survey / drill area and port, will effectively exclude vessels from portions of the drilling area at any one time. Thus, their presence presents a potential risk of interference with commercial, recreational and fishing boats and other marine recreational activities.
- Potential collision hazards with lost equipment drifting on the surface or in the water column, which may pose a public health and safety risk.
- An unlikely large oil spill (unplanned event) can also result in several socio-economic impacts, including:
    - Alteration of the coastline in terms of aesthetic and landscape appeal (sense of place).
    - Alteration of the coastline in terms of value with regard to spiritual, cultural and ritual importance.
    - Alteration of the coastline that supports a variety of commercial and private recreational and tourism activities.
    - Reduction in recreational activities, and small-scale and commercial fishing in the region, including all forms of near-shore and offshore fishing (e.g., exclusion areas for fishing, non-consumption due to toxicity, decline in recruitment of fish stocks).
    - Reduction in income for secondary and tertiary sectors that support tourism, recreational, fishing, and other coastal economies.
    - Pressure on national, regional, and local public services and facilities as part of any shoreline responses.
    - National, regional, and local collapse in public trust and increase in conflict related to environmental and social impacts from major spills.
    - Impacts on national GDP and economic growth.

Positive socio-economic impacts may include:

- Local employment income for service providers and suppliers: The exploration activities will result in limited local economic benefits due to the short-term and technical nature of the activity with respect to the use of local service providers or suppliers, which will result in direct and indirect positive impacts on employment and income. The demand for such local services will be largely limited to crew accommodation, meals, basic goods, and refuelling, provided at the onshore logistics base in Cape Town or Saldanha.

How the issues will be addressed in the ESIA:

A Socio-Economic Impact Assessment (SIA) will be commissioned to, inter alia, provide an overview of the social context of the project and determine the potential socio-economic impacts and benefits associated with the proposed exploration drilling activities, including unplanned events. The SIA will draw on information provided by the related technical modelling studies (e.g., oil spill modelling) and specialist studies (e.g., commercial fishing).

The SIA will include consideration of broad socio-economic impacts of the proposed additional exploration activities (normal operations) and an unplanned event (such as a well blow-out) on key economic sectors. The level of information that will provided on 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.

In addition, a cultural heritage assessment has been commissioned to investigate the cultural and spiritual beliefs of key coastal communities within the Project's indirect area of influence. The collection of primary field data, which commenced during the pre-application phase, will be used to assess the potential impacts related to both normal operations and upset conditions on the stated variables (culture, spiritual aspects and religion).

7.2.4 Impacts on Air Quality and Climate Change

The well drilling activities will generate air emissions through the operation of the drilling unit; movement of vessels and helicopters, and the flaring of gas during well testing (if hydrocarbon resources are found). This will have localised air quality impacts and contribute towards GHG emissions. These impacts are described further below:

- The release of gaseous pollutants, principally sulphur oxides (SO_x), nitrogen oxides (NOx), carbon dioxide (CO_2) and carbon monoxide (CO), together with lesser quantities of particulate matter (PM_{10}/$PM_{2.5}$) and volatile organic compounds (VOCs), from the project vessels, helicopters and well test have the potential to cause reductions in local air quality close to the emissions source, which in turn could have health effects (e.g., respiratory effects).
- Some of the gaseous pollutants released from the project vessels and helicopters could also contribute to global GHG emissions. The main effects of climate change (including increased temperatures, changing weather patterns and sea level rise) are related to increased atmospheric CO2 concentrations.

How the issues will be addressed in the ESIA:

A climate change and air emissions impact assessment will be undertaken to establish a greenhouse gas and criteria pollutant emissions inventory, model the dispersion of the pollutants and evaluate the significance of GHG emissions and non-GHG criteria pollutant emissions.

7.3 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 summarised in Table 3 below, together with preliminary mitigation measures. 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. Refer to Chapter 9 of the main report for the Plan of Study for the Impact Assessment.

TABLE 3: SUMMARY OF KEY IMPACTS AND PRELIMINARY MITIGATION

No.	Project Activity	Predicted Impacts	Preliminary Mitigation Measures / Project Controls
1.	**Normal Operations**		
1.1	Vessel operations and emissions to the atmosphere	• Contribution to greenhouse gases. • Reduction in local air quality, which in turn could have effects on health, etc.	• Optimise rig positioning, rig movement 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.
1.2	Operational discharges to sea (e.g., grey water, sewage, deck drainage)	• Local reduction in water quality and physiological effects on marine fauna.	• Compliance with MARPOL standards for discharges to sea. • Implementation of Waste & Discharge / Maintenance management plans
1.3	Discharge of ballast water	• Introduction of alien invasive species and harmful aquatic pathogens to the marine ecosystem.	• Compliance with requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments.
1.4	Helicopter operations and elevated airborne noise levels	• Disturbance of faunal species resulting in behavioural changes or displacement from important feeding or breeding areas • Disturbance / loss of sense of place.	• Minimum flying heights and flight paths to avoid sensitive habitats.
1.5	Seabed sampling	• Physical seabed disturbance on benthic fauna.	• Pre-drilling sampling surveys (with ROV) and implement buffer around sensitive hardgrounds and vulnerable habitats.
1.6	Drilling and discharge of drill cuttings	• Physical seabed disturbance on benthic fauna during spudding. • Smothering of benthic fauna/habitats by cuttings. • Increased sea water turbidity and water quality contamination.	• Pre-drilling site surveys (with ROV) and implement buffer around sensitive hardgrounds and vulnerable habitats. • Usage of low-toxicity drilling fluids and cement. • Monitor discharges.
		• Alteration of the seabed in terms of value with regard to spiritual, cultural and ritual importance.	• Stakeholder engagement and notification. • Implement, where necessary, a ritual event/s.
1.7	Generation of underwater noise from drilling and vessel activity and VSP	• Disturbance of marine fauna, particularly whales and dolphins, from exploration area.	• Pre-shoot watch by Marine Mammal Observer (MMO), including Passive Acoustic Monitoring (PAM). • Implement 'soft start' to VSP activities for slow ramp up of power output. • "Soft-start" procedures. • Shut-downs for animals in mitigation zone.

No.	Project Activity	Predicted Impacts	Preliminary Mitigation Measures / Project Controls
		• Displacement of fish and fishing.	• Stakeholder engagement and notification. • Navigational warning. • Fisheries Liaison Officer (FLO). • Grievance management.
1.8	Temporary safety zone around drilling unit	• Exclusion of fishing activities within 500 m safety zones during operational activities. • Reduction in catch rates and/or an increase in fishing effort.	• Stakeholder / vessel notification. • Navigational warning. • Fisheries Liaison Officer (FLO). • Vessel lighting and safety signals.
1.9	Well abandonment on seafloor	• Interference with trawling activities or fishing equipment.	• Over-trawlable abandonment cap. • Survey and accurately charted wellheads with the SAN Hydrographer.
1.0	Produced water discharge (if any)	• Local reduction in water quality and physiological effects on marine fauna.	• Onboard treatment of hydrocarbon component to <30 mg/l or ship to shore.
1.11	Procurement of local service providers and employment	• Procurement of local service providers for onshore base and helicopter transfers etc. • Employment of a limited number of staff (e.g., logistics base).	• TEEPSA local content policy. • Manage community expectations. • Stakeholder engagement.
1.12	Normal operations	• Alteration in sense of place and cultural / spiritual reliance on the sea.	• Stakeholder engagement. • Implement a ritual event/s that permits engagement with ancestral spirits and nature to alleviate potential and future negative impacts of non-consultation and poor cultural/nature respect.
2.	**Unplanned Events**		
2.1	Loss of equipment	• Potential disturbance and damage to seabed habitats and associated fauna within the equipment footprint. • Collision hazards for other vessels.	• Post drilling ROV survey. • Retrieve of lost objects / equipment, where practicable. • Notify SAN Hydrographer.
2.2	Vessel or equipment failure and bunkering of fuel	• Immediate detrimental effect on water quality, with the toxic effects	• Bunkering procedure. • Shipboard Oil Pollution Emergency Plan. • Emergency Response Plan. • Spill training and clean-up equipment.
2.3	Loss of well control / well blow-out	• Local and regional impacts on water quality, marine fauna and oiling of coastal habitats and marine fauna. • Exclusion of fisheries from polluted areas and gear damage. • Reduction in income for secondary and tertiary sectors that support tourism, recreational, fishing, and other coastal economies. • Alteration of the coastline in terms of value with regard to spiritual, cultural and ritual importance.	• Design and Technical Integrity. • Detailed Technical Risk Analysis. • Blow-out Preventer. • Well-specific response strategy and plans (Oil Spill Contingency Plan, Emergency Response Plan and Blow-Out Contingency Plan). • Cap and Containment Equipment. • Well-specific oil spill modelling. • Deploy and/or pre-mobilise shoreline response equipment. • Stakeholder engagement. • Implement, where necessary, a ritual event/s. • Grievance management.

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APPENDICES

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
2D	Two-dimensional
3D	Three-dimensional
ACAP	Agreement of the Conservation of Albatrosses and Petrels
ACEP	African Coelacanth Ecosystem Programme
ADZ	Aquaculture Development Zone
AEL	Atmospheric Emissions Licence
AHT	Anchor Handling Tug
ALARP	As Low As Reasonably Practicable
BAT	Best Available Techniques
B&B	Bed & Breakfast
BCC	Benguela Current Commission
BHA	Bottom Hole Assembly
BID	Background Information Document
BOCP	Blow-Out Contingency Plan
BOD	Biological Oxygen Demand
BOP	Blow-out preventer
CA	Competent Authority
$CaCl_2$	Calcium Chloride
CaO	Lime
CBD	Central Business District
CH_4	Methane
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
CO_2	Carbon dioxide
COGSA	Carriage of Goods by Sea Act
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea, 1972
CPUE	Catch per Unit Effort
CR	Critically Endangered
CSEM	Controlled Source Electro-Magnetic survey
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organisations
DD	Data Deficient
DEA	Directorate of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMA	Disaster Management Act, 2002 (No. 57 of 2002)
DMRE	Department of Minerals Resource and Energy
DSR	Draft Scoping Report
DST	Drill Stem Tests
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EBSA	Ecologically or Biologically Significant Area
EDS	Emergency Disconnect System
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EN	Endangered
EOO	Extent of Occurrence
ERP	Emergency Response Plan

Acronym / Abbreviation	Definition
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Programme
FSR	Final Scoping Report
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GIS	Geographic Information System
GN	Government Notice
GTL	Gas-to-Liquid
HABs	Harmful Algal Bloom
HFO	Heavy Fuel Oil
HRIA	Human Rights Impact Assessment
HSE	Health, Safety and Environmental
HSE MS	Health, Safety and Environmental Management System
HVAC	Heating Ventilating Air Conditioning
IAEA	International Atomic Energy Agency
I&APs	Interested and Affected Parties
IEM	Integrated Environmental Management
IEP	Draft Integrated Energy Plan
IBA	Important Bird Area
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICRP	International Commission of Radiological Protection
IDP	Integrated Development Plan
IFC	International Finance Corporation
ILO	International Labour Organisation
IMMAs	Important Marine Mammal Areas
IMO	International Maritime Organisation
IRP	Integrated Resources Plan (2019)
ISPPC	International Sewage Pollution Prevention Certificate
IUCN	International Union for Conservation of Nature
KCL	Potassium Chloride
KZN	KwaZulu Natal
LC	Least Concern
LNG	Liquefied Natural Gas
LWD	Logging While Drilling
MARISMA	Marine Spatial and Governance Programme
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973
MGO	Marine Gas Oil
MOC	Management of Change
MoU	Memorandum of Understanding
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resource Development Act
MSDS	Material Safety Data Sheet
Na_2CO_3	Soda Ash
NaCl	Sodium Chloride
NADF	Non-Aqueous Drilling Fluid
$NaHCO_3$	Sodium Bicarbonate
NaOH	Caustic Soda

Acronym / Abbreviation	Definition
NDP	National Development Plan
NE	North-East
NEMA	National Environmental Management Act
NEM: AQA	National Environmental Management: Air Quality Act
NEM: PAA	National Environmental Management: Protected Areas Act
NEM: WA	National Environmental Management: Waste Act
NGO	Non-Governmental Organization
NGP	New Growth Path
NHRA	National Heritage Resources Act
NRF	National Research Fund
NT	Near Threatened
O&G	Oil & Gas
OPRC Convention	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
PAHs	Polycyclic Aromatic Hydrocarbons
PASA	Petroleum Agency of South Africa
PDP	Provincial Development Plan
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PSDF	Provincial Spatial Development Framework
Q2	Second Quarter (of a year)
ROC	Retention of Cutting
ROV	Remotely Operated Vehicle
SACNASP	South African Council for Natural Scientific Professions
SAHRA	South African Heritage Resource Agency
SAGERS	South African Greenhouse Gas Emissions
SAN	South African Navy
SAMSA	South African Maritime Safety Authority
SBM	Synthetic Based Mud
SBS	Social Baseline Study
SDF	Spatial Development Framework
SDG	United Nations Sustainable Development Goals
SIA	Socio-Economic Impact Assessment
SLR	SLR Environmental Consulting (South Africa) (Pty) Ltd
SMME	Small and Medium Micro Enterprise
SOBM	Synthetic Oil-Based Mud
SOLAS	International Convection for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SSDI	Subsea Dispersant Injection kit
SW	South-West
SWIO	South Western Indian Ocean
TAC	Total Allowable Catch
TEEPSA	TotalEnergies EP South Africa B.V
TNPA	Transnet National Ports Authority
TSPM	Total Suspended Particulate Matter
UN	United Nations
UNCLOS	United Nations Law of the Sea Convention, 1982

Acronym / Abbreviation	Definition
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGP	United Nation Guiding Principles
VMEs	Vulnerable Marine Ecosystems
VSP	Vertical Seismic Profiling
VU	Vulnerable
WBM	Water-based mud
WWC	Wild Well Contain
WWF	WorldWide Fund for Nature

UNITS

Unit of Measurement	Definition
A	Amperes
Ci	Curries
cm	centimetres
dB	Decibel
eV	Electronvolt
gC/m2/day	Monthly average of gross primary production
Hz	Hertz
kA	Kiloampere
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km^2	Square kilometres
Km/h	Kilometres per hour
m	Metres
m^2	Square metres
m^3	Cubic metre
mg/l	Milligrams per litre
mg/ m^3	Milligram per cubic metre
mm	Millimetres
m/s	Metres per second
mR/hr	Milliroentgens per hour (unit of radiation)
nm	Nautical mile (1 nm = 1.852 km)
Nm^3	Normal cubic metre
nT	nanno tesla
nV/cm	nannoVolt per centimetre
nV/m	nannoVolt per metre
pH	Level of acid or base
ppm	Parts per million
psi	Per square inch (pressure)
µg	Micrograms
µm	Micrometre
µM/l	Micromole per litre
µg/l	Micrograms per litre
µPa	Micro Pascal
°C	Degrees Centigrade
~	Approximately
°	Degree
%	Percent
‰	Parts per thousand
<	Less than
>	Greater than
"	Inch

GENERAL TERMINOLOGY

Terms	Definition
Activity	An "activity" is defined as a distinct process or risk undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation.
Area of Influence	The IFC Performance Standard 1 defines the area of influence as: • The area likely to be affected by: (i) the project and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent. • Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable. • Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted In practical terms, the area of influence indicates where and to what extent TEEPSA should focus its efforts on analysing, mitigating and compensating for the direct and indirect impacts of the proposed project.
Aspect	An environmental or social 'aspect' is an element of an organisation's activities, products and services which can interact with the natural and social environment. The interaction of an aspect with the natural and social environment may result in an impact.
Baseline	A description of the physical, biological and socio-economic environment based on data and information from the pre-project conditions that provides a reference against which any future changes associated with a project can be assessed, and which provides information for subsequent monitoring of biodiversity performance. The baseline should identify and describe the attributes of the physical, biological, socio-economic and cultural receiving environment both in the immediate and wider area around a project site.
Cumulative Impact	Impacts that in combination with other impacts from the same project or other existing or planned (but reasonably foreseeable) projects affect the same environmental or social resources and/or receptors as the Project. They may be of two types: • Additive - impacts that may result from the combined or incremental effects of future planned activities (i.e. those developments currently in planning and not included as part of the existing baseline conditions); or • In-combination - impacts where individual project-related impacts are likely to affect the same environmental or socioeconomic feature (e.g., a combined effect of noise and drill cutting on a receptor acting together in space and time could result in increased effects greater than the individual effects in isolation).
Effect	Effect is a change in a variable or parameter caused or influenced by a project activity, but where no judgement or evaluation is made about the consequence of this change on a receptor. Effects are typically related to abiotic or physico-chemical changes (e.g., change in water quality, air quality or noise) (see 'Impact' below)
Embedded or Project Controls	The physical or procedural measures that are built into the design or operation of a project and required by law or standard for good international industry practice and which serves to mitigate potential consequences on the environment (e.g., application of MARPOL standards; installation of air quality scrubbers on smoke stacks). These measures are typically incorporated into the project description and should not be considered additional mitigation measures in the evaluation of post-mitigation impact significance.
Footprint	The area directly affected by a project usually through physical disturbance such as land clearance and placement of infrastructure and which falls within the direct area of influence of the project.
Impact	Impact is a change resulting from an aspect acting on a natural or environmental and socio-economic receptor (e.g., impact of air quality change on nearby settlement or impact of water quality change on instream biota etc.). Impacts are evaluated in an ESIA process using an agreed impact assessment methodology taking into account aspects such as receptor sensitivity, intensity, extent and duration. Impacts can be direct, indirect, induced, or cumulative.

Terms	Definition
Magnitude	A rating assigned to an impact to reflect the 'size' of the impact on the specific resource, based on intensity, extent and duration.
Mitigation Hierarchy	A process of sequentially prioritising the application of measures to avoid, mitigate, restore and offset impacts to minimise impacts to as low as reasonably possible (ALARP).
Offset	Measures taken to compensate for any significant residual, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve no net loss or preferably a net gain of biodiversity.
Planned Impact	An impact that is expected as a result of a Project's planned activity (e.g., generation of drill cuttings during drilling), i.e. impacts related to normal operations. Planned impacts would include a standard or normal occurrence that may arise during routine project activities (including small uncontrolled discharges during normal operations), as opposed to an unplanned event (such as well blow out, tanker collision, dam break etc.).
Pre-Mitigation	The assessment of impact significance **before** mitigation has been applied but which includes the implementation of embedded control measures.
Project	The Project includes all the infrastructure components and activities which form part of the development, including all related and ancillary facilities or infrastructure (e.g., power and water supply, roads, waste services etc.) without which the Project cannot proceed. It also includes any other developments or activities which follow as a necessary consequence of the project. The IFC Performance Standard 1 defines the term "project" as a set of business activities, including those where specific physical elements, aspects, and facilities likely to generate risks and impacts, have yet to be identified. Where applicable, this could include aspects from the early developmental stages through the entire life cycle (design, construction, commissioning, operation, decommissioning, closure or, where applicable, post-closure) of a physical asset.
Residual impact	The assessment of impact significance **after** additional technically feasible and agreed mitigation has been applied in accordance with the mitigation hierarchy (including the implementation of embedded control measures).
Receptor	Receptors are environmental components, people and cultural heritage assets that may be affected (adversely or beneficially) by the proposed project. They can be categorised into three types: • Physical marine environment (i.e. non-living (abiotic) environmental components, e.g., water and air quality, marine sediments, geology, noise, etc.). • Biological environment (i.e. terrestrial, coastal and marine habitats, flora and fauna, protected areas, etc.). • Socio-economic (i.e. local economy, people, settlements, livelihoods (e.g., resource users), and cultural heritage, etc.).
Scoping	Scoping is the process of defining the range of issues and alternatives to be considered and the approach to be followed in an environmental and social impact assessment (ESIA) process. It is typically designed to focus the ESIA on significant issues including those perceived as important by stakeholders.
Sensitivity	A term used to denote the importance or value or vulnerability of a receptor to an impact. Sensitivity ratings are defined specific to different receptor types.
Screening	Screening is a process to determine whether a proposed activity requires an environmental assessment, as well as the type and level of assessment required and is typically undertaken prior to commissioning an ESIA process. The term may also be used as a high-level assessment of potential impacts that may arise, for example, through the use of an activity- impact interaction matrix.
Unplanned Impact	Impacts that result from an unplanned or non-routine event and which are not reasonably foreseeable or expected during the Project. The probability or likelihood of occurrence is described when assessing unplanned impacts but is not used to influence the significance rating. Unplanned events include a fuel/oil spill during drilling operations but does not include routine spills during normal operations.

1. INTRODUCTION

This chapter provides a description of the project background and location; describes the purpose of this report, outlines how Interested and Affected Parties (I&APs) can comment and describes the structure of the report.

1.1. PROJECT BACKGROUND AND LOCATION

TotalEnergies EP South Africa B.V. (TEEPSA) is the operator for the Deep Western Orange Basin (DWOB) Licence Block (12/3/343 ER), located off the West Coast of South Africa (see Figure 1-1). The eastern border of the Licence Block is located between approximately 150 km and 188 km off the West Coast, roughly between Saldanha Bay (33°S) and Kleinzee (30°S), with water depths ranging from 400 m to 3 900 m. The area for the DWOB Licence Block is 37 335 km^2 in extent and the northern boundary of the Licence Block is located along the international boundary with Namibia. It should be noted that TEEPSA is currently in the process of relinquishing a section in the south-western portion of Block DWOB which would reduce the overall extent of the licence block once the application for relinquishment is approved.

TEEPSA is proposing to undertake various exploration activities within the DWOB Licence Block, including:

- Sonar bathymetry surveys throughout the year;
- Drop core sampling; and
- Exploration well drilling.

TEEPSA proposes to drill one exploration well, and success dependent, up to nine additional wells in total within an Area of Interest within the Block (i.e., up to ten wells in total). The Area of Interest for exploration drilling is 9 711.21 km^2 in extent and is located offshore roughly between Port Nolloth and Hondeklip Bay, approximately 188 km from the coast at its closest point and 340 km at its furthest, in water depths between 1000 m and 3000 m. The DWOB Licence Block itself, however, is located in water depths between 400 m and 3 900 m (see Figure 1-1).

These proposed exploration activities trigger several listed activities in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), and as such requires an Environmental Authorisation (EA) before such activities can commence. TEEPSA, as the Operator of the Block, is the applicant for the Environmental Authorisation.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake a full Scoping and EIA process for the proposed additional exploration activities (hereafter collectively referred to as "Environmental and Social Impact Assessment" or "ESIA" process).

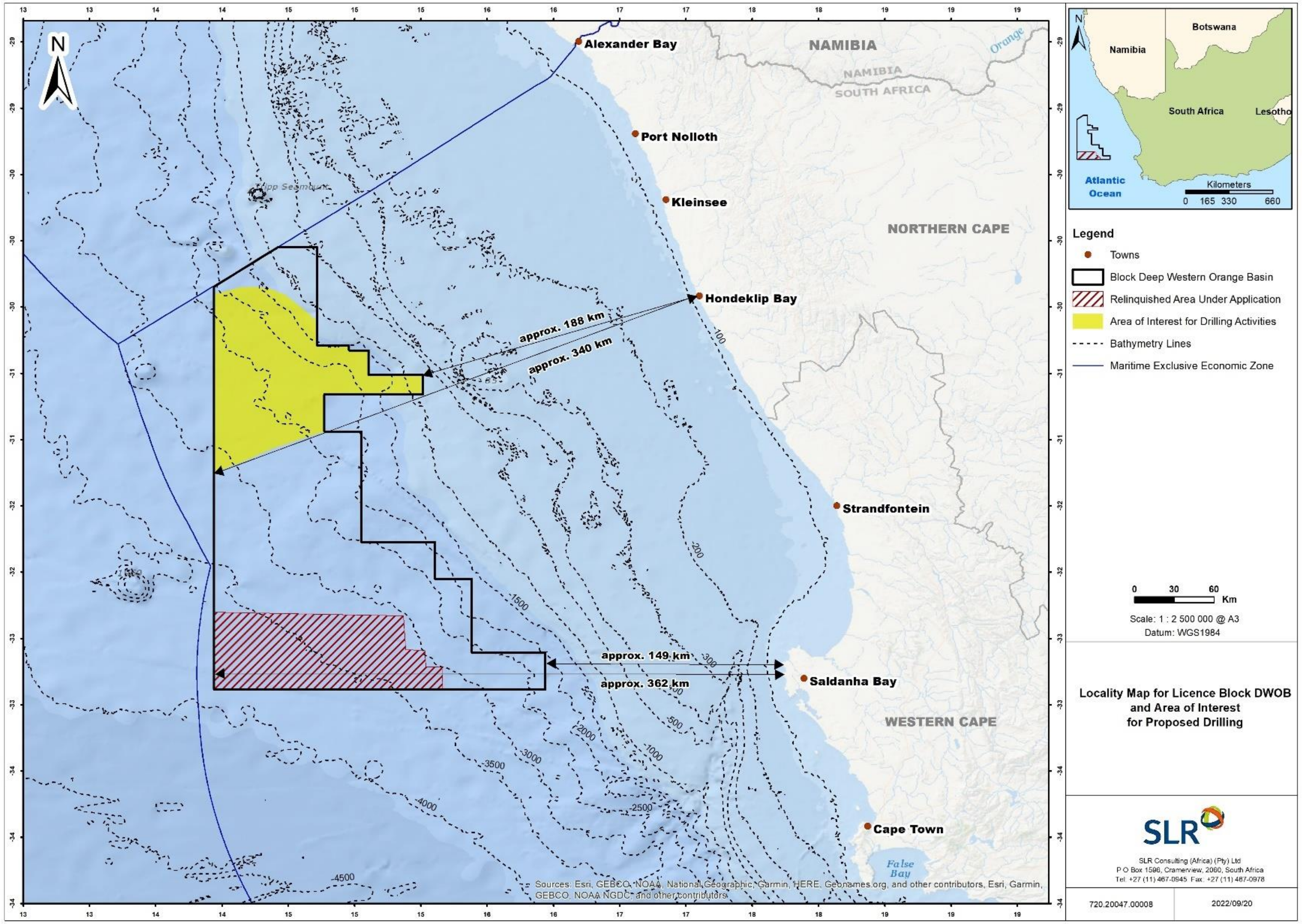


FIGURE 1-1: LOCALITY OF THE DWOB LICENCE BLOCK AND THE AREA OF INTEREST FOR PROPOSED EXPLORATION ACTIVITIES OFF THE WEST COAST OF SOUTH AFRICA.

1.2. OBJECTIVE AND PURPOSE OF THIS REPORT

This Draft Scoping Report (DSR) has been prepared in compliance with Appendix 2 of the EIA regulations 2014 (as amended) as part of the ESIA process that is being undertaken for the application by TEEPSA for the proposed exploration well drilling activities in the DWOB Licence Block.

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

- Identify the relevant policies and legislation relevant to the 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 project activities would occur.
- Screen and identify potential impacts that will be further investigated in the Impact Assessment Phase.
- Outline of 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 (i.e., the Plan of Study - see Chapter 9).

This report is submitted to the delegated authority, the Petroleum Agency of South Africa (PASA), for consideration and review. PASA will then make a recommendation on the acceptance or rejection of the report to the Minister of the Department of Mineral Resources and Energy (DMRE), who will make the final decision.

1.3. OPPORTUNITY TO COMMENT AND ATTEND PUBLIC INFORMATION-SHARING MEETINGS

This draft Scoping Report is distributed for a 30-day comment period from **4 November to 5 December 2022**. It provides an opportunity for I&APs to comment on any aspect of the proposed project and the potential impacts identified for further investigation in the Assessment Phase.

Copies of the full report are available for review on the SLR website (**https://www.slrconsulting.com/en/public-documents/TEEPSA-DWOB**), a data free website (**https://slrpublicdocs.datafree.co/en/public-documents/TEEPSA-DWOB**) and at various locations (refer to specific details in the I&AP notification letter). In addition, the Non-technical Summary (in English, Afrikaans, isiXhosa and Setswana) is available for collection at various locations (refer to the I&AP notification letter). The Non-technical Summary is also available on the above-mentioned websites as a document and audio recording.

Any comments should be sent to SLR at the address, WhatsApp / SMS numbers or e-mail shown below. For comments to be included in the final Scoping Report, comments should reach SLR by **no later than 5 December 2022**.

SLR Consulting (South Africa) (Pty) Ltd

5th Floor, Letterstedt House, Newlands on Main, Newlands, 7700
Tel: (021) 461 1118
WhatsApp / SMS: 072 422 3448
E-mail: TEEPSA-DWOB@slrconsulting.com

Stakeholders are also invited to attend public information-sharing meetings; specific details of these meetings are provided in the I&AP notification letter.

1.4. STRUCTURE OF THIS REPORT

This report has been prepared in compliance with Appendix 2 of the EIA Regulations 2014 (as amended). 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 Scoping Report.
Chapter 1	**Introduction** Provides a description of the project background and location, and describes the objectives, purpose and the structure of this report.
Chapter 2	**Administrative and Legal Framework** Outlines the key South African administrative authorities and legislative framework, international regulations and conventions, and TotalEnergies standards and policies applicable to the proposed project and ESIA-related guidelines considered in the compilation of the report.
Chapter 3	**ESIA Approach and Process** Presents the ESIA Project Team, ESIA assumptions and limitations, and outlines the approach and process followed during the ESIA.
Chapter 4	**Public Participation Process** Presents and describes the public consultation process undertaken during the ESIA process.
Chapter 5	**Policy, Need and Desirability** Provides an overview of the national and international policies informing the need and desirability for the project.
Chapter 6	**Project Description** Provides general project information and a detailed description of the proposed activities and associated project alternatives.
Chapter 7	**Receiving Environment** Describes the existing physical, biological, socio-economic and cultural environment that could potentially be affected by the proposed exploration activities.
Chapter 8	**Screening of Environmental and Socio-Economic and Key Impacts** Provides a high-level screening of the interaction between project activities and the biophysical and social environment; identifies key issues and impacts associated with the proposed exploration activities; and describes project 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.

Section	Contents
Appendices	Appendix 1: EAP declaration and undertaking Appendix 2: Curricula Vitae of the SLR ESIA Project Team Appendix 3: DFFE Screening Report Appendix 4: Public Participation Process Documents: Appendix 4.1: I&AP registration, notification letters and emails Appendix 4.2: Advertisements Appendix 4.3: Site notices

2. ADMINISTRATIVE AND LEGAL FRAMEWORK

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

2.1. SOUTH AFRICAN INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

2.1.1. Department of Mineral Resources and Energy (DMRE)

DMRE is the public trustee of South Africa's mineral and petroleum resources. According to the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002), as amended (MPRDA), read with the National Environmental Management Act, 1998 (No. 107 of 1998), as amended (NEMA), the Minister (or designated authority) is responsible for the following:

- Approving or refusing an Environmental Authorisation on the basis of environmental reporting prepared in terms of Chapter 5 of the NEMA as part of Exploration or Production Right applications;
- Granting or refusing Exploration Rights and Production Rights; and
- Prescribing and levying any fee, in consultation with the Minister of Finance, payable in terms of the MPRDA.

The Minister is required to consider environmental policy, norms and standards, while promoting economic and social development, in order to ensure that the development of South Africa's mineral and petroleum resources is undertaken in a sustainable manner.

2.1.2. Petroleum Agency of South Africa (PASA)

In terms of Section 70 of the MPRDA, the Minister of Mineral Resources and Energy in June 2004, designated various duties pertaining to petroleum exploration and production to PASA. This includes the receipt of applications for different types of permits and rights, some of which require Environmental Authorisations. Section 71(i) of the MPRDA provides that the designated agency must review and make recommendations to the Minister with regards to the acceptance of environmental reports and the conditions of Environmental Authorisations and amendments thereto.

PASA is responsible for promoting the exploration of oil and gas resources and the optimal development thereof on behalf of the South African government. As such, PASA deals with the regulation and monitoring of exploration and production activities and endeavours to make sure that all such activities have long-term economic benefit for South Africa. In addition, PASA is the custodian of the national exploration and production database for petroleum.

2.1.3. Department of Forestry, Fisheries and the Environment (DFFE)

DFFE is the custodian of environmental matters and is tasked with ensuring protection of the environment and conservation of natural resources in the context of sustainable development. DFFE is responsible for the administration of applications for and the issuing of Environmental Authorisations in terms of NEMA and the EIA Regulations 2014 (as amended), excluding applications related to mining and petroleum for which DMRE is the competent authority. The Minister of Forestry, Fisheries and the Environment, however, remains the competent authority for dealing with appeals for these applications and serves as the appeals administrator.

2.1.4. South African Heritage Resources Agency (SAHRA)

SAHRA is a statutory organisation established under the National Heritage Resources Act, 1999 (No. 25 of 1999), and serves as the national administrative body responsible for the protection of South Africa's cultural heritage.

SAHRA is responsible for establishing national principles, standards and policy for the purposes of identifying, recording and managing the national estate. SAHRA also manages South Africa's national cultural heritage, identifies and keeps record of nationally significant heritage resources and provides expertise to provincial and local heritage authorities where required. It also administers wrecks (those older than 60 years or which SAHRA considers worthy of conservation) within the territorial waters and the maritime cultural zone.

2.1.5. South African Maritime Safety Authority (SAMSA)

SAMSA was established in terms of the South African Maritime Safety Authority Act, 1998 (No. 5 of 1998) and reports to the Minister of Transport. The Act specifies that SAMSA's objectives are to ensure safety of life and property at sea, prevent and combat pollution of the marine environment by ships and promote the Republic's maritime interests. To this end, SAMSA provides the following (www.samsa.org.za):

- Safety and environment protection standards for responsible maritime transport operations;
- Monitoring and enforcing compliance with safety and environment protection standards;
- The capability to respond to marine pollution incidents and other maritime emergencies; and
- The capability to detect, locate and rescue people in maritime distress situations.

SAMSA administers several pieces of legislation relating to marine pollution, marine traffic and the transport of goods by sea and issues licences or permits related to these aspects.

2.1.6. Transnet National Ports Authority (TNPA)

TNPA is responsible for managing and controlling South Africa's commercial ports (Saldanha, Cape Town, Mossel Bay, Gqeberha (previously Port Elizabeth), Ngqura, East London, Durban and Richards Bay) and is accountable to the Minister of Transport. TNPA's mandate is granted by the National Ports Act, 2005 (No. 12 of 2005) and its purpose is to "own, manage, control and administer ports to ensure their efficient and economic functioning".

No person other than TNPA may provide a port service or operate a port facility unless an agreement has been entered into with TNPA or in terms of a licence issued by TNPA.

2.2. SOUTH AFRICAN LEGISLATION

2.2.1. Introduction

In terms of Section 24 of the Constitution of South Africa, 1996 (No. 108 of 1996) (the Constitution), "*everyone has the right:*

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that;

(i) Prevent pollution and ecological degradation;

(ii) Promote conservation; and

(iii) Secure ecologically sustainable development and use of natural; resources while promoting justifiable economic and social development".

NEMA provides for the incorporation of environmental considerations in decision-making. It applies alongside the State's responsibility to respect, protect, promote and fulfil the social and economic rights in Chapter 2 of the Constitution, together with the basic needs of categories of persons disadvantaged by unfair discrimination.

The MPRDA gives effect to Section 24 of the Constitution by ensuring that South Africa's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development.

The above Acts and other laws listed below are the key pieces of legislation in terms of which authorisation / approval is required in order for TEEPSA to undertake the proposed exploration activities. These laws govern the legal requirements, the application processes to be followed and stipulate where exploration activities may or may not occur.

2.2.2. National Environmental Management Act, 1998 (NEMA)

Chapter 2 of NEMA sets out a range of environmental and social principles that are to be applied by all organs of state when taking decisions that significantly affect the environment. Included amongst the key principles is that all development must be socially, economically and environmentally sustainable. It requires that environmental management must place people and their needs at the forefront of its concern, and must serve their physical, psychological, developmental, cultural and social interests equitably. NEMA also provides for the participation of Interested and Affected Parties (I&APs) and stipulates that decisions must consider the interests, needs and values of all of them.

Chapter 5 of NEMA outlines the general objectives and implementation of Integrated Environmental Management (IEM), which provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals. Section 24 of the NEMA provides a framework for the granting of an Environmental Authorisation. In order to give effect to the general objectives of IEM, the potential impacts on the environment of listed activities must be considered, investigated, assessed and reported on to the competent authority. Section 24(4) provides the minimum requirements for procedures for the investigation, assessment and communication of the potential impact of activities.

The EIA Regulations 2014 (as amended) promulgated in terms of Chapter 5 of NEMA and published in Government Notice (GN) No. R982 (as amended), provide for the control of certain listed activities. These activities are listed in GN No. R983 (Listing Notice 1), R984 (Listing Notice 2) and R985 (Listing Notice 3) of 4 December 2014 (as amended) and are prohibited until an Environmental Authorisation has been obtained from the competent authority. The Minister of Mineral Resources and Energy (the Minister) is responsible for the granting or refusing of an Environmental Authorisation for the application to undertake exploration activities in terms of the NEMA. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with GN No. R982 (as amended). The responsibility for granting Environmental Authorisations has been delegated to DMRE. For oil and gas exploration, the responsibility for processing applications has been delegated to PASA. However, DMRE remains the competent authority for the Environmental Authorisation decision-making process.

The EIA Regulations 2014 (as amended) sets out the procedures and documentation that need to be complied with when applying for an Environmental Authorisation. A Basic Assessment process must be undertaken if the authorisation applied for is in respect of an activity or activities listed in Listing Notice 1 and/or 3, while an ESIA process (scoping and impact assessment) must be undertaken if the authorisation applied for is in respect of an activity or activities listed in Listing Notice 2.

The proposed exploration project triggers activities contained in both Listing Notice 1 and 2 (see Table 2-1), thus an ESIA process must be undertaken for PASA and DMRE to consider the application.

The listed activities triggered by the proposed project are indicated Table 2-1 in below.

TABLE 2-1: LIST OF APPLICABLE ACTIVITIES IN TERMS OF LISTING NOTICE 1 AND 2 (AS AMENDED)

Activity No.	Activity Description	Description of Activity in relation to the Proposed Exploration Activities
GN No. R983: Listing Notice 1 (as amended by GN No. R327 of 2017, R706 of 2018 and R517 of 2021)		
14	"*The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 m^3 or more but not exceeding 500 m^3.*"	The proposed drilling operation would make use of infrastructure which would handle and potentially store oil, gas and/or fuel (diesel). Information on the anticipated handling volumes and storage capacity for these substances is currently not available; thus, this activity is included to provide for a situation where storage capacity exceeds 80 m^3 but falls below 500 m^3.
17	"*Development (i) in the sea ... in respect of (e) infrastructure or structures with a development footprint of 50 m^2 or more...*"	Wells may be abandoned on the seafloor with an over-trawlable cap, if deemed safe to do so based on a risk assessment. A single cap measures approximately 5.2 x 5.2 m (27 m^2); thus, the cumulative footprint for 10 wells would be greater than 50 m^2.
19A	"*The infilling or depositing of any material of more than 5 m^3 into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from:* *(iii) the sea. …*"	The proposed well drilling would result in various forms of disturbance to the seafloor and would result in more than 5 m^3 of sediment being disturbed and moved.
GN No. R984: Listing Notice 2 (as amended by GN No. 325 of 2017 and R517 of 2021)		
4	"*The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 m^3.*"	The proposed drilling operation would make use of infrastructure which would handle and potentially store oil, gas and/or fuel (diesel). Information on the anticipated handling volumes and storage capacity for these substances is currently not available; thus, this activity is included to provide for a situation where storage capacity exceeds 500 m^3.
6	"*The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, ...*"	Should TEEPSA decide to incinerate waste on the drilling unit and support vessels (if considered to be "installations") an Atmospheric Emission Licence will be required in terms of the National Environmental Management: Air Quality Act, 2004.
7	"*The construction of facilities or infrastructure for the bulk transportation of dangerous goods:* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity of more than 700 tons per day;*	The proposed project will make use of drilling infrastructure (e.g., pipes, casings, etc.) which would extract oil and/or gas for testing on the drilling unit. Due to the anticipated depth of the proposed wells of maximum 3 500 m below the seafloor, this infrastructure would exceed 1 000 m in length. The designed throughput capacity of this infrastructure could also exceed the thresholds specified in the listed activity. Most of the facilities proposed for exploration are

Activity No.	Activity Description	Description of Activity in relation to the Proposed Exploration Activities
	(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 m in length, with a throughput capacity more than 50 m³ per day;"	temporary (except for the casings inside the well bore and possibly the wellhead which may be abandoned on the seafloor).
14	*"The development and related operation of –* *(ii) an anchored platform; or* *(iii) any other structure or infrastructure on or along the seabed, ... "*	The proposed drilling operations would result in the placement of equipment (i.e., a wellhead) on the seabed. During well abandonment the wellhead(s) may be left on the seafloor, unless site-specific risk assessments conclude there is a danger or risk to other marine users in which case wellheads would be removed.
18	*"Any activity including the operation of that activity which requires an Exploration Right in terms of Section 79 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice, in Listing Notice 1 of 2014 or in Listing Notice 3 of 2014, required to exercise the exploration right…"*	TEEPSA is proposing to drill up to 10 exploration wells. Since the activity (namely sampling and drilling) requires an Exploration Right (although TEEPSA already holds an Exploration Right for the DWOB Licence Block), and drilling was not previously authorised, this activity is deemed applicable.

In terms of Section 24P of NEMA, where prescribed, an applicant for an Environmental Authorisation relating to exploration, must, before the Competent Authority issues an Environmental Authorisation, determine the financial provision, which is required for undertaking progressive rehabilitation, decommissioning, closure and post-closure activities. The Regulations pertaining to Financial Provision (GNR No. R1147 of 2015, as amended) set out the methods for determining and making Financial Provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts caused by exploration. Such provision does not include the management of unplanned events such as well blow-out. Refer to Section 6.5 for further detail on the Financial Provision for this project.

2.2.3. Guidelines for ESIA Process

The guidelines for undertaking the EIA Regulatory process listed in Table 2-2 have been and will be considered further during the ESIA process.

TABLE 2-2: GUIDELINES RELEVANT TO THE ESIA PROCESS

Guideline	Governing body	Applicability
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	DFFE	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, Integrated Environmental Management, Information Series 5 (2002)	DFFE	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.
Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7 (2004)	DFFE	This guideline will be consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	DFFE	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	DFFE	This guideline will be consulted to ensure that the Environmental and Social Management Programme (ESMP) is adequately compiled.

Guideline	Governing body	Applicability
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	DFFE	This guideline was consulted to inform the approach to impact reporting.
Guideline on Need and Desirability (2017)	DFFE	This guideline informed the consideration of the need and desirability aspects of the proposed project.
Public Participation Guideline in terms of NEMA (2017)	DFFE	The purpose of this guideline is to ensure that an adequate public participation process is undertaken during the ESIA process.

2.2.4. Mineral and Petroleum Resources Development Act (MPRDA), 2002

The MPRDA is the principal legislation governing prospecting and mining and the exploration and production of oil and natural gas. The Act provides for the equitable access to and sustainable development of mineral and petroleum resources. The MPRDA Regulations (GN R527 of 2004) provide for the application for and issuing of Reconnaissance Permits, Prospecting Rights, Exploration Rights, Mining Rights and Production Rights. As noted earlier, TEEPSA already holds an Exploration Right for DWOB Licence Block.

Since 8 December 2014, environmental regulation of prospecting, mining, exploration and production and related activities was removed from the MPRDA and transferred to NEMA, as set out in Section 2.2.2 above. As stated above, the Minister of the DMRE is the competent authority that authorises an application for an Environmental Authorisation, while the Minister of Forestry, Fisheries and the Environment remains the appeal authority for such an authorisation.

In terms of Section 102 of the MPRDA, an Exploration Right, Exploration Work Programme and/or Environmental and Social Management Programme (ESMP) may not be amended without the approval of the Minister (of Minerals and Energy). For the proposed exploration activities, any related amendments required to the Exploration Work Programme, linked to TEEPSA's Block DWOB Exploration Right, would need to be approved by that Minister.

2.2.4.1. Mineral and Petroleum Resources Development Regulations, 2004

These Regulations, promulgated in terms of Section 107 of the MPRDA, provide for a range of matters relating to the administration of the Act. Part 1 details regulations for the lodgement of applications, Part 2 deals with Social and Labour plans while Part 3 sets out environmental regulations for mineral development. These Regulations had not been practicably implementable since December 2014 following the commencement of the "One Environmental System" and the amendments of the overriding legislation (i.e. MPRDA and NEMA).

In March 2020, amendments to the Mineral and Petroleum Resources Development Regulations were gazetted (GN No. R 420 of 27 March 2020) which replaced the vast majority of the environmental provisions contained within Regulations. Of relevance to this ESIA process, the amended Regulations specify that public participation for applications made under the MPRDA must be conducted in accordance with provisions contained in the EIA Regulations 2014 (as amended).

2.2.5. National Environmental Management: Air Quality Act (NEM: AQA), 2004

The NEM: AQA, as amended, regulates all aspects of air quality, including prevention of pollution, providing for national norms and standards. The Minister of Forestry, Fisheries and Environment, in terms of Section 21 of the NEM: AQA, published a list of activities which result in atmospheric emissions and are believed to have significant detrimental effects on the environment, human health and social welfare. Minimum Emission Standards for these listed activities were originally published on 31 March 2010 (Government Gazette No. 33064) with revisions of the schedule on the 22 November 2013 (Government Gazette No. 37054) and 31 October 2018 (Government Gazette No. 42013). Activities that fall within these regulations require an Atmospheric Emissions Licence (AEL) to operate.

In terms of Section 22 of NEM: AQA no person may conduct a listed activity without an AEL. The incineration of waste is a listed activity (*Category 8.1 – Thermal treatment of Hazardous and General Waste*) and requires an AEL for all installations treating 10 kg or more of waste per day. Drilling operations and flaring are, however, not included in the listed activities and as such do not require an AEL. DFFE confirmed in correspondence for another well-drilling application[2] that proposed exploration well drilling do not fall under any of the Section 21 listed activities in terms of NEM: AQA.

In terms of Section 36(5)(e) of the Act, the Minister of Forestry and Fisheries and the Environment must perform the functions of the licensing authority where the listed activity relates to exploration activities, as contemplated in the MPRDA. DFFE: Air Quality Management Services previously confirmed[3] that this category would apply to an offshore installation (i.e. drilling unit). The Maritime Zones Act, 1994 (No. 15 of 1994) makes it clear that a vessel, including a platform used for exploration, is an 'installations' and that all laws applicable in South Africa are also applicable to installations on or above the continental shelf. Although it is not TEEPSA's intension to incinerate waste during the proposed exploration campaign (as per other drilling campaigns off the South Coast), an application for an AEL would need to be made should TEEPSA wish to incinerate waste on an offshore installation. In addition, TEEPSA will need to comply with the relevant specifications for incineration at sea in terms of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL), to which South Africa is a signatory.

NEM: AQA also provides for the monitoring and reporting of greenhouse gas (GHG) emissions. The purpose of the National GHG Emission Reporting Regulations (GNR 275 of 2017 as amended) is to implement a single national reporting system for the transparent reporting of GHG emissions. For oil and gas exploration activities (code 1B2) under Annexure 1 of the amended GHG Emission Reporting Regulations, no specific thresholds have been set, which by default means that the Regulations require that carbon dioxide (CO_2) and methane (CH_4) levels (calculated based on Tier 2 or 3 methodologies) be reported annually via the South African Greenhouse Gas Emissions Reporting System (SAGERS). The system forms part of the national atmospheric emission inventory component of South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP). TEEPSA would need to meet this requirement for all drilling and support vessel operations and flaring during well testing.

2 Letter from DFFE dated 23 August 2022 (ref. TESA/20/06/2022) submitted as part of another ESIA process to confirm the need for an AEL for flaring.

3 Letter from DFFE dated 14 January 2015, submitted as part of an ESIA for offshore exploration well drilling in the Orange Basin Seep Water Licence Area.

In Schedule 2 of the Act, the proposed project is classified under 1B2 and the tax threshold column states 'none', which therefore implies a carbon tax return submission. An annual Carbon Tax environmental levy will need to be submitted in July of each year after operations commence.

Certain production processes indicated in Annexure A of the Declaration of Greenhouse Gases as Priority Pollutants (Government Gazette 40966 of 21 July 2017) with GHG in excess of 0.1 Megatonne (Mt), measured as CO2-e, are required to submit a Pollution Prevention Plan to the Minister for approval. The Pollution Prevention Plan regulations under Sections 29(3), 53(o) and (p) read with section 57(1)(a) of the NEM: AQA, prescribe the requirements for the development and submission of Pollution Prevention Plan s. Whilst the Production and/or Processing of Natural Gas and the Production and/or Refining of Crude Oil are included in Annexure A, exploration and well testing is not specifically included in the list. Thus, it may be concluded that the current project does not require a Pollution Prevention Plan.

2.2.6. National Environmental Management: Waste Act (NEM:WA), 2008

The NEM: WA (No. 59 of 2008), as amended, regulates all aspects of waste management and has an emphasis on waste avoidance and minimisation. NEM: WA creates a system for listing and licensing waste management activities. Listed waste management activities above certain thresholds are subject to a process of impact assessment and licensing. Activities listed in Category A require a Basic Assessment, while activities listed in Category B require an ESIA process.
The DFFE (previously the Department of Environmental Affairs, DEA) previously indicated that NEM: WA is not applicable to offshore activities. Thus, a Waste Management Licence would not be required for offshore waste management activities. As noted in Section 2.2.5 above, although it is not TEEPSA's intention to incinerate waste during the proposed exploration campaign, an AEL is needed for the incineration of waste on offshore installations.

The management, treatment, recycling and disposal of waste arising from exploration activities at onshore locations would take place at facilities with the appropriate licensing, where required.

2.2.7. National Environmental Management: Protected Areas Act (NEM:PAA), 2003

The NEM: PAA (No. 57 of 2003), as amended, provides for the declaration and management of protected areas, and the promotion of sustainable utilisation of protected areas for the benefit of people in a manner that would preserve the ecological character of such areas.

Several Marine Protected Areas (MPA) were proclaimed in terms of NEM: PAA for the South African offshore in May 2019, some falling within the West Coast region in the vicinity of DWOB Licence Block (see Figure 7-43). For oil and gas exploration activities, although vessels are permitted to sail through these areas, no seismic acquisition or well drilling is permitted in any proclaimed MPA. This does not exclude vessels (including sonar/seismic survey vessels) sailing through these areas. The proposed exploration drilling activities within the DWOB Licence Block will avoid any MPAs and no discharge or disposal of waste will take place within any MPA.

2.2.8. National Heritage Resources Act (NHRA), 1999

The NHRA (No. 25 of 1999), as amended, provides for the protection of South Africa's natural heritage, including wrecks or associated debris or artefacts that may be found or disturbed on the seabed. As mentioned in Section 2.1.4, SAHRA is the statutory organisation responsible for the protection of South Africa's cultural heritage. Shipwrecks (those older than 60 years or which SAHRA considers worthy of conservation) within the territorial waters and the maritime cultural zone fall under the jurisdiction of SAHRA. According to Section 35 of the NHRA, any person who discovers archaeological objects or material (including wrecks) during a development must immediately report the find to SAHRA. No person may, without a permit issued by SAHRA, destroy, damage, excavate, alter, deface or otherwise disturb any archaeological site. In the event that a shipwreck is discovered during a pre-drilling site survey, TEEPSA would need to notify SAHRA and apply for the relevant permit or alternatively re-site the well.

In addition, Section 38 lists certain activities that would require authorisation by SAHRA. Under Section 38(1)(c)(i), SAHRA would need to be notified regarding any development or activity that will change the character of a site (including land covered by water) exceeding 5 000 m^2 in extent. Having considered such a notification, SAHRA will confirm whether a Heritage Impact Assessment would be required in order for an authorisation to be considered.

SAHRA is registered as a stakeholder on the project database and as such will be kept informed throughout the ESIA process of all opportunities for engagement and consultation (including ESIA document review / comment and meetings).

2.2.9. National Environmental Management: Integrated Coastal Management Act (NEM: ICMA), 2008 (No. 24 of 2008)

The NEM: ICMA (No. 24 of 2008) supports the authorisation requirements of NEMA but specifies additional criteria for regulating activities or developments (Section 63) and provides for pollution control within the coastal zone (Sections 69 to 73), where the coastal zone includes the Exclusive Economic Zone defined in the Maritime Zone Act (refer to line 11 in Table 2-3).

As the proposed project falls under the definition a "coastal activity" and is located within "coastal waters", the Competent Authority, in terms of Section 63, must take a number of factors into consideration in deciding on the application for Environmental Authorisation, including, amongst other:

- The likely impact of the proposed activity on the coastal environment, including cumulative effect of its impact together with those of existing activities.
- The likely impact of coastal environmental processes on the proposed activity.

2.2.10. Other South African Laws and Policies Relevant to Oil and Gas Exploration

Other South African legislation that TEEPSA may need to comply with should approval be granted to undertake the proposed exploration activities are summarised in alphabetical order in Table 2-3.

TABLE 2-3: OTHER APPLICABLE SOUTH AFRICAN LEGISLATION

No.	Title	Description
1	Carriage of Goods by Sea Act, 1986 (No. 1 of 1986) (COGSA)	This Act provides for the carriage of goods by sea and applies where: (a) the port of shipment is a port in South Africa; (2) the bill of lading is issued in a state which applies the Hague-Visby Rules; (3) the carriage is from a port in a contracting state; and (4) the contract contained in or evidenced by the bill of lading provides that the South African COGSA applies.
2	Carbon Tax Act, 2019 (No. 15 of 2019)	This Act provides for the imposition of a tax on the carbon dioxide equivalent (CO_2-e) of GHG emissions. Certain production processes indicated in Annexure A of the Declaration of Greenhouse Gases as Priority Pollutants (Government Gazette 40966 of 21 July 2017) with GHG in excess of 0.1 Mt, measured as CO_2-e, are required to submit a Pollution Prevention Plan to the Minister for approval. The Pollution Prevention Plan regulations under Sections 29(3), 53 (o) and (p) read with section 57(1) (a) of the NEM: AQA, prescribe the requirements for the development and submission of Pollution Prevention Plans. Whilst the Production and/or Processing of Natural Gas and the Production and/or Refining of Crude Oil are included in Annexure A, exploration and well testing is not specifically included in the list. Thus, the current project does not require a Pollution Prevention Plan.
3	Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983)	This Act provides for the control of substances which may cause injury or ill-health to or death of human. No person may, without a licence: (1) sell any Group I Hazardous Substance; (2) use, operate or apply any Group III Hazardous Substance (listed electronic products); and (3) install or keep any Group Ill Hazardous Substance. Authorisation is required to be in possession of, use or dispose of any Group IV Hazardous Substance (which include includes radioactive material).
4	The Human Rights Commission Act of 1994	This Act establishes a legal commission to monitor - pro-actively and by way of complaints brought before it - violations of human rights and redress for such violations.
5	Marine Living Resources Act, 1998 (No. 18 of 1998)	This Act provides for the conservation of marine ecosystems, the long-term sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and protection of certain marine living resources.
6	Marine Traffic Act, 1981 (No. 2 of 1981)	This Act regulates marine traffic in South Africa's territorial waters. It regulates the entry and dropping of anchor within 500 m safety zone of installations.
7	Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981)	The purpose of this Act is to provide protection of the marine environment from pollution by oil and other harmful substances, by giving power to SAMSA to take steps to prevent harmful substances being discharged from vessels. It is the responsibility of TEEPSA to disclose to SAMSA before the commencement of proposed activities the amounts and types of chemicals that would be used and disposed of during operations.
8	Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986)	This Act regulates pollution from ships, tankers and offshore installations, and for that purpose gives effect to MARPOL. In terms of the Act, it is an offence to discharge any oil from a ship, tanker or offshore installation within 12 miles (19 km) off the South African coast. The discharge of oily water or oil and any other substance which contains more than a hundred parts per million of oil is prohibited between 19 – 80 km offshore.
9	Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987)	This Act gives effect to the international convention relating to the Intervention of the High Seas in cases of oil pollution casualties, and to the Protocol relating to Intervention of the High Seas in cases of Marine Pollution by substances other than Oil in South African Waters.
10	Maritime Safety Authority Act, 1998 (No. 5 of 1998)	This Act provides for the establishment and functions of SAMSA. The objectives of the Act are to: (1) ensure safety of life and property at sea; (2) prevent and combat pollution of the marine environment by ship; and (3) promote South Africa's maritime interests.
11	Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.

No.	Title	Description
12	Marine Spatial Planning Act, 2018 (No. 16 of 2018)	This Act provides a framework for marine spatial planning in South Africa and the development of marine spatial plans. The objectives of this Act are to (1) develop and implement a shared marine spatial planning system to manage a changing environment that can be accessed by all sectors and users of the ocean, (2) promote sustainable economic opportunities which contribute to the development of the South African ocean economy through coordinated and integrated planning, (3) conserve the ocean for present and future generations, and (4) facilitate responsible use of the ocean.
13	Maritime Zones Act 1994 (No. 15 of 1994)	The Act defines the maritime zones, including territorial waters, contiguous zone, exclusive economic zone and continental shelf. Section 9(1) states that any law in force in South Africa shall also apply on and in respect of an installation.
14	Merchant Shipping Act, 1951 (No. 57 of 1951)	This Act provides for the control of merchant shipping and matters incidental thereto.
15	Mine Health and Safety Act, 1996 (No. 29 of 1996)	This Act provides for health and safety requirements for mining operations and includes hazard and risk assessments, monitoring and awareness training.
16	National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004)	This Act regulates the carrying out of restricted activities that may harm listed threatened or protected species or activities that encourage the spread of alien or invasive species subject to a permit.
17	National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999)	This Act provides for safety standards and regulatory practices for the protection of persons, property and the environment against nuclear damage. A licence is required for a vessel which has on board any radioactive material capable of causing nuclear damage (including any injury to or the death or any sickness or disease of a person). A certificate of registration is required for any action which is capable of causing nuclear damage.
18	National Policy on South African Living Heritage (March 2009)	This Policy framework was written in response to the need to create national policy on living heritage or intangible cultural heritage. This policy framework is an attempt to arrest continuing marginalisation of this important heritage and is aimed at affirming cultural diversity and mutual social existence, as well as empowering communities and individuals in safeguarding their heritage.
19	National Ports Act, 2005 (No. 12 of 2005)	This Act regulates and controls navigation within port limits and the approaches to ports, cargo handling, and the pollution and the protection of the environment within the port limits. The Act specifies a requirement for an agreement with or a licence from the National Ports Authority to operate a port facility or service.
20	National Water Act, 1998 (No. 36 of 1998)	This Act provides the legal framework for the effective and sustainable management of water resources in South Africa. It serves to protect, use, develop, conserve, manage and control water resources as a whole, promoting the integrated management of water resources with the participation of all stakeholders.
21	Nuclear Energy Act, 1999 (No. 46 of 1999)	This Act provides for the regulation of the acquisition, possession and use of nuclear fuel, certain nuclear and related material and certain related equipment and prescribes measures regarding the discarding of radioactive waste and the storage of irradiated nuclear fuel. Authorisation is required for the acquisition, possession and use of nuclear material (i.e. source material and special nuclear material), restricted material and nuclear-related equipment and material.
22	Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations	This Act provides for the health and safety of persons at work and the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work. Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.
23	Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973)	This Act provides for the control over certain islands and the protection of seabirds and seals. It is an offence to wilfully disturb seabirds and seals on the coast or on offshore islands, unless in possession of a permit.
24	Ship Registration Act, 1998 (No. 58 of 1998)	This Act provides for the registration of ships in South Africa.

No.	Title	Description
25	Traditional and Khoi-San Leadership Act, 2019 (No. 3 of 2019)	This Act provides for the recognition of traditional and Khoi-San communities, and the recognition and establishment of kingship or queenship councils, principal traditional councils, traditional councils, Khoi-San councils, traditional sub-councils and the National House of Traditional and Khoi-San Leaders.
26	World Heritage Convention Act, 1999 (No. 49 of 1999)	This Act provides for the incorporation of the World Heritage Convention into South African law and the recognition and establishment of World Heritage Sites.
27	Wreck and Salvage Act, 1995 (No. 94 of 1995)	This Act regulates the law of salvage in South Africa and provides for the application in South Africa of the International Convention of Salvage, 1989.

2.3. INTERNATIONAL REGULATIONS, CONVENTIONS AND BEST PRACTICE

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

TABLE 2-4: RATIFIED INTERNATIONAL CONVENTIONS AND TREATIES

No.	Title	Description
International Marine Pollution Conventions		
1	International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL)	MARPOL was developed by the International Maritime Organisation (IMO) 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 • 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.
2	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)	OPRC Convention is an international maritime convention establishing measures for dealing with marine oil pollution incidents nationally and in co-operation with other countries.
3	United Nations Convention on Law of the Sea, 1982 (UNCLOS)	UNCLOS defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.
4	1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention)	The London Convention is an agreement to control pollution of the sea from dumping and to encourage regional agreements supplementary to the Convention. It covers the deliberate disposal at sea of wastes or other matter from vessels, aircraft and platforms. It does not cover discharges from land-based sources, such as pipes and outfalls, wastes generated incidental to normal operation of vessels, or placement of materials for purposes other than mere disposal, providing such disposal is not contrary to aims of the Convention.
5	International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in	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 grave and imminent 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*".

No.	Title	Description
	Cases of Marine Pollution by substances other than oil, 1973	
6	International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2017 (BWM)	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.
7	Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989	This Convention is an international treaty that 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. It does not, however, address the movement of radioactive waste.
8	International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001	The Convention prohibits the use of harmful compounds in anti-fouling paints used on ships and rigs and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
Air and Atmosphere		
9	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. It is the first legally binding global agreement setting out specific obligations for the reduction of the amount of GHG.
10	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.
11	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.
12	United Nations Framework Convention on Climate Change, 1992	The objective of the Convention is to "stabilise GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".
13	Paris Agreement (United Nations Framework Convention on Climate Change - UNFCCC), 2016	South Africa signed the Paris Agreement on 22 April 2016. This Agreement aims to strengthen the global response to the threat of climate change by limiting the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase even further to 1.5°C. Parties aim to reach global peaking of GHG emissions as soon as possible, recognising that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century.
Flora, Fauna and Protected Areas		
14	Revised African Convention for the Conservation of Nature and Natural Resources, 2017	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.
15	United Nations Convention on Biological Diversity, 1992	This Convention has three main goals: (1) conservation of biological diversity (or biodiversity); (2) sustainable use of its components; and (3) fair and equitable sharing of benefits arising from genetic resources. Its objective is to develop national strategies for the conservation and sustainable use of biological diversity.
16	Convention on the Conservation of Migratory Species of Wild Animals, 1983 (Bonn Convention)	This Convention aims to conserve terrestrial, marine and avian migratory species throughout their range.
17	Memorandum of Understanding (MoU) on the Conservation of Migratory Sharks, 2010	The MoU was founded under the auspices of the Bonn Convention and serves as an international instrument for the conservation of migratory shark species, including species occurring off the South Coast of South Africa.
18	The MoU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia, 2001	The MoU is an intergovernmental agreement that aims to protect, conserve, replenish and recover sea turtles and their habitats in the Indian Ocean and South-East Asian region.

No.	Title	Description
19	Agreement on the Conservation of Albatrosses and Petrels, 2004 (ACAP)	The Agreement protects all the world's albatross species, seven southern hemisphere petrel and two shearwater species. A number of these occur off the South Coast of South Africa.
20	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.
21	Convention on International Trade of Wild Fauna and Flora Endangered Species, 1973 (CITES)	CITES is a multilateral treaty to protect endangered plants and animals.
22	Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, 1975	This is an international treaty for the conservation and sustainable use of wetlands. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". South Africa has 27 Ramsar sites (refer to Section 7.5.5).
23	Agreement on the Conservation of African-Eurasian Migratory Waterbirds, 1995) (AEWA)	AEWA is an independent international treaty developed under the auspices of the United Nations Environment Programme's Convention on Migratory Species. It was founded to coordinate efforts to conserve bird species migrating between European and African nations, and its current scope stretches from the Arctic to South Africa, encompassing the Canadian archipelago and the Middle East as well as Europe and Africa.
24	International Convention for the Regulation of Whaling, 1946	This Convention is an international agreement aimed at the "proper conservation of whale stocks and make possible the orderly development of the whaling industry". It governs the commercial, scientific and subsistence whaling practices of its member nations.
Archaeology and Cultural Heritage		
25	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.
26	United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention for the Safeguarding of the Intangible Cultural Heritage, 2003	This Convention provides for the safeguarding of intangible cultural heritage and to ensure intangible cultural heritage of communities is respected.
27	United Nations Declaration on the Rights of Indigenous Peoples, 2007 (UNDRIP)	This Declaration delineates and defines the individual and collective rights of indigenous peoples, including their ownership rights to cultural and ceremonial expression, identity, language, employment, health, education, and other issues. It prohibits discrimination against indigenous peoples and it promotes their full and effective participation in all matters that concern them and their right to remain distinct and to pursue their own visions of economic and social development.
28	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 artwork, treasures that may be looted, sacrificial and burial sites, and old ports that cover the oceans' floors.
29	United Nations Convention on Elimination of all Forms of Discrimination against Women (CEDAW), 1979	This Convention international treaty adopted in 1979 by the United Nations General Assembly. It is described as an international bill of rights for women.
30	Convention for the Safeguarding of the Intangible Cultural Heritage (ICH) (2003).	In 1999, it promulgated the country's World Heritage Convention Act (49 of 1999), a law to guide the identification and nomination process for World Heritage Sites. The World Heritage Convention Act and ratification of the ICH convention suggest that government has pledged to conserve both tangible and intangible heritage.

No.	Title	Description
Marine Safety		
31	Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS)	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.
32	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.
33	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. All assigned load lines must be marked amidships on each side of the ships engaged in international voyages.
34	International Commission on Radiological Protection (ICRP)	ICRP is an independent, international non-governmental organisation providing recommendations and guidance on radiation protection.
35	International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, 1984	IAEA is an international organisation that seeks to promote the peaceful use of nuclear energy, and to inhibit its use for any military purpose, including nuclear weapons. These regulations provide international standards and approaches to safety promote consistency, help to provide assurance that nuclear and radiation related technologies are used safely, and facilitate international technical cooperation and trade.
Human Rights and Labour		
36	International Labour Organisation Conventions	C029 - Forced Labour Convention, 1930 (No. 29) -05 Mar 1997 C087 - Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87) C098 - Right to Organise and Collective Bargaining Convention, 1949 (No. 98) C100 - Equal Remuneration Convention, 1951 (No. 100) C105 - Abolition of Forced Labour Convention, 1957 (No. 105) C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111) C138 - Minimum Age Convention, 1973 (No. 138) C182 - Worst Forms of Child Labour Convention, 1999 (No. 182) C081 - Labour Inspection Convention, 1947 (No. 81) C144 - Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144) C002 - Unemployment Convention, 1919 (No. 2) C004 - Night Work (Women) Convention, 1919 (No. 4) C019 - Equality of Treatment (Accident Compensation) Convention, 1925 (No. 19) C026 - Minimum Wage-Fixing Machinery Convention, 1928 (No. 26) C027 - Marking of Weight (Packages Transported by Vessels) Convention, 1929 (No. 27) C041 - Night Work (Women) Convention (Revised), 1934 (No. 41) C042 - Workmen's Compensation (Occupational Diseases) Convention (Revised), 1934 (No. 42) C045 - Underground Work (Women) Convention, 1935 (No. 45) C063 - Convention concerning Statistics of Wages and Hours of Work, 1938 (No. 63) C080 - Final Articles Revision Convention, 1946 (No. 80) C089 - Night Work (Women) Convention (Revised), 1948 (No. 89) C116 - Final Articles Revision Convention, 1961 (No. 116) C155 - Occupational Safety and Health Convention, 1981 (No. 155) C176 - Safety and Health in Mines Convention, 1995 (No. 176) MLC 2006 - Maritime Labour Convention, 2006 (MLC 2006) C188 - Work in Fishing Convention, 2007 (No. 188) C189 - Domestic Workers Convention, 2011 (No. 189)

No.	Title	Description
Social		
37	Equator Principles Equator Principles III (2013)	Large infrastructure and industrial Projects can have adverse impacts on people and on the environment. The Equator Principles (EP) are intended to serve as a common baseline and risk management framework for financial institutions to identify, assess and manage environmental and social risks when financing Projects. Financial institutions adopt the EP to ensure that the projects they finance are developed in a socially responsible manner and reflect sound environmental management practices. By doing so, negative impacts on project-affected ecosystems and communities should be avoided where possible. If unavoidable, negative impacts should be reduced, mitigated and/or compensated for appropriately.
38	HR/PUB/11/04 Guiding principles on Business and Human Rights. Implementing the United Nations "Protect, Respect and Remedy" Framework. United Nations, 2011	The Guiding Principles apply to all States and to all business enterprises, both transnational and others, regardless of their size, sector, location, ownership and structure. The objective of the Guiding Principles is to enhance standards and practices with regard to business and human rights so as to achieve tangible results for affected individuals and communities, and thereby also contributing to a socially sustainable globalization. These Guiding Principles pays particular attention to the rights and needs of, as well as the challenges faced by, individuals from groups or populations that may be at heightened risk of becoming vulnerable or marginalized, and with due regard to the different risks that may be faced by women and men.
39	IFC Stakeholder Engagement Stakeholder Engagement: A good practice handbook for companies doing business in emerging markets, 2007	This handbook endeavors to provide a comprehensive overview of good practice in stakeholder engagement, with a dedicated focus on stakeholder groups that are "external" to the core operation of the business, such as affected communities, local government authorities, non-governmental and other civil society organizations, local institutions and other interested or affected parties.
40	IPIECA-DIHR Integrating Human Rights into environmental, social and health impact assessments. A practical guide for the oil and gas industry. 2013.	This Guide describes how human rights can be integrated into environmental, social and health impact assessments (ESHIAs), which the oil and gas industry routinely uses to evaluate projects and activities. It provides an introduction to human rights and their relevance to the activities of the oil and gas industry, and briefly describes why it is important for the oil and gas industry to consider the impact that its projects and activities have on human rights.

2.4. TOTALENERGIES' STANDARDS, HSE POLICY AND SUSTAINABILITY COMMITMENTS

2.4.1. TotalEnergies' Sustainability Approach

A process of continuous improvement linked to the sustainable development goals

TotalEnergies has placed sustainable development in all its dimensions at the heart of its strategy, projects and operations, in order to contribute to the well-being of the planet's populations, and it wants to set the standard in terms of commitment to the Sustainable Development Goals (SDG), adopted in 2015 by the United Nations and its Member States and to which TotalEnergies has committed to contribute since 2016.

TotalEnergies has structured its CSR (Corporate Social Responsibility) approach for conducting its activities so as to contribute to the achievement of the United Nations Sustainable Development Goals (SDGs). The axes of TotalEnergies CSR strategy are summarised in Figure 2-1.

As part of its determination to strengthen its efforts in the segments in which it can act with most authority as an integrated multi-energy Company, TotalEnergies involves its employees in identifying the SDGs on which it can have the greatest impact, in connection with its ambition to reach carbon neutrality (net zero emissions) by 2050, together with society.

TotalEnergies' CSR approach is based on four pillars:

- **Climate and sustainable energy:** leading the transformation of the energy model to contribute to the fight against climate change and meet the needs of populations;
- **People's well-being:** being a reference as an employer and responsible operator. TotalEnergies intends on promoting a work environment that combines performance and conviviality and ensuring compliance with human rights in the workplace, both within the Company and among its partners, but also the safety and health of people;
- **Care for the environment:** to be exemplary in the management of the environment and the use of the planet's natural resources. TotalEnergies intends on ensuring that the environmental impacts of all its operations are managed according to the Avoid-Reduce-Offset approach, thereby helping to preserve the environment, biodiversity and freshwater resources. To this end, TotalEnergies promotes the circular economy;
- **Creating value for society:** generating shared prosperity across regions. TotalEnergies aims to be a creator and a driver of positive change for the communities in its host regions.

TotalEnergies actively works on each of its sustainability pillars in order to make its development a vehicle of progress that benefits as many people as possible and to be a factor of positive change for the societies and regions where it is present.

Support to global initiatives

TotalEnergies is committed to various international initiatives such as the fight against climate change, promotion of social dialogue, preservation of biodiversity, transparency in the conduct of business.

TotalEnergies abides by the principles of the United Nations Global Compact. TotalEnergies is committed to respecting internationally recognized human rights, wherever it operates, especially the Universal Declaration of Human Rights, the Fundamental Conventions of the International Labor Organization (ILO), the U.N. Guiding Principles on Business and Human Rights, the OECD Guidelines for Multinational Enterprises and the Voluntary Principles on Security and Human Rights (VPSHR).

Transparency, a principle of action

The Company believes that transparency is an essential principle of action in building a trust-based relationship with its stakeholders and enables a path of continuous improvement.

Pending the adoption of an international, standardized non-financial reporting framework, TotalEnergies ensures it is accountable for its performance on the basis of the various commonly used ESG reporting frameworks. As such, TotalEnergies refers to the Global Reporting Initiative (GRI) standards and those of the Sustainability Accounting Standards Board (SASB), for which detailed tables of correspondence are available on its website. TotalEnergies' reporting includes the World Economic Forum's core indicators[4]. Furthermore, the Company follows the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) for its climate

[4] Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation, white paper, September 2020.

reporting. TotalEnergies provides additional information on its website in pages specifically dedicated to its sustainability development approach.

TotalEnergies' sustainability approach is recognized: in 2021, the Company was once again confirmed as a LEAD Company by the United Nations Global Compact for its full commitment to CSR.

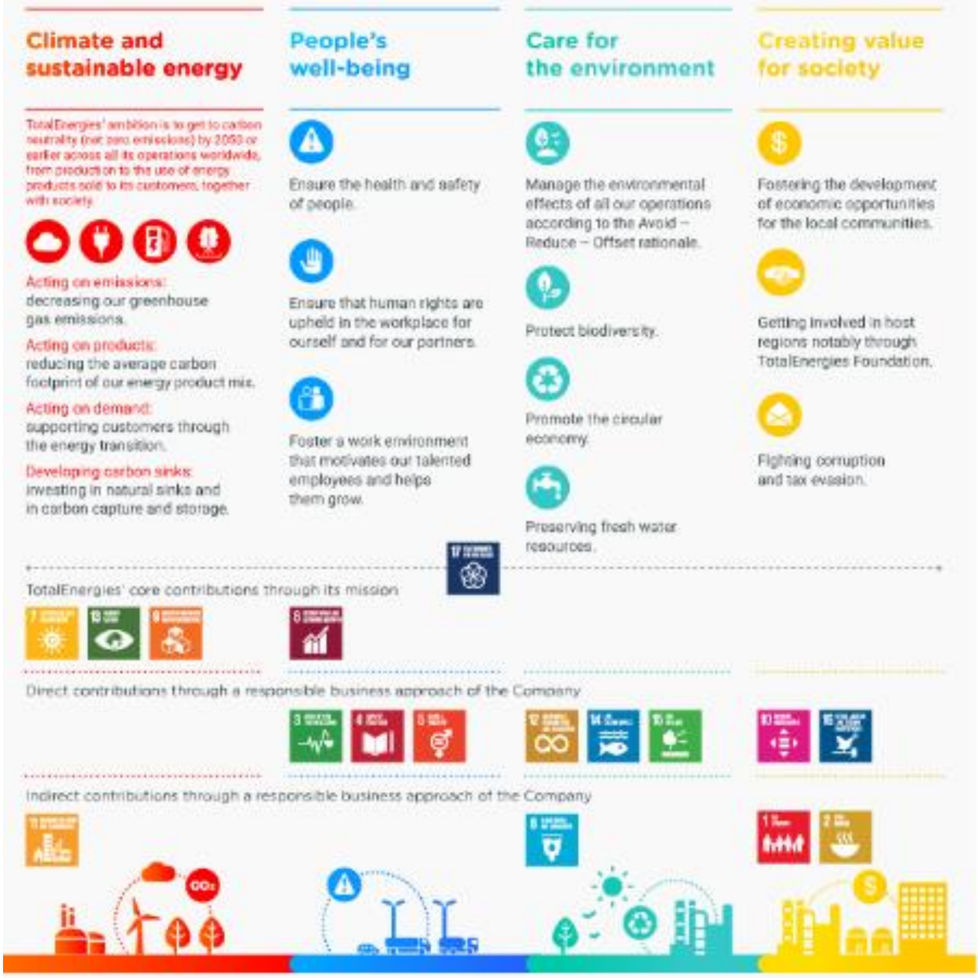


FIGURE 2-1: THE AXES OF TOTALENERGIES CSR STRATEGY

2.4.2. Project Standards for Exploration Activities

Apart from the requirement to comply with the national legislation described in Section 2.2 above and the conditions of an Environmental Authorisation issued by authorities, TEEPSA complies with a set of corporate specifications regulating environmental and social procedures and reporting requirements for undertaking ESIAs on its projects. The proposed exploration project will comply with the General Specification for Environment – Environmental Requirements for Project Design and Exploration and Production Activities (GS EP ENV 001). To reduce any potentially significant impacts of proposed future activities, mitigation measures shall be identified and selected according to the Best Available Techniques (BAT) concept and approved by the Company.

This specification deals with: Environmental Footprint; Flaring and Air Emissions; Fuel Gas and Energy Use; Management of Liquid Effluents; Waste Management; Drill Fluids and Cuttings; Chemicals; Noise; Dust, Odours and Lighting; Spill Response Equipment; and Decommissioning of Installations.

With respect to Oil Spill Contingency Planning and the management of responses related to unplanned events (e.g., well blow-out and oils spills), including the assessment of economic effects and related compensation, TEEPSA subscribes to the International Petroleum Industry Environmental Conservation Association (IPIECA) - International Association of Oil and Gas Producers (IOGP) Good Practice Guide Series. The primary reference document in this regard is the "Economic assessment and compensation for marine oil releases" (2015). TEEPSA would thus plan for and implement responses in terms of this guideline document.

2.4.3. General Specifications for ESIAs

This ESIA will be conducted within the framework of Corporate General Specifications for Environmental and Social Impact Assessments, implemented by TEEPSA, including:

- **General Specification for ESIAs for Exploration and Production activities (i.e. GS EP ENV 120)**: This document defines the processes and requirements to be implemented for conducting an ESIA. It recognises that the purpose of the ESIA is to ensure that the environment is given full and proper consideration in the decision-making process with respect to potential activities having possible negative and positive consequences on the environment. It outlines the minimum standard required by the Company to assess impacts on the environment and is adapted to the type and nature of a given project to define the Scope of Work.
- **General Specification for Social Performance – Social Baseline Study (SBS) (i.e. GS EP SDV 101) and General Specification for Social Performance – Social Impact Assessment (i.e. GS EP SDV 102)**: These specifications define the Company requirements for establishing an SBS and for undertaking a Social Impact Assessment, including stakeholder engagement. Together they specify the requirement for the content of the baseline studies and the process and requirements for stakeholder engagement (including disclosure) and the assessment of social impacts. The specifications require local laws and rules to be respected, and for further specific conditions to be added, if necessary.
- **General Specification for Sustainable Development – Human Rights Impact Assessment (HRIA) (i.e. GS EP SDV 103)**: This specification defines the Company guidelines for conducting an HRIA on projects where human rights issues are a potential concern. Where relevant, it requires identification of and engagement with stakeholders who are vulnerable to Human Rights abuses and the assessment of human rights impacts resulting from the Company's activities and potential mitigation measures.

It should be noted that an HRIA is not directly applicable to the proposed exploration activities in the West Coast offshore, which is far removed from coastal sensitivities and communities. Thus, an HRIA as such has not been undertaken, however, should any risk of implications of the project on human rights be identified, it will be considered as part of the SIA.

2.4.4. HSE Policies and Social Corporate Commitments

TotalEnergies is committed to upholding a number of global policies and principles on its projects. These include the Voluntary Principles for Security and Human Rights, the International Labour Organisation Conventions, United Nations Declaration of Human Rights, the United Nations Guiding Principles on Business and Human Rights, Partnering Against Corruption Initiative and sustainable performance reporting, amongst others.

TotalEnergies also has a Code of Conduct for its staff and supply chain governing health, safety, security, bribery and corruption, and respect for human rights. TEEPSA's HSE policy is provided in Box 2-1.

BOX 2-1: TEEPSA'S HSE POLICY

TotalEnergies

HEALTH, SAFETY & ENVIRONMENT POLICY

TotalEnergies EP South Africa B.V. is committed to conduct its business in a sustainable manner, which provides for and maintains a safe working environment, which is without risk to the wellbeing of its employees, contractors and stakeholders, and which furthermore will have a limiting impact on the surrounding environment.

The Management of TotalEnergies EP South Africa B.V. takes the responsibility to apply, drive and sustain the principles listed in this policy in order to ensure continued improvement of our HSE performance and impact.

IT IS OUR POLICY TO:

- Encourage and promote a positive HSE work culture throughout the organisation, by demonstrating strong visible felt leadership from management and supervision, and to involve the workforce, to take personal ownership, responsibility and accountability for Health, Safety and the Environment in the workplace.
- Comply with all Local and International Laws and Regulations, as well as all Corporate Policies and Specifications applicable to our operations.
- Pro-actively identify and implement continuous improvement initiatives by setting measurable HSE targets and objectives, and regularly review our actual performance against these targets and objectives.
- Ensure that all risks associated with our operations are continuously identified, monitored and reviewed in order to mitigate and maintain our risk profiles as low as reasonably possible.
- Continuously communicate with and consult all personnel, contractors and stakeholders on any HSE related matters.
- Incorporate and plan for effective HSE management methods in all ongoing engineering and operations activities.
- Ensure all people are trained and competent for any task they perform and ensure that such work is performed under the supervision of a person who has been trained to acknowledge the related hazards and has the authority to implement precautionary measures
- Provide for appropriate and sufficient resources, including training, in order to achieve targeted performance levels on ongoing bases.
- Work and partner with those industrial and commercial partners who demonstrate a similar commitment to our own HSE visions.
- Implement, maintain and regularly test emergency response and contingency plans.

Each and every employee, contractor and person acting on behalf of the company, has the responsibility to prevent harm to themselves, others and the surrounding environment, which may be affected by their acts or omissions.

TotalEnergies EP South Africa B.V. is committed to ensure that our resources, organisational strategies and processes are aligned with the goals and objectives as set out in this policy, in order to satisfy our stakeholder's needs.

Adewale FAYEMI
General Manager

TEPSA/1/POL/HSE/01.01

September 2021

TOTALENERGIES EP SOUTH AFRICA B.V.

The TotalEnergies Charter of Principles and Guidelines regarding Indigenous and Tribal Peoples sets out its commitment to respect the culture, values and lifestyle of the local communities, and contributes to their economical development while carrying out its business. As such, TotalEnergies endeavours to honour the principles of the charter together with applicable legal standards, while dealing with Indigenous and Tribal Peoples.

2.4.5. TotalEnergies Sustainable Performance

Energy is one of the major challenges of the 21st century: to preserve the planet threatened by climate change, while enabling majority of humanity to escape from poverty. In this sense, energy is inseparable from the major global challenges of sustainable development.

TotalEnergies' purpose is to supply to as many people as possible a more affordable, more available and cleaner energy. As a supporting component of society's evolutions, energy is a fundamental resource for economic, social and human development, which currently faces a twofold challenge: (1) satisfying the energy needs of an ever-growing world population, while (2) reducing global warming. TotalEnergies' intention in becoming a broad energy company is to help meet that challenge in a responsible way, in line with its support of the United Nations Sustainable Development Goals (SDG) since 2016.

Main pillars of this strategy are introduced below. For further information on TotalEnergies' commitments, refer to its website https://sustainable-performance.totalenergies.com/en.

Energy Transition

TotalEnergies' ambition is to become a world-class player in the energy transition. TotalEnergies' strategy consists of transforming it into a broad energy company by profitably growing its energy production, particularly from liquefied natural gas (LNG) and electricity, the two fastest growing energy markets, to create long-term value for its shareholders. In the next decade, TotalEnergies' sales of oil products are expected to diminish by almost 30% and its sales mix will become 30% oil products, 5% biofuels, 50% natural gas and 15% electricity, primarily of renewable origin.

Climate and carbon neutrality ambition

TotalEnergies supports the objectives of the Paris Agreement, which calls for the reduction in greenhouse gas emissions and its goal of limiting the average rise in planetary temperatures to well below 2°C from pre-industrial levels.

TotalEnergies also supports the objective set out in the Paris Agreement of achieving global carbon neutrality – i.e. net zero emissions, which is the balance between GHG emissions and anthropogenic removals in the form of sinks and reservoirs, such as forests, carbon capture and storage facilities. TotalEnergies has set an ambition of reaching carbon neutrality (net zero emissions) by 2050 in Europe, from the production to the use of the energy products sold to its customers (Scopes 1, 2, 3 as defined by the GHG Protocol) and the objective of 60% or more reduction in the average carbon intensity of energy products used worldwide.

Sustainable value creation

TotalEnergies' model of value creation is based on integration across the energy value chain, from exploration and production of oil, gas and electricity (including renewables) to energy distribution to the end customer, and including refining, liquefaction, petrochemicals, trading, and energy transportation and storage. This integrated business model enables TotalEnergies to capitalise on synergies among the various businesses, while responding to volatility in feedstock prices. With this integration of its operations across the entire value chain, TotalEnergies can manage the bottom of the cycle more effectively and capture margins when the market improves. This transition will cement the durability and resilience of TotalEnergies' value creation model and bolster its ambition of getting to Net Zero (net zero emission).

Preservation of the Environment

TotalEnergies considers the respect for the environment to be a priority and, therefore, strives to minimise the footprint of its activities by controlling its energy consumption, its emissions in natural environments (water, air, soil), its residual waste production, its use of natural resources and its impact on biodiversity. Prevention and management of accidental pollution risk are covered by a strong policies framework. In 2020, TotalEnergies set itself a new biodiversity ambition to coincide with the preparation of the United Nations' global biodiversity plan, which is based on four core principles, including voluntary exclusion zones on more sensitive areas such as UNESCO World Cultural Heritage sites and Arctic sea-ice regions. Regarding the "circular economy", since 2017, TotalEnergies has focused on waste reduction and valorisation (i.e. increase in the value of), including developing polymers from recycled plastics.

Business ethics

TotalEnergies operates in many different countries with disparate and complex economic, social and cultural environments, where governments and civil society have especially high expectations of TotalEnergies as an exemplar. Within this context, TotalEnergies strives to act as an agent for positive change in society by helping to promote ethical principles in every region where it operates. Accordingly, TotalEnergies is committed to respecting internationally recognised human rights wherever it operates. TotalEnergies is also fully committed to fighting corruption and has adopted a policy of zero tolerance in that area.

Participative Stakeholder Engagement

Transparency is an essential factor in building a trust-based relationship with stakeholders and ensuring that a company or project is on a path of continuous improvement.

Dialogue with TotalEnergies external stakeholders is essential for the company to conduct its business responsibly and integrate the long-term challenges of sustainable development in the company's strategy and policies. This dialogue informs TotalEnergies's decision-making, by, in addition to specific studies, helping it identify the non-technical risks and impacts of its operations, including the Human Rights component and, more generally, by providing greater insight into changing societal patterns and expectations.

TotalEnergies' financial / non-financial reporting is published in a Universal Registration Document (https://totalenergies.com/system/files/documents/2022-03/DEU_21_VA.pdf).

3. ESIA APPROACH AND PROCESS

This chapter outlines the team members and the approach and methodology followed in the ESIA process.

3.1. DETAILS OF THE ESIA PROJECT TEAM

As noted in Chapter 1, SLR has been appointed as the independent EAP to undertake the ESIA for the proposed exploration activities. The details of the SLR ESIA project team and appointed specialists are provided in Table 3-1.

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. SLR has declared its independence as required by the EIA Regulations 2014, as amended (see Appendix 1).

TABLE 3-1: DETAILS OF THE ESIA PROJECT TEAM AND SPECIALISTS

Company	Name	Qualifications	Experience (years)	Roles
ESIA Project Team				
SLR Consulting	Edward Perry	M.Sc. (Applied Hydrobiology), Cardiff University B.Sc. Hons (Environmental Science), Plymouth University	28	Project Director and QA/QC
	Nicholas Arnott	Hons. (Earth & Geog. Sci.), University of Cape Town	16	Project Manager - management of the ESIA process, including process review, specialist baseline study review and ESIA report compilation
	Jeremy Blood	MSc. (Cons. Ecol.), University of Stellenbosch	23	Project technical support
	Wasila Vorajee	B.Sc Hons (Geological Sciences), University of KwaZulu-Natal B.Sc (Geological Sciences) , University of KwaZulu-Natal	5	Project support, including report compilation
	Castro Ravhuhali	BSc Env. Science, University of Venda	4	Project support and public participation administration
	Jonathan Crowther	MSc. (Env. Sci.), University of Cape Town	34	Technical Advisor
Specialist Team				
Independent Public Participation Consultant	Antoinette Pietersen	Hons (BA Psychology), North-West University, Potchefstroom IAP2 Certificate in the Foundations for Public Participation and Techniques for Public Participation IAP2 Certificate in Strategies to deal with Public Emotion and Outrage	25	Stakeholder mapping and PPP Facilitator
	Julian Drew (NMA Effective Social Strategists)	BSc (Civil Engineering), Bolton Institute of Technology (UK) Social Impact Assessment (Certificate), University of Pretoria	32	PPP Facilitator

Company	Name	Qualifications	Experience (years)	Roles
HES (H-Expertise Services SAS)	Benjamin Livas	MSc. (Dynamic of Aquatic Ecosystems, Biodiversity), University of Pau – France	12	Drilling Discharges and Oil Spill Modelling
PRDW	Stephen Luger	MSc. (Engineering), University of Cape Town	30	Independent peer review of Drilling Discharges and Oil Spill Modelling
SLR Consulting Australia	Jonathan Vallarta	PhD Underwater Acoustics – Acoustical Localisation), Heriot-Watt University B.Eng. Hons (Electronics & Communications), Ibero-American University B.Sc. (Biological Sciences), National Autonomous University of Mexico	19	Underwater Noise Modelling
	Dana Lewis	ME (Mech), University of Queensland	4	
Pisces Environmental Services	Andrea Pulfrich	PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany	27	Marine Ecology Impact Assessment
Capricorn Marine Environmental	Dave Japp	MSc. (Ichthyology and Fisheries Science), Rhodes University	34	Fisheries Impact Assessment
	Sarah Wilkinson	BSc. (Hons) (Botany), University of Cape Town	19	
SLR Consulting	Greg Huggins	MSocSc. (Anthropology), University of Cape Town	32	Socio-Economic Impact Assessment
University of Cape Town, School of Economics	Anthony Leiman	MA (Economics), University of Cape Town	25	
Nelson Mandela University	Rose Boswell	PhD (Anthropology), Vrije Universiteit, Amsterdam MSc (Anthropology), University of Cape Town	27	Cultural Heritage Impact Assessment
Airshed Planning Professionals	Lucian Burger	PrEng, PhD (Natal), MScEng(chem), BScEng(chem)	36	Climate Change and Air Emissions Impact Assessment

Edward Perry is the Operations Manager for the SLR Environmental Management, Planning and Approvals team in Africa. Edward is a registered Environmental Auditor and has over 28 years of consulting experience for a wide range of projects including the oil and gas, mining, renewables and water storage. He is a registered South African Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa.

Nicholas Arnott has worked as an environmental assessment practitioner since 2006 and has been involved in numerous projects covering a range of environmental disciplines, including Basic Assessments, ESIAs and Environmental Management Programmes. He has gained experience in a wide range of projects relating to mining and prospecting, infrastructure projects (e.g., roads), housing and industrial developments. He is a registered South African Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa, as well as a registered Professional Natural Scientist with SACNASP.

Jeremy Blood has 23 years of experience in a range of environmental disciplines, including ESIAs, Environmental Management Programmes/Plans, Environmental Auditing and Monitoring in South Africa, Namibia, Mozambique and Kenya. He has expertise in a wide range of projects, including oil and gas, mining and infrastructure. He is a registered South African Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa, as well as a registered Professional Natural Scientist with SACNASP.

Jonathan Crowther is an SLR Associate and has been involved in environmental consulting since 1988. He has expertise in a wide range of environmental disciplines, including ESIAs, Environmental Management Plans / Programmes, Environmental Planning & Review, Environmental Control Officer services, and Public Consultation & Facilitation. He has project managed numerous offshore oil and gas EIAs for various exploration and production activities in South Africa and Namibia. He is registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP).

CVs of the SLR team for the ESIA are included in Appendix 2.

3.2. ESIA ASSUMPTIONS AND LIMITATIONS

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

- SLR assumes that all relevant project information has been provided by TEEPSA and that it was correct and valid at the time it was provided;
- Precise locations for the project activities are not confirmed and the drilling sites are to be located within an indicative Area of Interest. The ESIA studies assess generic well drilling locations within this defined area and the impact assessment is representative of well drilling at any location within this defined area;
- 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 roughly equivalent to that which will be used during the proposed future drilling campaigns;
- This ESIA will consider potential impacts of the proposed exploration activities on the biophysical and social environments that have been identified within the project's Area of Influence, which encompasses:
    - Activities and facilities that are directly owned, operated and/or managed by TEEPSA (including contractors and sub-contractors) as part of the project;
    - Unplanned events, which are unintended but may occur as a result of accidents or abnormal operating conditions; and
    - Indirect project impacts on biodiversity or ecosystem services upon which potential affected communities' livelihoods are dependent.
- The ESIA considers the assessment of activities proposed as part of the additional exploration activities, but does not aim to identify or assess the impacts or benefits of possible future exploration or production activities or outcomes;
- The EIA Regulations 2014 (as amended) require the consideration of the "cumulative impact", which includes the 'reasonably foreseeable future impact of an activity'. Cumulative impacts of the proposed activities, in the context of other exploration activities, will be considered in the ESIA, to the extent that this is feasible and 'reasonably foreseeable'. While it is foreseeable that further exploration and future production activities could arise from the proposed exploration activities (if granted), there is not currently sufficient information to make reasonable assertions as to nature of any future activities due to the current lack of relevant geological information;
- No significant changes to the project description or surrounding environment will occur between the submission of the final ESIA Report and implementation of the proposed project that could substantially influence findings and recommendations with respect to mitigation and management; and

- TEEPSA will undertake the proposed exploration well drilling in line with South African Legislation, International regulations and best practices, as well as TEEPSA's project standards (see Section2.4).

3.3. ESIA PROCESS

The ESIA process consists of two phases: Scoping Phase and Impact Assessment Phase. A flowchart indicating the entire ESIA process is presented in Figure 3-1. The process is currently in the Scoping phase.

3.3.1. Scoping Phase

3.3.1.1. Objectives

The Scoping Process consists of a series of steps to ensure compliance with the Scoping objectives (as presented in Section 1.2) and the EIA Regulations 2014 as set out in GN No. R982 (as amended). The process is required to involve an open, participatory approach to ensure that all impacts are identified, and that decision-making takes place in an informed, transparent and accountable manner.

Key steps (excluding public consultation) of the Scoping Phase are summarised in Sections 4.3.1 and 4.3.3 below. The public consultation process is summarised in Chapter 4.

3.3.1.2. Pre-application Meeting with PASA

A pre-application meeting was held with PASA on 6 September 2022. The aim of the meeting was to inform PASA of TEEPSA's proposed project and application for Environmental Authorisation, as well as to obtain agreement on the ESIA process.

3.3.1.3. DFFE Screening Report

In terms of Regulation 16 (1)(b)(v) of the EIA Regulations 2014 (as amended), a Screening Report was generated by the DFFE National Screening Tool on 16 September 2022 (see Appendix 3). The Screening Report was submitted to PASA with the Application for Environmental Authorisation (see Section 3.3.1.4 below).

The Screening Tool essentially provides site specific information and identifies specific ESIA requirements including specialist studies applicable to the proposed site and/or development, based on the national sector classification and the environmental sensitivity of the site. The related specialist assessments identified by the DFFE Screening Tool and the rationale for why they will or will not be undertaken in the ESIA phases is provided in the Site Sensitivity Verification Report in Box 3-1.

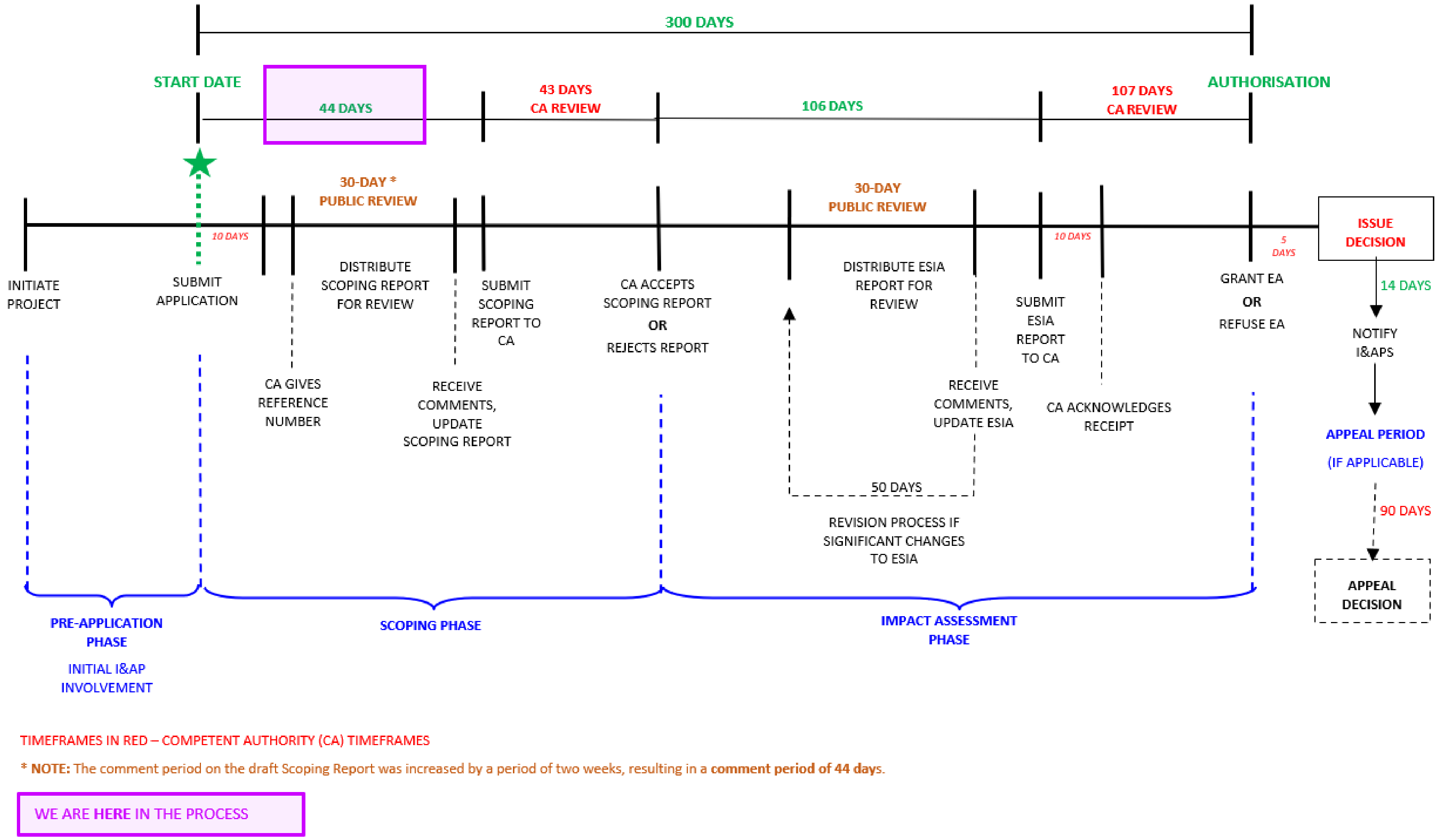


FIGURE 3-1: FLOW DIAGRAM SHOWING THE ESIA PROCESS

BOX 3-1: SITE SENSITIVITY VERIFICATION REPORT FOR THE DWOB LICENCE BLOCK

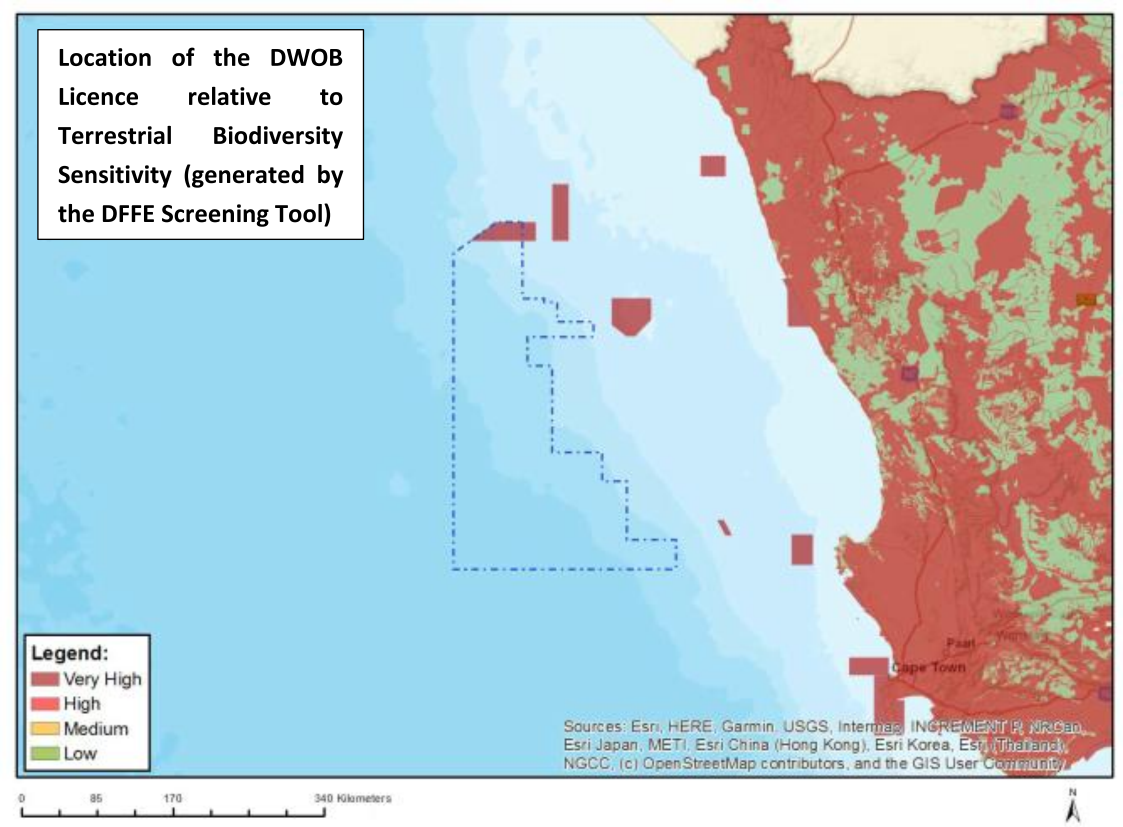
1. PURPOSE OF THIS REPORT

In accordance with the Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of NEMA, this Site Sensitivity Verification Report has been compiled to provide a rationale for the specialist studies, as identified by the DFFE Screening Tool, that will be undertaken as part of the environmental process.

2. SITE ENVIRONMENTAL SENSITIVITY

The inshore boundary of the DWOB Licence Block and the proposed drill area are located approximately 188 km offshore at the closest point.

Although the proposed project is located in the offshore marine environment, the DFFE Screening Tool identifies the licence block as being of **VERY HIGH** sensitivity in the **Terrestrial Biodiversity Theme**. This is related to the licence block overlapping with Marine Protected Areas (MPA), namely the Orange Shelf Edge Marine Protected (see figure below). **Considering only the Area of Interest for drilling, the DFFE Screening Tool identifies no overlap with any sensitive areas.**



3. RATIONALE FOR DFFE IDENTIFIED SPECIALIST STUDIES

The related specialist assessments identified by the DFFE Screening Tool and the rationale for why they will or will not be undertaken in the ESIA phases is provided below.

Specialist Assessments Identified by the National Screening Tool	Rationale for Inclusion/ Exclusion
Landscape/Visual Impact Assessment	***Excluded***: No assessment will be undertaken as the proposed project is located more than 188 km offshore, would entail a temporary installation and would not be visible to any sensitive visual receptors.
Aquatic Biodiversity Impact Assessment	

Marine Impact Assessment Avian Impact Assessment	***Included***: A Marine Ecology Impact Assessment will be undertaken in the ESIA phase which will address impacts on all coastal and marine ecosystems and species.
Defence Assessment	***Excluded***: No assessment would be undertaken as the nearest edge of the DWOB block is located more than 188 km offshore. No marine ammunition dumps are located in the block and none of these activities would have an impact on national defence operations.
Noise Impact Assessment	***Included***: A specialist Underwater Noise Modelling Study will be undertaken. The findings of this report will be used to assess the impact of sonar and drilling noise on marine fauna as part of the Marine Ecology Impact Assessment.
Radioactivity Impact Assessment	***Excluded***: No assessment will be undertaken as the target resources are not naturally radioactive. If any radioactive sources are used during the exploration activities, it would be of minimal volumes and would be managed in line with the relevant legislation and guidelines for the management of radioactive sources.
Traffic Impact Assessment	***Excluded***: Impacts related to marine traffic will be assessed in the ESIA Phase, but due to the offshore location and relatively small impact area, no specific specialist assessment is deemed necessary.
Geotechnical Assessment	***Excluded***: No assessment will be undertaken as the proposed project is located more than 188 km offshore and the project components itself is deemed to be a geotechnical investigation.
Health Impact Assessment	***Excluded***: No Health Impact Assessment would be undertaken as the proposed exploration activities are short term and located more than 188 km offshore, with only a logistics base required onshore at the selected port/harbour and thus no health impacts on third parties are not anticipated
Socio-economic Assessment	***Included***: A Social Impact Assessment and a Fisheries Impact Assessment will be undertaken in order to assess the potential impacts on the social environment, specifically related to the potential impact on fisheries. In addition, a Cultural Heritage Assessment will be undertaken to investigate and assess the cultural and spiritual beliefs of South Africa's coastal fisher communities and indigenous peoples within the Project's indirect Area of Influence. Site sensitivity will be confirmed in these specialist studies.
Climate Impact Assessment Ambient Air Quality Impact Assessment Air Quality Impact Assessment	***Included***: A Climate Change and Air Emissions Impact Assessment will be undertaken. An Air Emissions Inventory will be established for the proposed project considering both greenhouse gasses (GHG) and criteria pollutant emissions. This study will also include atmospheric dispersion screening (worst-case) and a Climate Change Statement, which will evaluate the significance of GHG and non-GHG emissions. Site sensitivity will be confirmed in this specialist study.
Seismicity Assessment	***Excluded***: No assessment would be undertaken as the proposed exploration activities are located more than 188 km offshore and there are no geotechnical-related issues associated with the proposed project.

3.3.1.4. Application Form for Environmental Authorisation

An "Application Form for Environmental Authorisation" (including the DFFE Screening Report) was compiled and submitted to PASA at the same time as the draft Scoping Report was released for review and comment.

3.3.1.5. Baseline Information and Collection

SLR commissioned a marine ecologist, a fisheries specialist and a social scientist to provide input into the description of the baseline affected environment and to aid with the identification of key issues and potential impacts as part of the preparation of the Scoping Report during the pre-application phase. The establishment of the baseline did not involve primary research but included consultation of reference material (see Chapter 10) and Marine Mammal Observation (MMO) data from previous exploration activities undertaken off the West Coast.

3.3.1.6. Compilation and Review of Scoping Report

The draft Scoping Report was prepared in compliance with Appendix 2 of the EIA Regulations 2014 (as amended) (see Table 3-2). The report aimed to present all information in a clear and understandable format, suitable for easy interpretation by I&APs and authorities, and to provide an opportunity for I&APs to comment on the proposed project, findings of the Scoping Phase and impact assessment approach. Steps undertaken as part of the draft Scoping Report review and comment process are summarised in Chapter 4.

TABLE 3-2: REQUIREMENTS OF A SCOPING REPORT IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

No.	Content of Scoping Report	Completed (Y/N or N/A)	Location in report
2(a)	*(i & ii) Details and expertise of the Environmental Assessment Practitioner (EAP) who prepared the report.*	Y	Table 3-1
(b)	*The location of the activity, including:*	Y	Section 6.4.1
	(i) the 21 digit Surveyor General code of each cadastral land parcel; or	N/A	
	(ii) where available, the physical address and farm name	N/A	
	(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Y	
(c)	*A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is:*	Y	Figure 1 1 & Figure 6 1
	(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or	N/A	
	(ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken.	N/A	
(d)	*A description of the scope of the proposed activity, including:*	Y	Table 2-1
	(i) all listed and specified activities triggered;		
	(ii) a description of the activities to be undertaken, including associated structures and infrastructure.	Y	Chapter 6
(e)	*A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process.*	Y	Chapter 2
(f)	*A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location.*	Y	Chapter 5
(h)	*A full description of the process followed to reach the proposed preferred activity, site and location within the site, including:*	Y	Section 6.6
	(i) details of all the alternatives considered;		
	(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Y	Chapter 4 & associated appendices

No.	Content of Scoping Report	Completed (Y/N or N/A)	Location in report
	(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	N	To be presented in the final Scoping Report
	(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Section 6.6 & Chapter 7
	(v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts: (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated.	Y	Sections 8.2 to 8.5 Specialists will assess impacts in the Impact Assessment Phase (see Section 9.2)
	(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;	Y	Section 9.3
	(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Section 8.4 & 8.5
	(viii) the possible mitigation measures that could be applied and level of residual risk;	Y	Section 8.4
	(ix) the outcome of the site selection matrix;	Y	Section 8.1 & 8.5
	(x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and	Y	
	(xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity.	Y	
(i)	*A plan of study for undertaking the environmental impact assessment process to be undertaken, including:*	Y	Chapter 9
	(i) a description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity;		Section 8.5
	(ii) a description of the aspects to be assessed as part of the environmental impact assessment process;		Section 8.2
	(iii) aspects to be assessed by specialists;		Section 9.2
	(iv) a description of the proposed method of assessing the environmental aspects, including a description of the proposed method of assessing the environmental aspects including aspects to be assessed by specialists;		Section 9.3
	(v) a description of the proposed method of assessing duration and significance;		Section 9.3
	(vi) an indication of the stages at which the competent authority will be consulted;		Chapters 3 & 4
	(vii) particulars of the public participation process that will be conducted during the environmental impact assessment process;		Chapter 4
	(viii) a description of the tasks that will be undertaken as part of the environmental impact assessment process; and		Sections 3.3.2, 4.4 & Chapter 9
	(ix) identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored.		Chapter 8.4
(j)	*An undertaking under oath or affirmation by the EAP in relation:*	Y	Appendix 1

No.	Content of Scoping Report	Completed (Y/N or N/A)	Location in report
	(i) the correctness of the information provided in the report;		
	(ii) the inclusion of comments and inputs from stakeholders and interested and affected parties; and		
	(iii) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties.		
(k)	*An undertaking under oath or affirmation by the EAP in relation to the level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environmental impact assessment.*	Y	Appendix 1
(l)	*Where applicable, any specific information required by the competent authority.*	N/A	-
(m)	*Any other matter required in terms of Section 24(4)(a) and (b) of the Act.*	N/A	-

3.3.1.7. Completion of the Scoping Phase

The following steps will be undertaken to complete the Scoping Phase:

- After closure of the comment period, the draft Scoping Report will be updated to a final version. All comments received on the draft version of the report will be collated and responded to in a Comments and Responses Report, which will be appended to the final Scoping Report; and
- As noted in Section 1.2, the final Scoping Report will be submitted to PASA for consideration and review. PASA will then forward the FSR with recommendation to DMRE for a decision on the acceptance or rejection of the report. If the final Scoping Report is accepted, the project will proceed onto the Impact Assessment Phase (see section 3.3.2).

3.3.2. Impact Assessment Phase

3.3.2.1. Objectives

In accordance with Appendix 3 of the EIA Regulations 2014 (as amended), "*the objective of the environmental impact assessment process is to, through a consultative process:*

a) determine the policy and legislative context within which the activity is located and document and how the proposed activity complies with and responds to the policy and legislative context;

b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;

c) identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;

d) determine the -

(i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and

(ii) degree to which these impacts—

(aa) can be reversed;

(bb) may cause irreplaceable loss of resources, and

(cc) can be avoided, managed or mitigated;

e) *identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;*

f) *identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;*

g) *identify suitable measures to avoid, manage or mitigate identified impacts; and*

h) *identify residual risks that need to be managed and monitored."*

Requirements of the ESIA and ESMP are set out in Appendix 3 and 4 of the EIA Regulations 2014 (as amended), respectively. Chapter 6 of these Regulations sets out the requirements to enable a reasonable opportunity for potential or registered interested and affected parties to comment on the application. The public participation process for this study is described in Chapter 4.

3.3.2.2. 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:
  - Drilling Discharges Modelling.
  - Oil Spill Modelling.
  - Underwater Noise Modelling.
- Specialist Studies / Assessments:
  - Marine Ecology Impact Assessment.
  - Fisheries Impact Assessment.
  - Socio-Economic Impact Assessment.
  - Cultural Heritage Impact Assessment.
  - Climate Change and Air Emissions Impact Assessment.

The technical modelling studies will predict potential outputs from the proposed exploration well drilling and associated operations. These modelled outputs will be used by the specialists to determine and assess impacts that may occur. In addition to those listed above, an independent peer review of the Drilling Discharges and Oil Spill Modelling studies will also be undertaken.

The other specialist studies will involve the collection of primary data (e.g. cultural heritage), the use and review of secondary data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed exploration well drilling and associated operations. These impacts will be assessed according to pre-defined rating scales (see Section 9.3). 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, as well as the independent peer review, are presented in Section 9.2. The ESIA specialist team is listed in Table 3-1.

3.3.2.3. ESIA Report and Environmental and Social Management Programme

The specialist information and other relevant information will be integrated into a draft ESIA Report, in compliance with Appendix 3 of the EIA Regulations 2014 (as amended), and will include an Environmental and

Social Management Programme (ESMP)[5] compiled in terms of Appendix 4 of the EIA Regulations 2014 as amended. The specialist studies will be included as appendices to the ESIA Report. This document will be released for at least 30-day review and comment period. Steps that will be undertaken as part of the I&AP review process are summarised in Section 4.4.

After closure of the comment period, all comments received on the draft report will be incorporated and responded to in a Comments and Responses Report. The draft ESIA Report will then be updated to a final version, to which the Comments and Responses Report will be appended and submitted to PASA for consideration and review. After its review, PASA will provide a recommendation to DMRE on whether to grant or refuse Environmental Authorisation.

After DMRE issues its decision, all I&APs registered on the project database will be notified of the outcome of the application and the reasons for the decision within 14 days of the date of the decision. A statutory appeal period in terms of the National Appeal Regulations, 2014 (GN No. R993) will follow the issuing of the decision. In terms of Regulation 4(1)(a), "*an appellant must submit an appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered I&AP and any organ of state with interest in the matter within 20 days from: a) the date that the notification of the decision for an application for an Environmental Authorisation … was sent to the registered I&APs by the applicant*".

3.4. MANAGEMENT OF CHANGE

As with most large, complex projects, refinement of the project design 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 project design change after submission of the final ESIA Report, a Management of Change (MOC) Procedure will be implemented. The MOC Procedure applies to any changes to the project description (i.e. approved activities), impact assessment and / or mitigation and monitoring measures described in the ESIA Report and associated ESMP.

The level of change will determine the action to be taken to ensure the changes do not affect the Project's ability to meet environmental and social performance requirements outlined in the ESIA Report, Environmental Authorisation and other relevant South African legislation (see Table 3-3). All future design changes will undergo an "Internal Screening" exercise to determine whether the change triggers a 'Level 1' or a 'Level 2' change.

TABLE 3-3: MANAGEMENT OF CHANGE PROCEDURE

Level of Change	Description of Level of Change and Action
Level 1: Minor Change	Where the change is largely immaterial to the ESIA findings, the listed activities that were applied for are still triggered and it does not affect the Project's ability to meet environmental and social performance requirements outlined in the ESIA Report and ESMP.

[5] The ESMP provides an implementation mechanism, by project phase, for project controls and mitigation. It sets out the mitigation required to ensure the negative impacts associated with the proposed exploration activities are avoided and, where they cannot be avoided, are minimised. It also establishes a monitoring programme and record-keeping protocol against which the operator and its contractor's/sub-contractor's performance can be measured and to allow for corrective actions or improvements to be implemented when needed.

Level of Change	Description of Level of Change and Action
	Assuming the project is approved by DMRE, compliance with the Environmental Authorisation and ESMP would need to be externally audited in line with the frequency specified in the Environmental Authorisation. As part of these external audits, the relevance of the ESMP will be reviewed and amendments proposed where necessary. These changes and their evaluation should be communicated to PASA and DMRE for information purposes and the ESMP revised where necessary (in terms of Regulation 35 of the EIA Regulations 2014, as amended). • In terms of Regulation 36(1), where an amendment is required to the impact management actions of an ESMP, such amendments may immediately be effected by the holder and reflected in the next environmental audit report. • In terms of Regulation 36(2), where an amendment to the impact management outcomes of an ESMP is required before an audit is undertaken in terms of the Environmental Authorisation, an ESMP may be amended on application by the holder of the Environmental Authorisation in terms of Regulation 37. In terms of Regulation 29, an Environmental Authorisation may be amended if the amendment will not change the scope of a valid Environmental Authorisation, nor increase the level or nature of the impact, which impact was initially assessed and considered when application was made for an Environmental Authorisation.
Level 2: Significant Change	Where a future change or upgrade 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 either a new listed activity(s) is triggered, or the scope of an approved activity would change (Part 2 amendment in terms of Regulation 31 of the EIA Regulations 2014, as amended). • If the change, on its own, constitutes a listed or specified activity, then a new application for Environmental Authorisation would be required. • If a Part 2 (substantive) amendment process is required, the ESIA Report (and ESMP) should be updated through an amendment application in terms of NEMA and Sections 31 and 37 of the EIA Regulations 2014 (as amended) and submitted to PASA and DMRE for review and decision.

4. PUBLIC CONSULTATION PROCESS

This chapter presents the principles of public participation and the process undertaken during the Scoping and Impact Assessment phases.

4.1. PRINCIPLES

The public participation guidelines in terms of EIA Regulations (DEA, 2017) sets out the characteristics of comprehensive public participation process. At a minimum, the public participation process undertaken must allow for the following:

- *"to provide for the opportunity for all role-players including potential I&APs, EAPs, state departments, organs of state, and the competent authority to obtain clear, accurate and understandable information about the environmental impacts of the proposed activity or implications of a decision;*
- *to provide for role-players to voice their support, concerns and questions regarding the project, application or decision;*
- *to provide the opportunity for role-players to suggest ways for reducing or mitigating any negative impacts of the project and for enhancing its positive impacts;*
- *to enable the person conducting public participation to incorporate the needs, preferences and values of potential or I&AP's into its proposed development that becomes the subject of an application for an Environmental Authorisation;*
- *to provide opportunities for clearing up misunderstandings about technical issues, resolving disputes and reconciling conflicting interests;*
- *to encourage transparency and accountability in decision-making;*
- *to contribute toward maintaining a healthy, vibrant democracy; and*
- *to give effect to the requirement for procedural fairness of administrative action as contained in the Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000)."*

The requirements of the public participation process are clearly set out in Chapter 6 of the EIA Regulations 2014 (as amended) and will be, as a minimum, adhered to during current ESIA process.

4.2. SCOPING PHASE

The public participation steps undertaken during the Scoping Phase are summarised below. **All supporting personal information and/or documentation will be presented in appendices to the final Scoping Report to be submitted to PASA / DMRE** (to ensure compliance with the relevant provisions of the Protection of Personal Information Act, 2013 (Act 4 of 2013).

A consolidated approach will be utilised for the Public Participation Process in order to optimize resources as well as time. This approach was also informed by public participation processes undertaken during application for Environmental Authorisation process in other Blocks (e.g., Block 5/6/7). The consolidated approach will address both the notification for registration of I&APs and the notification of the availability of Draft Scoping Report for review and comment. As such, the following Public Participation activities will be conducted during the Scoping Phase:

- Distribution and notification of registration and availability of Draft Scoping Report for comment letter and Background Information and Non-Technical Summary (NTS) via email, SMS and WhatsApp;
- Upload of all Public Participation documents onto SLR and Data free websites;

- Newspaper advertisement and site notice board placement notifying I&APs of the ESIA commencement, Draft Scoping Report comment period and planned Public Participation meetings;
- Radio notifications for ESIA commencement, Draft Scoping Report comment period and planned Public Participation meetings; and
- Public Participation meetings (i.e. public information-sharing and focus group meetings).

4.2.1. Stakeholder Identification

A preliminary I&AP database was compiled based on:

- TEEPSA's existing databases for its South African offshore licence blocks (specifically Block 5/6/7);
- Stakeholder mapping undertaken by SLR, Antoinette Pietersen (Independent Public Participation Consultant) and TEEPSA;
- Input from the Fisheries Specialist (CapMarine) to ensure the fisheries sector database is comprehensive and up to date;
- Input from DFFE and other stakeholders on the small-scale fishing and interim relief representatives;
- Input from Civil Society Organisations (CSO); and
- Data from the primary anthropological baseline study undertaken as part of the Cultural Heritage Impact Assessment (see Section 9.3.3).

An initial 885 stakeholders, who were identified to be directly or indirectly affected by the project, were registered on the project database[6]. These stakeholders have been divided into the following categories:

- Authorities:
  - South African Government (National, Provincial and Local Municipalities)
  - Wards located on the coast within Area of Influence (including Ward Councillors)
  - Maritime Authorities
- Civil Society:
  - Community Outreach Organisations
  - Traditional Authorities
  - Indigenous Communities
  - Environmental Groups, Research Institutions and other NGOs
  - Fishing Associations
  - Small-scale Fishing
  - Tourism Association Groups
  - Harbour User Groups/Associations
  - Women and the youth
  - General Public and Other
- Business:
  - Fishing Companies and Operators
  - Offshore Mining and Oil / Gas Operators
  - Other

[6] The project database containing the list and contact details of registered I&APs cannot be provided to the public. This is in line with the requirements of the Protection of Personal Information Act, 2014 (No 4 of 2014) (POPI Act). A copy of the database will, however, be provided to the competent authority as required by the EIA regulations 2014 (as amended).

The initial I&AP database will be continually updated during the ESIA process. Additional I&APs will be added to the database based on comments received on public documents, attendance at meetings, etc. In addition, people wanting to be removed from the initial project database have been deleted, as requested.

4.2.2. Pre-Application Meeting with PASA

A meeting was held with PASA on 6 September 2022 to provide notification of the proposed project and TEEPSA's intent to submit an application for Environmental Authorisation, as well as consult on the ESIA process (including associated public participation strategy) and PASA requirements.

4.2.3. Public Participation Plan

Although a Public Participation Plan is no longer required as the Disaster Management Act, 2002 (No. 57 of 2002) Regulations regarding measures to address, prevent and combat the spread of COVID-19 have been withdrawn, a Plan was prepared to meet international good practice requirements and to demonstrate adherence to the principles contained in the NEMA Public Participation Guidelines. This plan was submitted to PASA for information purposes.

4.2.4. Application Notification and Registration, Consultation and Disclosure of the Draft Scoping Report

As mentioned above, a consolidated approach will be followed for the Public Participation Process to address both the notification for registration of I&APs and the notification of the availability of the Draft Scoping Report for review and comment. The objective of these public participation steps is summarised below:

- The main purpose of the application notification and registration is to provide initial notification to stakeholders about the proposed project and ESIA process, an opportunity for initially identified I&APs to confirm their participation in the ESIA process and allow other members of the public to register as an I&AP to further develop the initial I&AP database for the project.
- The objective of the Draft Scoping Report review and comment period is to ensure that I&APs are notified about the proposed project, given an opportunity to register on the project database and given an opportunity to provide comments on the Draft Scoping Report (which includes the identified potential impacts that will be assessed and scope of specialist studies that will be undertaken in the Assessment Phase).

4.2.4.1. Notification to Register and Availability of the Draft Scoping Report

All I&APs included on the initial project database were notified of the proposed project, application for Environmental Authorisation, ESIA process and the availability of the Draft Scoping Report for comment by means of the following documents:

- Letter of notification for registration and availability of Draft Scoping Report for comment; and
- Background Information and Non-technical Summary.

These documents are further detailed below.

4.2.4.2. Letter of notification for registration and availability of Draft Scoping Report for comment

The letter provided notification of the commencement of the ESIA process and the availability of the Draft Scoping Report for review and comment. The letter also requested I&APs to indicate if they did not wish to participate in the ESIA process so that they could be removed from the project database.

All I&APs registered on the project database were notified of the application, ESIA process and Draft Scoping Report comment and review period by means of the letter (see Appendix 4.1 for a copy of the letter). To facilitate the commenting process, a copy of the Executive Summary and Background Information and Non-technical Summary were attached to the letter (which notes that the Non-technical Summary is available in English, Afrikaans, isiXhosa and Setswana, as well as in audio format on the SLR websites).

4.2.4.3. Background Information and Non-Technical Summary

To make the content of the Draft Scoping Report more accessible to a wider audience a Background Information and Non-technical Summary was prepared in English, Afrikaans, isiXhosa and Setswana (see Appendix 4.1 for a copy of the document). The document aims to present key information on the proposed project and ESIA process in a clear and concise manner. The objective is to provide I&APs with adequate and meaningful information from the draft Scoping Report for them to determine their interest in further participation through the ESIA process.

The letter, and background information and non-technical summary document was available for distribution electronically (via email and WhatsApp) and in hardcopy (on request), as well as in audio format on the SLR websites (in English, Afrikaans isiXhosa and Setswana). Copies of these documents have also been made available for collection at various public locations (refer to specific details in the I&AP notification letter). A copy of the registration Letter, BID, draft Scoping Report notification letter and non-technical summary and proof of distribution is provided in Appendix 4.1.

4.2.4.4. Advertising

Newspaper advertisements announcing the proposed project, the pre-application I&AP registration period and availability of the Draft Scoping Report for review and comment were placed in various regional and local newspapers in English, Afrikaans, isiXhosa and Setswana.

The advertisements provided the following:

- Notification of the proposed project and ESIA process;
- Invited I&APs to register on the project database, and
- Availability of the Draft Scoping Report for review and Comment.

Text for the newspaper advertisements is provided in Appendix 4.2.

4.2.4.5. Site Notices

Site notices were placed various at in coastal towns / cities between Alexander Bay and Cape Town on the West Coast. The placement of the site notices targeted locations used for small-scale and recreational fishing and coastal tourism. Site notices were erected in English, Afrikaans, isiXhosa and Setswana. A copy of the site notice and proof of placement is provided in Appendix 4.3.

4.2.4.6. Radio Announcements

Radio announcements were aired to notify coastal users, including vulnerable and disadvantaged communities, of the proposed project, availability of this Draft Scoping Report and the planned public meetings. The notices were aired multiple times per day on various stations in three different languages (English, Afrikaans, isiXhosa and Setswana) over a period of a few days. Details of the flight times and proof of airing will be provided in the final Scoping Report.

4.2.4.7. Cell Phone Number for SMS and WhatsApp

While potential I&APs, particularly from vulnerable and disadvantaged communities, may not have access to the internet and email, South Africa has a high level of cell phone usage[7]. In order to facilitate registration, engagement, and access to the Public Participation documents, a cell phone number was provided in all notifications. Advertisements, site notices, radio announcements and communication sent to I&APS detailed that SLR can be contacted via SMS or WhatsApp messaging.

4.2.4.8. Data Free Website

In addition to the draft Scoping Report being made available on SLR's website, the report and the non-technical summary (document and audio recording) has also been placed on a data free website (https://slrpublicdocs.datafree.co/en/public-documents/TEEPSA-DWOB). This enables I&APs to access and download the report and the Non-technical Summary from internet enabled mobile devices without incurring any data costs.

4.2.4.9. Information-sharing Meetings

Ten public information-sharing meetings are planned during the draft Scoping Report review and comment period, in Cape Town, Yzerfontein, Langebaan, Saldanha Bay, St Helena Bay, Elands Bay, Lamberts Bay, Doringbaai, Hondeklipbaai and Port Nolloth, as well as online (MS Teams). Specific details of these meetings are provided in the I&AP notification letter.

In addition to the above, various focus group meetings will arranged with key stakeholders (e.g., small-scale fishing sector, Traditional Authorities, etc.). The details of these meeting will be presented in the final Scoping Report.

The purpose of these meetings will be to provide an overview of the project proposal and ESIA process, and to provide stakeholders with the opportunity to raise any grievances, issues, concerns or comments. Minutes of these meetings will be documented and presented in the final Scoping Report.

4.2.4.10. I&AP Comments and Responses

All issues raised by I&APs during the public participation process – by e-mail, telephone or during stakeholder meetings – will be consolidated into a Comments and Responses Report, which will be attached as an appendix to the final Scoping Report.

[7] According to the 2020 State of the ICT Sector report, South Africa's smartphone penetration reached 91.2% in 2019, up from 81.7% in 2018 (Source: https://www.itweb.co.za/content/xA9PO7NZRad7o4J8).

4.2.5. Engagement with Key Stakeholder Communities within the Indirect Area of Influence

Prior to the commencement of the proposed project, primary anthropological research commenced in key local communities within the Project's indirect Area of Influence between Port Nolloth and Cape Town. The purpose of this research and engagement was to describe, discuss and analyse the receiving environment, specifically key stakeholders' intangible cultural heritage and the prevalence / frequency / commonality and relative importance of cultural and spiritual reliance on the sea. The engagement extended beyond just the small-scale fishing group. The results of this engagement will be presented in the Cultural Heritage Impact Assessment in the next phase of the ESIA.

4.3. ASSESSMENT PHASE

Public participation-related tasks that will be undertaken during the Impact Assessment Phase are summarised below:

- **Release of draft ESIA Report for review and comment:** The draft ESIA Report will be released for a 30-day review and comment period.
- **Availability of the draft ESIA Report:** Copies of the draft ESIA Report will made available in a similar manner to the draft Scoping Report. It will be made available on the SLR website and on a data free website that enables I&APs to access and download the documents without incurring any data costs. Hardcopies of the draft ESIA Report will be made available for the duration of the review and comment period at various public locations or venues at selected coastal towns (based on the findings of the technical and specialist studies and outcome of the Scoping Phase public participation process).
- **Notification letters:** Notification letters, together with the non-technical summary (English, Afrikaans, isiXhosa and Setswana), will be emailed to all registered I&APs. The letter will inform them of the release of the draft ESIA Report, and where the report can be reviewed. Where I&APs registered with a cell phone number only, they would be notified via SMS or WhatsApp.
- **Public and focus group meetings:** The proposal is to hold meetings as undertaken during the Scoping Phase. Registered I&APs will be notified of these meetings and any changes thereto. The purpose of these meetings is to present the findings of the ESIA process and provide stakeholders the opportunity to raise any grievances, issues, concerns or comments regarding the proposed project.
- **Notice of ESIA Report submission:** All registered I&APs will be notified via e-mail of the submission of the final ESIA Report to PASA for consideration and recommendation to DMRE.
- **Decision notification:** DMRE's decision will be uploaded onto the SLR website for review. All registered I&APs will be notified of the issuing of DMRE's decision on the application and the formal appeal process to be followed in terms of the National Appeal Regulations, 2014.
- **Appeal process:** In terms of the National Appeals Regulations, 2014, an appellant must submit the appeal to the appeal administrator, and a copy of the appeal to the applicant (if the appellant is an I&AP), any registered I&APs and any organ of state with interest in the matter, within 20 days from the date that the notification of the decision was sent to the registered I&APs.

4.4. GRIEVANCE MANAGEMENT

TotalEnergies adheres to the United Nation Guiding Principles (UNGP) on Business and Human Rights and is, therefore, committed to ensure all its stakeholders have access to an effective Grievance Mechanism. The UNGP give a framework for companies to respect Human Rights through two main principles: (1) avoid causing or contributing to adverse Human Rights impacts through their own activities (directly or through their contractors) and in case of adverse impacts, (2) provide remediation through a Grievance Mechanism at operational level.

Thus, in parallel of the ESIA public participation process, TEEPSA has put in place a grievance procedure detailing how to manage stakeholder grievances related to negative or perceived negative impacts caused by Project related activities.

In compliance with international standards, this procedure will protect the complainant’s rights to access to information, access to the grievance procedure, and the right to have one’s confidentiality and/or anonymity protected, if requested.

This grievance procedure will be promoted among external stakeholders through different possible access points and communication means (TEEPSA grievance administrator, toll free number, web page, email, complaint boxes, posters and leaflets, etc).

The key steps of the process consists of:

- Receiving and registering the grievance;
- Acknowledgement of the grievance received and informing stakeholders about the follow-up actions;
- Assessing and investigating the grievance;
- Proposing a solution;
- Implementing the solution when the solution is approved by the complainant; and
- Closing-out the grievance when no further action is required.

After a solution is proposed to the complainant, different levels of resolution are possible, depending on the acceptation of the solution by the complainant, until a final solution is satisfactory and accepted. TEEPSA will appoint a Grievance Management Committee to support the resolution process internally and will require support from an external party when necessary.
TEEPSA will ensure the complainant is informed and involved all along the resolution process. All grievances will be documented to ensure they are handled properly and within the timeframe described in the procedure. It must also reflect that Human Rights have been respected all along the process.

5. NEED AND DESIRABILITY

This chapter provides an overview of the "need and desirability" of the proposed project, and essentially considers the strategic context of a project proposal within broader societal needs and the public interest.

The DFFE guideline on need and desirability (GN R891 of 20 October 2017) notes that while addressing the growth of the national economy through the implementation of various national policies and strategies, it is also essential that these policies take cognisance of strategic concerns such as climate change, food security, as well as the sustainability in supply of natural resources and the status of our ecosystem services. The guideline further notes that at a project level (as part of an ESIA process), the need and desirability of the project should take into consideration the content of regional and local plans, frameworks and strategies.

This chapter firstly highlights the applications for the use of hydrocarbons and, secondly, indicates how these applications are aligned within the strategic context of South Africa national and international policy and energy planning, broader societal needs, and regional planning, as appropriate.

5.1. THE USE OF HYDROCARBONS AND THE PETROLEUM INDUSTRY IN SOUTH AFRICA

The information in this section is mostly summarised from the report by KPMG (2016) for the South African Petroleum Industry Association on the petroleum industry's contribution to South Africa.

5.1.1. Description of Upstream, Midstream and Downstream Activities

The petroleum / hydrocarbon industry is divided into three major sectors: upstream, midstream and downstream (see Figure 5-1). The upstream sector includes all the steps involved from the preliminary exploration through to the extraction of the resource, i.e., identifying potential reservoirs, drilling wells and recovering raw materials from underground. The midstream sector involves the transportation (by pipeline, rail, barge, oil tanker or truck), storage and wholesale marketing of crude or refined petroleum products, while the downstream sector is responsible for refining and the sale of the finished products (McClay 2021).

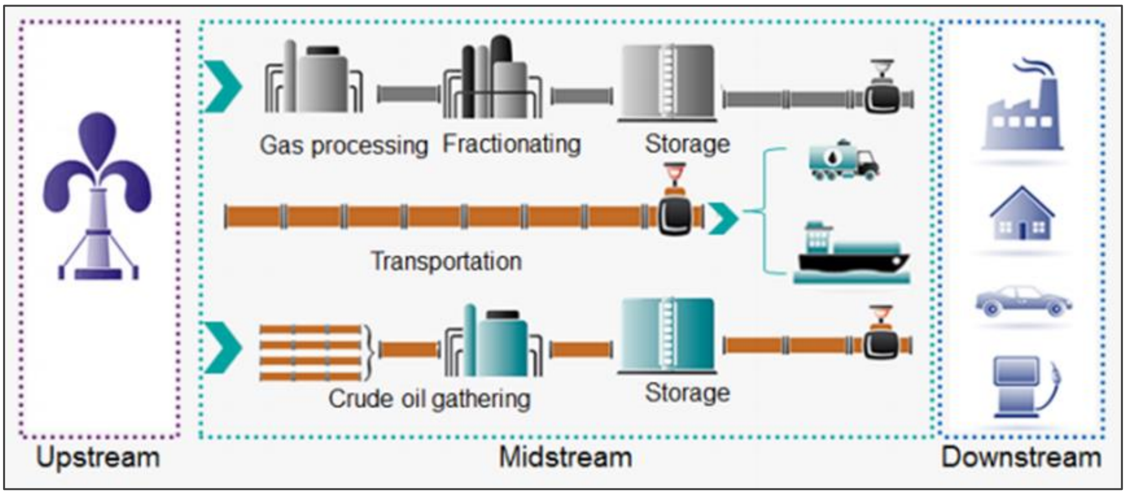


FIGURE 5-1: THE MAJOR SEGMENTS OF THE OIL & GAS/HYDROCARBON INDUSTRY
Source: KPMG 2016

South Africa has minimal commercially exploitable crude oil, with estimated proven reserves amounting to approximately 15 million barrels. Since there are minimal crude oil reserves in South Africa, the country imports nearly all its crude oil requirements from the Middle East and other parts of Africa. Thus, the South African value chain begins with crude imports or refined product imports. Crude is shipped to a refinery where it is transformed into a variety of value-added products, which are distributed to depots (secondary storage facilities) or to major customers. At a refinery, the products are supplemented by internationally and locally sourced finished products and blended, where necessary. From the depots, final products are distributed to major customers and the retail network.

5.1.1.1. Refinery Activities

As noted above, South Africa currently relies on imports of crude oil and refined fuels to meet its liquid fuels needs. South Africa has the second largest refining capacity in Africa after Egypt, with a total refining / liquid fuels capacity of 703 000 barrels per day (bll/d), with approximately 72% (503 000 bll/d) crude oil refining, with the balance synthetic fuel refining. Petroleum consumed in South Africa is derived mainly from domestic refineries that import crude oil, and Coal-to-Liquid (CTL) and Gas-to-Liquid (GTL) plants. Although petrol and diesel make up 55% of total liquid-fuel exports, South Africa is also the main supplier of all other liquid fuels to Botswana, Namibia, Lesotho and Swaziland.

Chemical engineering and other processes and other facilities are used to transform hydrocarbons (i.e. crude oil or natural gas) into useful products such as Liquefied Petroleum Gas (LPG), gasoline or petrol, kerosene, jet fuel, diesel oil and fuel oils. In this way, crude oil is the starting point for many products including:

- LPG - used for heating and cooking;
- Petrol - motor fuel;
- Kerosene - fuel for jet engines, lighting and heating; input material for other products;
- Diesel - used for diesel fuel and heating oil; input material for other products;
- Base oil - used for motor oil, grease, use in many other lubricating oils;
- Fuel oil - used for industrial fuel; input material for other products; and
- Residuals - coke, asphalt, tar, waxes; input material for other products.

In South Africa, these petroleum products were produced at six refineries (see Figure 5-2):

- Crude oil refiners, including Astron Energy Cape Town refinery (previously CHEVREF) (Cape Town), ENREF (Durban), NATREF (Sasolburg) and SAPREF (Durban);
- CTL and GTL fuels (by Sasol in Sasolburg); and
- Natural GTL fuels (by PetroSA in Mossel Bay).

The shutdown of the ENREF refinery, a lack of feedstock for state-owned PetroSA's GLT plant and an explosion at Cape Town refinery have all affected capacity. SAPREF, the country's biggest plant, stopped operations as it awaits a sale (https://www.bloomberg.com/news/articles/2022-05-06/south-africa-s-dependence-on-fuel-imports-set-to-multiply). The NATREF refinery also closed after Sasol declared force majeure on the supply of petroleum products due to delays in deliveries of crude to the NATREF refinery it owns with TotalEnergies, leaving just a fraction of the country's fuel-production capacity still operational (https://www.news24.com/fin24/companies/sasol-outage-means-all-south-african-oil-refineries-are-now-shut-20220717).
The products and by-products from these refineries are important contributors to the economy, not only as a source of fuel, but also a variety of petrochemical products such as lubricants, bitumen and solvents. Base oils

and lubricants service a variety of machinery and equipment in the construction, manufacturing and agri-processing sectors. With limited infrastructure to import LPG, an important by-product, these local sources are key for security of supply. LPG also contributes to the diversification of South Africa's energy mix.

FIGURE 5-2: MAP SHOWING LOCATION OF REFINERIES IN SOUTH AFRICA

Source: SAPIA (https://www.sapia.org.za/Overview/South-African-fuel-industry)

5.1.1.2. Storage and Distribution Activities

Once the oil has been produced, it is transported to short-term storage. BP Southern Africa, Astron Energy (previously Chevron South Africa), Engen Petroleum, PetroSA, Sasol Oil, Shell South Africa and TEEPSA are the main players in the South African oil sector. They operate storage terminals and distribution facilities throughout the country, which provide ease of distribution to retail wholesalers and, ultimately, consumers.

Distribution activities involve the movement of petroleum from refineries to wholesalers and retail locations.

In South Africa, liquid fuels are distributed from refineries by pipeline, road and rail to approximately 200 depots, 4 600 service stations and 100 000 direct consumers.

5.1.1.3. Wholesale and Retail Activities

From the depots and storage facilities, liquid fuels are delivered to commercial customers. Oil companies distribute roughly half of their petrol, diesel and fuel oils to commercial and retail customers. Petroleum fuels are supplied directly to about 100 000 consumers. Oil companies also sell petrol, diesel and fuel oils to commercial segments, which include customers such as parastatals, commercial/passenger transport, agriculture, manufacturing, construction, mining, local communities and resellers.

Oil companies sell the other half of petrol, diesel and other liquid fuels to the retail segment through petrol stations. The South Africa Petroleum Retailers Association reported that retail stations sell about 950 million litres of petrol and 830 million litres of diesel per month at approximately 4 600 service stations.

5.1.2. Use of Fossil Fuels in South Africa

This section sets out the use of fossil fuels in South Africa, by setting out a high-level energy supply overview, providing descriptions of the oil, power, gas and coal markets, and a review of emissions.

5.1.2.1. South African Energy Sector and Energy Mix

South Africa's energy sector is critical to its economy and is the centre of economic and social development, and is particularly important when economic growth and job creation are such high priorities in the country. As the country's economy grows, it is critical to ensure that energy resources are available, and that there is access to energy services in an affordable, reliable and sustainable manner, while minimising the associated adverse environmental impacts (DoE, 2019).

As noted in Section 5.1.1, South Africa has limited proved reserves of oil and natural gas and uses its large coal deposits to meet most of its energy needs, particularly in the electricity sector, with renewable energy playing an increasingly significant role. In 2016, the South African energy supply was dominated by coal, which constituted 69% of the primary energy supply, followed by crude oil with 14%, renewables with 11%, nuclear with 3%, and natural gas with 3% (DoE, 2019). There is something notable about the energy mix data from the 2016 survey, as in that year there was extensive use of diesel as the country relied on open cycle gas turbines at that time (Stats SA[8]). In 2018, the South African energy supply continued to be dominated by coal which comprised 65% of the Total Primary Energy Supply (TPES), followed by crude oil (18%), renewables (11%), gas (3%) and nuclear (2%).

The power sector in South Africa is dominated by Eskom, which operates 30 power stations with an aggregate nominal capacity of 45 117 MW and in 2020 produced 214 968 GWh. The power generation sector can be described at a high level in Table 5-1. Coal fired power is generated in eastern South Africa. The Western Cape is relatively power deficient with the nuclear power plant at Koeberg (1 860 MW), and the Open Cycle Gas Turbine’s (OCGT) at Ankerlig (1 327 MW), Gourikwa (740 MW) and Acacia (171 MW) comprising the significant generation assets.

TABLE 5-1: SOUTH AFRICAN POWER GENERATION

Type	Merit order position	Aggregate nominal capacity MW	2020 Generation GWh
Coal	Baseload	37 424	194 357
Nuclear	Baseload	1 860	13 252
Pumped Storage	Mid merit / peaking	2 724	5 060
Hydro	Mid merit / peaking	600	688
OGCTs	Mid merit / peaking	2 409	1 328

Source: Eskom Integrated Results 2021

[8] http://www.statssa.gov.za/?p=14643

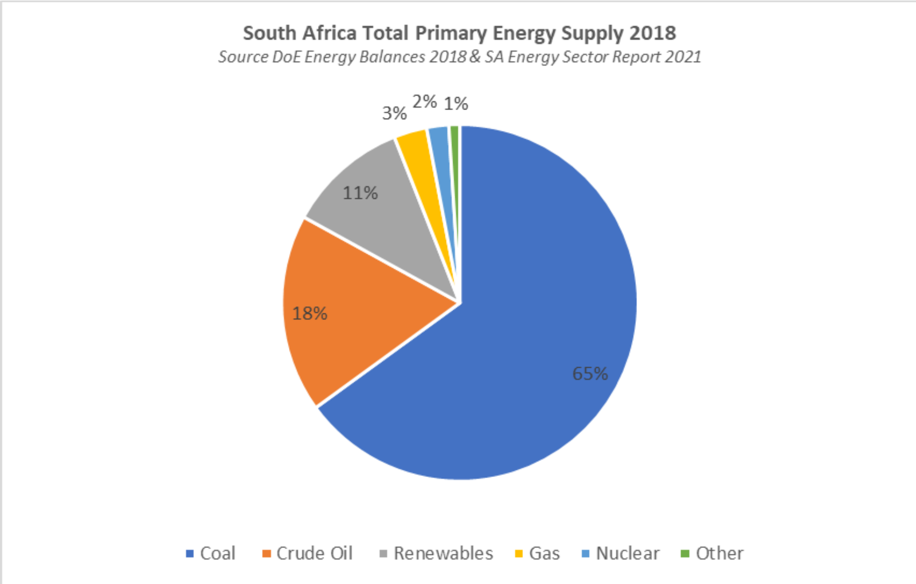


FIGURE 5-3: SOUTH AFRICA PRIMARY ENERGY SUPPLY 2018.
Source: DoE Energy Balances 2018 & SA Energy Sector Report 2021

Eskom faces multiple and complex generation challenges. In the Group Interim Results for the period ending 30 Sep 21 announced on 15 December 21, Eskom stated that the plant availability had declined to 65.27% (from 67.86% in the prior period), load shedding had increased from 19 days to 21 days and gas turbine use had increased leading to a cost increase from R 2.6 bn to R 4.5 bn. Major incidents had been announced at two key power generation units (Mepudi and Kendal). Since these results Eskom operational performance has deteriorated considerably leading to "load shedding" of up to six – ten hours day and reduction in load of up to 6 000 MW (BBC July 2022). An increasing number of customers are seeking alternatives to Eskom supply, this is true of industrial users, with a reported deal pipeline of 6.0 GW of captive power projects (Operation Vulindlela Progress Update Q2 National Treasury 2022/23) and also residential users with an estimated 600 MW of solar panels installed on rooftops each year.

By 2030 (as per the IRP 2019), energy supply aims to be dominated by renewables (PV, wind, CSP, hydro and storage) which constitutes 46% of the primary energy supply, followed by coal with 43%, gas and diesel with 8.1%, and nuclear with 2.4%. Although the capacity allocations in the IRP 2019 see a significant increase in renewables and a decrease in hydrocarbons (coal, oil and gas), the IRP 2019 acknowledges that gas-to-power technologies are required to provide the flexibility required to complement renewable energy in the "just transition" to a net-zero and climate resilient society. South Africa has developed a promising renewable power programme (REIPPP), which has been very successful. However, it is widely reported that grid constraints in high yield wind and PV areas in the Northern and Western Cape constrain further development. In any event, renewables capacity inherently expose the system to weather risk (lack or wind and or sun), further current battery technology is unproven at very large-scale for protracted periods. There is, therefore, a potential role for natural gas fired power generation at least as a transitional fuel.

Owing to the lack of reserves, most of South Africa's liquid fuel requirements are imported in the form of crude oil (Stats SA[9]; also see Section 5.1.2.2). This reflects South Africa's vulnerability and dependence on imports for its petroleum requirements. Almost all the imported crude oil was used for the production of liquid fuels, with a small percentage used towards lubricants, bitumen, solvents and other petrochemicals.

In 2016, natural gas domestic production amounted to 18%, whilst imports from the Temane and Pande gas fields in Mozambique amounted to 82% during the same period (DoE, 2019). While in the short-term the opportunity is to pursue gas import options, the use of local gas resources will allow for scaling up within manageable risk levels (refer to the South African Gas Masterplan Base Case Report in Section 5.2.13). DMRE's Annual Performance Plan 2020/2021 acknowledges that although exploration activities to assess the magnitude of local resources are being pursued, they must be accelerated, as currently the majority is imported (DMRE, 2021). The Plan (DMRE 2021) also states that there is enormous potential and opportunity in this respect and the Brulpadda gas resource discovery in the Outeniqua Basin of South Africa, piped natural gas from Mozambique (Rovuma Basin), and indigenous gas (e.g., coal-bed methane and ultimately shale gas), could form a central part of the strategy for regional economic integration within the SADC region.

5.1.2.2. Oil and Refined Products

Due to a lack of South African indigenous reserves, the country imports nearly all its crude oil from oil producing nations. Refined products are produced from crude oil (54.4%), coal via CTL (42.3%) and natural gas via GTL (3.2%) (DoE Energy Balance 2018[10]). The majority of refined products are produced in country, but an increasing proportion are imported.

Crude Imports

Crude oil supplies are all imported and dominated by volumes from Saudi Arabia, Nigeria and Angola. There is a clear long-term declining trend demonstrating that South African refiners are processing lower volumes of crude oil (see Figure 5-4).

Refined Product Imports

Imports of refined products show a clear increasing trend (see Figure 5-5). This is particularly clear for imports of diesel, as increase in demand for diesel is not being met by local production.

Refined Product Consumption

The volume of refined petroleum products consumed in South Africa is broadly flat (see Figure 5-6).

Refined Product Production

South Africa has six facilities capable of producing refined products (see Section Figure 5-4).

[9] https://unstats.un.org/oslogroup/meetings/og-06/docs/6th%20mtg%20DAY_3_Paper_Energy_Accounts_Statistics_South_Africa.pdf

[10] South African Energy Sector Report 2021

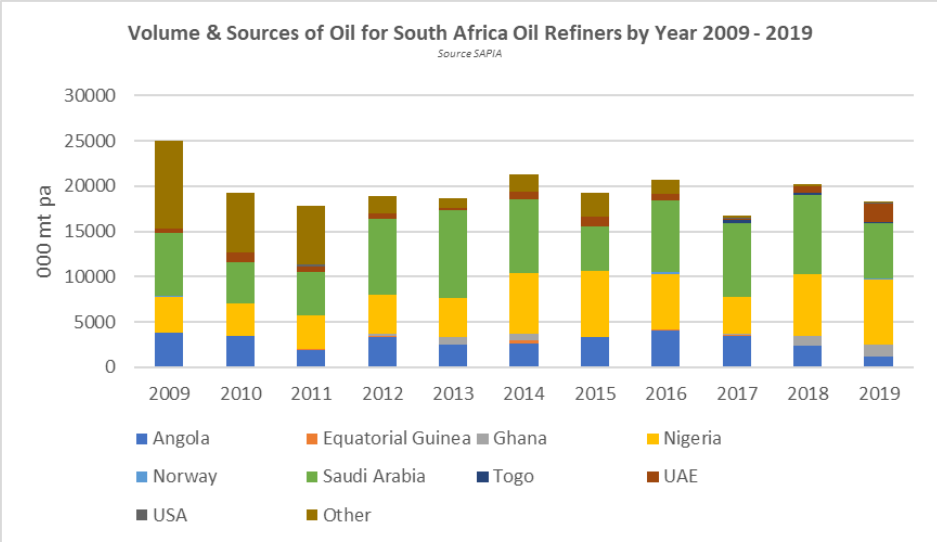


FIGURE 5-4: VOLUME AND SOURCES OF OIL FOR SOUTH AFRICA OIL REFINERS BY YEAR 2009 - 2019

Source: SAPIA Annual Report 2019

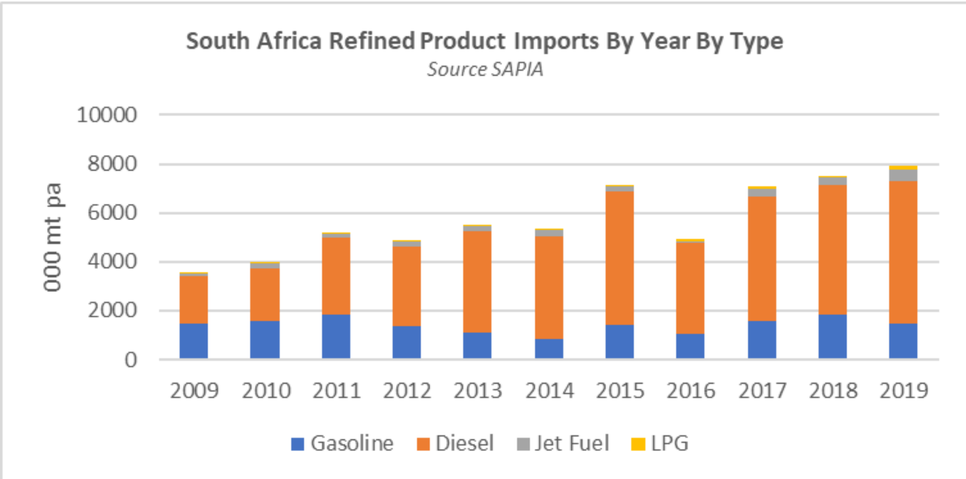


FIGURE 5-5: SOUTH AFRICA REFINED PRODUCT IMPORTS BY YEAR BY TYPE

Source: SAPIA Annual Report 2019

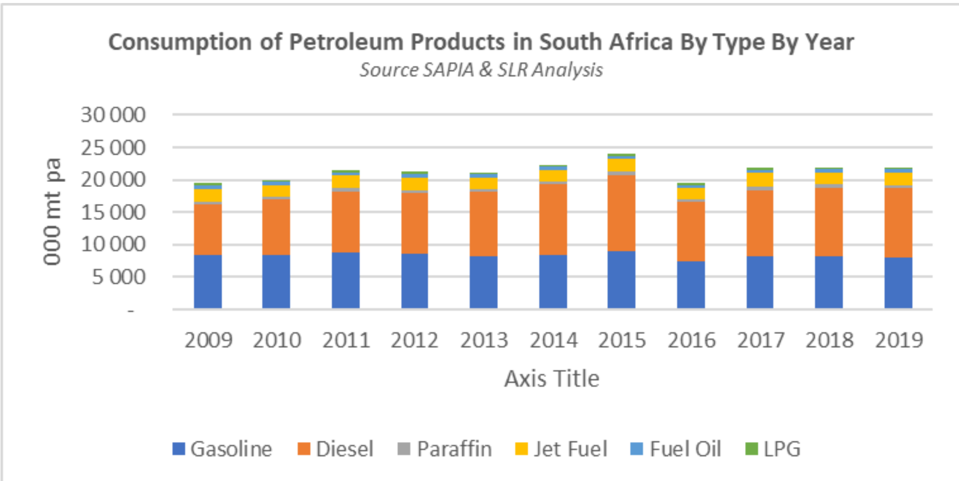


FIGURE 5-6: CONSUMPTION OF PETROLEUM PRODUCTS IN SOUTH AFRICA BY TYPE BY YEAR

Source: SAPIA Annual Report 2019

Oil and Refined Product Conclusions

The market for refined products in South Africa is essentially flat. South Africa imports all its crude oil and an increasing proportion of its refined products. A high proportion of the crude oil originates in less secure countries, or in regions with high geopolitical risk. South African refineries are processing reducing quantities of crude oil and increasing quantities of refined product are being imported. Of the six refined product production facilities, five face profound threats to their long-term future.

5.1.2.3. Natural Gas

Overview

South Africa has a well-developed gas industry and associated infrastructure in the east centred around Secunda and at Mossel Bay. Secunda and Mossel Bay are separated by over 1 350 km and it is most unlikely that they will be linked by pipeline. Thus, it is unlikely that there will be a single gas market in South Africa in the short or medium term.

The eastern half of South Africa has two current sources of gas supply, arising from the Pande Temane gas fields in Mozambique and the methane rich gas synthetically produced by operations at Secunda. Natural gas has been produced from the Pande Temane gas field operations since 2004 and the field is expected to transition from plateau to decline in approximately 2026 and cannot be relied on going forward (https://www.offshore-technology.com/marketdata/pande-temane-complex-conventional-gas-field-mozambique/). Currently the supply solution for Sasol's gas demand has not been finalised. Further gas supplies are being sought, but there is no certain new supply at this point. The Northern Mozambican fields are presently facing political / military risks as a result of the Islamist insurgency in Cabo Delgado.

Gas was produced by PetroSA to supply the Mossel Bay GTL plant. It is widely reported that the gas supply from Block 9 was due to cease in late 2020 (Business Insider, 2020) and it seems likely to close unless a domestic gas supply is identified or a large bail out by the South Africa taxpayer is agreed to fund processing of higher cost feedstocks. In this respect, it should be noted that in September 2022 a production licence application was filed for offshore Block 11B/12B (https://www.offshore-energy.biz/totalenergies-moves-to-secure-production-right-for-south-african-block, September 2022), which may offer hope to the Mossel Bay GTL plant, assuming the necessary approvals are obtained.

Geopolitics

Recent events in Russia and Ukraine have had a profound impact in many areas. Russia was the most important supplier of gas to Europe, with major nations such as Germany and Italy being highly reliant on Russian gas supplies. Thus, gas import initiatives for South Africa will be contingent on international market developments. Strong desire to replace Russian gas supply will keep the Liquified Natural Gas (LNG) and Floating Storage and Regasification Unit (FSRU) markets tight (fully contracted) and, due to strong European demand, new FSRUs may not be available until 2028. Thus, it is estimated that import gas supply will become available from about 2028, if South African terminals can offer a compelling destination for gas (compared to European alternatives) and for FSRUs (in the context of a motivated European market to secure gas and infrastructure to replace Russian gas supply).

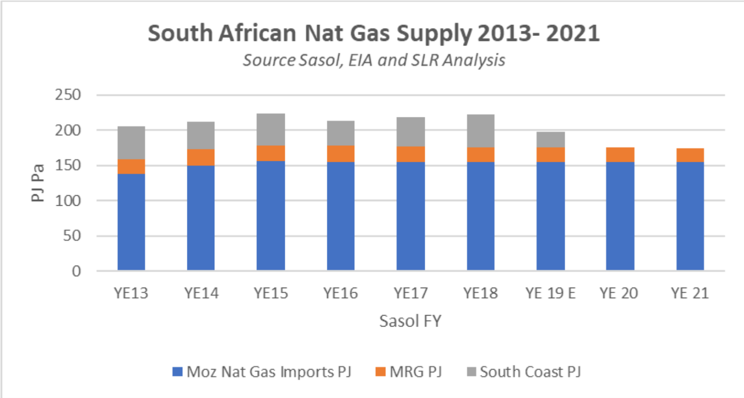


FIGURE 5-7: SOUTH AFRICAN NATURAL GAS SUPPLY 2013- 2021

Source: Sasol Production and Sales Metrics (www.sasol.com/financial reports/production and sales metrics)

5.1.2.4. Coal

Overview

Coal is a significant industry in South Africa. South Africa's coal reserves at 53 000 million tonnes are the 6th largest in the world. The South African coal industry is concentrated in Mpumalanga with some activity in Limpopo, Gauteng and the Free State. The most significant domestic users of coal are Eskom's coal fired power stations and Sasol's petrochemical facilities.

In 2021 coal production declined from 248 million tonnes to 229 million tonnes. The international coal price for South African coal increased to an average $120/mt compared to $66/mt in the previous year. The industry employs 93 000 people in South Africa. The coal industry is an important part of the South African economy and will likely to continue to remain so for years to come.

Emissions

South Africa's total primary energy supply is based on coal and, therefore, South African CO_2 emissions are significant. CO_2 emissions have increased by 78% since 1990 (see Figure 5-8) and South Africa is the 12th largest CO_2 emitter, with the two largest emitters being Eskom and Sasol.

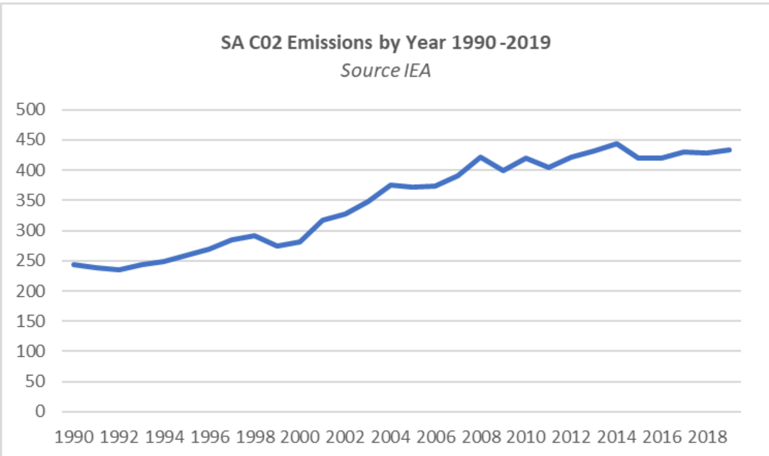


FIGURE 5-8: SOUTH AFRICAN CO_2 EMISSIONS BY YEAR 1990 -2019

Source: IEA South Africa country analysis (https:/www.iea.org/countries/southafrica)

5.2. CONSISTENCY WITH LOCAL, NATIONAL AND INTERNATIONAL POLICY AND PLANNING FRAMEWORKS

5.2.1. White Paper on the Energy Policy of the Republic of South Africa (1998)

The White Paper on the Energy Policy (1998) is an overarching policy document which was to guide future policy and planning in the energy sector. The policy objectives include the stimulation of economic development, management of energy related environmental and health impacts and diversification of the country's energy supply to ensure energy security.

The paper stated that the government will "*promote the development of South Africa's oil and gas resources…*" and "*ensure private sector investment and expertise in the exploitation and development of the country's oil and gas resources*". The successful exploitation of these natural resources would contribute to the growth of the economy and relieve pressure on the balance of payments. Before the development of the country's oil and gas resources can take place, there is a need to undertake exploration activities to determine their extent and the feasibility of utilising these resources for production.

5.2.2. New Growth Path (2011)

The New Growth Path (NGP) reflected the commitment of Government to prioritise employment creation in all economic policies and set out the key drivers and sectors for employment which was the focus of Government. The identified focus sectors were infrastructure, agriculture, mining, manufacturing, tourism and the green economy.

The NGP further identified the need to develop macroeconomic strategies and microeconomic measures to achieve sustainable expansion of work opportunities and output. The NGP stated that one microeconomic measure is South Africa being the driving force behind the development of regional energy, transport and telecommunications infrastructure. Priorities in this regard included strengthening the regional integration of energy by undertaking urgent improvements in electricity interconnectors and exploring other opportunities for enhancing clean energy across central and southern Africa, including natural gas.

5.2.3. National Development Plan 2030 (NDP) (2013)

The National Development Plan (NDP) 2030 provides the context for all growth in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa through the promotion of development. It provides a broad strategic framework to address poverty and inequality based on the six focused and interlinked priorities. One of the key priorities is "faster and more inclusive economic growth". To transform the economy and create sustainable expansion for job creation, an average economic growth exceeding 5% per annum is required. The NDP supports transformation of the economy through changing patterns of ownership and control.

Meeting the development initiatives goals represent a challenge, as the NDP emphasises, at the same time, the need to:

- Protect the natural environment;
- Enhance the resilience of people and the economy to climate change;
- Reduce carbon emissions in line with international commitments;

- Make significant strides toward becoming a zero-waste economy; and
- Reduce GHG emissions and improve energy efficiency.

The NDP makes numerous mentions of the need to act responsibly to mitigate the effects of climate change. Diversification of the energy mix away from fossil fuels will be key as energy generation makes up 48% of South Africa's GHG emissions. The NDP indicates that "*the country will explore the use of natural gas as a less carbon intensive transitional fuel*" and that there a requirement for "*increasing exploration to find domestic gas feedstock… to diversify the energy mix and reduce carbon emissions*". Thus, the ongoing exploration of local natural gas reserves is a key action required to ensure that natural gas is a viable transitional fuel for use in the national electricity generation mix.

5.2.4. Draft Integrated Energy Plan (2013)

The Draft Integrated Energy Plan (IEP) (2013) considered how current and future energy needs can be addressed. The plan considered security of supply, increased access to energy, diversity in supply sources and primary sources of energy, and minimising emissions. The plan indicated that projected demand for natural gas between 2010 and 2050 would be second only to petroleum products, primarily due to increased growth in the industrial sector.

The Draft IEP stated that given South Africa is a net importer of oil, the liquid fuels industry and its economy is vulnerable to fluctuations in the global oil market. Current natural gas consumption exceeds production, with the majority of demand being met through imports from Mozambique.

The plan stated that the use of natural gas as an alternative electricity generator must be considered in moderation due to limited proven reserves, but that it has significant potential both for power generation, as well as direct thermal uses. The role of renewable energy to deliver the intended policy benefits of improved energy security and reduced GHG emissions is also acknowledged in the plan. The availability of untapped renewable energy resources within the country is highlighted. The DMRE (previously under the Department of Energy) has implemented the Renewable Energy Independent Power Producers procurement process to increase the share of renewable energy technologies in the energy mix but, due to the intermittent nature of renewable energy systems and the variability in electricity load requirements, storage remains the most important challenge to the widespread use of renewable energy. Consequently, the need to incorporate fossil fuels and nuclear power to ensure that there is both sufficient base-load electricity generating power to meet the minimum needs and peak-load power to meet the needs during peak periods was acknowledged in the plan. The use of natural gas for power generation is also considered as an option to assist South Africa to move towards a low carbon future given that natural gas has a lower carbon content than coal.

5.2.5. Operation Phakisa (2014)

In July 2014, the South African Government launched Operation Phakisa, which is an innovative, pioneering and inspiring approach that will enable South Africa to implement its policies and programmes better, faster and more effectively. Operation Phakisa aims to unlock the economic potential of South Africa's oceans. In this regard four priority sectors have been selected as new growth areas in the ocean economy, including:

(a) Marine transport and manufacturing activities, such as coastal shipping, trans-shipment, boat building, repair and refurbishment;
(b) Offshore oil and gas exploration;

(c) Aquaculture; and
(d) Marine protection services and ocean governance.

In terms of offshore oil and gas exploration, the goal is to further enhance the enabling environment for exploration of oil and gas, resulting in an increased number of exploration wells drilled, while simultaneously maximising the value captured for South Africa. In this regard, a key target identified by Operation Phakisa is the drilling of 30 exploration wells in ten years.

As the proposal by TEEPSA entails the drilling of up to ten wells, it provides an opportunity to further establish the extent and economic viability of the indigenous gas reserves and/or oil in the DWOB Licence Block and contribute to the above-mentioned target of the drilling of exploration wells.

In terms of marine protection, the 2011 National Biodiversity Assessment noted that offshore ecosystems in South Africa were poorly protected. An offshore Marine Protected Area (MPA) project (2007- 2011) initiated plans to increase protection of offshore ecosystems, the project was advanced towards implementation during Operation Phakisa Oceans Economy. The process culminated in the gazetting of 20 new MPAs, which came into effect on 1 August 2019 and expand the protection of South Africa's mainland ocean territory to 5%.

5.2.6. National Climate Change Response White Paper (2014)

The National Climate Change Response Paper presents the South African Government's vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society. South Africa's response to climate change has two objectives:

- Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- Make a fair contribution to the global effort to stabilise GHG concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.

The Paper acknowledges that South Africa has relatively high emissions for an emerging economy. The energy intensity of the South African economy, largely due to the significance of mining and minerals processing in the economy and the coal-intensive energy system, means that South Africa is a significant emitter of GHGs. The majority of South Africa's energy emissions arise from electricity generation.

The Paper sets out South Africa's overall response strategy though strategic priorities, leading to a series of adaption, mitigation, response measures and priority flagship programmes. Policy decisions on new infrastructure investments must consider climate change impacts to avoid the lock-in of emissions intensive technologies into the future. In the medium-term, the Paper indicates that a mitigation option with the biggest potential includes a shift to lower-carbon electricity generation options. The Renewable Energy Flagship Programme is identified as possible driver for the deployment of renewable energy technologies. Renewable energy and not fossil fuel /gas is ultimately recommended for climate change mitigation.

5.2.7. Western Cape Climate Change Response Strategy (February 2014)

The Western Cape Government (WCG) recognises the urgency to reduce our collective GHG emissions and adapt to global climate change. In contributing to global and national efforts to mitigate climate change and build resilience, the WCG proposes leading a collective strategic approach to reduce the Western Cape's carbon contribution and dependency, whilst enabling locally effective adaptation action to address the impacts of unavoidable climate change occurring now and in future. In line with the National Climate Change Response Policy, the Strategy takes a two-pronged approach to addressing climate change:

- Mitigation: Contribute to national and global efforts to significantly reduce GHG emissions and build a sustainable low carbon economy, which simultaneously addresses the need for economic growth, job creation and improving socio-economic conditions.
- Adaptation: Reduce climate vulnerability and develop the adaptive capacity of the Western Cape's economy, its people, its ecosystems and its critical infrastructure in a manner that simultaneously addresses the province's socio-economic and environmental goals.

The majority of the Western Cape's emissions arise from energy generation (electricity and liquid fuels) and use (industry and transport), and mitigation actions therefore need to focus on these areas. The Western Cape Climate Change Response Strategy notes that the main opportunities for mitigation include energy efficiency, demand-side management and moving to a less emissions-intensive energy mix, which is dominated by electricity, coal, petrol, and diesel (in that order).

Policy decisions on new infrastructure investments must consider climate change impacts to avoid the lock-in of emissions-intensive technologies into the future. However, in the short-term, due to the age of existing infrastructure and the planning around new infrastructure, the most promising mitigation options are primarily energy efficiency and demand-side management, coupled with increasing investment in a renewable energy programme in the electricity sector. Western Cape Climate Change Response Strategy does, however, highlight the need to introduce natural gas processing infrastructure to use gas as a transition fuel.

5.2.8. 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 South Africa on 22 April 2016.

The long-term goals of the Paris Agreement are:

- Limiting 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 the 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 country is responsible for determining its 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, South Africa is required to adopt the agreement within its own legal systems, through ratification, acceptance, approval or accession.

As a signatory to the Paris Agreement, South Africa is 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.

5.2.9. Integrated Resources Plan (2019)

The Integrated Resource Plan (2019) was gazetted in October 2019 (IRP 2019). In order to achieve the outcomes envisaged in the National Development Plan, the Integrated Resource Plan provides a path to meet electricity needs over a 20-year planning horizon to 2030 and identifies the preferred electricity generation technologies to meet projected electricity demand. It thus provides a mechanism for Government to drive the diversification of the country's electricity generation mix and promote the use of renewable energy and other low-carbon technologies. The plan aims to balance a number of objectives, namely, to ensure security of supply; to minimise cost of electricity; to minimise negative environmental impact (emissions), and to minimise water usage.

The IRP 2019 notes that there is a requirement to pursue a diversified energy mix with respect to electricity production, which reduces the country's reliance on a few primary energy sources. This Plan also noted that Natural Gas is considered a transition fuel globally that can provide the flexibility required to complement renewable energy sources. It is further noted that there is currently a reliance for the importation of gas and that the use of local and regional gas resources will allow for scaling up within manageable risk levels. It is further noted that the "*exploration to assess the magnitude of local recoverable shale and coastal gas are being pursued and must be accelerated*".

The potential availability of gas provides an opportunity to convert to closed-cycle gas turbines (CCGT) and run open-cycle gas turbine plants at Ankerlig (outside Cape Town), Gourikwa (Mossel Bay), Avon (Outside Durban) and Dedisa (Coega IDZ) on gas.

In this regard, the proposed project could support this requirement through the ongoing exploration to determine the nature and extent of potentially viable offshore resources, which could include gas finds.

5.2.10. South African Economic Reconstruction and Recovery Plan (2020)

South African Economic Reconstruction and Recovery Plan's interventions are in pursuit of the National Development Plan goals of reducing unemployment, poverty and inequality. This document sets out a reconstruction and recovery plan for the South African economy that is aimed at stimulating equitable and inclusive growth. For the past decade, the South African economy has experienced stagnation which has put a strain in the effort to tackle the historical structural inequalities, unemployment and poverty. There is consensus that there needs to be substantial structural change in the economy that would unlock growth and allow for development. Government's conviction is that South Africa has to massively mobilise all its resources and efforts in economic activities to put the economy in a sustainable recovery trajectory. The Covid-19 pandemic deepened the economic crisis in South Africa with many people losing their jobs. As a result, inequality is expected to widen and poverty to deepen.

One of the priority intervention areas is Energy Security, which is critical for the maintenance of a stable economy and is also important in ensuring growth. Specific interventions in the energy sector include creating and securing additional supply, including gas, and finalising the Petroleum Resources Development Bill and related fiscal measures to enable Upstream Sector Investments.

The proposed project could support meeting this priority intervention in Energy Security, through the ongoing exploration to determine the nature and extent of potentially viable offshore resources, which could include gas finds.

5.2.11. South Africa's Low-Emission Development Strategy (SA-LEDS) 2050 (February 2020)

SA-LEDS was prepared in response to Article 4 of the Paris Agreement and presents South Africa's first low-emissions development strategy. The Strategy sets out the path going forward to place the country on a low-carbon trajectory towards ultimately reaching a net zero carbon economy by 2050, while at the same time ensuring broader socio-economic development. The strategy acknowledges that as one of the top 20 global emitters, with a high dependency on fossil fuels, substantial emission cuts will be required. It also acknowledges that the rapid transition that will be required presents a potential risk to economic growth and sustainable development if not managed properly.

The strategy centres on measures currently being implemented to address mitigation across the four key sectors of the economy, namely energy; industry; Agriculture, Forestry and Land Use (AFOLU); and waste. With regards to energy supply, the decarbonisation will largely be driven through the following:

- the Integrated Energy Plan, which analyses current energy supply and demand trends within the different sectors of the economy, and projects the country's future energy requirements under a variety of different scenarios,
- the Integrated Resource Plan (see Section 5.2.9), which guides the South African electricity supply sector, by identifying the preferred electricity generation technologies to meet projected electricity demand. It, thus, provides a mechanism for Government to drive the diversification of the country's electricity generation mix and promote the use of renewable energy and other low-carbon technologies.

The Strategy recognises that many of the current measures address only the short-term and are not considered to be transformational. Thus, the Strategy also presents planned cross sectoral measures that will contribute to driving mitigation action. It acknowledges that a broad range of structural changes will be necessary, in order to ensure the global economy achieves carbon neutrality within the second half of the century. Changes will be required in terms of service demand, technology fleet, infrastructure, operating practice, and energy sources, for all sectors of activity.

5.2.12. South Africa's Draft Nationally Determined Contribution (NDC) (2021)

On 31 March 2021 the Minister of Forestry, Fisheries and the Environment officially launched South Africa's updated draft Nationally Determined Contribution (NDC) for public consultation. The updated draft NDC is the cornerstone of South Africa's climate change response and expresses South Africa's commitment to the Paris Agreement and a statement as to how South Africa will address the climate challenge. South Africa remains committed to addressing climate change based on science, equity and sustainable development. Similarly, the present draft updated NDC seeks to balance the three structural components of mitigation, adaptation and means of implementation / support requirements (Source: https://www.environment.gov.za/mediarelease/creecy_indc2021draftlaunch_climatechangecop26).

The Intergovernmental Panel on Climate Change (IPCC) indicates that more urgent and rapid reductions in emissions are required by all countries. The updated mitigation NDC proposes a significant reduction in GHG emissions target ranges up to 2030, with the 2025 target range allowing time to fully implement the national mitigation system, including those elements contained in the Climate Change Bill (see Section 5.2.16). It will also allow space for the implementation of IRP 2019 and other key policies and measures, as well as the national recovery from COVID-19. The 2030 target range (398 - 440 Mt CO2-eq) is consistent with South Africa’s fair share, and also an ambitious improvement on South Africa's current NDC target. The upper range of the proposed 2030 target range represents a 28% reduction in GHG emissions from the 2015 NDC targets. South Africa’s updated NDC targets are aligned with planned policies and measures to provide opportunities for accessing large-scale international climate finance to fund low carbon infrastructure and also to fund the just transition.

The Presidential Climate Commission (PCC) was established in order to advise government and its social partners on the climate transition and viable pathways to a climate resilient net-zero economy and society. The PCC believes that the NDC should give expression to the need for a “just transition”, to which Government and its social partners are committed. It states that it is important to protect those most vulnerable to climate change, including women, children, people with disabilities, the poor and the unemployed, and protect workers' jobs and livelihoods as the economy shifts to cleaner, more sustainable production.

In reviewing the draft NDC, the PCC recommends that (PCC 2021):

- The upper and lower bounds of the emissions trajectory in the NDC should be compatible with South Africa’s ‘fair share’ of emission reductions, taking into account common but differentiated responsibilities and respective capabilities.
- The NDC should reaffirm South Africa’s commitment to reaching ‘net-zero’ carbon emissions by 2050.
- A net-zero target will be consistent with the direction other countries are taking and will set the context for evaluating the 2025 – 2030 emission trajectory.
- Since current policies will result in emissions below the draft updated NDC trajectory, the implementation of these current policies and programmes allows for increased ambition in the updated NDC.
- Further ambition beyond existing policies is possible by adopting least-cost measures to accelerate emissions reductions, provided that the required investment is supported by scaled up climate finance.
- South Africa should maximise the employment opportunities and other co-benefits associated with higher levels of and more rapid decarbonisation mitigation, at the same time as addressing negative local employment effects.
- The NDC should note the sensitivity of tradable sectors of South Africa’s economy to global carbon measures as trading partners embark on net-zero targets and seek to be competitive in low-carbon goods and services.
- The NDC should lower South Africa’s emissions target range to at least 350 – 420 Mt CO2-eq by 2030. This will be consistent with South Africa’s fair share contribution to a 2°C global target.

In addition, the NDC should indicate South Africa’s long-term emissions target of achieving net-zero carbon emissions by 2050, as set out in SA-LEDS. In arguing for a proactive stance, it is important to be mindful of the enormous challenges South Africa faces in terms of unemployment, poverty and inequality. South Africa is committed to a just transition to a net-zero and climate resilient society. The process of transition to a decarbonised economy has to be carefully managed, and the social and economic cost of the transition for vulnerable groups must be factored into the planning process, while the economic opportunities of the transition should be fairly distributed.

5.2.13. South African Gas Masterplan Base Case Report (DMRE, 2021)

The NDP envisions that by 2030 South Africa will have an energy sector that promotes economic growth and development through adequate investment in energy infrastructure. At just 2.6% of the country's total energy mix, South Africa's natural gas market is small, but with all its inherent benefits, it has the potential to change the economy by stimulating economic growth and development, stability and job creation.

The meaningful addition of natural gas to the country's energy mix will rejuvenate an overburdened, out-dated energy infrastructure and reduce cyclical energy shortfalls. It will also stimulate the economy by allowing business and industry to lower their energy and operational spend, while also creating significant numbers of new jobs and skills development opportunities.

A challenge in developing the gas sector is to bring gas demand and supply on stream at the same time and spread geographically to stimulate broader localised demand through South Africa. Without such localised gas demand, it is difficult to develop distributed gas supply and without such distributed gas supply it is difficult to develop localised gas demand. In pursuit of adding generating capacity, lowering carbon emissions, enhancing energy security and supporting industrial development, South Africa has taken the first steps in a gas-to-power programme to be executed under the IRP 2019, aiming to increase the national energy mix natural gas contribution from 2.6% to 15.7% by 2030.

The purpose of the Gas Masterplan Base Case Report is to establish baseline information for the natural gas sector in South Africa and to outline the Gas Master Plan roadmap. Such baseline information includes an overview of the gas value chain and regulatory framework. The report also sets the scene for the Gas Master Plan development process.

5.2.14. International Energy Agency: Net Zero by 2050 - A Roadmap for the Global Energy Sector (IEA, 2021)

The International Energy Agency (IEA) is a Paris-based autonomous intergovernmental organisation established in the framework of the Organisation for Economic Co-operation and Development (OECD) in 1974. Today the IEA acts as a policy adviser to its member states, as well as major emerging economies, such as South Africa (which is an association country to the IEA), to support energy security and advance the clean energy transition worldwide. The IEA's mandate has broadened to focus on providing analysis, data, policy recommendations and solutions to help countries ensure secure, affordable and sustainable energy for all. In particular, it has focused on supporting global efforts to accelerate the clean energy transition and mitigate climate change. The IEA has a broad role in promoting rational energy policies and multinational energy technology co-operation with a view to reaching net zero emissions. In response to the growing number of pledges by countries and companies around the world to limit their emissions to net zero by 2050 or soon after, IEA announced in January 2021 that it would produce a roadmap for the global energy sector to reach 2050 net zero. The report maps out a pathway in line with preventing global temperatures from rising above 1.5°C (Source: https://www.iea.org/reports/net-zero-by-2050).

The global pathway to net-zero emissions by 2050 detailed in this report requires all governments to significantly strengthen and then successfully implement their energy and climate policies. The proposed pathway calls for scaling up solar and wind so that the energy sector is dominated by renewables with a significant decline in fossil fuels (reducing from four-fifths of total energy supply to slightly over one-fifth by 2050). Although the proposed pathway still recognises the need for fossil fuels in the energy mix, it does not provide for the approval of new oil and gas fields for development due to the projected drastic reduction in oil and gas demand (IEA, 2021).

The report, however, recognises that the route mapped out is a path, not necessarily the only path, and so it examines some key uncertainties, including the speed with which demand and behaviours adapt, the real level of energy efficiency, the pace at which new decarbonisation technologies (such as hydrogen and carbon capture and storage) scale up, etc. The report thus concludes that the proposed pathway to net-zero emissions is just one possible pathway to achieve net-zero emissions by 2050.

5.2.15. Just Transition and Climate Pathways Study for South Africa (NBI, 2021[11])

While gas is set to play a major role in South Africa's path to net-zero emissions, this report by the National Business Initiative, Business Unity South Africa and the Boston Consulting Group shows that a lack of supply threatens the country's decarbonisation strategy. This report unpacks the impact of including gas in the country's plans to reduce emissions from carbon-heavy sectors such as electricity, transport and industrial.

It is envisioned that natural gas will replace coal and diesel fuel sources, which are more emissions-intensive. Eventually, gas would be phased out by 2050 and replaced by greener alternatives like green hydrogen once the latter is developed and becomes more affordable.

According to this report, the country's current gas consumption comes to 180 petajoules (180 trillion kilojoules) per annum. The majority of gas is used in the synfuels sector, followed by the industrial sector. Most of the country's gas is sourced from the Pande-Temane gas fields in Mozambique, which supplies approximately 160 petajoules to Gauteng, KwaZulu-Natal and Mpumalanga. Energy and chemicals company Sasol provides about 20 petajoules of gas to KwaZulu-Natal via the Lilly pipeline. However, the Pande-Temane reserves are declining and will be constrained from 2025, which "*poses a risk to the decarbonisation ambitions of key sectors in the South African economy, which will rely on gas as a transition fuel or low carbon feedstock*".

South Africa's potential future gas demand will be driven by four key sectors with proven use cases for gas as a transition fuel or lower emission feedstock:

a) Power: Use gas in gas-to-power (GTP) plants to enable a high penetration of renewable energy in the power system by providing the flexible capacity to manage the long-duration intermittency, which battery storage cannot currently address.

[11] Report summarised, in part by, by https://www.news24.com/fin24/economy/shortage-of-gas-could-derail-sas-plans-to-decarbonise-20220221

b) Synfuels: Introduce additional gas to enable the phase-out of significantly more carbon-intense coal feedstock in the production of liquid fuels.
c) Industry: Phase out higher emitting coal, and to a lesser extent diesel, with additional gas as an energy source for industrial heat generation and other processes.
d) Transport: Use gas as an alternative to diesel, albeit at a small scale, for heavy-duty commercial road transport in the short- to mid-term, while alternative greener technologies mature and become economically viable.

The study warns that without additional gas, there would be more emissions in the long run because the synfuels, power and industrial sectors would rely on carbon-intensive fuels like coal and diesel for longer. The report, however, does highlight other potential sources of South Africa's gas supply over the short, medium and long term:

- In the short term (2021 to 2024), the country can supplement the Pande-Temane reserves by relying on LNG. LNG mainly would be supplied from floating storage regasification units or gas-carrying ships stationed at ports like Matola in Mozambique and South African ports such as Richards Bay, Coega and Saldanha.
- In the medium term (2024-2030), the supply from Pande-Temane could be maximised through "technical work" on the reserves. For example, this is possible through regional cooperation between South Africa and Mozambique to achieve a "win-win" for both parties. The report, however, notes that the additional gas available from Pande-Temane is not fixed and depends on contractual and other technical uncertainties.
- In the long term (beyond 2030), other supply options include LNG and piped gas from Rovuma and other gas fields from Mozambique. Gas can also be sourced from South Africa's exploration activities like TEEPSA's Brulpadda and Luiperd gas fields.

The study warned against unconstrained gas demand - as the goal is to ultimately move away from using the fuel in favour of green alternatives. The report encourages research into repurposing gas infrastructure for green synfuels and green hydrogen.

5.2.16. Climate Change Bill (2022)

On 18 February 2022, the Climate Change Bill was formally introduced to the National Assembly by the Minister of Forestry, Fisheries and the Environment. The aim of the Bill is to enable the development of an effective climate change response and a long-term, just transition to a low-carbon and climate-resilient economy and society for South Africa in the context of sustainable development.

The objects of this Act are to:

a) *"provide for a coordinated and integrated response by the economy and society to climate change and its impacts in accordance with the principles of cooperative governance;*

b) *provide for the effective management of inevitable climate change impacts by enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic and environmental resilience and an adequate national adaptation response in the context of the global climate change response;*

c) *make a fair contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system;*

d) *to ensure a just transition towards a low carbon economy and society considering national circumstances;*
e) *give effect to the Republic's international commitments and obligations in relation to climate change; and*
f) *protect and preserve the planet for the benefit of present and future generations of humankind".*

When promulgated, the Bill will form the legislative foundation for South Africa's climate change adaptation and mitigation response. With respect to the mitigation response, the Bill provides for future review and determination of the national greenhouse gas emissions trajectory; determination of sectoral emissions targets for emitting sectors and subsectors; and allocation of carbon budgets (Source: SA-LEDS).

5.2.17. UN IPCC Report II (February 2022) and Report III (March 2022)

The IPCC released a new climate report in March 2022, building on the findings of a previous report released in February 2022. This provides the IPCC's guidance on what the world can do to avoid the consequences of climate change. The report outlines the most up-to-date science regarding current emissions levels and mitigation strategies in order to transition from fossil fuels. In order to ensure that the 1.5°C degree target can be fulfilled, the report notes that alternative fuels need urgent investment and scaling up to combat the rising global warming margins.

The latest IPCC report shows greenhouse gas emissions continue to rise and that current policies to address climate change are not ambitious enough to limit warming to 1.5°C above pre-industrial levels. The report notes that without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2°C by 2100.

Although growth in emissions has slowed, global GHG emissions remain at their highest level ever. Global GHGs must peak around 2020 and before 2025 at latest in order to remain below 1.5°C with no or limited overshoot. To achieve the 1.5°C degree target, global GHGs must fall by 43% below 2019 by 2030 and 84% by 2050, while CO2 emissions must fall by 48% by 2030 and to net-zero in early 2050s and methane must fall by 4% by 2030. If the world cuts emissions quicker, then there is slightly more time before CO2 has to reach net-zero.

Current and historical GHG emissions are not evenly distributed, with the top 10% of households being responsible for 34-45% of emissions today. Least-developed countries have contributed to less than 0.4% of historical CO2 emissions.

The report notes that cutting emissions requires a "substantial reduction in overall fossil fuel use", energy efficiency, low-emission energy sources, such as renewables and alternative energy carriers, such as hydrogen.

5.3. CONSISTENCY WITH NEMA PRINCIPLES

As set out in the DFFE Need and Desirability Guidelines (2017), the national environmental management principles contained in NEMA serve as a guide for the interpretation, administration and implementation of NEMA and the EIA Regulations 2014 (as amended). In order to demonstrate consistency with the NEMA principles, a discussion of how these principles are taken into account during the ESIA process to date is provided in Table 5-2.

TABLE 5-2: CONSIDERATION OF THE NEMA PRINCIPLES IN RELATION TO THE PROPOSED PROJECT

National Environmental Management Principles	Comment
(2) Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.	The proposed project aims to determine the extent and economic viability of the indigenous hydrocarbon reserves in the DWOB Licence Block. Confirmation of the economic viability of such resources would enable the country to refine its short- to-medium-term planning for the development of the petroleum sector within the country. The sector is known to have economic benefits and environmental risks which need to be balanced. The ESIA process will also serve to identify the needs and interests of potentially affected parties and to address issues and concerns raised through the course of the study.
(3) Development must be socially, environmentally and economically sustainable.	The South African Government has indicated that there is a need for the country to reduce its reliance on coal-based electricity and is committed to a "just" transition to a net-zero and climate resilient society (as per SA-LEDS and draft NDC). Natural gas is included in the energy mix of the country to serve as a transition or bridge on the path to a carbon-neutral goal (as per the Paris Agreement) and provide the flexibility required to complement renewable energy sources. By determining the presence (and extent) of such resources, the sustainability of developing the petroleum sector within the country can be better considered.
(4)(a) Sustainable development requires the consideration of all relevant factors including the following: *(i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;* *(ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;* *(iii) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;* *(iv) that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;* *(v) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;*	Although the ESIA process will consider potential social, economic, biophysical impacts that could result through the implementation of the proposed project, national strategic policy issues relating to energy and climate change fall beyond the scope of this project ESIA. The ESIA will also identify measures to avoid, minimise and/or remedy potential pollution and/or degradation of the environment that may occur as a result of the proposed project. These will be presented in the ESIA Report.

National Environmental Management Principles	Comment
(vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised.	
(vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and	Assumptions, uncertainties and limitations associated with the ESIA process are discussed in Section 3.2. Compliance with the various legislative requirements is presented in Chapter 2.
(viii) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.	The ESIA Report will consider and assess the identified potential social, economic and biophysical impacts of this exploration project (not production). The ESMP will provide the recommended management measures to mitigate the significance of identified impacts.
(4)(b) Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.	The ESIA process that is being followed recognises that all elements of the environment are linked and interrelated. DMRE (as the decision-making authority) and PASA (as the designated authority) will be responsible for taking all aspects of the environment, including whether or not the potential impacts of the project would unfairly discriminate against any person, into consideration when making a decision regarding the proposed project.
(4)(c) Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons.	
(4)(d) Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination.	Due to the offshore location of the proposed activities, it is not anticipated that access to environmental resources that meet basic human needs would be limited.
(4)(e) Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.	TEEPSA has indicated that it is committed to comply with environmental health and safety consequences of the proposed exploration activities.
(4)(f) The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured.	The public participation process will be undertaken in accordance with the requirements of the EIA Regulations 2014, as amended (see Chapter 4).

National Environmental Management Principles	Comment
(4)(g) *Decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognizing all forms of knowledge, including traditional and ordinary knowledge.*	The ESIA process will take into the account and present the interests, needs and values of I&APs, through the submission of comments on the proposed project, during the Scoping and Assessment phases. Consequently, the decision-makers will have the necessary information before them, based on which an informed decision can be made.
(4)(h) *Community wellbeing and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means.*	The Scoping Report and ESIA Report prepared for the proposed project will be made available to communities for review and comment (see Chapter 4).
(4)(i) *The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.*	The ESIA process will consider identified potential social, economic, biophysical impacts of this exploration project in an integrated manner. The significance of these impacts will be assessed in according to pre-defined rating scales (see Section 9.3). As noted above, national strategic policy issues relating to energy and climate change fall beyond the scope of this project ESIA.
(4)(j) *The right of workers to refuse work that is harmful to human health or the environment and to be informed of dangers must be respected and protected.*	TEEPSA (and its appointed contractors) would be required to comply with the relevant Occupational Health and Safety legislative requirements for the proposed activities. An Environmental Awareness Plan will also be prepared to inform staff about any aspects of their work that may pose a danger to the environment.
(4)(k) *Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law.*	The public consultation process is being undertaken in accordance with the requirements of the EIA Regulations 2014 (as amended) and allows for the distribution of the Scoping Report and ESIA Report for public review and comment (see Chapter 4). This information is provided in an open and transparent manner.
(4)(l) *There must be intergovernmental co-ordination and harmonisation of policies, legislation and actions relating to the environment.*	The public participation process for the proposed project provides an opportunity for the Organs of State to provide comment on the proposed project and address any potential conflicts between policies or other developmental proposals administered by them that may be in conflict with the proposed project before decision-making.
(4)(m) *Actual or potential conflicts of interest between organs of state should be resolved through conflict resolution procedures.*	It is not anticipated that the proposed project would result in any conflicts between organs of state. If they do, they will be resolved as required by law.
(4)(n) *Global and international responsibilities relating to the environment must be discharged in the national interest.*	DMRE, as the decision-making authority, will be responsible for taking cognisance of any international obligations that could have an influence on the project.
(4)(o) *The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.*	The ESIA process will consider and assess the identified potential social, economic, biophysical impacts of this exploration project. National strategic policy issues relating to energy and climate change fall beyond the scope of this project ESIA.

National Environmental Management Principles	Comment
(4)(p) *The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.*	As the applicant, TEEPSA will be responsible for the implementation of the measures included in the ESMP.
(4)(q) *The vital role of women and youth in environment management and development must be recognised and their full participation therein must be promoted.*	The public participation process being undertaken for the proposed project aims to be inclusive of women and the youth.
(4)(r) *Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.*	The ESIA process being undertaken for this proposed exploration project identifies relevant sensitive and/or vulnerable areas and assess potential impacts if applicable. Appropriate mitigation measures will be proposed where required.

5.4. SECURING ECOLOGICAL SUSTAINABLE DEVELOPMENT AND USE OF NATURAL RESOURCES

The biophysical impacts of the proposed project will be further investigated in the Assessment Phase. Measures to enhance the benefits and mitigate the impacts to these resources, as applicable, will be included in the ESIA Report.

5.5. PROMOTING JUSTIFIABLE ECONOMIC AND SOCIAL DEVELOPMENT

The social impacts of the proposed project will be further investigated in the Assessment Phase. Measures to enhance the benefits, avoid negative impacts where possible and mitigate the impacts to these resources, as applicable, will be included in the ESIA Report.

5.6. NEED AND DESIRABILITY SUMMARY

South Africa, like the rest of the world, is vulnerable to climate change. There is global concern for the need to reduce GHG emissions and achieve carbon neutrality by 2050. South Africa has a high dependency on fossil fuels and, as one of the top 20 global GHG emitters, will need to make substantial emission cuts. However, the rapid transition to carbon neutrality presents a potential risk to economic growth and sustainable development if not managed properly. South Africa is committed to a just transition to a net-zero carbon economy and climate resilient society (as per SA-LEDS and draft NDC), whereby the need to reduce emissions is balanced with the need to grow the economy, create jobs and develop skills, so that the needs of vulnerable groups are addressed.

The COVID-19 pandemic has deepened the economic crisis in South Africa and as a result, inequality is expected to widen and poverty to deepen. There is a drive from National Government to stimulate development and grow the economy of South Africa with a strong focus on job creation in all sectors, whilst protecting the environment. In order to facilitate this economic growth and reduce dependency on imported fuel products, there is a critical need to ensure that there is sufficient, stable capacity in the country's energy supply by diversifying the primary energy sources within South Africa. In this regard, South Africa needs to balance the three core dimensions of what has been defined as the "energy trilemma": (1) affordability and accessibility, (2) energy security and (3) environmental sustainability (https://trilemma.worldenergy.org/). In weighing up these core dimensions, the South African Government policy currently supports exploration for indigenous oil and gas resources and promotes the use of natural gas as part of the energy mix in the short- to medium-term up to 2030 (as per the IRP 2019). This is also in line with international policy, which recognises the need for natural gas in the energy mix in the pathway to net-zero emissions by 2050.

The use of fossil fuels is, however, not aligned with other national and international agreements, laws, policies and plans, which identify the need to reduce the reliance on fossil fuels and for the global community, including South Africa, to reduce its GHG emissions and meet international law obligations and commitments. Notwithstanding the above, natural gas is included in the energy mix of the country to serve as a transition or bridge on the path to carbon-neutrality from 2050 onwards (as per the Paris Agreement) and provide the flexibility required to complement renewable energy sources (as per the IRP 2019). The "Just Transition and Climate Pathways Study" (NBI, 2021) concludes that a lack of gas supply threatens South Africa's decarbonisation strategy because the synfuels, power and industrial sectors would rely on carbon-intensive fuels (e.g., coal and diesel) for longer. In addition to the use of natural gas for electricity generation, the many other uses of oil and gas (e.g., transportation fuels, asphalt, and feedstocks for making chemicals, polyurethane, solvents, plastics and other synthetic materials) will also need to see adaptation and mitigation during this transition period.

It is acknowledged that the proposed **exploration project**, itself, would not result in the production of oil and gas, but rather the generation of information on possible indigenous resources. By gaining a better understanding of the extent, nature and economic feasibility of extracting these potential resources, the viability of developing indigenous gas resources would be better understood. The proposed exploration project, as contemplated (i.e. not including possible production), has no direct influence on South Africa's reliance on fossil fuels and whether consumers use more or less oil or gas, nor on which types of fossil fuels contribute to the country's energy mix. The proposed exploration project will not necessarily change how fossil fuels are used in South Africa and has no direct influence on GHG emissions that would arise from the consumption of fossil fuels. These aspects are influenced by South Africa's energy and climate change related policies, the financial costs of the various energy sources and consumer choices in this regard.

The proposed exploration project will potentially lead to South Africa optimising its own indigenous resources to provide its identified oil and gas needs until the 2050 deadline to achieve carbon neutrality, rather than having to mainly import, as at present (a situation which has been exacerbated by the recent closure of several South African refineries). It won't necessarily change how fossil fuels are used in South Africa in the short- to medium-term in the transition towards the goal of carbon neutrality by 2050. Although the national and international strategic agreements, laws, policies and plans will be taken into consideration by the Competent Authority in the decision-making process, National strategic policy decisions relating to energy and climate change fall beyond the scope of this exploration project ESIA.

5.7. IMPLICATIONS OF THE NO-GO ALTERNATIVE

The No-Go alternative represents the option not to proceed with the proposed exploration well drilling activities. This would leave the project Area of Influence in its current state (refer to the baseline description in Chapter 7), except for ongoing natural variations and changes caused by other human activities (e.g., fishing, commercial shipping, etc.). It thus represents the current status quo against which all potential project-related impacts will be assessed. Opting for the No-Go alternative means that none of the impacts anticipated from normal exploration drilling operations would occur. Additionally, the No-Go alternative would preclude the risks associated with accidental drilling-related events.

As noted in Section 5.6 above, the South African Government and international policy both promote the use of natural gas in the energy mix in the pathway to net-zero emissions by 2050, i.e., gas is needed in the just transition. At present, and in the proximate future (and therefore also in the ‘No Go’ option), this gas will have to be imported; however, there may be local reserves that could be used instead of imports. The government has a continuing view that any existing oil or gas resources should be developed (see especially the MPRDA and the proposed Upstream Petroleum Resources Development bill: https://www.parliament.gov.za /bill/2298070). The presence and activity of TEEPSA, and other exploration operators, in South African territory is as a result of this policy.

The No-Go alternative (which here assumes no future oil and gas exploration and production in South Africa) means that any domestic oil and gas resources that might occur in the target area cannot be identified and South Africa will not be able to optimise the used of its own domestic oil and gas resources, should they exist, to assist in the transition to the 2050 carbon neutrality. Unless other fields are developed, South Africa's demand for gas and oil refined products will continue to be met by imports. It is assumed that these imports, and the supply of electricity, will remain at current levels and natural gas will continue to have a role in energy supply (especially as South African moves away from coal).

This appears to be reasonable as the South African demands for oil products, electricity and gas have been stable for some time. If current trends continue then Eskom’s aging coal plants will continue to suffer poor reliability. End users will, where possible, develop alternatives to unreliable Eskom supply, which may include dispatchable power (coal, natural gas, oil, coal-bed methane) and renewables.

It is reasonable to believe that current supply / demand trends will continue (South African Petroleum Industries Association, International Energy Association) with the caveat that South Africa will not be immune from the current global energy disruptions. The impact of the Ukraine Russia conflict could continue to be felt global energy markets for many years. If so, international oil and prices will be higher for longer and countries in the West will pay greater attention to security of supply in their strategic energy policies. If South Africa wishes to import oil and gas it will be competing with motivated European buyers.

In terms of oil, the trend of South African oil refinery closures will continue. These closures include or will potentially include ENREF, SAPREF, CHEVREF and NATREF. In terms of gas, Mossel Bay Gas-to-Liquid (GTL) plant seems likely to close unless a domestic gas supply is identified or a large bail out by the South Africa taxpayer is agreed to fund processing of higher cost feedstocks (in this respect, it should be noted that a production licence has been sought for the offshore Block 11B/12B). Due to refinery closures, the demand for oil refined products is likely to be met by increased imports (probably from India and the Middle East). This will expose South Africa to large price risk due to the international energy market and high levels of energy supply risk.

In terms of electricity, current end user consumption trends suggest that demand for power will remain broadly constant. Eskom supply seems likely to remain unreliable and load shedding likely to continue. Eskom's increasing cost and high carbon emission power will continue to be a burden to the South African taxpayer. In the short- to medium-term the push for increasing electricity generation from renewable sources will continue to be frustrated by a lack of Eskom transmission capacity from the most suitable wind and solar areas. South Africa has relatively few sites for pumped storage and utility-scale batteries are not yet available; consequently solar and wind are not presently viable sources of base-load power. South Africa, therefore, uses diesel to operate open cycle gas turbines to meet peak demand (https://www.eskom.co.za/wp-content/uploads/2021/09/GS-0003-Ankerlig-Gourikwa-Technical-Brochure-Rev-9-1.pdf). As South Africa shifts from coal fired thermal power to renewable (solar and wind), the reliance on peaking plants will increase. Gas would be both cheaper and less polluting than diesel.

The cost of onshore wind and solar generation has decreased over the period 2010- 2019. However, both these sources provide intermittent power, as production is curtailed when the sun does not shine or the wind does not blow, respectively. To ensure reliable supply, it is necessary to supplement these sources with dispatchable power. This could be (i) pumped storage (but South Africa has limited opportunity for additional pumped storage capacity), (ii) batteries (but based on current technologies batteries can offer limited capacity and discharge durations, and (iii) peaking thermal plants such as open (or preferably closed) cycle gas turbines (OCGT's). South African's currently installed OCGTS are using diesel, which is more carbon emissions intensive than gas.

Eskom's heavy reliance on coal for electricity generation will keep South Africa's carbon emissions high and the meeting of 2050 targets will be challenging based on current power transmission infrastructure and storage technologies.

At present, Eskom controls much of its coal through production agreements and long-term pricing contracts. These mean that its major input's price is stable. In contrast, gas and oil will need to be purchased on the (volatile) open market. Future contracts for oil and gas are available, but for shorter periods and on less favourable terms than those in the local market for coal.

Gas import initiatives will be contingent on international market developments. Strong desire to replace Russian gas supply will keep the Liquified Natural Gas (LNG) and Floating Storage and Regasification Unit (FSRU) markets tight (fully contracted) and, due to strong European demand, new FSRUs may not be available until 2028. Thus, it is estimated that import gas supply will become available from about 2028, if South African terminals can offer a compelling destination for gas (compared to European alternatives) and for FSRUs (in the context of a motivated European market to secure gas and infrastructure to replace Russian gas supply).

Gas supplies currently piped to Gauteng from the Pande and Temane fields in central Mozambique are almost at an end and cannot be relied on going forward (https://www.offshore-technology.com/ marketdata/pande-temane-complex-conventional-gas-field-mozambique/). The Northern Mozambican fields are presently facing political / military risks as a result of the Islamist insurgency in Cabo Delgado. Thus, unless a local supply is identified and developed, it seems certain that South Africa will need to develop and operate an LNG terminal (at significant additional cost) and bring in tankers. There are financial and environmental threats associated with both options, i.e. relying on the Mozambican gas fields or building LNG terminals.

South African domestic gas exploration offers an opportunity to seek an energy supply that could be competitively priced, produce relatively low carbon dispatchable power (lower carbon emissions than coal or oil or oil fired generation) without the inherent weather risk of PV or wind generation (in the absence of utility scale batteries) and reduce South Africa's exposure to the highly volatile international energy markets (fluctuating price).

6. PROJECT DESCRIPTION

This chapter describes the sequence of the proposed project phases and activities, provides technical information, and describes the proposed exploration activities and alternatives.

6.1. LICENCE BLOCK DETAILS AND EXPLORATION RIGHT HOLDERS

The DWOB Licence Block is located off the West Coast of South Africa. The Block covers an area of approximately 37 335 km^2 (this will be reduced once the relinquishment application is finalised) and is located offshore approximately 150 km and 188 km off the West Coast, roughly between Saldanha Bay (33°S) and Kleinzee (30°S), with water depths ranging from 400 m to 3 900 m (see Figure 6-4 and Table 6-1).

TABLE 6-1: LICENCE BLOCK INFORMATION

Exploration Right No.:	12/3/343
Licence Block No.:	Deep Western Orange Basin
Size of licence area:	37 335 km^2
Water depths across licence area:	500 m to 3 900 m
Closest Distance offshore:	150 km to Saldanha Bay and 188 km to Hondeklip Bay
Locality:	Refer to Figure 6-4

TEEPSA holds the controlling interest in the DWOB Licence Block, with its partners Qatar Energy and Sezigyn (Pty) Ltd holding the remaining interest (see Table 6-2). The current exploration right was issued in November 2019. Contact details for TEEPSA are presented in Table 6-3.

TABLE 6-2: STRUCTURE OF LICENCE HOLDING AND SHAREHOLDING OF DWOB LICENCE BLOCK

Organisation	Shareholding
TEEPSA	50%
Qatar Energy	30%
Sezigyn (Pty) Ltd	20%

TABLE 6-3: CONTACT DETAILS OF OPERATOR

Address:	TOTALENERGIES EP SOUTH AFRICA B.V. 3rd Floor Tygervalley Chambers Two 27 Willie van Schoor Avenue Bellville, 7530
Responsible person:	Bertrand Bouvet (Managing Director)
Contact person:	Eduard Groenewald +27 21 003 4077
E-mail:	eduard.groenewald@totalenergies.com

6.2. APPROVED EXPLORATION ACTIVITIES

TEEPSA holds an existing Exploration Right for the DWOB Licence Block which is limited to desktop activities. TEEPSA is planning to undertake sonar surveys, seabed coring and well drilling exploration activities across the block as described in the following section below.

6.3. OVERVIEW OF PROPOSED PROJECT ACTIVITIES

The key components and activities of the proposed exploration activities are summarised in Table 6-4 and are detailed in Sections 6.4 to 6.7.

TABLE 6-4: SUMMARY OF KEY PROJECT COMPONENTS

Exploration and appraisal well drilling	
Purpose	To confirm and test the presence and quality of hydrocarbon resources
Number of exploration and appraisal wells	10 wells
Size of Area of Interest for proposed exploration drilling	9 711.21 km^2
Well depth (below seafloor)	Variable depending on depth of resource which is not currently known. A notional well depth of 3 500 m is assumed for the ESIA
Water depth range	• Water depth range of area of interest: 500 m to 3 500 m • Water depth range of most probable prospect(s): 1 000 m to 3 000 m
Duration to drill each well	• Mobilisation phase: up to 45 days • Drilling phase: ○ Exploration well: Up to three months ○ Appraisal well: Up to four months • Well plugging and abandonment: up to 15 days • Demobilisation phase: up to 10 days
Commencement of drilling and anticipated timing	Commencement is not confirmed, but possibly between first quarter of 2024 (Q1 2024) and fourth quarter of 2024 (Q4 2024) to drill first well.
Proposed drilling fluids (muds)	Water-based Muds (WBM) will be used during the first (riserless) drilling stage and Non-Aqueous Drilling Fluid (NADF) during the second (risered) drilling stage.
Drilling and support vessels	• Semi-submersible drilling unit or drillship • Three support vessels during mobilisation, riserless and demobilisation periods. Two during the risered phase. These vessels will be on standby at the drilling site, as well as moving equipment and materials between the drilling unit and the onshore base.
Operational safety zone	Minimum 500 m around drilling unit
Flaring[12]	Possibly, if hydrocarbons are discovered– up to 2 Drill Stem Tests (DST) per appraisal well, with each test taking up 2 days to flow and flare, 24-hours a day
Logistics base	Port of Cape Town, but alternatively at the Port of Saldanha
Logistics base components	Office facilities, laydown area, mud plant
Support facilities	Crew accommodation in Cape Town
Staff requirements:	• Specialised drilling staff supplied as part of the hire of drilling unit • Additional specialised international and local staff at logistics base

[12] In the petroleum industry, flaring occurs during well testing to dispose of oil or gas in a safe and reliable manner through combustion in an open flame.

Staff changes	Rotation of staff every three to four weeks with transfer by helicopter to shore
Drop core sampling	
Purpose	Sampling of seabed sediment
Method	• Piston core • Box core
Number	20 cores
Duration	4 weeks
Location	Water depth < 3 500 m (no specific target identified)
Safety Zone	500 m
Sonar Surveys	
Purpose	Investigate the structure if the ocean bed sediments
Method	• Multi beam echo-sounder (70-100 kHz) • Single beam echo-sounder (38-200 kHz) • Sub-bottom profiler (2-16 kHz)
Duration/Extent	4 weeks/approximately 15 000 km^2
Location	Not confirmed but localised areas within the whole block
Safety zone	500 m

TABLE 6-5: SUMMARY OF EXPLORATION WELL DRILLING ACTIVITIES AND PHASES

Exploration phases		Exploration activities
1. Pre-Drilling Surveys		Operation survey vessels
		Seabed surveying, including: - multi and single beam echo sounding, and sub-bottom profiling - piston and box core sampling
2. Drilling	2.1 Mobilisation Phase	Establish onshore logistic base using existing infrastructure and rental of quay space for use as laydown area, warehouse and mud plant (for preparation of drilling fluids)
		Appointment of specialised 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
		Discharge / exchange of ballast water
	2.2 Operation Phase	Presence and operation of drilling unit and supply vessels - routine discharges to sea / air and lighting
		Operation of helicopters
		Well drilling (including ROV site selection; spudding; installation of conductor pipes, wellhead, BOP, marine riser, etc.)
		Discharge of cuttings, drilling fluid and residual cement
		Vertical Seismic Profiling (VSP)
		Well (flow) testing and flaring including the possible discharge of treated produced water

		Interaction with local economy (jobs and business opportunities; use of local services and facilities)
	2.3 Demobilisation Phase	Abandonment of well (plugging well with cement, test integrity and seabed clearance survey)
		Demobilisation of drilling unit and support vessels from drill site
		Demobilisation of logistics base, services and work force

6.4. PRE-DRILLING SURVEYS

Pre-drilling surveys may be undertaken prior to drilling in order to confirm baseline conditions at the drill site and to identify and delineate any geo-hazards that may impact the proposed exploration drilling operations. Such hazards could include:

- Seabed hazards:
  - Seafloor geologic features such as slumps or faults extending up to the seabed;
  - Synthetic objects, for example, wrecks, mines, pipelines, etc.; and
  - Seafloor conditions such as very soft clay or cemented sand.
- Sub-seabed hazards:
  - Shallow gas or shallow water flow reservoirs;
  - Gas hydrates;
  - Layers of boulders;
  - Unconsolidated formations; and
  - Shallow prospects.

Pre-drilling surveys may involve sonar surveys and sediment sampling.

6.4.1. Sonar Surveys

Pre-drilling sonar surveys may involve multi- and single beam echo sounding and sub-bottom profiling. Such surveys entail transmitting frequency pulses down to the seafloor to produce a digital terrain model and identify any seafloor obstructions or hazards (see Figure 6-16). These surveys would not be limited to a specific time of the year but would be of short duration (around 15 days per survey) and focused on selected areas of interest within the block. These surveys would take up to four weeks to complete. A description of the proposed techniques is provided below.

6.4.1.1. Echo Sounders

The majority of hydrographic depth/echo sounders are dual frequency, transmitting a low frequency pulse at the same time as a high frequency pulse. Dual frequency depth/echo sounding has the ability to identify a vegetation layer or a layer of soft mud on top of a layer of rock. TEEPSA is proposing to utilise a single beam echo-sounder with a frequency range of 38 to 200 kHz. In addition to this single beam echo sounder technique, TEEPSA is also proposing to utilise multibeam echo sounders (70 - 100 kHz range and 200dB re 1µPa at 1m source level) that are capable of receiving many return "pings". This system produces a digital terrain model of the seafloor (see Figure 6-1).

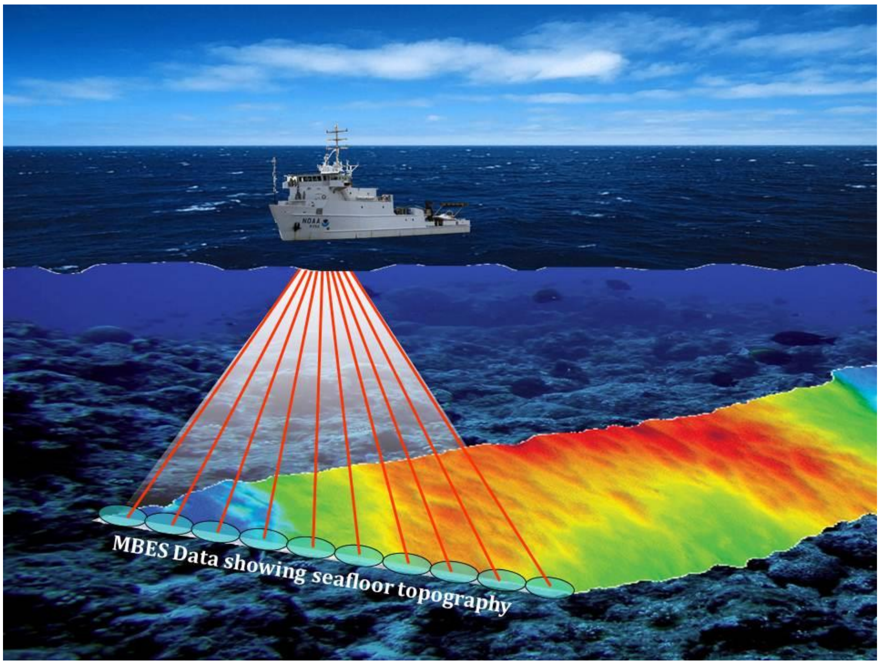


FIGURE 6-1: ILLUSTRATION OF A VESSEL USING MULTI-BEAM ECHO SOUNDER (MBES)
Source: US National Oceanic and Atmospheric Administration

6.4.1.2. Sub-bottom profilers

Sub-bottom profilers are powerful low frequency echo-sounders that provide a profile of the upper layers of the ocean floor. TEEPSA is proposing to utilise a bottom profiler emitting an acoustic pulse at frequencies ranging between 2 and 16 kHz, typically producing sound levels in the order of 200-230 db re 1µPa at 1m.

6.4.2. Seabed Sediment Coring

Seabed sediment sampling may involve the collection of sediment samples in order to characterise the seafloor and for laboratory geochemical analyses in order to determine if there is any naturally occurring hydrocarbon seepage at the seabed or any other type of contamination prior to the commencement of drilling.

Piston and box coring (or grab samples) techniques 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 licence block. Each individual piston and box core would have a maximum volume of 1.8 m³ and 0.15 m³, respectively. A total of 20 cores would be taken (thus the maximum cumulative volume of material that would be removed from the seabed during seabed sampling would be less than 36 m3). It is anticipated that seafloor sampling will take in the order of three to five weeks to complete depending on weather conditions.

6.4.2.1. Piston 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 6 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 6-2 B), 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 6-2 B & C), forcing the core barrel to travel down over the piston into the sediment (see Figure 6-2 D). 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.

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.

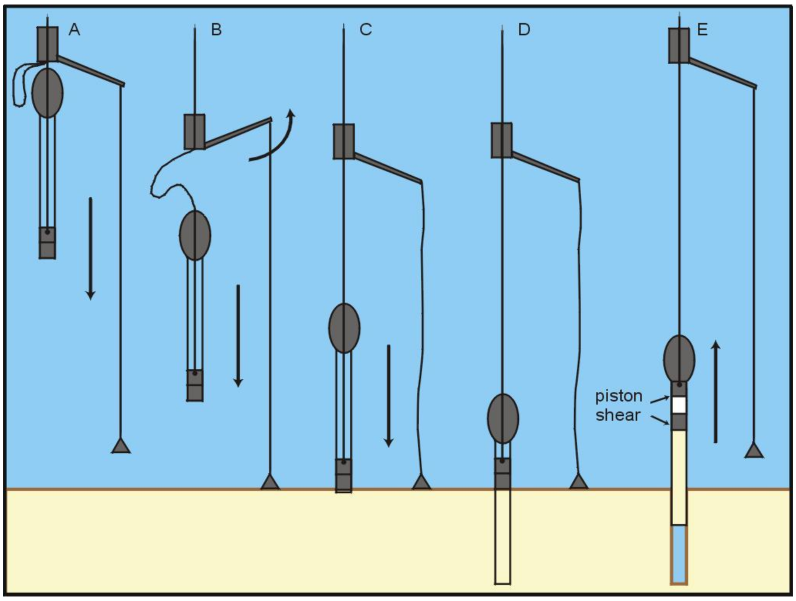


FIGURE 6-2: SCHEMATIC OF A DROP PISTON CORE OPERATION AT THE SEABED

Source: TDI Brooks International

6.4.2.2. Box Coring

The box corer (see Figure 6-3) is deployed for 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. TEEPSA is proposing to take box core samples (50 cm x 50 cm) at a depth of less than 60 cm.

FIGURE 6-3: A BOX CORER
Source: TEEPSA

6.5. EXPLORATION AND APPRAISAL WELL DRILLING

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. TEEPSA is proposing to drill up to 10 exploration wells within an Area of Interest in the DWOB Licence Block. This section describes the site selection, anticipated timing, the different logistical components (i.e., drilling unit, vessels, etc.), the proposed drilling phases and the anticipated discharges, waste and emissions from the drilling unit and support vessels.

6.5.1. Area of Interest for Proposed Drilling and Anticipated Timing

The Area of Interest has been selected based on the analysis of available data (see Section 6.2). This area is 9 711.21 km^2 in extent and is located offshore roughly between Port Nolloth and Hondeklip Bay, approximately 188 km from the coast at its closest point and 340 km at its furthest, in water depths between 1 000 m and 3 000 m (see Figure 6 1). The co-ordinates for the DWOB Licence Block and the Area of Interest are presented in Table 6-6.

The schedule for drilling the wells is not confirmed yet; however, the earliest anticipated date for commencement of drilling, if an Environmental Authorisation is granted, is between the first quarter of 2024 (Q1 2024) and third quarter of 2024 (Q3 2024). The expected target drilling depth is not confirmed yet and a notional well depth of 3 570 m is assumed at this stage.

It is expected that it would take approximately three to four months to complete the physical drilling and testing of each well (excluding mobilisation and demobilisation). TEEPSA's strategy for future drilling is that drilling can be undertaken throughout the year (i.e. not limited to a specific seasonal window period).

TABLE 6-6: COORDINATES OF BLOCK DWOB AND THE AREA OF INTEREST FOR PROPOSED EXPLORATION DRILLING

No.	Longitude (⁰) (E)	Latitude (⁰) (S)	No.	Longitude (⁰) (E)	Latitude (⁰) (S)
DWOB Licence Block					
A	14°42'14.785"E	29°59'50.502"S	**L**	14°59'35.316"E	32°0'30.86"S
B	14°41'45.881"E	30°40'3.955"S	**M**	15°29'27.34"E	32°15'12.42"S
C	14°54'46.279"E	30°39'49.503"S	**N**	15°29'56.244"E	32°14'57.969"S
D	14°55'0.731"E	30°42'14.021"S	**O**	15°44'52.256"E	32°15'12.42"S
E	15°2'43.189"E	30°41'59.569"S	**P**	15°44'52.256"E	32°45'18.897"S
F	15°2'57.641"E	30°52'6.545"S	**Q**	16°14'44.281"E	32°44'49.993"S
G	15°25'7.208"E	30°52'35.449"S	**R**	16°14'44.281"E	33°0'0.457"S
H	15°24'38.304"E	31°0'17.907"S	**S**	14°0'5.718"E	33°0'0.457"S
I	14°45'8.207"E	31°0'17.907"S	**T**	13°59'36.814"E	30°16'27.677"S
J	14°44'39.303"E	31°15'13.919"S	**U**	14°26'6.514"E	30°0'4.954"S
K	15°0'4.219"E	31°14'59.467"S			
Area of Interest for Drilling					
1	14° 0' 9.924" E	30° 19' 5.897" S	**13**	14° 54' 43.648" E	30° 40' 7.043" S
2	14° 1' 15.694" E	30° 18' 41.078" S	**14**	14° 54' 50.627" E	30° 42' 1.629" S
3	14° 5' 52.474" E	30° 17' 43.542" S	**15**	15° 3' 1.099" E	30° 42' 5.630" S
4	14° 10' 30.665" E	30° 16' 18.413" S	**16**	15° 3' 0.265" E	30° 52' 9.826" S
5	14° 16' 25.308" E	30° 16' 4.909" S	**17**	15° 24' 54.173" E	30° 52' 3.699" S
6	14° 22' 33.091" E	30° 16' 46.685" S	**18**	15° 25' 2.337" E	30° 59' 59.085" S
7	14° 29' 6.696" E	30° 19' 32.951" S	**19**	14° 45' 8.977" E	31° 0' 10.177" S
8	14° 34' 31.480" E	30° 23' 52.642" S	**20**	14° 44' 53.221" E	31° 15' 9.346" S
9	14° 38' 23.639" E	30° 26' 59.981" S	**21**	14° 39' 23.603" E	31° 16' 47.609" S
10	14° 40' 26.819" E	30° 28' 54.500" S	**22**	14° 23' 40.936" E	31° 22' 10.512" S
11	14° 42' 11.184" E	30° 29' 39.543" S	**23**	14° 11' 11.469" E	31° 27' 39.470" S
12	14° 42' 6.702" E	30° 39' 54.019" S	**24**	14° 0' 23.637" E	31° 31' 35.196" S

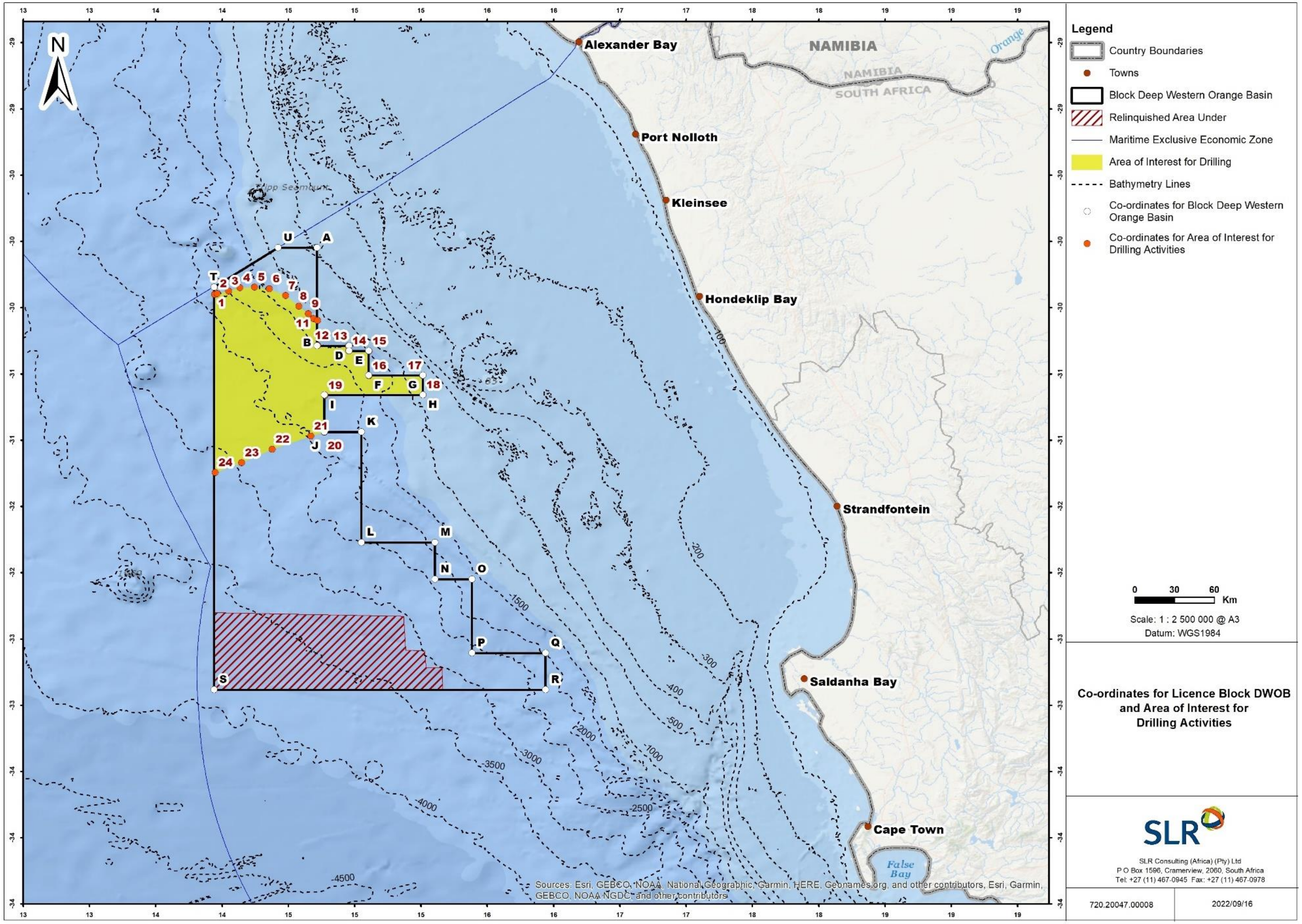


FIGURE 6-4: OUTLINE OF BLOCK DWOB AND THE AREA OF INTEREST FOR PROPOSED EXPLORATION DRILLING

6.5.2. Exploration Drilling Logistics

This section describes the main drilling logistical components, these include the following:

- Drilling unit;
- Supply vessels;
- Helicopters; and
- Onshore logistics base.

6.5.2.1. Drilling Unit

Various types of drilling technology can be used to drill an exploration well (e.g., barges, jack-up rigs, semi-submersible drilling units (rigs) and drill-ships) depending on the water depth and marine operating conditions experienced at the well site (see Figure 6-5). Based on the anticipated sea conditions, TEEPSA is proposing to utilise a semi-submersible drilling unit (as used for the drilling of the Brulpadda and Luiperd wells off the South Coast in 2018/19 and 2020, respectively) or a drill-ship (6th or 7th generation), both with dynamic positioning system suitable for the deep-water harsh marine environment. The final rig selection will be made depending upon availability and final design specifications.

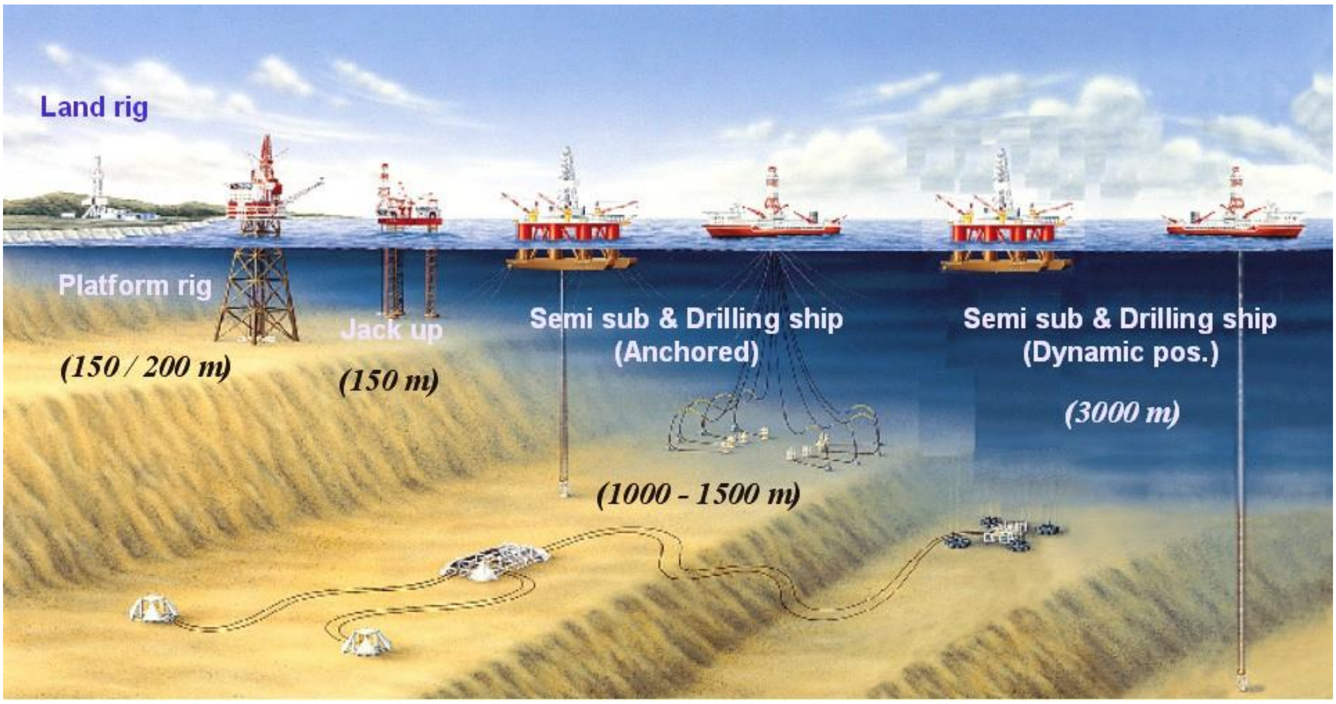


FIGURE 6-5: DRILLING UNIT TYPES

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

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.

A drill-ship is a fit for 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 reduced requirement of supply vessels

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", which requires that power-driven and sailing vessels 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), 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.

6.5.2.2. 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.

6.5.2.3. Helicopter

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 four trips per week between the drilling unit and the helicopter support base in Cape Town (i.e., 17 weeks (˜120 days) x 4 = 68 trips per well). The helicopters can also be used for medical evacuations from the drilling unit to shore (day or night), if required.

6.5.2.4. Onshore logistic Base

The primary onshore logistics base will most likely be located at the Port of Cape Town (preferred option), but alternatively at the Port of Saldanha. 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. It is anticipated that space and equipment requirements to service the operation at the shore base will cover a surface of approximately 16 000 m^2.

All the service infrastructure required to provide the onshore support facilities and logistics will be provided at any one of the two potential support base locations. No additional onshore infrastructure is expected to be required to support the additional exploration activities.

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.

6.5.2.5. Accommodation

The shore-based staff will be accommodated in Cape Town. 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.

6.5.3. 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.

6.5.3.1. Stakeholder Notification

A formal notification will be submitted to PASA 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. PASA 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 exploration activities prior to commencement. Relevant authorities will be engaged as necessary for the establishment of an onshore logistics base (e.g., TNPA, local authority, etc.).

6.5.3.2. 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 South African waters or from a South African 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 the stability and trim of the drilling unit and the support vessels, seawater would be pumped into designated ballast tanks and released to sea during mobilisation and transit to site. Core specialist and skilled personnel would arrive in South Africa onboard the drilling unit and the rest of the personnel will be flown to Cape Town. 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.

6.5.4. Operation Phase

6.5.4.1. Final Drilling Site Selection

The selection of the specific well locations will be based on a number of factors, including further detailed analysis of the pre-drilling survey data and the geological target. A Remote Operating Vehicle (ROV) will be used in finalising the well position based on the presence of any seafloor obstacles or the presence of any sensitive features that may become evident.

6.5.4.2. 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.

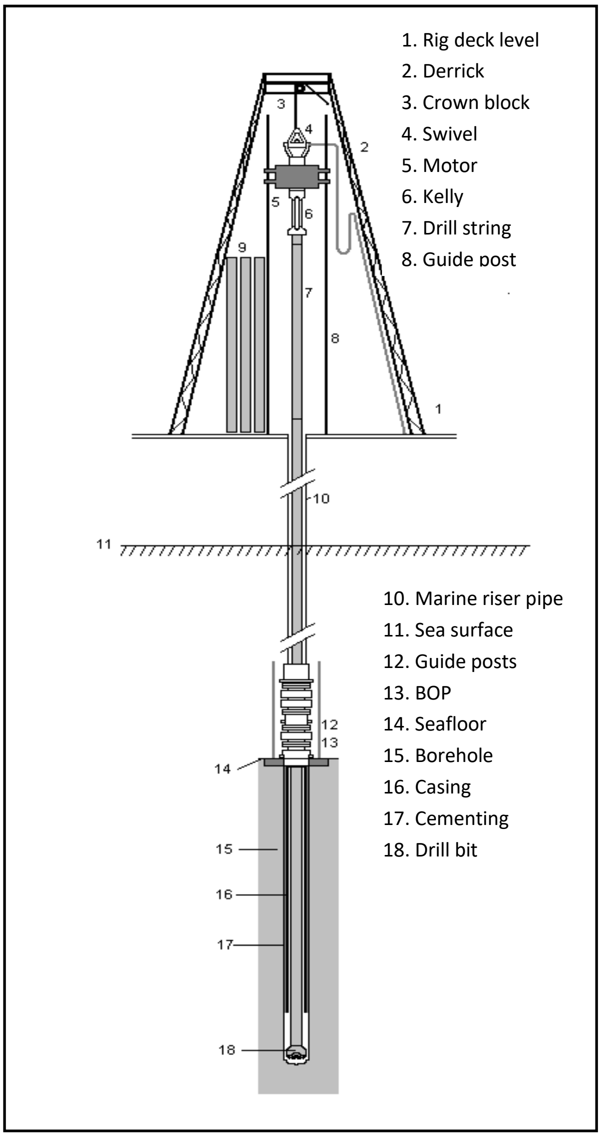


FIGURE 6-6: GENERALISED COMPONENTS OF THE DRILLING UNIT AND DRILL STRING

Source: Jahn *et al*. 1998

6.5.4.2.1. 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 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.

6.5.4.2.2. 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 (BHA) 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 more quickly engage and disengage pumps or the rotary while removing or running the pipe. 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.

6.5.4.2.3. 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).

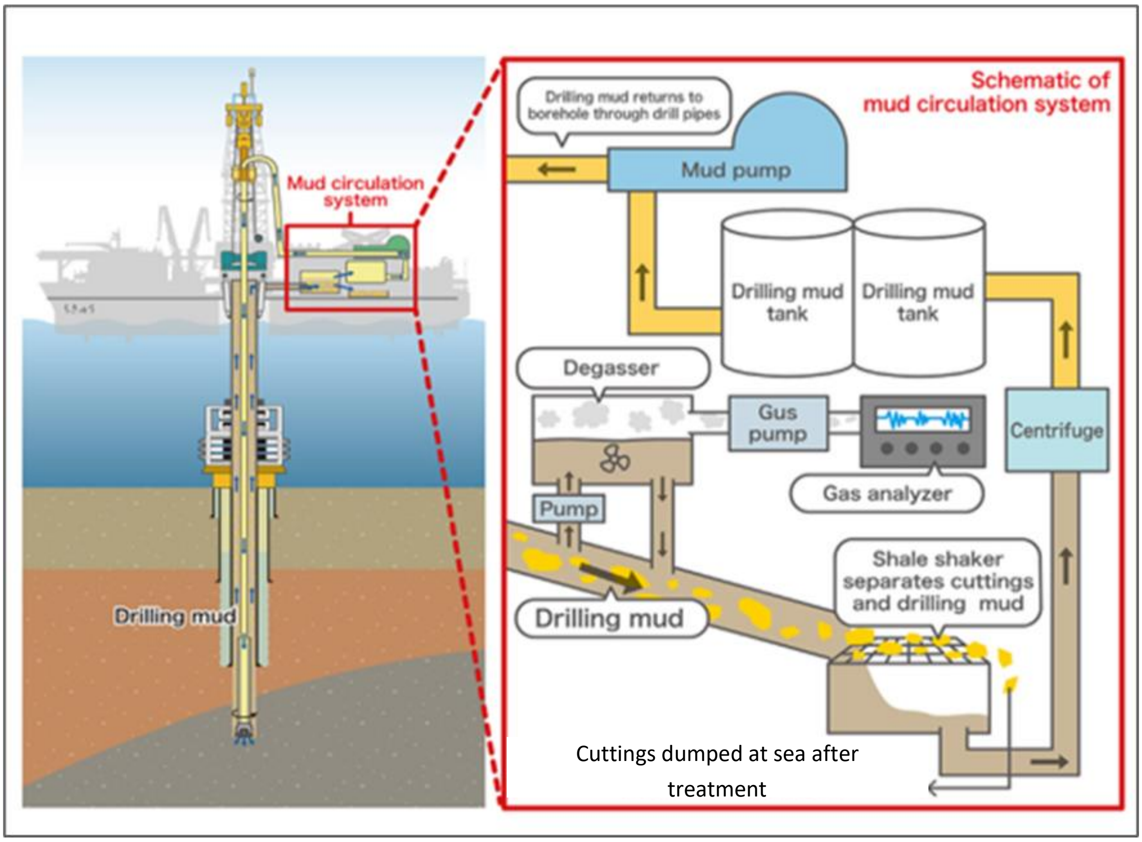


FIGURE 6-7: SIMPLIFIED ILLUSTRATION OF A MUD CIRCULATING SYSTEM

Source: Google Image

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).

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.

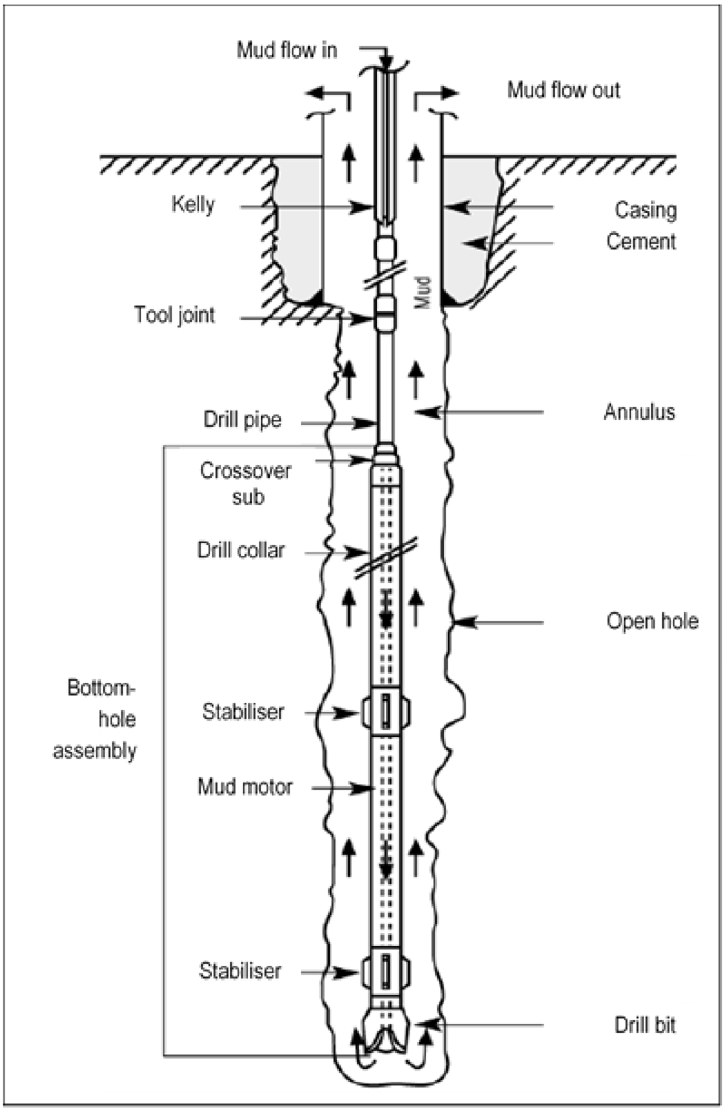


FIGURE 6-8: DRILLING MUD CIRCULATES DOWN THE DRILL PIPE
Adapted from: Candler and Leuterman, 2008

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 above the sea surface.

6.5.4.2.4. Blow-out Prevention and Well Control

Although the probability of a well blow-out is extremely low, it is a worst-case scenario that provides the greatest environmental risk during drilling operations. TEEPSA will have a Blow-Out Contingency Plan (BOCP) 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 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 6), 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 (explained below), 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 wellbore. 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:

- Annular preventer: The annular-type BOP can close around the drill string, casing or a non-cylindrical object, such as a kelly driver (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.
- Ram type preventers: 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):

- 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;
- 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;
- Shear rams cut through the drill string or casing with hardened steel shears; and
- 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.

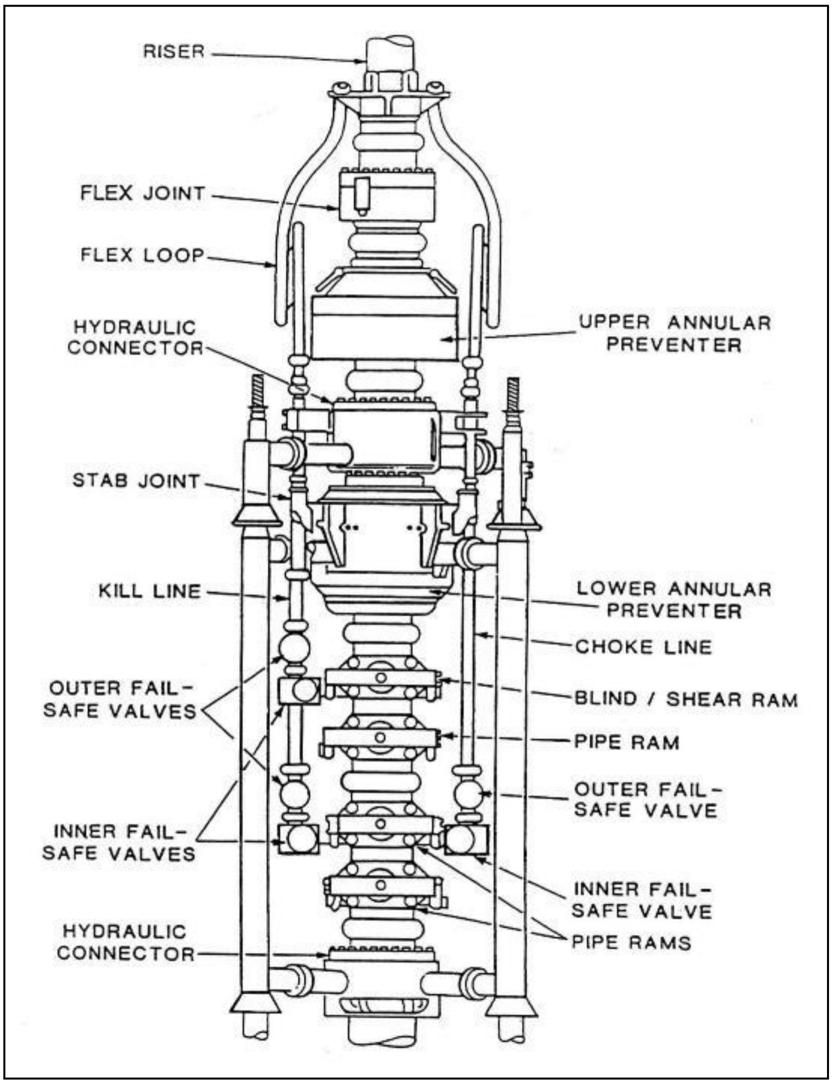


FIGURE 6-9: SCHEMATIC OF A TYPICAL SUBSEA BOP STACK

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;
- Acoustical 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 cable;
- ROV intervention, which mechanically controls valves and provides hydraulic pressure to the stack (via “hot stab” panels); and
- Emergency Disconnect System (EDS) - 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 6.5.7.

6.5.4.2.5. Power System

The drilling unit will require power to operate the circulating, rotating and hoisting systems. Marine Gas Oil (MGO) would be used to generate power and transmit electricity to the drilling unit.

6.5.4.2.6. Heating Ventilating Air Conditioning

The heating and cooling of the drilling team's living quarters will involve a Heating Ventilating Air Conditioning (HVAC) system using refrigerant gas.

6.5.4.2.7. 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.

6.5.4.3. 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). TEEPSA is proposing to use WBM during the riserless drilling stage and NADF during the risered drilling stage for operations in the DWOB Licence Block.

6.5.4.3.1. 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.

- 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 are used to reduce the swelling tendencies of clays being drilled and help to maintain a stable wellbore.

All the chemicals to be used will have associated Material Safety Data Sheet (MSDS) or other bioassay information for ecotoxicology data. Selection of constituents will follow best industry practices and will consider ecotoxicity, biodegradability and bioaccumulation criteria.

Categories of materials typically used in WBM, their functions and typical chemicals in each category are provided in Table 6-7.

TABLE 6-7: 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, & 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

Functional category	Function	Typical chemicals
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
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

6.5.4.3.2. Non-Aqueous Drilling Fluids

As indicated previously, TEEPSA plans to use NADF during the risered drilling stage ("closed loop system"). NADF are used 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 6-8.

TABLE 6-8: 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.

Material	Description
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 that 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 (SOBM) or synthetic-based muds (SBM), 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 project, TEEPSA would only consider using Group III type NADF.

6.5.4.4. Drilling Method and Sequence

6.5.4.4.1. Drilling Method

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) in order to reach the geological target (see Figure 6 7). 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.

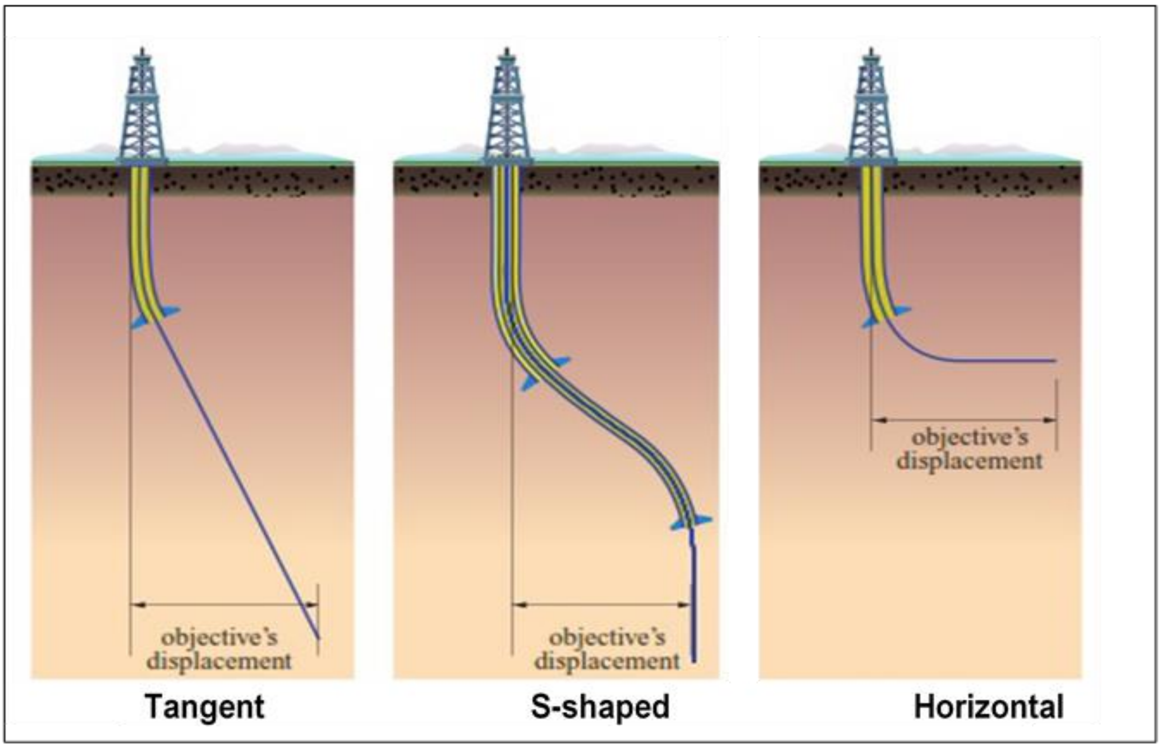


FIGURE 6-10: TANGENT, HORIZONTAL OR S-SHAPED DRILL TRAJECTORIES
Adapted from http://www.valiantenergy.ca/services-2

6.5.4.4.2. 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 Table 6-8).

The casings provide structural integrity to the newly drilled hole, 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 project, 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 a casing.

Drilling is essentially undertaken in two stages, namely the riserless 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 30- or 36 inch diameter structural conductor pipe is drilled and cemented into place or in some cases jetted.

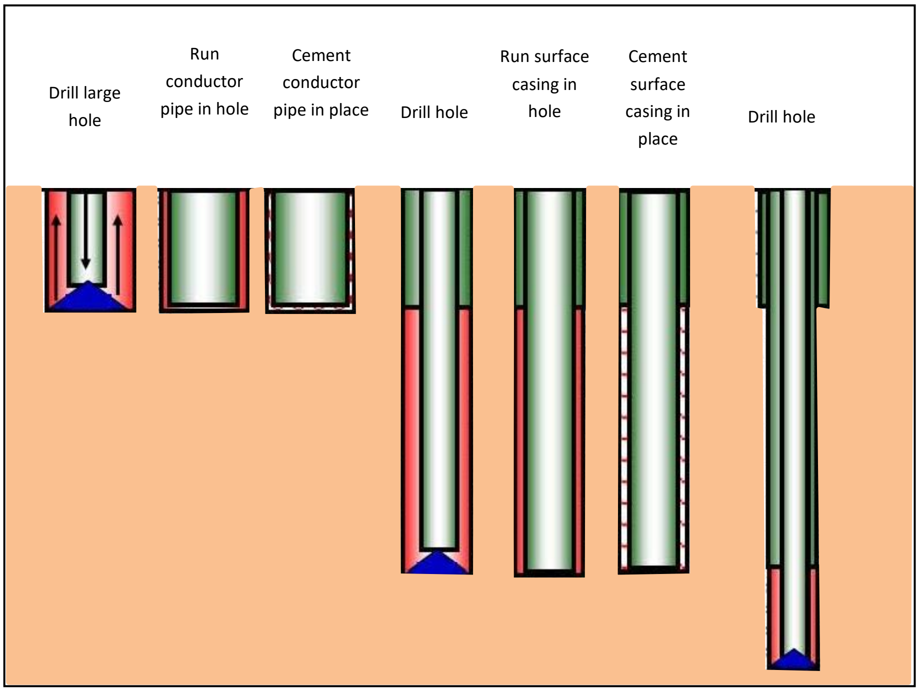


FIGURE 6-11: SIMPLIFIED VIEW OF WELL DRILLING STAGES

Adapted from Nergaard, 2005

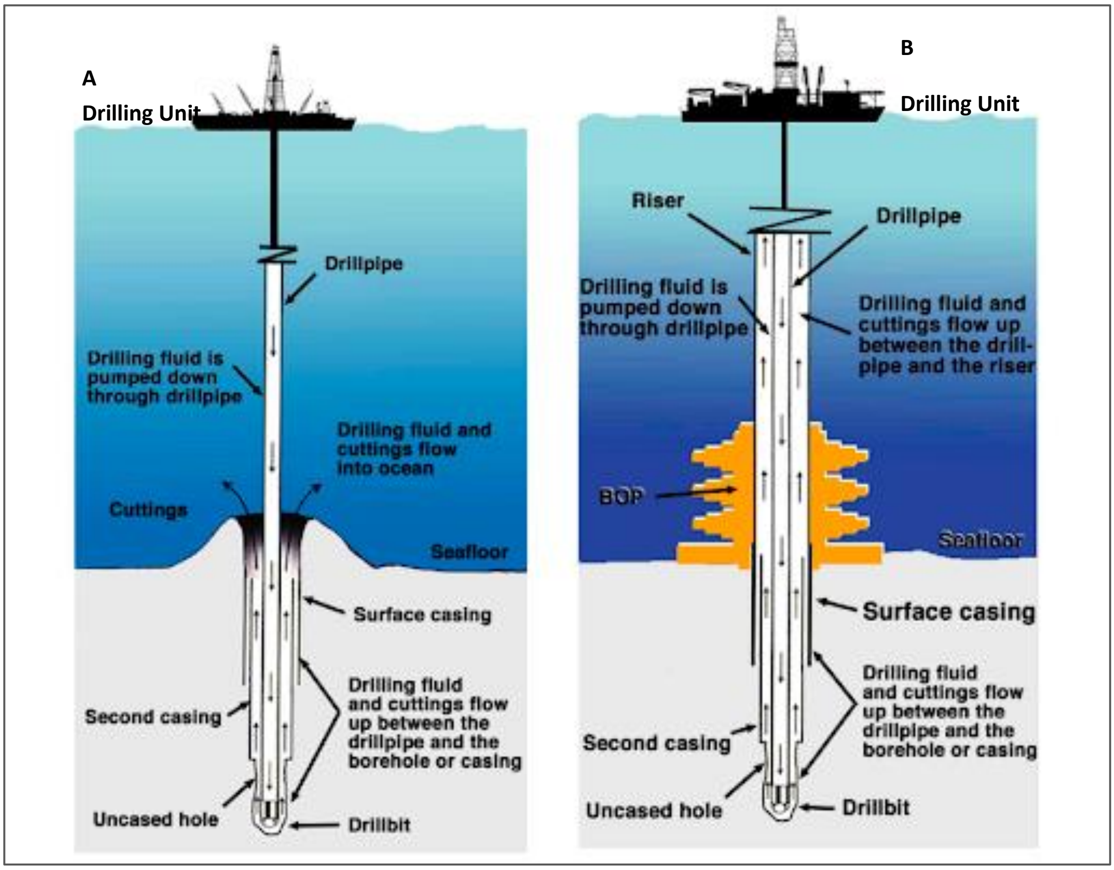


FIGURE 6-12: DRILLING STAGES: (A) RISERLESS DRILLING STAGE; AND (B) RISERED DRILLING STAGE

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

For the proposed wells, the drill and cement option is preferred. It is usually implemented where the nature of the seafloor sediments (hard sediments) necessitate drilling. A hole of diameter 36 to 42 inches will be drilled and the conductor pipe will be run into the hole and cemented into place. The cement returns exit the bottom of the conductor and travel up the annular space between the conductor and the hole with some cement being deposited on the seabed around the conductor pipe.

When the conductor pipe and low-pressure wellhead are at the correct depth, approximately 70 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 inches in diameter will be drilled to a depth of approximately 1 070 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 sections of the hole 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 hole.

<u>Risered Drilling Stage</u>

The risered drilling stage (see 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 (e.g. oil, gas or condensate) 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 required to safely drill the well, 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.

The cuttings are removed from the returned drill mud (as described in Section 6.5.4.2.3) 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 6.5.6.

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 3 570 m below the seafloor with a final hole diameter between of 8.5 and 12 inches and a casing diameter of between 7 and 9.6 inches.

6.5.4.4.3. 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 two 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.

6.5.4.4.4. 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 6-9. It should be noted that several contingency strings are typically made available depending on the geological uncertainties of a well.

TABLE 6-9: NOTIONAL BASE CASE WELL DESIGN AND ESTIMATED DRILLING DISCHARGES

Drill Section	Hole diameter (inches)	Depth of section (m)	Type of drilling fluid used	Mass of drilling fluid discharged (tonnes)	Mass of cuttings released (tonnes)	Drilling fluid and cuttings discharge location
Riserless drilling stage						
1	42”	96	Seawater, viscous sweeps	324	209	At sea bottom
2	26”	773	Seawater & $CaCl_2$ Polymer (PAD mud)	540	877	
Risered drilling stage						
3	17.5”	731	NADF	51.9*	376	10 m below mean sea level
4	12.25”	1 265		44*	319	
5	8.5”	467		7.8*	57	
-	Suspension / Displacement before drilling Section 3	-	$CaCl_2$ Polymer PAD mud	1040	-	1 m above seabed
Totals	-	**3 332**	-	**967.7**	**1 838**	-

Note: * Total quantity of NABM mud discharged including Oil On Cuttings (OOC) @ 6.9% by weight of cuttings (metricT) + Other constituents.

6.5.4.4.5. 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.

6.5.4.5. Well Logging and Testing

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

6.5.4.5.1. 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.

Radioactive sources may be used for certain types of data acquisition. The sources can be mounted in the Wireline and LWD tools, where it generates a radioactive field that interacts with the rocks penetrated at the wellbore. The measured response is directly related to the physical properties of the rocks. Where radioactive sources are used during well testing, they would be of minimal volumes and would be 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. 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.

6.5.4.5.2. 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.

VSP uses a small airgun array (1 200 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 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 250 shots, depending on the well's depth and number of stations being profiled. A typical VSP arrangement is provided in Figure 6-13.

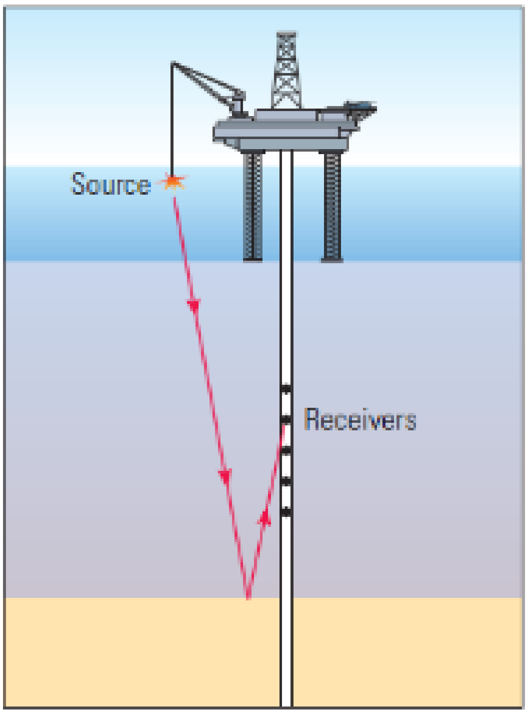


FIGURE 6-13: SCHEMATIC OF A TYPICAL VSP ARRANGEMENT

Source: http://researchgate.net/figure/Rig-Source-Vertical-Seismic-Profile

6.5.4.5.3. Well (Flow) Testing

Well or flow testing is undertaken to determine the economic potential of the discovery before decommissioning where the well is either abandoned (i.e. a well that is permanently sealed with no intension of coming back later) or suspended (i.e. a well that is safely secured with the intention to come back later for further testing or production) (see Figure 6 11). One test would be undertaken per exploration well should a resource be discovered and up to two tests per appraisal well. Each test would take up to 7 days to complete (5 days of build-up and 2 days of flowing and flaring). 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 volume of hydrocarbons (to be burned) and possible associated produced water from the reservoir which could be generated during well testing cannot be reliably predicted due to variations in gas composition, flow rates and water content. Burners are manufactured to ensure emissions are kept to a minimum. The estimated volume of hydrocarbons to be burned cannot be with much accuracy because the actual test requirements can only be established after the penetration of a hydrocarbon-bearing reservoir. However, an estimated 10 000 barrels (bbl) of oil could be flared per test (refer to emissions in Section 6.4.6.4), i.e., up to 20 000 bbl over the two tests associated with an appraisal well. If produced water is generated during well testing, it will be separated from the hydrocarbons (refer to discharges to sea in Section 6.4.6.2).

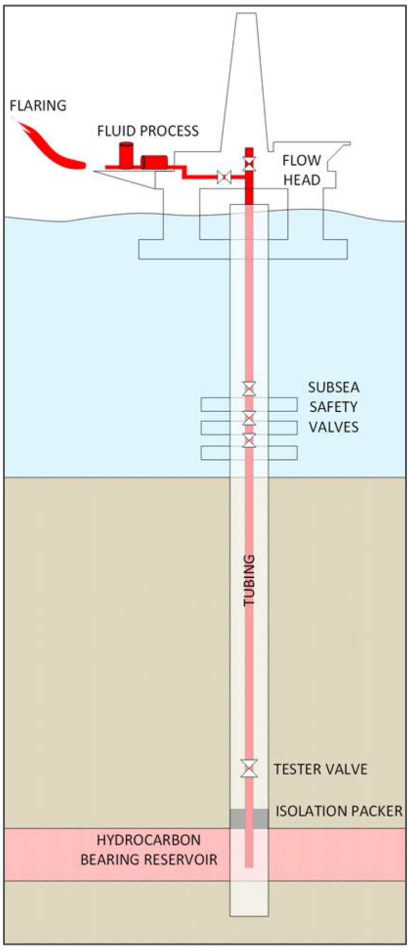


FIGURE 6-14: SCHEMATIC OF A TYPICAL WELL TESTING ARRANGEMENT

SOURCE: TEEPSA

6.5.4.6. 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 exploration 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. 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. Typical cement plug formulation (composition) for plugging and abandonment application in South Africa (based on drilling off the South Coast in Block 11B/12B) is presented in Table 6-10. Cement plug formulation is based on several well conditions and status, viz. depth, fluids in the well, gas or oil reservoir, temperature, etc. As such, it can be adjusted based on the logistics and product availability, without compromising the objectives.

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.

TABLE 6-10: TYPICAL CEMENT PLUG FORMULATION FOR PLUGGING AND ABANDONMENT APPLICATION IN SOUTH AFRICA

Product	Function	Chemical definition
G Neat Cement	Binder	Portland Cement Clinker
Fresh Water	Base fluid	Water
NF-6	Anti-foam agent	Glycol
HALAD-344	Fluid Loss agent	Polymer
HALAD-413	Fluid Loss Agent	Polymer
CFR-3L	Dispersant (friction reducer)	Polymer
HR-4L	Retarder	Lignosulfonate
GasCon-469	Bonding Agent	Silica

* Barite may be used as a weighting material for the spacer. However, it is not generally needed when Newtonian fluids (i.e. a fluid in which the viscous stresses arising from its flow are at every point linearly correlated to the local strain rate) are in the wellbore, in which case the spacer would be water.

6.5.4.7. Resource Requirements

6.5.4.7.1. Personnel

The majority of the workforce will comprise highly specialised skilled staff on the drilling unit and support vessels (180 - 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 in line with TEEPSA’s local content policy and commitments.

6.5.4.7.2. 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.

6.5.4.7.3. Fuel consumption

Marine gas oil (MGO) with 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 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 6-11.

TABLE 6-11: ESTIMATED FUEL CONSUMPTION FOR DRILLING OF ONE WELL

Source		Quantity	Units	No. units	Consumption of marine fuel (Tons)	Kerosene consumption (Tons)
Well Drilling (per well)	1 x Drilling unit	100*	Tonnes / day	120 days	12 000	-
	3 x Supply vessels	27	Tonnes / day	120 days	3 240	-
	Helicopter**	0.64	Tonnes / round trip	68 round trips	-	44
	Total				**15 240**	**44**

* Values provided by TEEPSA, based on previous drilling campaigns.

** Calculations based on 4 round trips per week (i.e., 17 weeks (˜120 days) x 4 = 68 trips per well) of 100 minutes per roundtrip with a consumption of 0.4 tonnes per hour.

6.5.4.7.4. 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 6.5.4.3) 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 of up to 5 000 m^3.

6.5.4.7.5. 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 (see Section 6.5.4.7.5).

6.5.4.7.6. 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 South African legal requirements for waste disposal. Envisaged waste types are summarised in Section 6.5.6.3.

6.5.5. Demobilisation Phase

After the exploration wells have been sealed, tested for integrity and abandoned (see Section 6.5.4.6), the intention is to abandon the wellheads on the seafloor if it is deemed safe to do so based on a risk assessment. The risk assessment criteria will consider factors such as the water depth and use of the area by other sectors (e.g., fishing). Where it is deemed to be safe, the wellhead will be left in place on the seafloor and fitted with an over-trawlable abandonment cap. The over-trawlable cap is estimated to measure approximately 5.2 m x 5.2 m, with a height of 4.4 m (see Figure 6-15).

Monitoring gauges to monitor pressure and temperature through wireless communication with frequencies between the transmitter and the receiver in the 12.75 to 21.25 kHz range may be installed on wells where TEEPSA will return in the future for appraisal / production purposes. The gauges will be placed and remain under the over-trawlable cap. Monitoring gauges will not be installed on exploration wells which are earmarked for abandonment

With the exception of the abandoned wellheads and associated over-trawlable caps, and drilling discharges deposited on the seabed, 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.

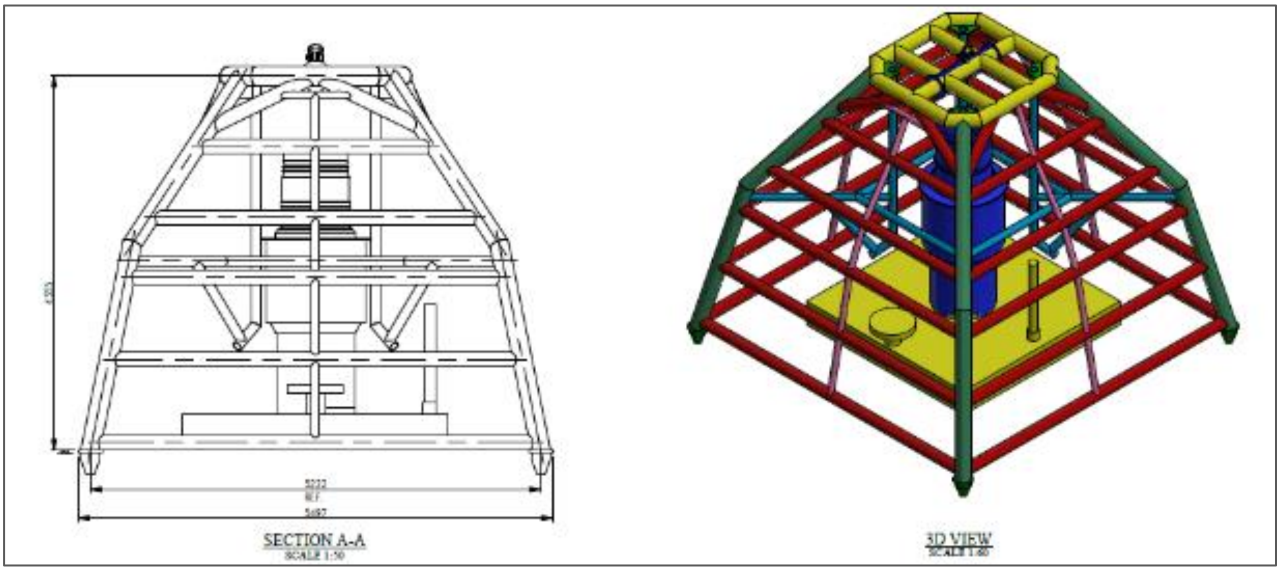


FIGURE 6-15: EXAMPLE OF OVER-TRAWLABLE CAP TO BE INSTALLED ON WELLHEAD ON SEA FLOOR
Source: TEEPSA

6.5.6. Emissions, Discharges and Wastes

6.5.6.1. Introduction

This section presents the main sources of emissions to air, discharges to water and waste generated that will result from survey 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 TEEPSA 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.

6.5.6.2. 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.

6.5.6.2.1. Drilling 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 for most countries (including South Africa) for early exploration development 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, TEEPSA proposes to use the "offshore treatment and disposal" option for their drilling campaign in Block DWOB. The same method was applied and approved for drilling of TEEPSA's other exploration wells in Block 11B/12B (namely Brulpadda and Luiperd wells).

During the riserless drilling stage, all cuttings and WBM will be discharged directly onto the seafloor adjacent to the wellbore. An estimated volume of 1 235 t of cuttings and 5 140 t of drilling fluid will be discharged per well (based on notional depth of 3 332 m) (refer to Table 6-9).

Where NADFs are used (possibly during the risered drilling stage, if WBMs are not able to provide the necessary characteristics), these are sometimes treated onshore and disposed, treated to recover oil and disposed offshore and sometimes re-injected into wells. For the current project TEEPSA, in instances where NADFs are used, cuttings will be treated offshore to reduce oil content to <6.9% Oil On Cutting (OOC) and discharged overboard. An estimated volume of 1 838 t of cuttings and 2 007.7 t of drilling fluid will be discharged per well (based on notional depth of 3 332 m) (refer to Table 6-9). During this drilling stage the circulated drilling fluid will be cleaned and the cuttings discharged into the sea at least 10 m below sea level. The drill cuttings will be treated to reduce their mud content using shakers and a centrifuge as described in Section 6.5.4.2.3.

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 Table 6-9). Discharge is intermittent as actual drilling operations are not continuous while the drilling unit is on location.

Further drilling fluid totalling 1040 tonnes 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 $CaCl_2$ Polymer PAD mud[13].

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 9.2.1.1) for the terms of reference for this study).

6.5.6.2.2. 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 100 m^3 of cement could be discharged onto the seafloor.

6.5.6.2.3. 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 are completely biodegraded in seawater within 28 days.

6.5.6.2.4. Produced Water

If water from the reservoir arises during well flow testing (note: 14.5 m3 was produced during the recent Luiperd well drilling campaign in 2020), 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:
    - if hydrocarbon content is < 30 mg/l, discharged overboard; or
    - if hydrocarbon content is > 30 mg/l, subject to a 2nd treatment or directed to tank prior to transfer to supply vessel for onshore treatment and disposal.

[13] 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)

Reinjection of the produced water may be considered if volumes are large and cannot be managed onboard the drilling unit.

6.5.6.2.5. 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.

6.5.6.2.6. 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.

6.5.6.2.7. 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).

6.5.6.2.8. 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 project 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.

6.5.6.2.9. 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 traveling more than 3 nautical miles (approximately 5.5 km) from land. Disposal overboard without macerating is permitted for moving vessels greater than 12 nautical miles (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.

6.5.6.2.10. 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 South Africa. 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.

6.5.6.2.11. 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.

6.5.6.3. Waste Management

A number of other types of solid wastes generated during the exploration drilling activities will not be discharged at sea, but will be transported to shore for ultimate disposal in Cape Town (where there are general and hazardous landfill sites) and / or Saldanha area (e.g., Vredenberg general landfill site), depending on the location of the onshore logistics base. 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 6-12.

TABLE 6-12: TYPICAL WASTE TYPES

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

6.5.6.4. Air Emissions

The principal sources of emissions to air from the proposed exploration 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) or heavy fuel oil (HFO) with less 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 6-11. Typical combustion products from these unit operations include sulphur oxides (SOx), oxides of nitrogen (NOx, N2O), carbon dioxide (CO2), carbon monoxide (CO), volatile organic compounds (VOC) Methane (CH4) and non-methane volatile organic compounds (NMVOC) and particulate matter (PM). Other minor sources include diffuse emissions from refrigerants.

As noted in Section 6.5.4.5.3, the estimated volume of hydrocarbons to be burned during possible well testing cannot be estimated with much accuracy. However, TEEPSA has estimated that 10 000 bbl oil could be flared per test, i.e. up to 20 000 bbl over the two tests associated with an appraisal well.

The anticipated emissions (GHG and non-GHG) from the proposed project will be investigated in the Climate Change and Air Emissions Impact Assessment (see terms of reference in Section 9.2.2.6).

6.5.6.5. Noise Emissions

The key sources generating underwater noise are vessel propellers (and positioning thrusters), with a contribution from the pontoons (e.g., noise originating from within the pontoons and on-deck machinery), 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.

- Drilling noise: 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 current project.
- 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 in order to maintain a vessel's position. The noise produced by a drilling unit's dynamic positioning systems 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/pontoons 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: If relevant, VSP will be undertaken in order to generate a high-resolution image of the geology in the well's immediate vicinity (see Section 6.5.4.5.2). It is expected to use a small dual airgun array, comprising a system of three 250 cubic inch airguns and three 150 cubic inch airguns with a total volume of 1 200 cubic inches of compressed nitrogen at about 2 000 psi. VSP source will generate a pulse noise level in the 5 to 1 000 Hz range. 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 250 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 6.5.4.5.3): Flaring would produce some air-borne noise above the sea level where flaring is implemented for up to two days of 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.
- 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 project-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 project).

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 9.2.1.3). These modelling results will be used in the assessment of impacts on marine fauna and commercial fisheries.

6.5.6.6. 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.

6.5.6.7. Heat Emissions

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

6.5.7. Emergency Response

TEEPSA has contract agreements with global response companies to use globally advanced capping stacks in the event of a well blow-out. One contract is held with Oil Spill Response Limited (OSRL) based in Saldanha Bay and another with Wild Well Contain (WWC), based in Aberdeen. 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 (see Figure 6 13), while WCC has 15K capping stacks housed in the UK (Aberdeen) and Singapore. These are available for global mobilisation and transportation by sea and/or air in the event of an incident.

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 TEEPSA’s OSCP and BOCP.

TEEPSA motivate that 20 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 have advanced since, and because of, the Deepwater Horizon spill event, which occurred in the Gulf of Mexico in April 2010. 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 and, therefore, well placed for a rapid response to an unplanned event in Block DWOB.

Note: As part of the well response strategy, TEEPSA would also initiate the mobilisation of the Subsea Dispersant Injection (SSDI) kit from OSRL.

FIGURE 6-16: EXAMPLE OF AN OIL SPILL RESPONSE LIMITED CAPPING STACK
Source: https://www.oilspillresponse.com/services/subsea-well-intervention-services/capping

6.6. FINANCIAL PROVISION AND TEEPSA INSURANCES

As required in terms of Section 24P of NEMA, the ESIA Report will include an estimation of the financial provision determination required for the proposed additional exploration activities as per the Regulations pertaining to Financial Provision (GN R1147 of 2015, as amended). Such provision does not include the costs associated with the management of unplanned events such as well blow-out.

In terms of NEMA, the holder(s) of an Exploration Right is accountable for any pollution or degradation of the environment as a result of their activities and would be responsible for funding the response to an oil spill or well blow-out. TEEPSA will have the necessary insurances and global service agreements (e.g., with companies such as OSRL) in place to manage the consequences of any unplanned event. Proof of such insurance and global service agreements would be submitted to the regulator before activities would be allowed to commence.

6.7. PROJECT 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 the project alternatives considered during the project design, which have been considered in the ESIA are summarised in Table 6 12 below. These are presented in alignment with the mitigation hierarchy which prioritises the need for avoidance over minimisation and both of these before consideration of restoration or offsetting requirements. Avoidance measures are typically the most important way of minimising project impacts primarily through site selection or timing of activities. The need to assess alternatives is specifically required where significant impacts of the proposed project activity are predicted to arise.

A comparative assessment of the project alternatives will be provided in the ESIA Report.

TABLE 6-13: SUMMARY OF PROJECT ALTERNATIVES

MH	No.	Alternatives	Description	Comment on Status
Avoidance	**1. Site / location alternatives**			
	1.1	Drill site locations	The specific drill site locations have not been finalised as additional exploration activities still need to be undertaken to determine whether any potential resource targets are located within the Licence Block. However, TEEPSA has confirmed the drill sites will be located within the defined Area of Interest within Block DWOB (see Figure 6-4) –which avoids all MPAs and Ecologically or Biologically Significant Areas (EBSA) (see Figure 7-43).	Since the TEEPSA is the holder and operator of Block DWOB, drilling will be limited to the licence area. TEEPSA is, however, proposing to limit the well drilling to an Area of Interest within the Block (see Figure 6-4). Although the final well locations within the Area of Interest will be based on a number of factors, including further analysis of available data, the geological target and seafloor obstacles, this ESIA assumes that the wells could be drilled anywhere within the Area of Interest. Drill site locations within the Area of Interest 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) in order to assess the worst-case scenarios for oil spill dispersion for an unplanned event or predicted cuttings dispersion. Drill cutting modelling will determine the extent of the cuttings plume, which will be used in the marine ecology study to confirm potential impacts on nearby sensitive areas (CBAs / EBSAs / MPAs) and recommend mitigation measures. Modelling results will be presented in the ESIA Report. These results will be used in the assessment of impacts on marine fauna and commercial fisheries. Should modelling show that drilling discharges may have significant impacts on sensitive areas close to the selected well sites then mitigation would be required to ensure that any proposed well locations are sufficiently set back from these areas.
	1.2	Onshore base locations	While the onshore logistics base is most likely to be located in Cape Town there is	The ESIA will consider the options of an onshore logistics base in Cape Town or Saldanha Bay.

			a possibility the drilling campaign may be operated out of Saldanha Bay depending on logistical requirements.	
	2. Timing / Scheduling Alternatives			
	2.1	Timing of Exploration Drilling	Drilling may have impact on marine fauna, such as whales, dolphins and turtles, that have seasonal occurrences in the Project Area.	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.
	3. No-Go alternative			
	3.1	No-Go option	The No-Go alternative represents the option not to proceed with exploration drilling and represents maintaining the status quo, except for variations from natural causes or other human activities. This leaves the project Area of Influence (see Section 7.1) in its 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. Refer to Section 5.7.
Minimisation	**4. Design and Technology Alternatives**			
	4.1	Number of wells	The proposal is to drill up to ten wells in the licence area.	The ESIA will assess the potential impacts associated with exploration drilling of up to 10 wells in any locations within the Area of Interest for proposed exploration drilling.
	4.2	Drilling unit	Given the high energy oceanographic conditions the semi- submersible vessel is the most feasible option for well drilling for technical safety reasons.	The ESIA assess the potential impacts of a semi-submersible unit. Although the alternative of using a drill ship is not be assessed, as it is not technically feasible, 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. TEEPSA propose 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 South Africa) for early exploration development 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, TEEPSA proposes to use the “offshore treatment and disposal” option for their drilling campaign in Block DWOB. The same method was applied for drilling of their exploration wells in Block 11B/12B (namely Brulpadda and Luiperd wells). Thus, this ESIA will only assess this disposal method. 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.
	4.6	Helicopter flight paths	Helicopter flights between the shore 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 MPAs.
	4.7	Well abandonment	Wellheads can be either be left in place or removed from the seafloor as is standard practice for deep-water wells. Given the water depth over most of the proposed drill area (up to 3 900 m), the preferred option would be to leave the wellheads on the seafloor. Remaining wellheads can pose a hazard to fish trawling if present in the area.	The ESIA will assess the potential impacts and risks related to removing wellheads versus leaving them in place with over trawlable structures with specific consideration of risks to fisheries.
Restoration	**5. Rehabilitation**			
	5.1	Rehabilitation of sea floor	No restoration measures are considered technically feasible or warranted at the drilling depths of between 1 000 m and 3 900 m.	The ESIA will not consider any physical restoration measures for the marine environment. However, an ROV clearance survey will be conducted to confirm the status of seafloor around the well to ensure no dropped objects remain.
Offset	**6. Offsetting**			
	6.1	Biodiversity Offsets	Biodiversity offsets are required for significant residual impacts on biodiversity values of high importance such as unique or threatened ecosystems or priority threatened species, which can include MPAs and EBSAs. The Area of Interest avoids all MPAs, Critical Biodiversity Areas and EBSAs.	Should significant adverse impacts on sensitive marine habitats or species be identified from exploration drilling and other activities in the ESIA, then biodiversity offsets or feasible conservation actions may need to be considered, where appropriate. This will be confirmed by the marine faunal assessment.

7. RECEIVING ENVIRONMENT

The DWOB Licence Block is located within the southern Benguela Region. This chapter provides a description focusing on the West Coast regions and the physical, biological and socio-economic environment within the Project's area of influence. The extent of the effect of a proposed project activity on a particular physical, biological or social resource will vary and is termed the area of influence. An understanding of the environmental and social context and sensitivity within which the proposed project activities would be located is important for the consideration and assessment of the potential impacts.

7.1. PROJECT'S AREA OF INFLUENCE

The area of influence of the proposed exploration project 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:

- **Direct area of influence (normal operations)** (see Figure 7-1) will be confirmed based on the results of the underwater noise modelling and marine ecology / fisheries assessments.
    - Block DWOB and specifically the Area of Interest for proposed exploration drilling within which project activities will take place (includes a 20 km buffer around the area of interest). These include drilling operations, refuelling at sea and maintenance of an operational safety zone during drilling;
    - Cape Town (port / harbour) as the most likely location for the onshore logistics base for the supply of equipment and materials, waste management and accommodation for staff. Saldanha Bay could also be considered as an alternative for the onshore base;
    - Airspace between airport and the drilling unit for helicopter-based crew changes;
    - Marine traffic routes between Cape Town (or possibly Saldanha) and the drilling unit; and
    - Indirect impacts on ecosystem services, such as commercial fishing areas, marine mammals, etc. due to underwater noise and safety exclusion zone which may extend beyond the Area of Interest.
- **Indirect area of influence (unplanned events)** will be confirmed based on the oil spill modelling results:
    - The coastal and nearshore region located landward of Block DWOB and between approximately Alexander Bay and Saldanha Bay on the West Coast that could be affected in the unlikely event of a well blow-out.

7.2. GEOPHYSICAL CHARACTERISTICS

7.2.1. Bathymetry

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (see Figure 7-2). The nature of the shelf break varies off the South African West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate inshore[14] area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m.

[14] As per the 2019 National Biodiversity Assessment inshore is defined as the area influenced by wave energy and light, with the fair weather wave base at a depth ranging between -30 to -50 m used to determine the outer limits of this zone in South Africa. Offshore areas are those that extend beyond this zone.

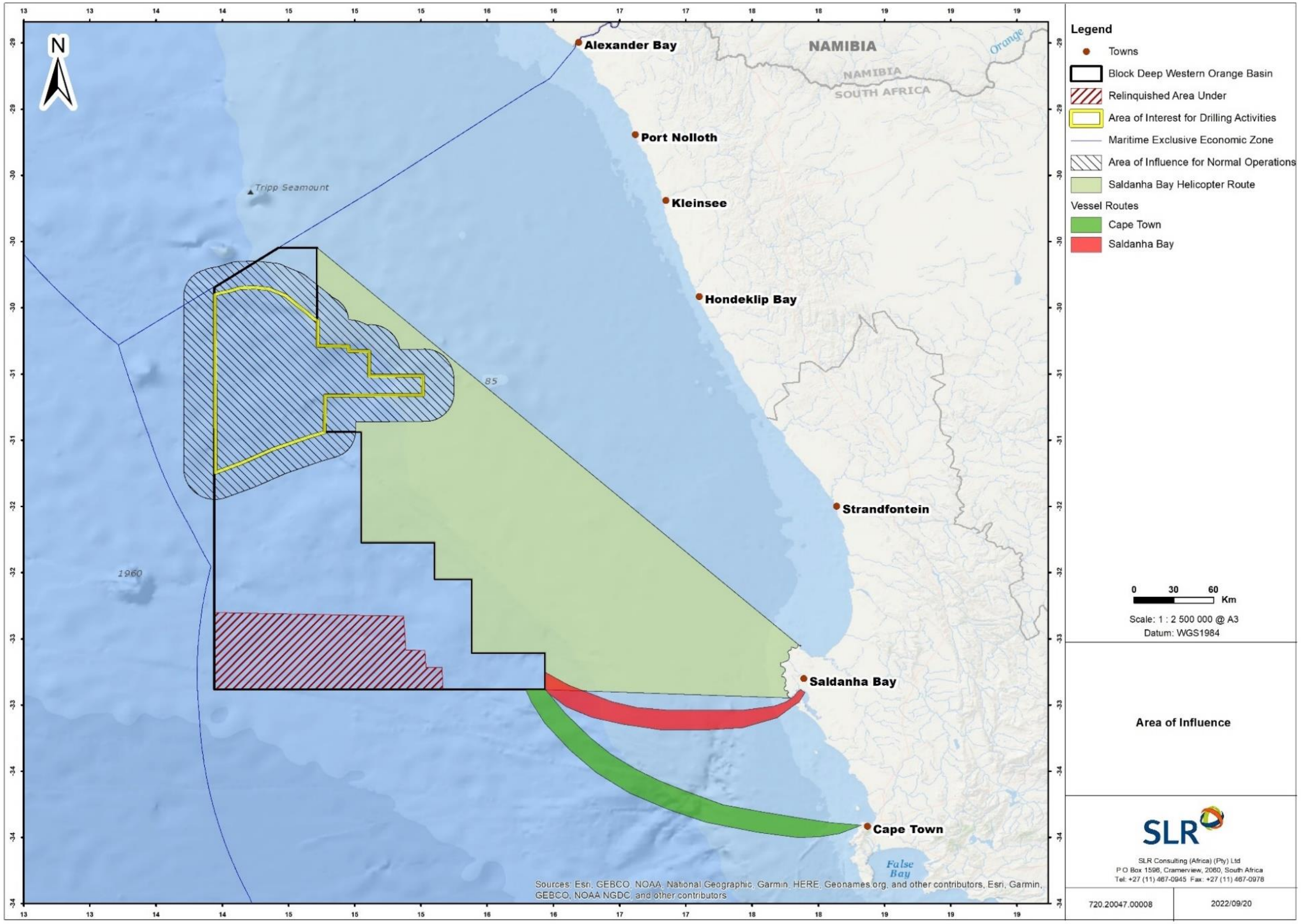


FIGURE 7-1: AREAS OF INFLUENCE DURING NORMAL OPERATIONS

The middle (-50 to -150 m) and outer shelf (-150 to -350 m) normally lacks relief and slopes gently seawards reaching the shelf edge at a depth of between -350 to -500 m (Sink *et al.* 2019). The three shelf zones characterising the West Coast are recognised following both abiotic (de Wet 2013) and biotic (Karenyi *et al.* 2016) patterns.

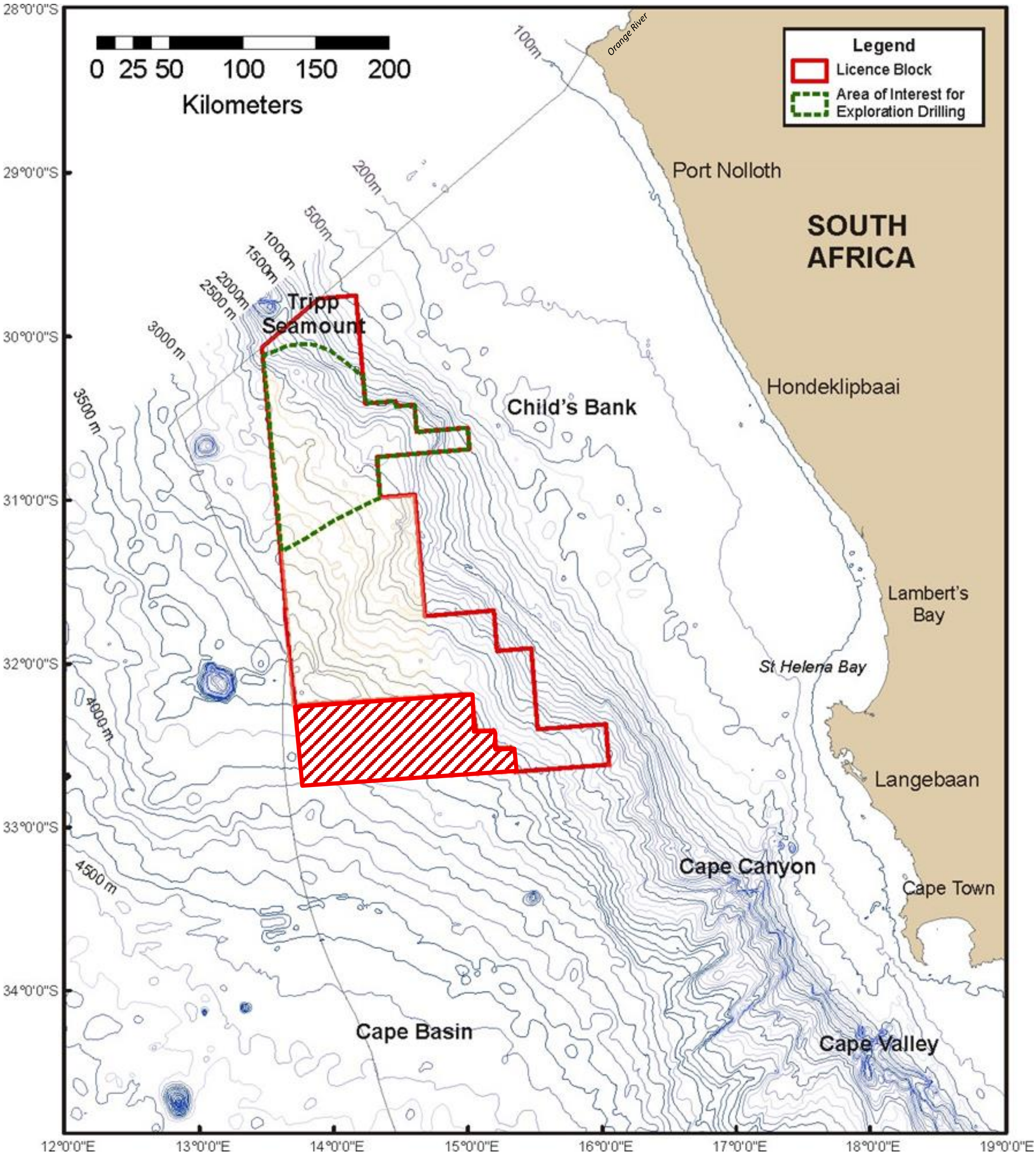


FIGURE 7-2: MAP INDICATING LOCATION OF THE DEEP WESTERN ORANGE BASIN LICENCE AREA IN RELATION TO BATHYMETRIC FEATURES OFF THE WEST COAST.

Note: Places mention in the text are also indicated.

Banks on the continental shelf include the **Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, situated approximately 150 km offshore at about 31°S, and approximately 75 km east of the licence block.** Child's Bank is a major feature on the West Coast margin and is the only known submarine bank within South Africa's Exclusive Economic Zone (EEZ), rising from a depth of 350 - 400 m water to less than 200 m depth at its shallowest point. It is a rounded, flat topped, sandy plateau, which lies at the edge of the continental shelf. The bank has a gentle northern, eastern and southern margin but a steep, slump-generated outer face (Birch & Rogers 1973; Dingle *et al.* 1983; de Wet 2013). At its southwestern edge, the continental slope drops down steeply from 350 to -1 500 metres below sea level (mbsl) over a distance of less than 60 km (de Wet 2013) creating precipitous cliffs at least 150 m high (Birch & Rogers 1973). The bank consists of resistant, horizontal beds of Pliocene sediments, similar to that of the Orange Banks, and represents another perched erosional outlier formed by Post-Pliocene erosion (Dingle 1973; Siesser *et al.* 1974). The top of this feature, has been estimated to cover some 1 450 km^2 (Sink *et al.* 2012).

Tripp Seamount, a geological feature **approximately 25 km to the north of the licence block**, rises from the seabed at 1 000 mbsl to a depth of 150 mbsl. It is a roughly circular feature with a flat apex that drops steeply on all sides.

A further two **unnamed seamounts are situated approximately 50 km to the west of the western boundary of the licence block** rising from depths of 3 000 and 3 500 mbsl.

Further underwater features in the vicinity of the **licence block include the Cape Canyon and Cape Point Valley, which lie approximately 120 km and 260 km to the southeast of the southern boundary of the licence block, respectively** (Simpson & Forder 1968; Dingle 1986; Wigley 2004; Wigley & Compton 2006). The Cape Canyon was discovered in the 1960s. The canyon head forms a well-developed trench on the continental shelf, 100 m deep and 4 km wide (Wigley 2004; Wigley & Compton 2006). South of Cape Columbine the canyon becomes progressively narrower and deeper. Adjacent to Cape Town in a water depth of 1 500 mbsl, the canyon has a local relief in the order of 500 - 800 m (Simpson & Forder 1968; Dingle *et al*. 1987). The Cape Canyon has a longitudinal extent of at least 200 km and can be traced to a water depth of at least 3 600 m (Dingle 1970), where the topography of the distal end is rugged and complex (Dingle *et al*. 1987). Sediments in the canyon are predominately unconsolidated sands and muds. The canyon serves as an upwelling feature funnelling cold, nutrient-rich South Atlantic Central Water up the canyon slope providing highly productive surface waters which in turn power feeding grounds for cetaceans and seabirds (Filander *et al*. 2018; www.environment.gov.za/dearesearchteamreturnfromdeepseaexpedition).

The Cape Point Valley, which lies about 70 km south of the Cape Peninsula, is another large canyon breaching the shelf. This canyon has sustained the highest fishing effort and catches in the South African demersal trawl fishery for almost a century (www.marineprotectedareas.org.za/canyons).

Using high-resolution bathymetry collected between 315 – 3 125 m depth, Palan (2017) identified numerous new and previously undocumented submarine canyon systems, most of which are less extensive than the Cape Canyon and Cape Point Valley and do not incise the shelf (Figure 7-3). Canyon morphology was highly variable and included linear, sinuous, hooked and shelf-indenting types. Large fluid seep/pockmark fields of varying morphologies were similarly revealed situated in close proximity to the sinuous, hooked and shelf-indenting canyon types thereby providing the first evidence of seafloor fluid venting and escape features from the South African margin. These pockmarks represent the terminus of stratigraphic fluid migration from an Aptian gas reservoir, evidenced in the form of blowout pipes and brightened reflectors. This area lies well to the southeast of the licence block.

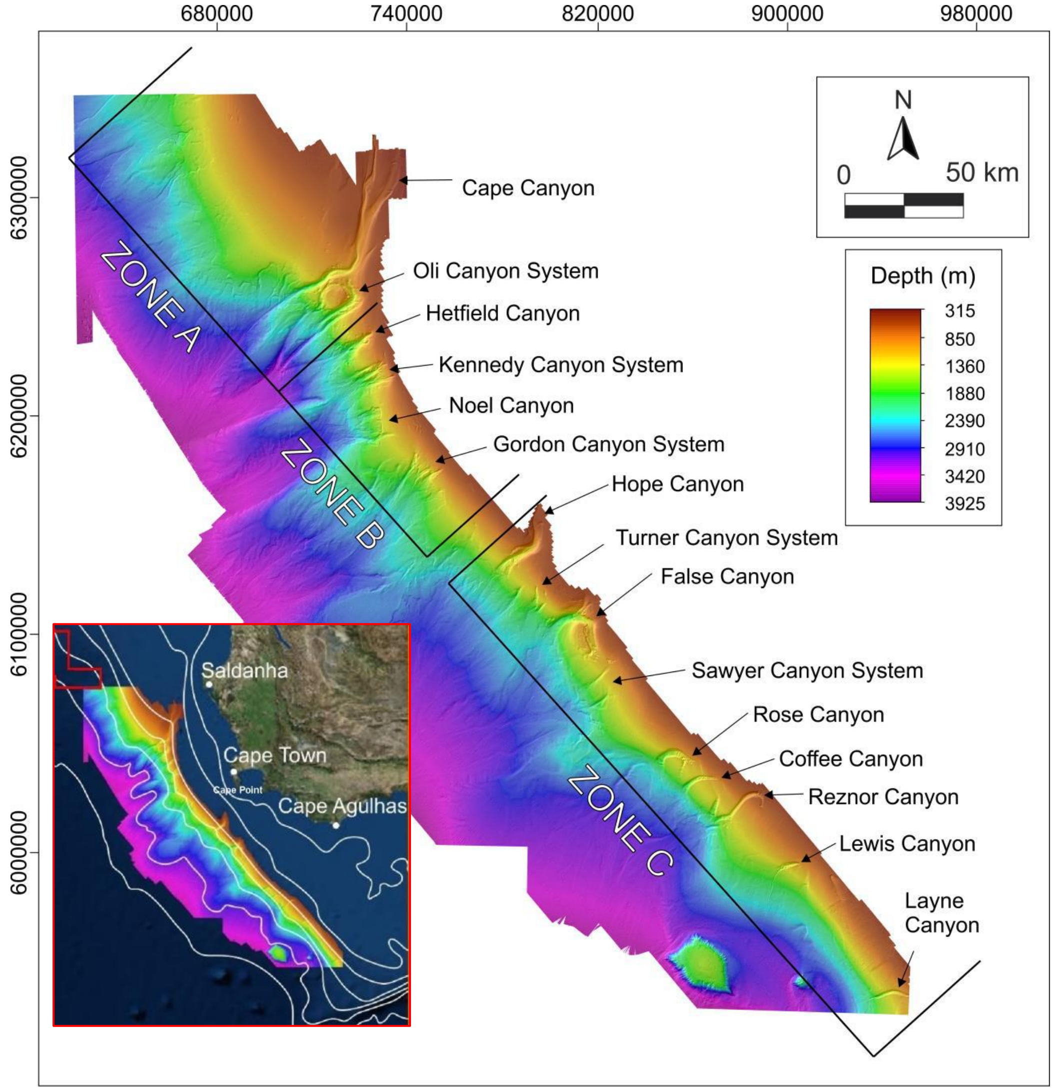


FIGURE 7-3: SUBMARINE CANYON DOMAINS OF THE SOUTH WESTERN CAPE CONTINENTAL MARGIN IDENTIFIED BY PALAN (2017).

Note: Insert shows the locality of the study area in relation to the DWOB Licence Block
Adapted from Palan 2017

7.2.2. Coastal and Inner-shelf Geology and Seabed Geomorphology

Figure 7-4 illustrates the distribution of seabed surface sediment types off the South African north-western coast. The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Dingle *et al.* 1987; 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 ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the innershelf shelf between the Orange River and St Helena Bay (Birch *et al.* 1976). Further offshore **and within the licence block, sediment is dominated by muds and sandy muds, with the northern portion of the licence block having muddy sands.** The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

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

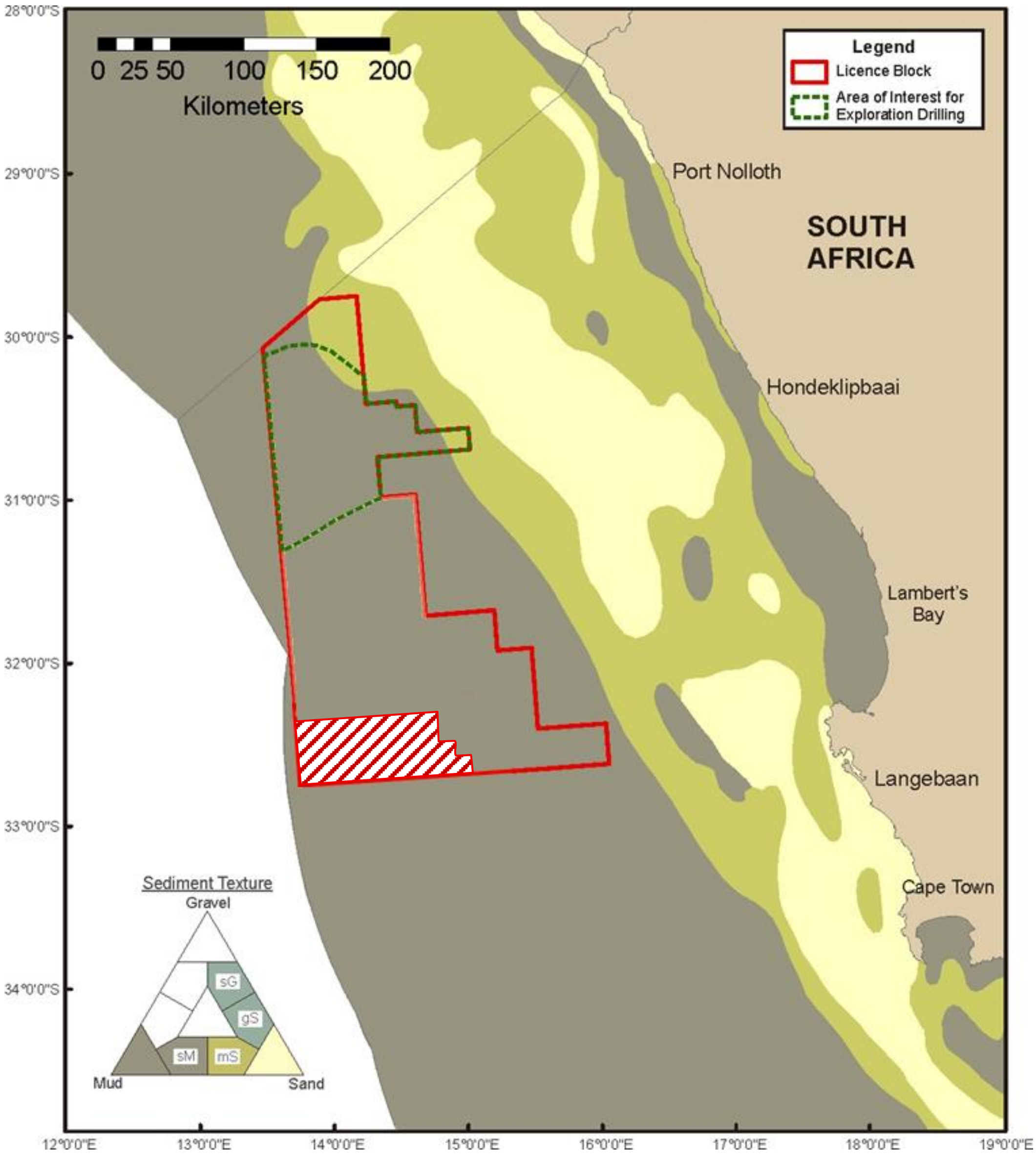


FIGURE 7-4: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO SEDIMENT DISTRIBUTION ON THE CONTINENTAL SHELF OF THE SOUTH-WEST COAST

Adapted from Rogers 1977

The benthic habitat types of the West Coast were classified and mapped in detail through the 2011 National Biodiversity Assessment (NBA) (Sink *et al.* 2012a). These were refined in the 2018 NBA (Sink *et al.* 2019) to provide substratum types (Figure 7-5).

In the licence block the water depth ranges from 400 m to nearly 3 900 m. The Southeast Atlantic Unclassified Slopes and Southeast Atlantic Unclassified Abyss substrata dominate across the area. The shelf inshore of the licence block boasts a diversity of substrata (Sink *et al.* 2019).

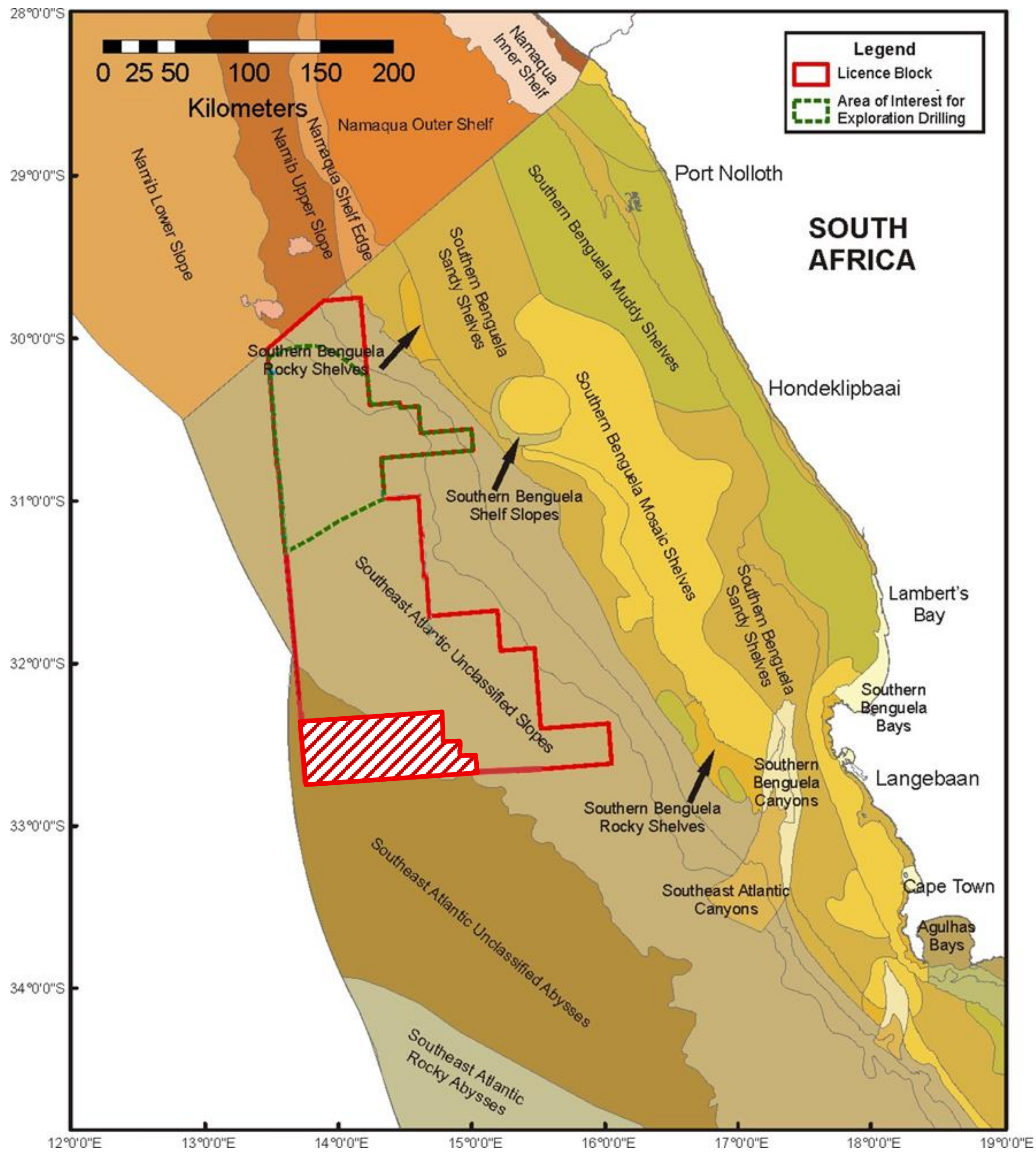


FIGURE 7-5: BLOCK DWOB AND AREA OF INTEREST IN REALTION TO THE DISTRIBUTION OF SEABED SUBSTRATUM TYPES ALONG THE SOUTH-WEST COAST

Adapted from Sink *et al.* 2019

7.2.3. Sedimentary Phosphates

Phosphorite, or phosphate-rich rock, is defined as sedimentary rock typically containing between 5%-20% phosphate. In the marine environment, it occurs either as a nodular hard ground capping of a few metres thick or as series of unconsolidated sediments (Morant 2013). Several types of sedimentary phosphates occur offshore and onshore in South Africa, the largest of which is the diagenetic replacement resource on the Agulhas Bank. These replacement phosphate resources occur as near-continuous 'pavements' or cappings of limestones at depths between 200 m and 500 m on the continental shelf between Cape Agulhas and Cape Recife, covering an approximate area of 21 500 km^2. Further sporadic phosphate mantles over the continental shelf are known to occur from Lamberts Bay, north to the mouth of the Orange River (Figure 7-6).

The phosphate-rich rocks on the Agulhas Bank are estimated to have an average P_2O_5 content of 16.2%. With an area of 35 000 km^2, an average thickness of 0.5 m, the Agulhas Bank offshore phosphate deposits are estimated to contain in the order of 5 000 million tons of P_2O_5 (Birch 1990).

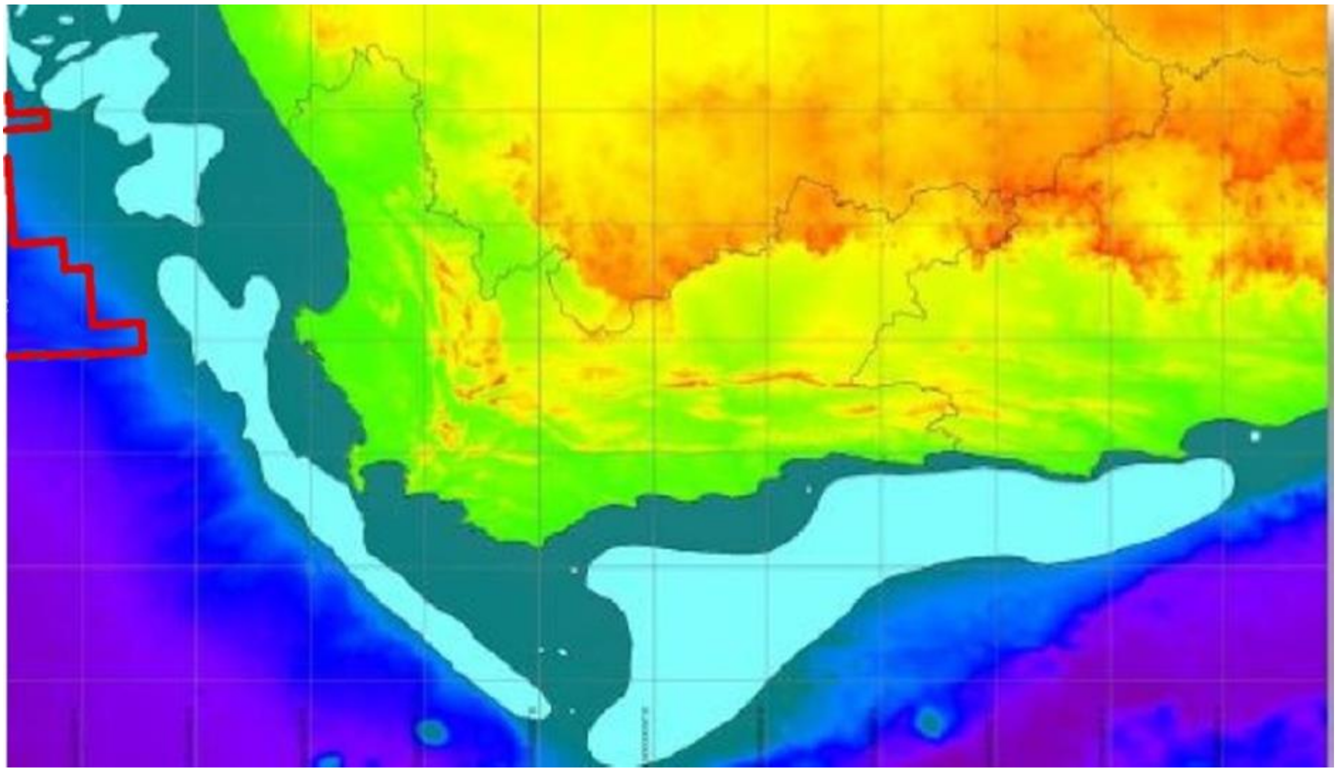


FIGURE 7-6: BLOCK DWOB IN RELATION TO THE DISTRIBUTION OF PHOSPHATE HARD GROUNDS (CYAN/ LIGHT BLUE)

Adapted from Morant 2013

7.3. BIOPHYSICAL CHARACTERISTICS

7.3.1. Climate

The climate along the West Coast of South Africa transitions from the Mediterranean winter (May to August) rainfall climate in the Western Cape, which occurs between Cape Town and Saldanha Bay, to arid conditions in Namaqualand to the north. Average minimum and maximum temperatures at Cape Towns are 15 and 26°C, respectively, in summer and approximately 7 to 18°C in winter. At Cape Columbine (between Saldanha Bay and

St Helena Bay), average minimum and maximum temperatures are similar at approximately 13°C and 26.5°C in summer and approximately 7°C and 17.5°C in winter (CSAG 2020; BSL 2021).

Variability in precipitation is also influenced by the El Niño Southern Oscillation (ENSO). ENSO events are caused by changes in the temperature of the surface waters of the tropical Pacific Ocean and are characterised by two opposing patterns: El Niño and La Niña. During El Niño, unusual warming of the sea surface temperature occurs due to the weakening of the trade winds, which causes weakening of upwellings and changes in rainfall and temperature. South Africa experiences hotter and drier weather during the El Niño phase, while the La Niña brings cooler and wetter conditions (BSL 2021).

7.3.2. Wind Patterns

Winds are one of the main physical drivers of the nearshore 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. Consequently, physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure field over the subcontinent. The south Atlantic anticyclone is a perennial feature that forms part of a discontinuous belt of high-pressure systems which encircle the subtropical southern hemisphere. This undergoes seasonal variations, being strongest in the austral summer, when it also attains its southernmost extension, lying south west and south of the subcontinent. In winter, the south Atlantic anticyclone weakens and migrates north-westwards.

These seasonal changes result in substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system, and the associated series of cold fronts, moves northwards in winter, and southwards in summer. The strongest winds occur in summer (October to March), during which winds blow 98% of the time (PRDW 2013), with a total of 226 gales (winds exceeding 18 m/s or 35 kts) being recorded over the period (CSIR 2006). **Virtually all winds in summer come from the south to south-southeast** (Figure 7-7). These southerlies occur over 40% of the time, averaging 20 – 30 kts and reaching speeds in excess of 60 kts, bringing cool, moist air into the coastal region and driving the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer. The winds also play an important role in the loss of sediment from beaches. These strong equatorwards winds are interrupted by the passing of coastal lows with which are associated periods of calm or north or northwest wind conditions. These northerlies occur throughout the year, but are more frequent in winter.

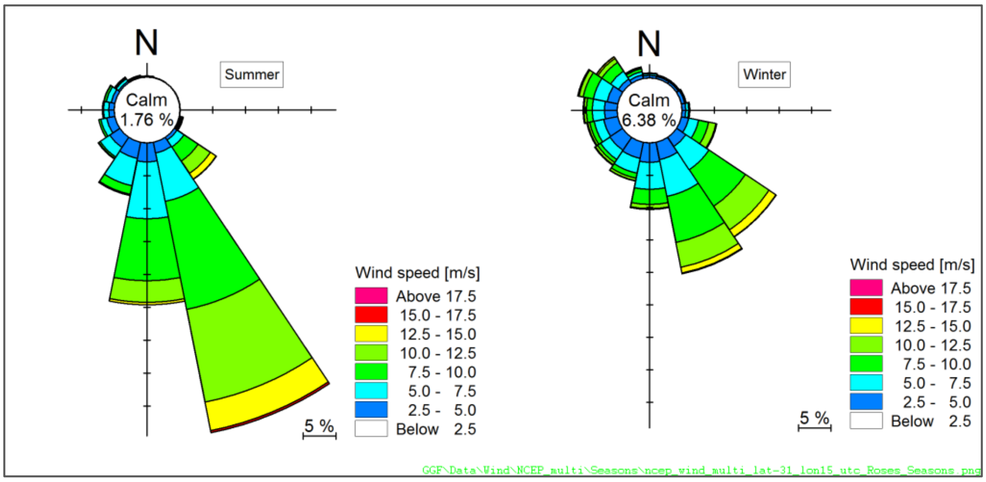


FIGURE 7-7: WIND SPEED VS. WIND DIRECTION FOR NCEP HIND CAST DATA AT LOCATION 15°E, 31°S
Source: PRDW

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (Figure 7-7). This 'reversal' from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

During autumn and winter, catabatic, or easterly 'berg' winds can also occur. These powerful offshore winds can exceed 50 km/h, producing sandstorms that considerably reduce visibility at sea and on land. Although they occur intermittently for about a week at a time, they have a strong effect on the coastal temperatures, which often exceed 30°C during 'berg' wind periods (Shannon & O'Toole 1998). The winds also play a significant role in sediment input into the coastal marine environment with transport of the sediments up to 150 km offshore (Figure 7-8).

7.3.3. Large-Scale Circulation and Coastal Currents

Licence Block DWOB is primarily located within the Benguela Current with the North East Portion infringing on the Bottom Poleward Current (Figure 7-9). The southern African West Coast is strongly influenced by the Benguela Current (Figure 7-10). Current velocities in continental shelf areas generally range between 10–30 cm/s (Boyd & Oberholster 1994), although localised flows in excess of 50 cm/s occur associated with eddies (PRDW 2013). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. This results in considerable variation in current speed and direction over the domain (PRDW 2013). In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The surface flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983). Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Current speeds decrease with depth, while directions rotate from predominantly north-westerly at the surface to south-easterly near the seabed. Near bottom shelf flow is mainly poleward with low velocities of typically <5 cm/s (Nelson 1989; PRDW 2013). The poleward flow becomes more consistent in the southern Benguela.

FIGURE 7-8: DWOB (RED POLYGON) IN RELATION TO AEROSOL PLUMES OF SAND AND DUST DUE TO A 'BERG' WIND EVENT ON THE SOUTHERN AFRICAN WEST COAST IN OCTOBER 2019

Image Source: LandWaterSA

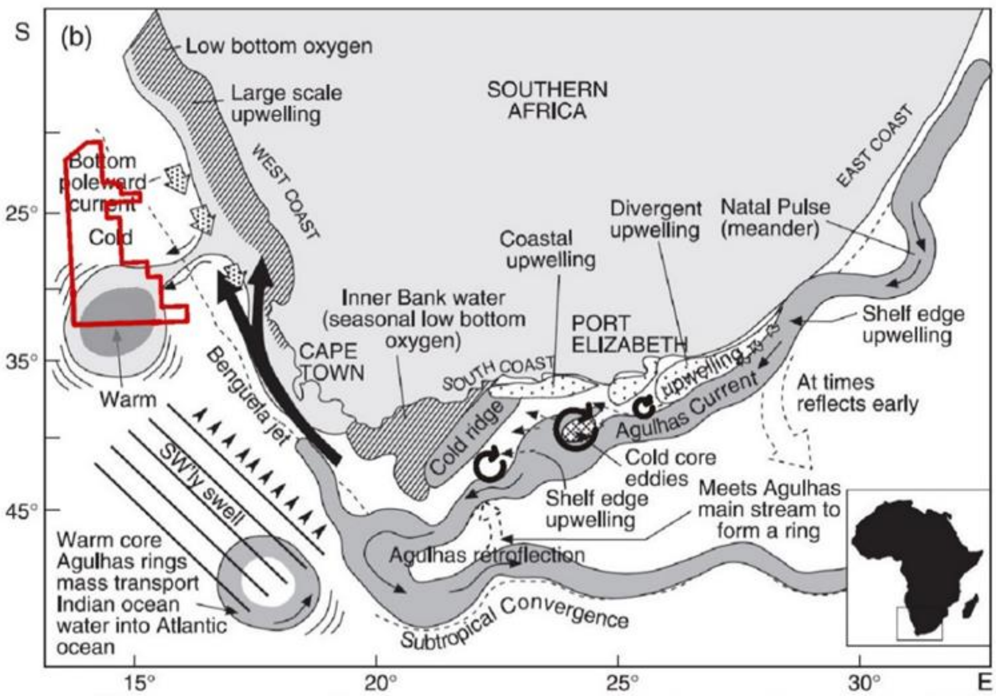


FIGURE 7-9: OCEANOGRAPHIC CURRENTS ON THE SOUTH AFRICAN COAST IN RELATION TO THE APPROXIMATE LOCATION OF LICENCE BLOCK DWOB

Source: Adapted from: Roberts, 2005

The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Taunton-Clark 1985) (Figure 7-10). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. **The licence area is located well offshore of these upwelling events.**

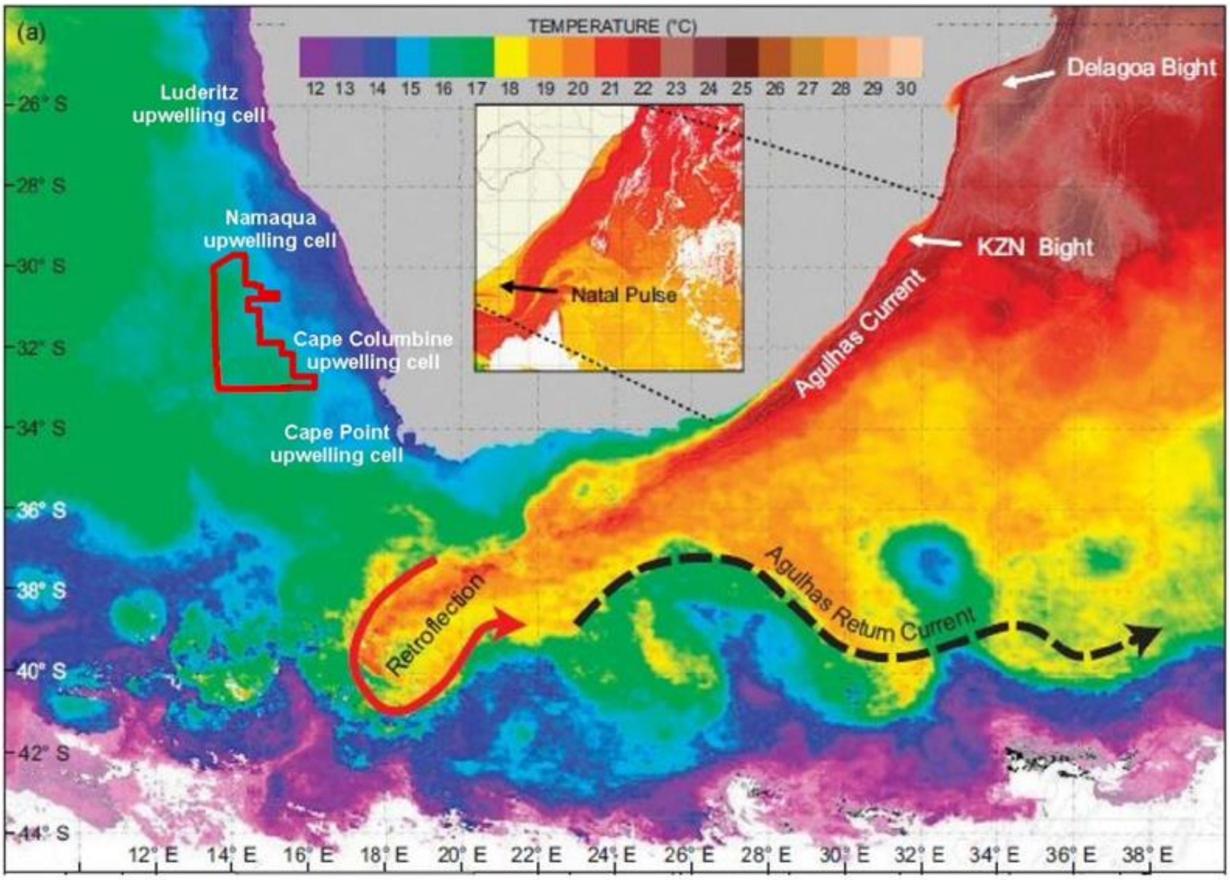


FIGURE 7-10: LICENCE BLOCK DWOB AND AREA OF INTEREST IN RELATION TO SEA-SURFACE TEMPERATURE
Adapted from Roberts *et al.* 2010

Where the Agulhas Current passes the southern tip of the Agulhas Bank (Agulhas Retroflection area), it may shed a filament of warm surface water that moves north-westward along the shelf edge towards Cape Point, and Agulhas Rings, which similarly move north-westwards into the South Atlantic Ocean. These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantarctic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species (Best 2007**). The licence area lies offshore of 15°E on the outer edge of these features.**

7.3.4. Waves and Tides

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds characteristic of the region.

The wave regime along the southern African west coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the S and SSW direction**. Winter swells are strongly dominated by those from the S and SSW, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.**

In comparison, **summer swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter.** There is also a slightly more pronounced southerly swell component in summer. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves (CSIR 1996). These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves.

In common with the rest of the southern African coast, **tides are semi-diurnal diurnal** (i.e., two equally high and equally low tides during a day), with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods. **Tidal influence in the offshore regions of Block DWOB will be minimal**.

7.3.5. Water

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the study area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinities range between 34.5‰ and 35.5‰ (Shannon 1985).

Seawater temperatures on the continental shelf of the southern Benguela typically vary between 6°C and 16°C. Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore. South and east of Cape Agulhas, the Agulhas retroflection area is a global "hot spot" in terms of temperature variability and water movements.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey *et al.* 1985; Chapman & Shannon 1985).

Nutrient concentrations of upwelled water of the Benguela system 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). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

7.3.6. Upwelling & Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & 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 (jackass 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. **The Deep Western Orange Basin Block is located well offshore (>100 km) of these upwelling events and waters are expected to be comparatively warm and nutrient poor (see Figure 7-10).**

7.3.7. Organic Inputs

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s the Benguela region supported biomasses of 76.9 tons/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone (Shannon *et al.* 2003). Thirty six percent (36%) of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the **high organic content of the muds in the region.** As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters (see Section 7.3.8).

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (Shannon & Pillar 1985; Pitcher 1998; Pitcher & Calder 2000). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water. **HABs, being associated primarily with upwelling cells, may occur in the northern inshore portions of the Area of Interest for proposed drilling.**

7.3.8. Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (e.g., Visser 1969; Bailey *et al.* 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches, there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al.* 2000). The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. **Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.**

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al.* 2000). The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by phytoplankton blooms is the main cause for these mortalities and walkouts. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures are high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

7.3.9. Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, the PIM loading in nearshore waters is strongly related to natural inputs from the Orange River or from 'berg' wind events. Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 - 26 million tons/yr (Rogers 1979). 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999). For example, a 'berg' wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20 000 km^2.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al.* 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/ℓ, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured PIM concentrations ranged from 14.3 mg/ℓ at Alexander Bay just south of the mouth (Zoutendyk 1995) to peak values of 7 400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood (Bremner *et al.* 1990).

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorwards. 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).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake *et al.* 1985; Ward 1985). Data from a Waverider buoy at Port Nolloth have indicated that 2-m waves are capable of re-suspending medium sands (200 µm diameter) at ~10 m depth, whilst 6-m waves achieve this at ~42 m depth. Low-amplitude, long-period waves will, however, penetrate even deeper. Most of the sediment shallower than 90 m can therefore be subject to re-suspension and transport by heavy swells (Lane & Carter 1999).

Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs. The waters in the Deep Western Orange Basin Block are thus expected to be comparatively clear.

7.3.10. Natural Hydrocarbon Seeps

Petroleum discharges, both from natural seeps at the seabed and discharges occurring during the production and transport of petroleum are a common source of toxic substances in marine ecosystems (NRC 2003a). Satellite imagery analysis was used by TEEPSA (in 2021) in an oil slicks detection study of the western offshore part of South Africa. The large radar dataset covering 12 years included medium and high resolution 864 ENVISAT (2002 - 2012) and 1 864 SENTINEL (2015 - 2021) radar images, respectively.

The following was concluded from the oil slicks detection study:

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

7.4. THE BIOLOGICAL ENVIRONMENT

7.4.1. Introduction

Biogeographically, **the study area falls into the cold temperate Namaqua Bioregion, which extend from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine** (Emanuel *et al.* 1992; Lombard *et al.* 2004). **The Deep Western Orange Basin Block falls primarily into the Southwest Atlantic Deep Ocean Ecoregion** (Sink *et al.* 2019) (Figure 7-11). The coastal, wind-induced upwelling characterising the Western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, deepwater reefs and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed exploration activities.

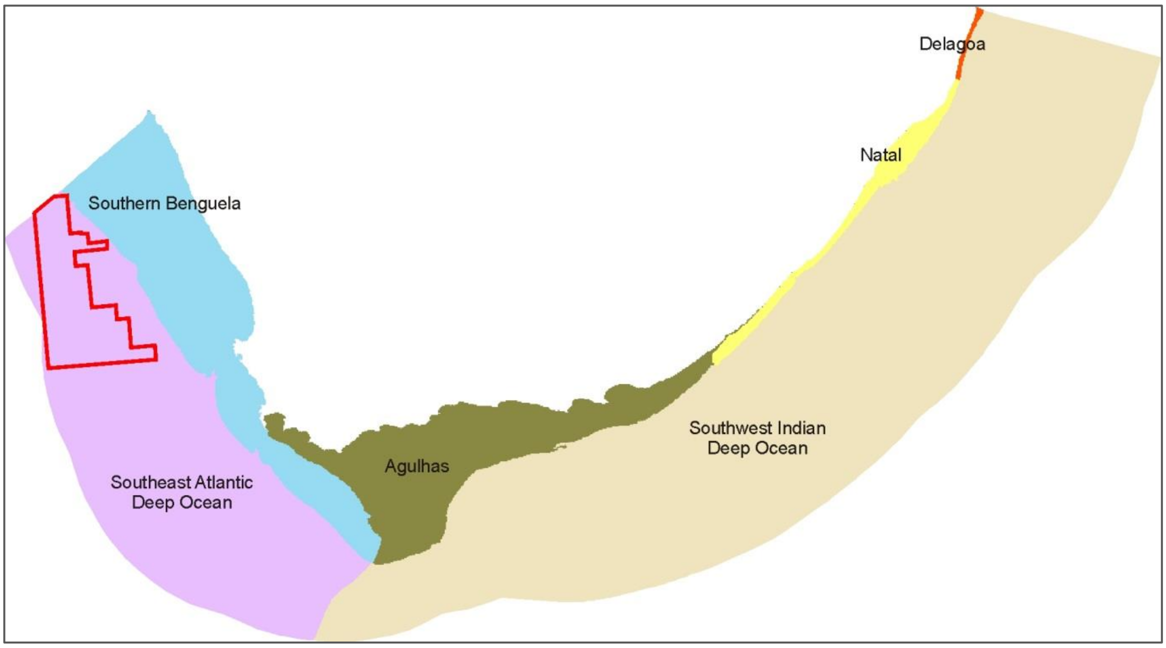


FIGURE 7-11: THE DEEP WESTERN ORANGE BASIN BLOCK (RED OUTLINE) IN RELATION TO THE INSHORE AND OFFSHORE ECOREGIONS OF THE SOUTH AFRICAN COAST

Adapted from Sink *et al*. 2019

7.4.2. Demersal Communities

7.4.2.1. Benthic Invertebrate Macrofauna

The seabed communities in the Deep Western Orange Basin Block lie within the Namaqua sub-photic and continental slope biozones, which extend from a 30 m depth to the shelf edge, and beyond to the lower deepsea slope, respectively. The benthic habitats of South Africa were mapped as part of the 2018 National Biodiversity Assessment (Sink *et al.* 2019) to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (Figure 7-12) and assigned an ecosystem threat status based on their level of protection (Figure 7-13). **The Licence Area is characterised by a limited variety of ecosystem types, with the majority of the Deep Western Orange Basin Block characterised by Southeast Atlantic Lower Slope habitat, with some representation by Southeast Atlantic Mid and Upper Slope, and Cape Basin Abyss habitats.**

The Area of Interest for drilling, coincides with three ecosystem types, namely:

- **Southeast Atlantic Lower Slope** - Unknown seabed type on the lower slope of Southeast Atlantic with a depth range of -1 800 m to -3 500 m.
- **Southeast Atlantic Mid Slope** - Unknown seabed type on the mid slope in the Southeast Atlantic ecoregion spanning depths of -1 000 m to -1 800 m.
- **Southeast Atlantic Upper Slope** - Unknown seabed type and associated water column on the upper slope (-500 m to -1 000 m) in the Southeast Atlantic ecoregion.

The benthic biota of unconsolidated marine sediments constitutes invertebrates that live on (epifauna) or burrow within (infauna) the sediments, and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). Numerous studies have been conducted on southern African West Coast continental shelf benthos, mostly focused on mining, pollution or demersal trawling. These studies, however, concentrated on the continental shelf and nearshore regions, and consequently the benthic fauna of the outer shelf and continental slope (beyond ~450 m depth) are very poorly known. This is primarily due to limited opportunities for sampling as well as the lack of access to Remote Operated Vehicles (ROVs) for visual sampling of hard substrata.

To date very few areas on the continental slope off the West Coast have been biologically surveyed (Sink *et al*. 2019; Harris *et al.* 2022). Although sediment distribution studies (Rogers & Bremner 1991) suggest that the outer shelf is characterised by unconsolidated sediments (see Figure 7-4), recent surveys conducted between 180 m and 480 m depth offshore of the Northern Cape coast revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification (Karenyi unpublished data).

There have also to date been no studies examining connectivity between slope, plateau or abyssal ecosystems in South Africa and there is thus limited knowledge on the benthic biodiversity of all three of these broad ecosystem groups in South African waters (Sink *et al.* 2019). There is no quantitative data describing bathyal ecosystems in South Africa and hence limited understanding of ecosystem functioning and sensitivity (Anderson & Hulley 2000; Harris *et al.* 2022**). Due to the lack of information on benthic macrofaunal communities beyond the shelf break, no description can be provided for the offshore portions of the Licence Area.** The description below for areas on the continental shelf, offshore of the Northern Cape coast is drawn from recent surveys by Karenyi (2014), Duna *et al.* (2016), Mostert *et al.* (2016), and Giwhala *et al.* (2018, 2019).

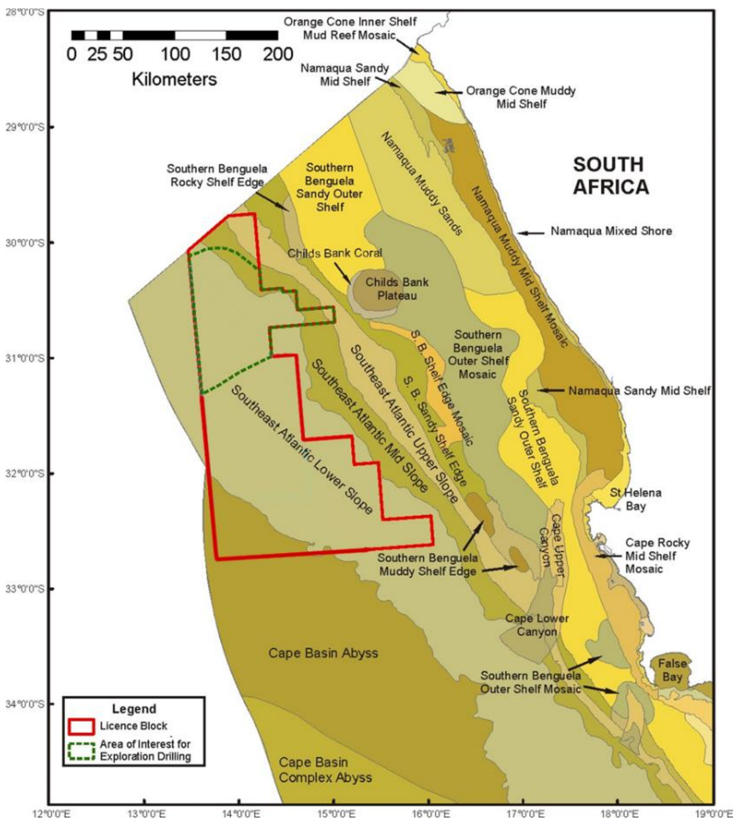


FIGURE 7-12: DWOB BLOCK IN RELATION TO ECOSYSTEM TYPES ALONG THE WEST COAST

Adapted from Sink *et al.* 2019

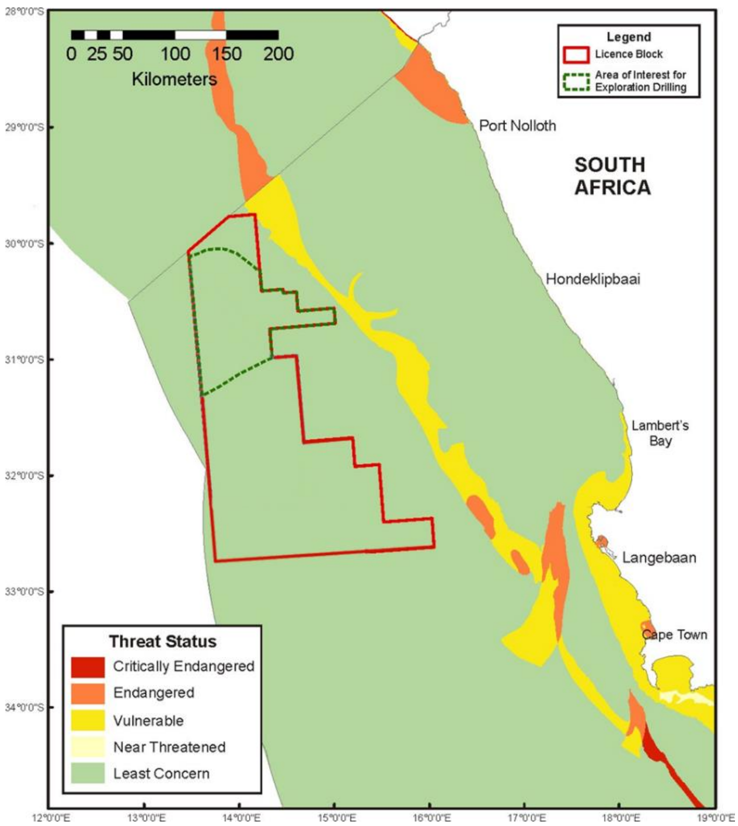


FIGURE 7-13: DWOB BLOCK AND THE AREA OF INTEREST IN RELATION TO ECOSYSTEM THREAT STATUS FOR COASTAL AND OFFSHORE BENTHIC AND PELAGIC HABITAT TYPES ON THE WEST COAST

Adapted from Sink *et al.* 2019

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth) (Karenyi *et al.* 2016). Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile gastropod and polychaete predators and sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by mud prawns. A second mid-shelf community occurring in sandy sediments is characterised by various deposit-feeding polychaetes. 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).

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna off the edge of the continental shelf, the marine component of the 2018 National Biodiversity Assessment (Sink *et al.* 2019), rated the South Atlantic bathyal and abyssal unconsolidated habitat types that characterise depths beyond 500 m, as being of 'Least Concern' (Figure 7-13), with only those communities occurring along the shelf edge (-500 m) being considered 'Vulnerable'. This primarily reflects the great extent of these habitats in the South African Exclusive Economic Zone (EEZ).

Karenyi *et al.* (2016) 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.

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African west coast (Christie 1974, 1976; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b) and elsewhere in the world (e.g. Gray 1981; Ellingsen 2002; Bergen *et al.* 2001; Post *et al.* 2006). However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration (Post *et al.* 2006; Currie *et al.* 2009; Zettler *et al.* 2009, 2013), productivity (Escaravage *et al.* 2009), organic carbon and seafloor temperature (Day *et al.* 1971) may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deep water shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability (Monteiro & van der Plas 2006; Pulfrich *et al.* 2006). 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.

The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability) and serve as 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).

Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. According to Lange (2012) the continental shelf on the West Coast between depths of 100 m and 250 m, contained a single epifaunal community characterised by the hermit crabs *Sympagurus dimorphus* and *Parapaguris pilosimanus*, the prawn *Funchalia woodwardi* and the sea urchin *Brisaster capensis*. Atkinson (2009) also reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

Information on the benthic fauna of the lower continental slope and abyss (beyond 1 800 m depth) is largely lacking due to limited opportunities for sampling. However, deep water benthic sampling was undertaken (Benthic Solutions Ltd 2019) as part of the Environmental Baseline Survey for TotalEnergies E&P Namibia's Block 2913B just to the north of the Licence Area. This provided valuable information on the benthic infaunal communities of the lower continental slope. **As conditions in such deep-water habitats tend to be more uniform (low temperatures and low oxygen concentrations characterising the SACW that comprises the bulk of the water in the area), similar communities may be expected in the Deep Western Orange Basin Block.**

The macrofauna in Block 2913B were generally impoverished but fairly consistent, which is typical for deep water sediments. The 105 species recorded, were dominated by polychaetes, which accounted for 64.1% of the total individuals. Molluscs were represented by 11 species (19.6% of total individuals), whilst 20 species of crustaceans were recorded (contributing to only 9.8% of total individuals). Echinoderms were represented by only 3 species (5.8% of total individuals), whilst all other groups (Actiniaria, Nemertea, Nematoda, Ascidiacea and Priapulida) accounted for the remaining 5.9% of individuals. The deposit-feeding polychaete *Spiophanes* sp. was the most abundant species recorded. This small bristleworm can either be a passive suspension feeder or a surface deposit feeder, living off sediment particles, planktonic organisms and meiobenthic organisms. The bivalve mollusc *Microgloma mirmidina* was the second most common species, with the polychaete tentatively identified as a *Leiocapitellide* being the third most abundant. With the exception of the carnivorous polychaete *Glycera capitata*, most species were suspension or deposit feeders typical of soft unconsolidated sediments.

Examples of the macroinvertebrate infauna of the Block 2913B area are illustrated in Figure 7-14. A wide diversity of macroinvertebrates has been recorded inshore of the 1 000 m depth contour, and the reader is referred to the comprehensive field guide compiled by Atkinson & Sink (2018).

The 2018 National Biodiversity Assessment for the marine environment (Sink *et al.* 2019) points out that very few national IUCN Red List assessments have been conducted for marine invertebrate species to date owing to inadequate taxonomic knowledge, limited distribution data, a lack of systematic surveys and limited capacity to advance species red listing for these groups.

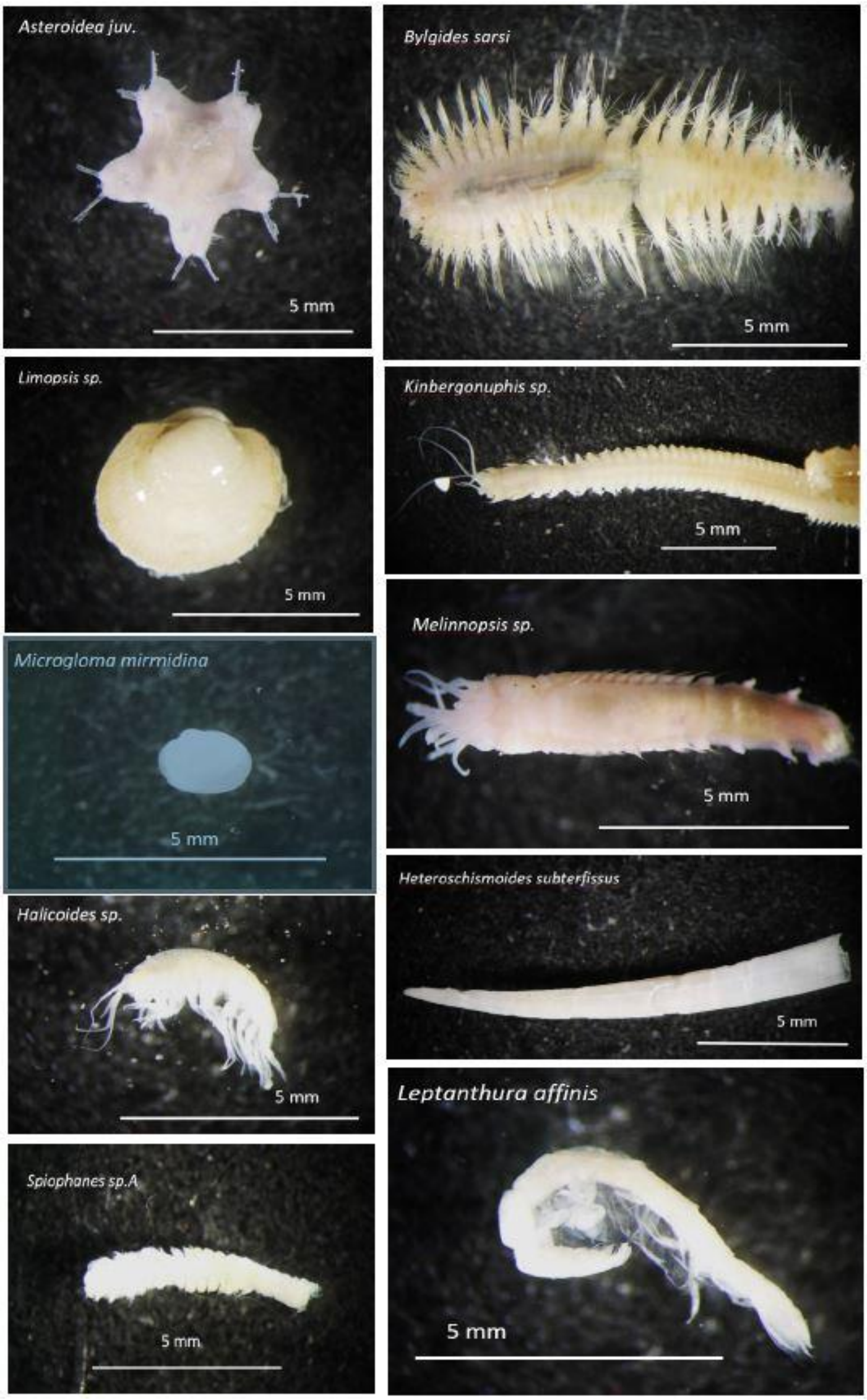


FIGURE 7-14: EXAMPLES OF MACROINVERTEBRATES RECORDED IN BLOCK 2913B TO THE NORTH OF THE DWOB LICENCE BLOCK

Source Benthic Solutions Ltd 2019

7.4.2.2. Deep-water coral communities

There has been increasing interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths below 150 m with some species being recorded from as deep as 3 000 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al.* 1997; MacIssac *et al.* 2001). Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement (Hovland *et al.* 2002). **In the productive Benguela region, substantial areas on and off the edge of the shelf should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities, and various species of scleractine and stylastrine corals have been reported from depths beyond -200 m in the Orange Basin.**

Such communities would also be expected with topographic features such as seamounts located adjacent to the northern and western boundary of the DWOB Licence Block (see Figure 7-3). Nonetheless, our understanding of the invertebrate fauna of the sub-photic zone is relatively poor (Gibbons *et al.* 1999) and the conservation status of the majority of invertebrates in this bioregion is not known.

7.4.2.3. 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 of the West Coast (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; Yemane *et al.* 2015), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake *M. 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 *Merluccius paradoxus*, monkfish *Lophius vomerinus*, kingklip *Genypterus capensis*, bronze whiptail *Lucigadus ori* and hairy conger *Bassanago albescens* and various 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 north of Cape Point 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.* 2008).

The diversity and distribution of demersal cartilagenous fishes on the West Coast is discussed by Compagno *et al.* (1991). **The species that may occur in the general project area and on the continental shelf inshore thereof,**

and their approximate depth range, are listed in Table 7-1. Details on demersal cartilaginous species beyond the shelf break and in the Deep Western Orange Basin Block are lacking, however. The distribution of some of these species was provided in Harris *et al.* (2022) (Figure 7-15 and Figure 7-16).

There is limited information about bathyal fish communities in South Africa. South Africa defines its bathyal zone as extending from 500 m to 3 500 m, recognising an upper slope (500-1 000 m), mid slope (1 000-1 800 m) and lower slope (1 800-3 500 m). Typical upper slope fishes (200-2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus* species), notacanthids, halosaurs, chimaeras, skates, bythitids such as *Cataetyx* spp. and morids (deepsea cods) (Smith & Heemstra 2003). Rattails, bythitids, liparidids (snail fishes) and notacanthids (*Polyacanthonotus* species and halosaurs) are characteristic of the lower bathyal (see also Iwamoto & Anderson 1994; Jones 2014).

TABLE 7-1: DEMERSAL CARTILAGINOUS SPECIES FOUND ON THE CONTINENTAL SHELF ALONG THE WEST COAST, WITH APPROXIMATE DEPTH RANGE AT WHICH THE SPECIES OCCURS

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
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
Tigar 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 (EN)
Houndshark	*Mustelus mustelus*	<100	EN (DD)
Whitespotted houndshark	*Mustelus palumbes*	>350	LC

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Little guitarfish	*Rhinobatos annulatus*	>100	VU (LC)
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 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 spinacidermis*	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 (LC)
Cape chimaera	*Chimaera notafricana*	680-1 000	LC
Brown chimaera	*Chimaera carophila*	420-850	LC
Spearnose chimaera	*Rhinochimaera atlantica*	650-960	LC

LC - Least Concern; VU - Vulnerable; NT - Near Threatened; EN - Endangered; CR - Critically Endangered; DD - Data Deficient
Source: Compagno *et al.* 1991

7.4.2.4. Seamount and Submarine Canyon Communities

Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui 1985; Haney *et al.* 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007; Derville *et al.* 2020). Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers *et al.* 2008).

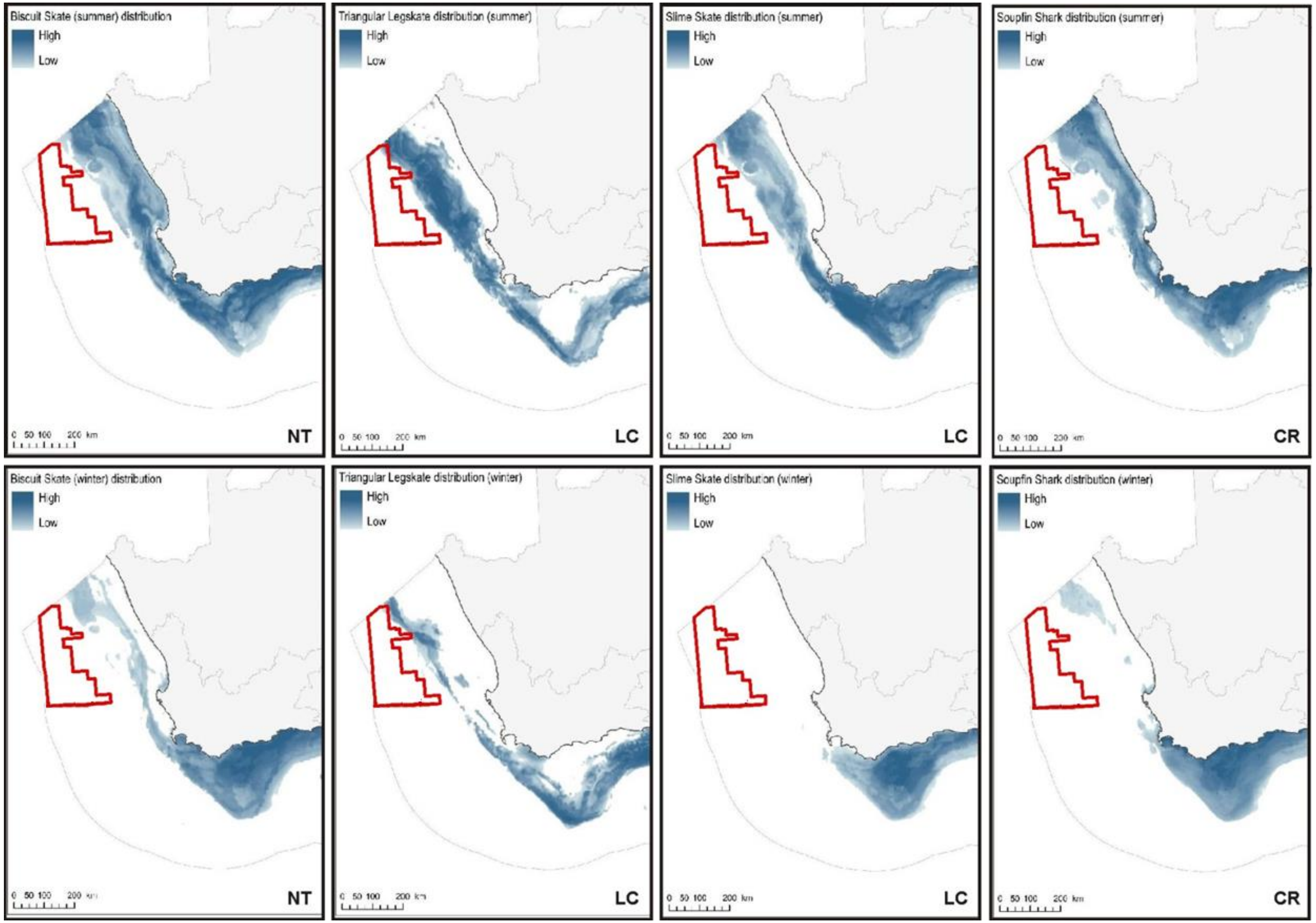


FIGURE 7-15: BLOCK DWOB (RED POLYGON) AREA OF INTEREST IN RELATION TO SUMMER (TOP) AND WINTER (BOTTOM) DISTRIBUTION OF BISCUIT SKATE, TRIANGULAR LEGSKATE AND SOUPFIN SHARK

Note: IUCN conservation status is provided

Adapted from Harris et al. 2022

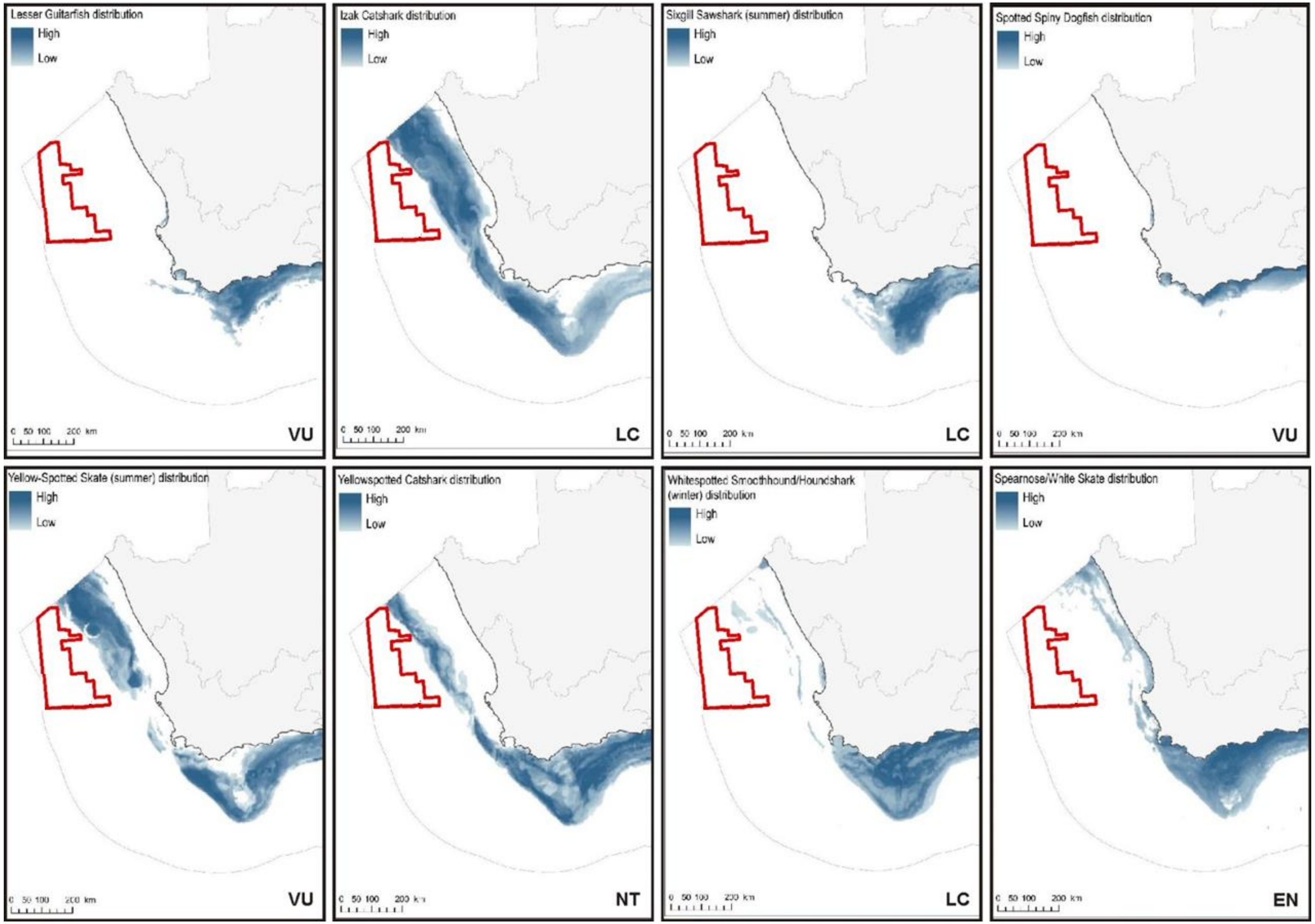


FIGURE 7-16: BLOCK DWOB (RED POLYGON) AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF CARTILAGINOUS SPECIES

Note: IUCN conservation status is provided

Adapted from Harris et al. 2022

As a result of conservative life histories (*i.e.*, very slow growing, slow to mature, high longevity, low fecundity and unpredictable recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs) (see Box 7-1). 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).

BOX 7-1: VULNERABLE MARINE ECOSYSTEMS

The concept of a 'Vulnerable Marine Ecosystem' (VME) centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities (Parker et al. 2009; Auster et al. 2011; Hansen et al. 2013).

VMEs are known to be associated with higher biodiversity levels and indicator species that add structural complexity, resulting in greater species abundance, richness, biomass and diversity compared to surrounding uniform seabed habitats (Buhl-Mortensen et al. 2010; Hogg et al. 2010; Barrio Froján et al. 2012; Beazley et al. 2013, 2015). Compared to the surrounding deep-sea environment, VMEs typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Levels of endemism on VMEs are also relatively high compared to the deep-sea. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity (Bett & Rice 1992; Raes & Vanreusel 2005; Beazley et al. 2013; Ashford et al. 2019).

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species (Pham et al. 2015; Ashford et al. 2019). They can provide a wide range of ecosystem services ranging from provision of aggregation- and spawning sites to providing shelter from predation and adverse hydrological conditions (Husebø & Nøttestad et al. 2002; Krieger & Wing, 2002; Tissot et al. 2006; Baillon et al. 2012; Pham et al. 2015). Indicator taxa for VMEs are also known to provide increased access to food sources, both directly to associated benthic fauna, and indirectly to other pelagic species such as fish and other predators due to the high abundance and biomass of associated fauna (Krieger & Wing, 2002; Husebø & Nøttestad et al. 2002; Buhl-Mortensen et al. 2010; Hogg et al. 2010; Auster et al. 2011).

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders (Krieger & Wing 2002; Buhl-Mortensen & Mortensen 2005; Buhl-Mortensen et al. 2010). Poriferans and cold-water corals further shown to provide a strong link between pelagic and benthic food webs (Pile & Young 2006; Cathalot et al. 2015). VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning (Ashford et al. 2019).

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism

Geological features of note within the broader project area are Child's Bank and Tripp Seamount, with an unnamed seamount located in ~3 500 m at ~32°20'S; 13°30'E, as well as the Cape Canyon and Cape Point Valley (see section 7.2.1 for further details on features within the project's area of influence). During 2016-2018 the Department of Environmental Affairs: Oceans and Coast Branch (DEA: O&C) undertook research cruises to explore some of the undocumented areas of seabed off the West Coast, among them the Cape Canyon. Using tow-cameras, benthic grabs and dredges, the biota of the canyon head to -500 m depth were sampled (Figure 7-17). A diversity of echinoderms, molluscs, and crustaceans were reported to dominate the canyon head, while scavengers such as ophuiroidea and decapoda were prevalent within habitats ranging from sandy areas, to patches of inshore and offshore mud belts. At depths of <100 m inshore of the canyon head, boulder beds hosted gorgonian and stylasterine corals.

FIGURE 7-17: DEEP WATER BENTHIC MACROFAUNA FROM VARIOUS DEPTHS IN THE CAPE CANYON

Source: www.environmedeepwaternt.gov.za/dearesearchteamreturnfromdeepseaexpedition

As sampling beyond 1 000 m depth has not taken place (Atkinson & Sink 2018) it is not known whether similar communities may be expected in the DWOB Licence Block. The distribution of known and potential Vulnerable Marine Ecosystem habitat based on potential VME features, DFFE and SAEON trawl survey data, and many visual surveys indicating the presence of indicator taxa were mapped by Harris *et al*. 2022 (Figure 7-18). Some sites need more research to determine their status. **The location of the Deep Western Orange Basin Block is well offshore of these known and potential VMEs emphasising the gaps in our knowledge specific to the vulnerability of marine communities of abyssal habitats.**

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. Some scientists believe there is a strong correlation between the occurrence of deep-water coral reefs and the relatively high values 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 recent study by January (2018) identified that hydrocarbon seeps and gas escape structures have been identified in the Orange Basin area. Large fluid seep/pockmark fields of varying morphologies were also reported to the south of the Licence Area by Palan (2017).**

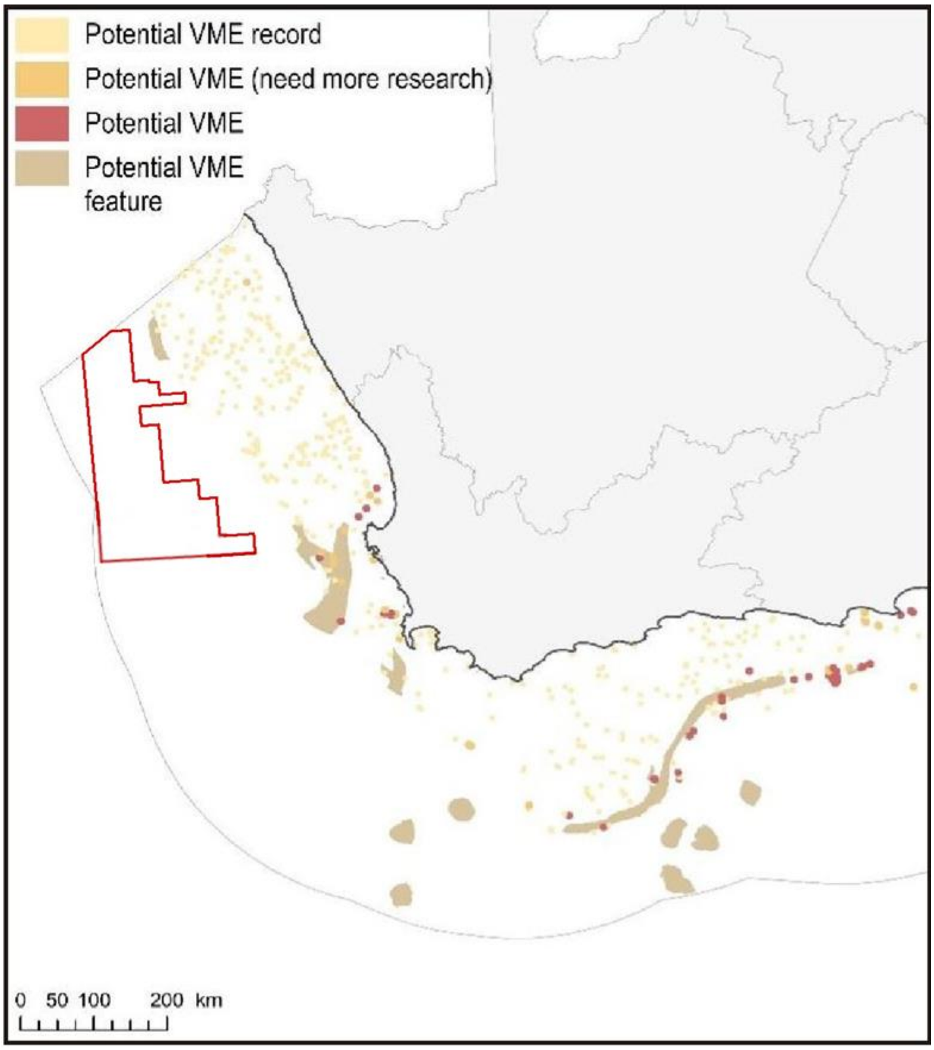


FIGURE 7-18: DWOB AREA (RED POLYGON IN RELATION TO THE DISTRIBUTION OF KNOWN AND POTENTIAL VULNERABLE MARINE ECOSYSTEM HABITAT

Adapted from Harris et al. 2022

7.4.3. Pelagic 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.

7.4.3.1. Plankton

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

7.4.3.2. Phytoplankton

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Walker & Peterson 1991). The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are *Chaetoceros*, *Nitschia*, *Thalassiosira*, *Skeletonema*, *Rhizosolenia*, *Coscinodiscus* and *Asterionella* (Shannon & Pillar 1985). Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. *Prorocentrum*, *Ceratium* and *Peridinium*) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Red-tides are ubiquitous features of the Benguela system (see Shannon & Pillar, 1986). The most common species associated with red tides (dinoflagellate and/or ciliate blooms) are *Noctiluca scintillans*, *Gonyaulax tamarensis*, *G. polygramma* and the ciliate *Mesodinium rubrum*. *Gonyaulax* and *Mesodinium* have been linked with toxic red tides. Most of these red-tide events occur quite close inshore although Hutchings *et al.* (1983) have recorded red-tides 30 km offshore. **They are unlikely to occur in the offshore regions of the Deep Western Orange Basin Block.**

7.4.3.2.1. Zooplankton

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. The macrozooplankton (≥1 600 µm) are dominated by euphausiids of which 18 species occur in the DWOB Licence Block.

Although biomass shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplankton (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank and the Southeast Atlantic Seamounts in response to topographically steered upwelling around such seabed features. Zooplankton biomass also varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

7.4.3.2.2. Ichthyoplankton

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* 1987; Hutchings 1994; Hutchings *et al.* 2002) (see Figure 7-18 and Figure 7-19), and their eggs and larvae form an important contribution to the ichthyoplankton in the region.

Spawning of key species is presented overleaf.

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a minimum and their eggs and larvae drift northwards and inshore to the west coast nursery grounds. Figure 7-19 highlights the temporal variation in hake eggs and larvae with there being a greater concentration of eggs and larvae between September - October compared to March - April. However, hake are reported to spawn throughout the year (Strømme *et al.* 2015). Snoek spawn along the shelf break (150-400 m) of the western Agulhas Bank and the West Coast between June and October (Griffiths 2002).
- Horse mackerel spawn over the east/central Agulhas Bank during winter months.
- Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period (Figure 7-21, right). There is also sardine spawning on the east coast and even off KwaZulu-Natal, where sardine eggs are found during July–November.
- Anchovies spawn on the whole Agulhas Bank (Figure 7-21, left), with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.

The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. **There is no overlap of the Deep Western Orange Basin Block with the northward egg and larval drift of commercially important species, and the return migration of recruits** (Figure 7-19**). In the offshore oceanic waters of the Deep Western Orange Basin Block, ichthyoplankton abundance is, therefore, expected to be low.**

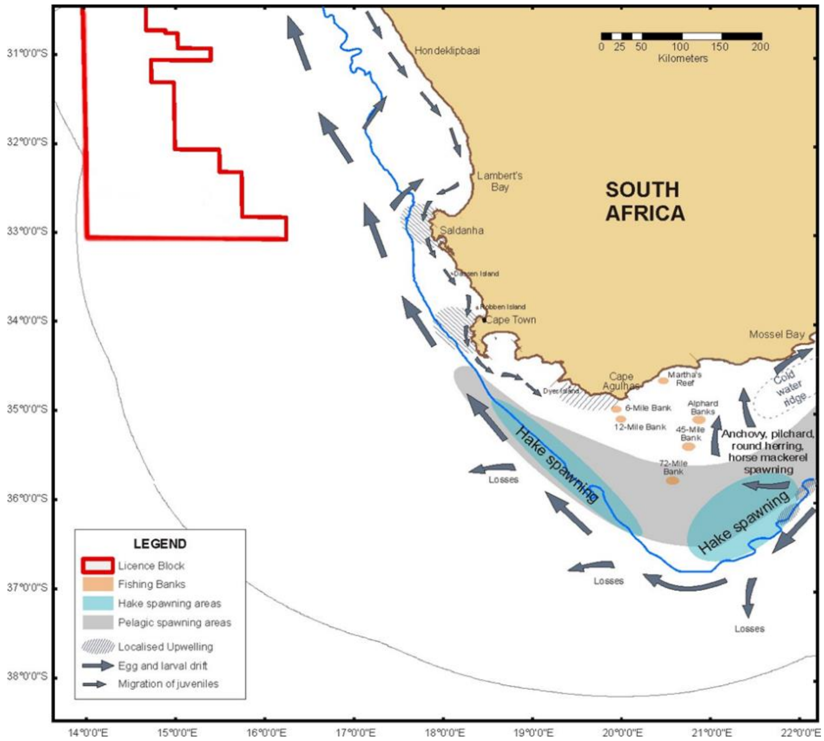


FIGURE 7-19: DWOB (RED POLYGON) IN RELATION TO MAJOR SPAWNING, RECRUITMENT AND NURSERY AREAS IN THE SOUTHERN BENGUELA REGION

Adapted from Crawford *et al.* 1987; Hutchings 1994; Hutchings *et al.* 2002

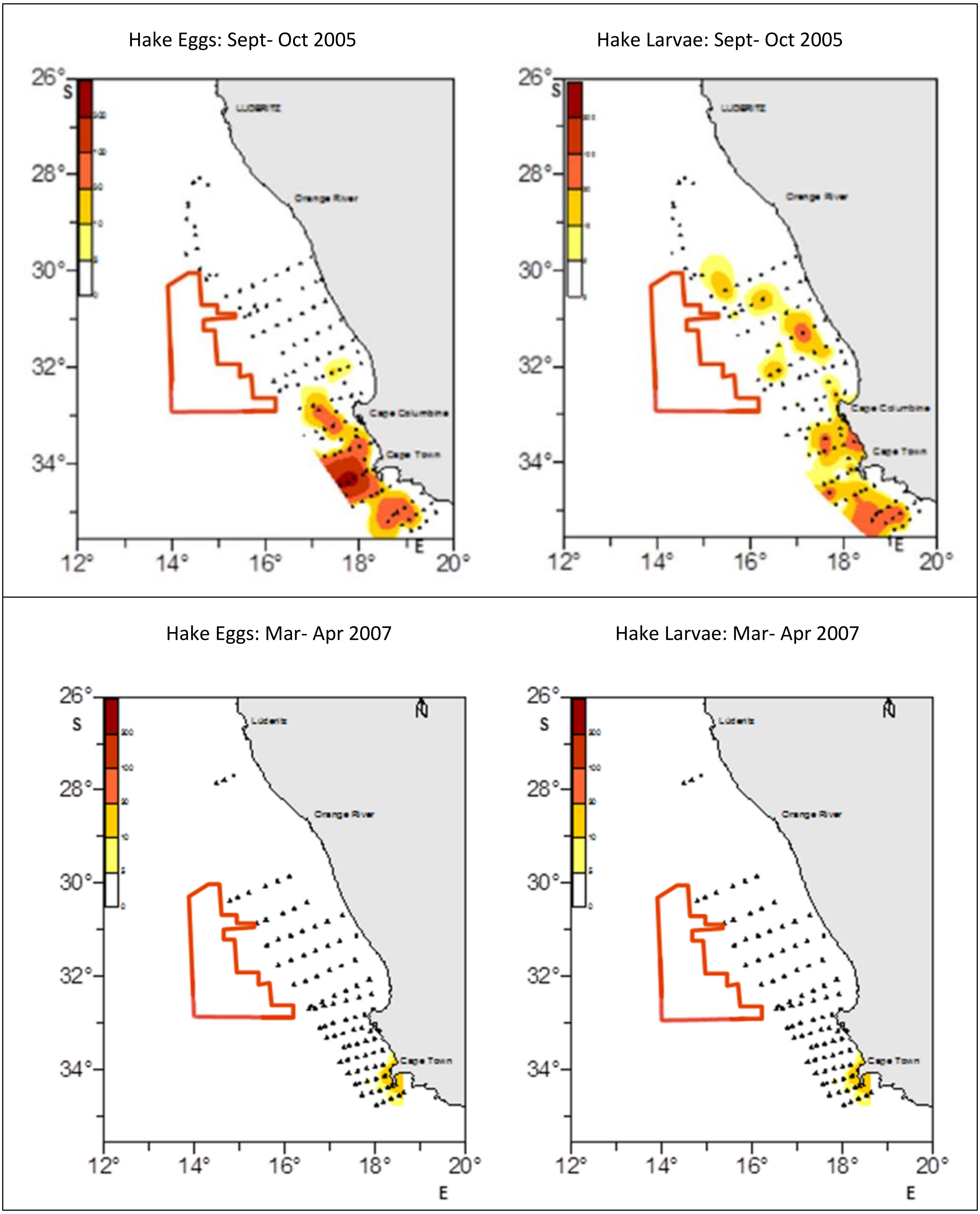


FIGURE 7-20: BLOCK DWOB AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF HAKE EGGS AND LARVAE OFF THE WEST COAST OF SOUTH AFRICA BETWEEN SEPTEMBER - OCTOBER 2005 AND MARCH - APRIL 2007

Adapted from Stenevik *et al.* 2008

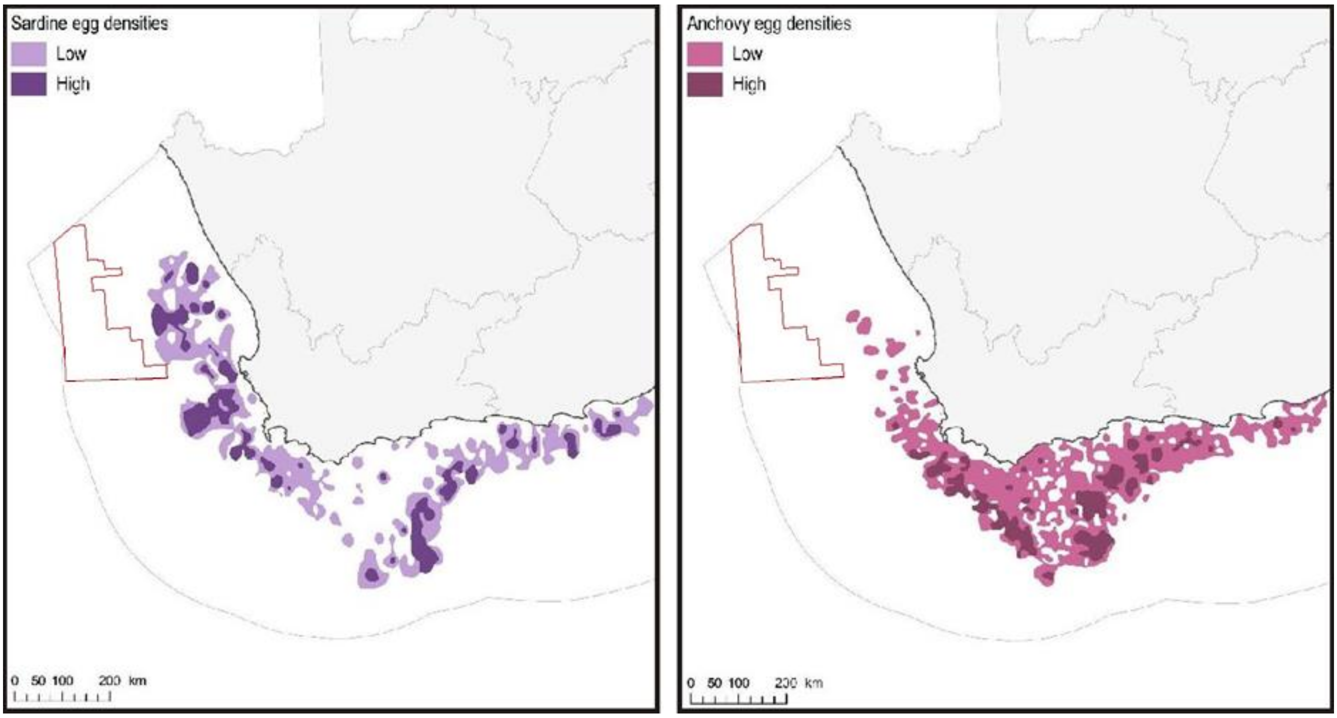


FIGURE 7-21: BLOCK DWOB IN RELATION TO DISTRIBUTION OF SARDINE (LEFT) AND ANCHOVY (RIGHT) SPAWNING AREAS, AS MEASURED BY EGG DENSITIES

Adapted from Harris *et al.* 2022

7.4.3.3. Cephalopods

Fourteen species of cephalopds 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 with *Sepia australis* being most abundant at depths between 60-190 m, whereas *S. hieronis* densities were higher at depths between 110-250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter.

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). Cuttlefish form an important food item for demersal fish.

The colossal squid *Mesonychoteuthis hamiltoni* and the giant squid *Architeuthis* sp. may also be encountered in the project area. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-antarctic Southern Ocean (Figure 7-22, top) while the giant squid is usually found near continental and island slopes all around the world's oceans (Figure 7-22, bottom). **Both species could thus potentially occur in the pelagic habitats of the project area, although the likelihood of encounter is extremely low.**

Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing 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.

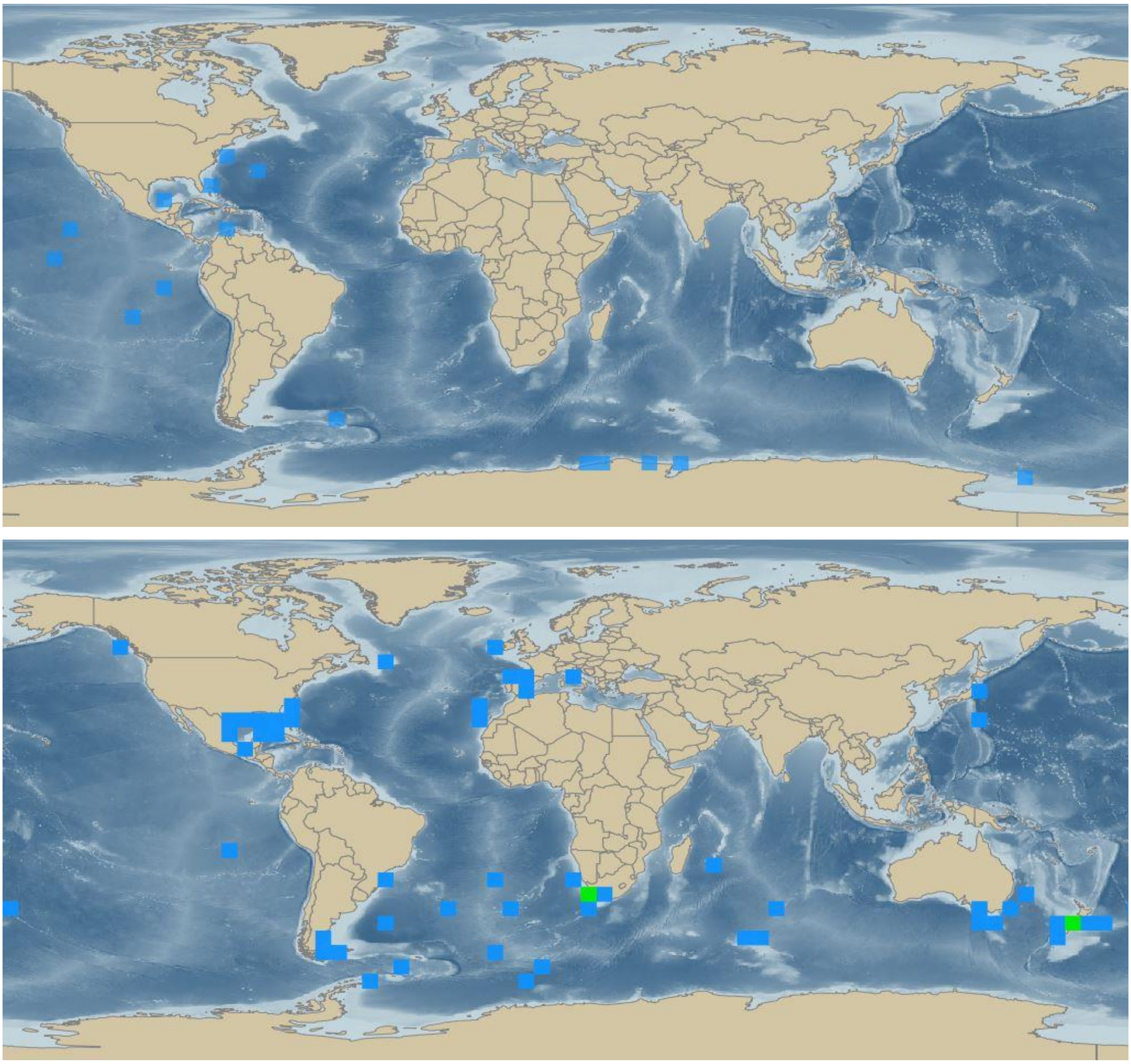


FIGURE 7-22: DISTRIBUTION OF THE COLOSSAL SQUID (TOP) AND THE GIANT SQUID (BOTTOM).

Note: Blue <5 observations; Green 5-10 observations

Source: http://iobis.org

7.4.3.4. Pelagic Fish

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* 1987), and **generally occur within the 200 m contour and thus likely to only be encountered in southeastern inshore portion of the project area.** Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986) (see Figure 7-19). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Recruitment success relies on the interaction of oceanographic events, and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small, short-lived (1-3 years) pelagic fish is highly variable both within and between species.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Both these species have been rated as 'Least concern' on the national assessment (Sink *et al.* 2019). While the appearance of chub mackerel along the West and South-West coasts is highly seasonal, adult snoek are found throughout their distribution range and longshore movement 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. In contrast, those found further south along the western Agulhas Bank remain on the spawning grounds throughout the spawning season (Griffiths 2002) (Figure 7-23). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989). **The distribution of snoek and chub mackerel therefore lies well inshore of the DWOB Licence Block.**

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Deep Western Orange Basin Block are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing (Table 7-2). Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins (for human consumption), where the fins are removed and the remainder of the body discarded.

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Species occurring off western southern Africa include the albacore/longfin tuna *Thunnus alalunga*, yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans*, the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius* (Payne & Crawford 1989). The distribution of these species is dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts (Shannon *et al.* 1989; Penney *et al.* 1992). Seasonal association with Child's Bank and Tripp Seamount occurs between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/ NAM/body.htm).

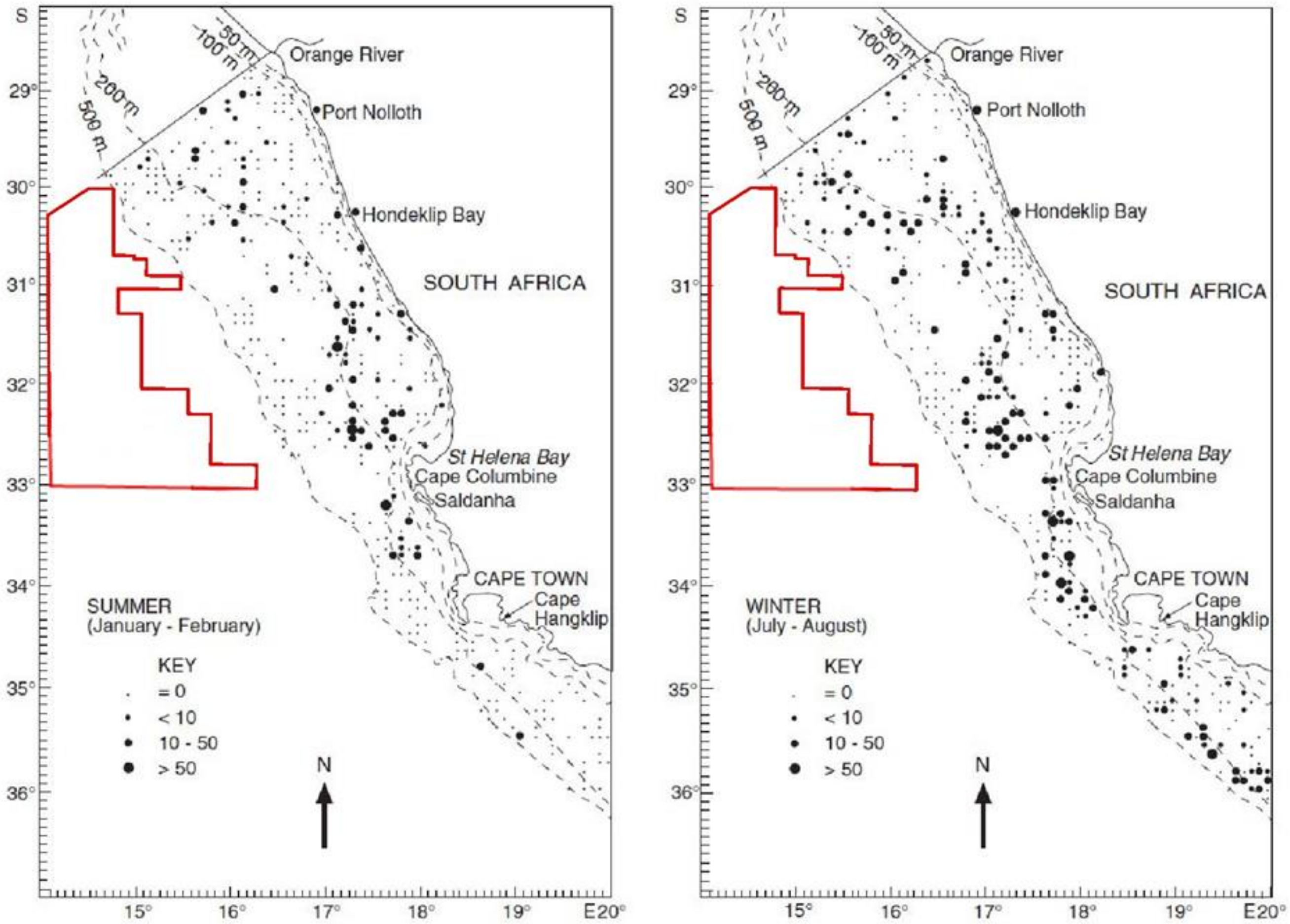


FIGURE 7-23: BLOCK DWOB IN RELATION TO THE MEAN NUMBER OF SNOEK PER DEMERSAL TRAWL PER GRID BLOCK (5 X 5 NM) FOR WINTER AND SUMMER FOR THE WEST COAST (JULY 1985- JAN 1991)

Adapted from: Griffiths 2002

TABLE 7-2: IMPORTANT LARGE MIGRATORY PELAGIC FISH LIKELY TO OCCUR IN THE OFFSHORE WATERS OF THE WEST COAST

Common Name	Species	National Assessment	IUCN Conservation Status
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*	Not Assessed	Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	Least concern
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	Least concern
Frigate Tuna	*Auxis thazard*	Not Assessed	Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	Least concern
Atlantic Bonito	*Sarda sarda*	Not Assessed	Least concern
Billfish			
Black Marlin	*Istiompax indica*	Data deficient	Data deficient
Blue Marlin	*Makaira nigricans*	Vulnerable	Vulnerable
Striped Marlin	*Kajikia audax*	Near Threatened	Near Threatened

Common Name	Species	National Assessment	IUCN Conservation Status
Sailfish	*Istiophorus platypterus*	Least concern	Least concern
Swordfish	*Xiphias gladius*	Data deficient	Least concern
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Not Assessed	Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Data deficient	Vulnerable
Bronze Whaler Shark	*Carcharhinus brachyurus*	Data deficient	Near Threatened
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*	Not Assessed	Vulnerable
Whale Shark	*Rhincodon typus*	Not Assessed	Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

Note: Species reported from Deep Western Orange Basin Block by MMOs are highlighted (CapFish 2013a).
Source: Sink *et al*. 2019; www.iucnredlist.org

A number of species of pelagic sharks are also known to occur on the West Coast, including blue *Prionace glauca*, short-fin mako *Isurus oxyrinchus* and oceanic whitetip sharks *Carcharhinus longimanus*. Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great whites *Carcharodon carcharias* and whale sharks *Rhincodon typus* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts. The recapture of a juvenile blue shark off Uruguay, which had been tagged off the Cape of Good Hope, supports the hypothesis of a single blue shark stock in the South Atlantic (Hazin 2000; Montealegre-Quijano & Vooren 2010) and Indian Oceans (da Silva *et al*. 2010). **Using the Benguela drift in a north-westerly direction, it is likely that juveniles from the parturition off the south-western Cape would migrate through the project area *en route* to South America (da Silva *et al.* 2010).**

The shortfin mako inhabits offshore temperate and tropical seas worldwide. It can be found from the surface to depths of 500 m, and as one of the few endothermic sharks is seldom found in waters <16 °C (Compagno 2001; Loefer *et al.* 2005). As the fastest species of shark, shortfin makos have been recorded to reach speeds of 40 km/h with burst of up to 74 km/h, and can jump to a height of 9 m (http://www.elasmo-research.org/education/shark_profiles/ i_oxyrinchus.htm). Most makos caught by longliners off South Africa are immature, with reports of juveniles and sub-adults sharks occurring near the edge of the Agulhas Bank and off the South Coast between June and November (Groeneveld *et al.* 2014), whereas larger and reproductively mature sharks were more common in the inshore environment along the East Coast (Foulis 2013).

Until recently, the Southern Bluefin Tuna was globally assessed as 'Critically Endangered' by the IUCN, and in South Africa the stock is considered collapsed (Sink *et al.* 2019). 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 as globally 'Endangered'.

Whale sharks are regarded as a broad ranging species typically occurring in offshore epipelagic areas with sea surface temperatures of 18–32°C (Eckert & Stewart 2001). Adult whale sharks reach an average size of 9.7 m and 9 tonnes, making them the largest non-cetacean animal in the world. They are slow-moving filter-feeders and therefore particularly vulnerable to ship strikes (Rowat 2007). Although primarily solitary animals, seasonal feeding aggregations occur at several coastal sites all over the world, those closest to the project area being off Sodwana Bay in KwaZulu Natal (KZN) (Cliff *et al.* 2007). Satellite tagging has revealed that individuals may travel distances of tens of 1 000s of kms (Eckert & Stewart 2001; Rowat & Gore 2007; Brunnschweiler *et al.* 2009). On the West Coast their summer and winter distributions are centred around the Orange River mouth and between Cape Columbine and Cape Point (Harris *et al*. 2022). **The likelihood of an encounter in the offshore waters of the Deep Western Orange Basin Block is relatively low.**

The whale shark and shortfin mako are listed in Appendix II (species in which trade must be controlled in order to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and Appendix I and/or II of the Bonn Convention for the Conservation of Migratory Species (CMS). The whale shark is also listed as 'vulnerable' in the List of Marine Threatened or Protected Species (TOPS) as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA).

The distributions of some of the pelagic sharks (Great white, Bronze whaler, shortfin mako and whale shark) were provided in Harris *et al.* (2022) (Figure 7-25).

7.4.3.5. Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (Figure 7-24, left), and occasionally the Loggerhead (*Caretta caretta*) (Figure 7-24, right) and the Green (*Chelonia mydas*) turtle. Green turtles are non-breeding residents often found feeding on inshore reefs on the South and East Coasts and are expected to occur only as occasional visitors along the West Coast. The most recent conservation status, which assessed the species on a sub-regional scale, is provided in Table 7-3.

FIGURE 7-24: LEATHERBACK (LEFT) AND LOGGERHEAD TURTLES (RIGHT) OCCUR ALONG THE WEST COAST OF SOUTHERN AFRICA

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

After completion of the nesting season (October to January) both Leatherbacks and Loggerheads undertake long-distance migrations to foraging areas. Loggerhead turtles are coastal specialists keeping inshore, hunting around reefs, bays and rocky estuaries along the African South and East Coast, where they feed on a variety of benthic fauna including crabs, shrimp, sponges, and fish. In the open sea their diet includes jellyfish, flying fish, and squid (www.oceansafrica.com/turtles.htm).

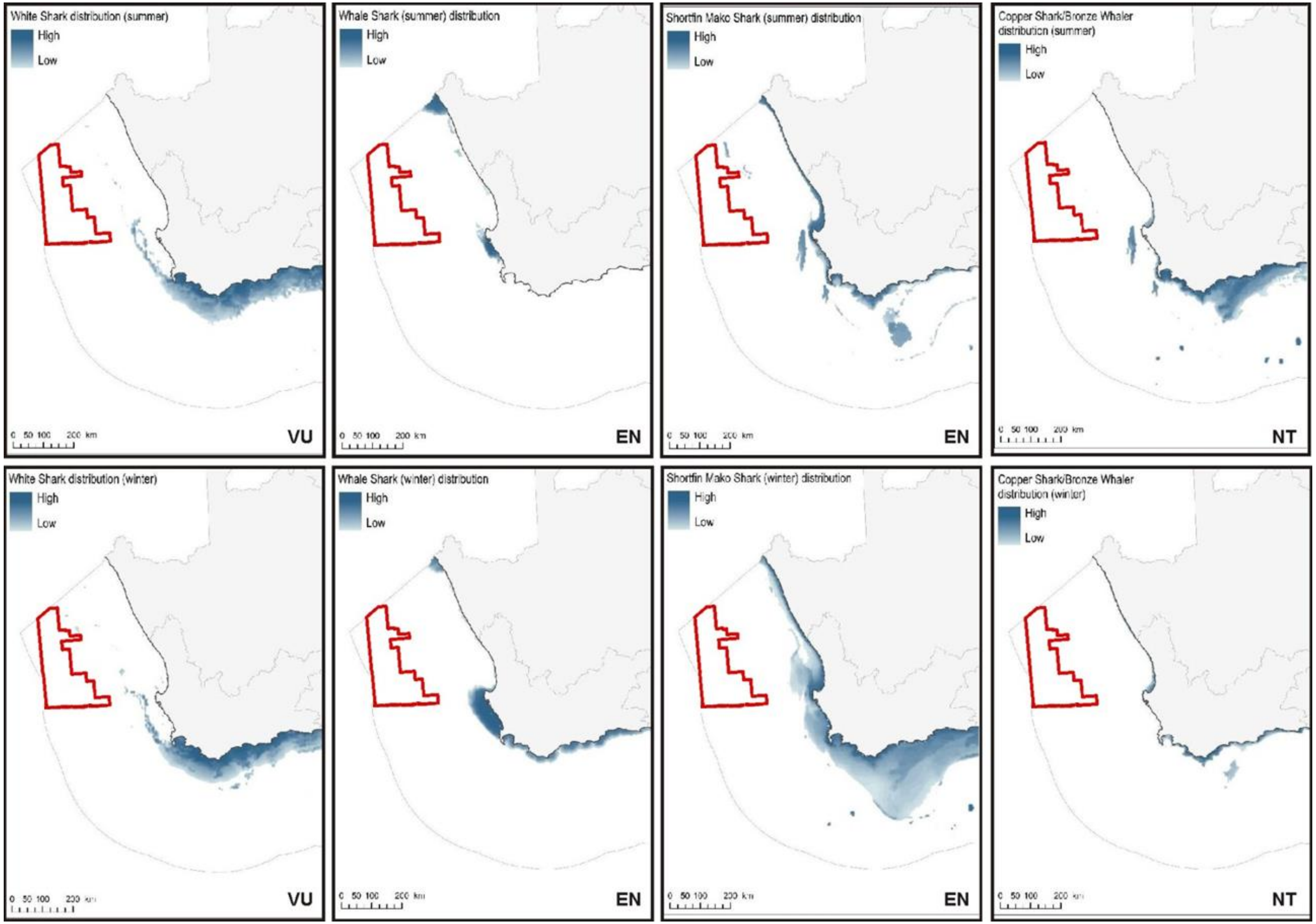


FIGURE 7-25: BLOCK DWOB IN RELATION TO THE SUMMER (TOP) AND WINTER (BOTTOM) DISTRIBUTION OF WHITE SHARK, WHALE SHARK, SHORTFIN MAKO AND BRONZE WHALER SHARK

Adapted from Harris *et al.* 2022

TABLE 7-3: GLOBAL AND REGIONAL CONSERVATION STATUS OF THE TURTLES OCCURRING OFF THE WEST COAST

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

NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered DD – Data Deficient UR – Under Review
* - not yet assessed

Satellite tagging of loggerheads suggests that they seldom occur west of Cape Agulhas (Harris *et al.* 2018; Robinson *et al.* 2018). **A sighting of a Loggerhead turtle in the Deep Western Orange Basin Block has, however, been reported** by an MMO (CapFish 2013a). **The Leatherback is the turtle most likely to be encountered in the offshore waters of west South Africa.** The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa) (Lambardi *et al.* 2008, Elwen & Leeney 2011; SASTN 2011[15]). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008; Robinson *et al.* 2018) (Figure 7-26).

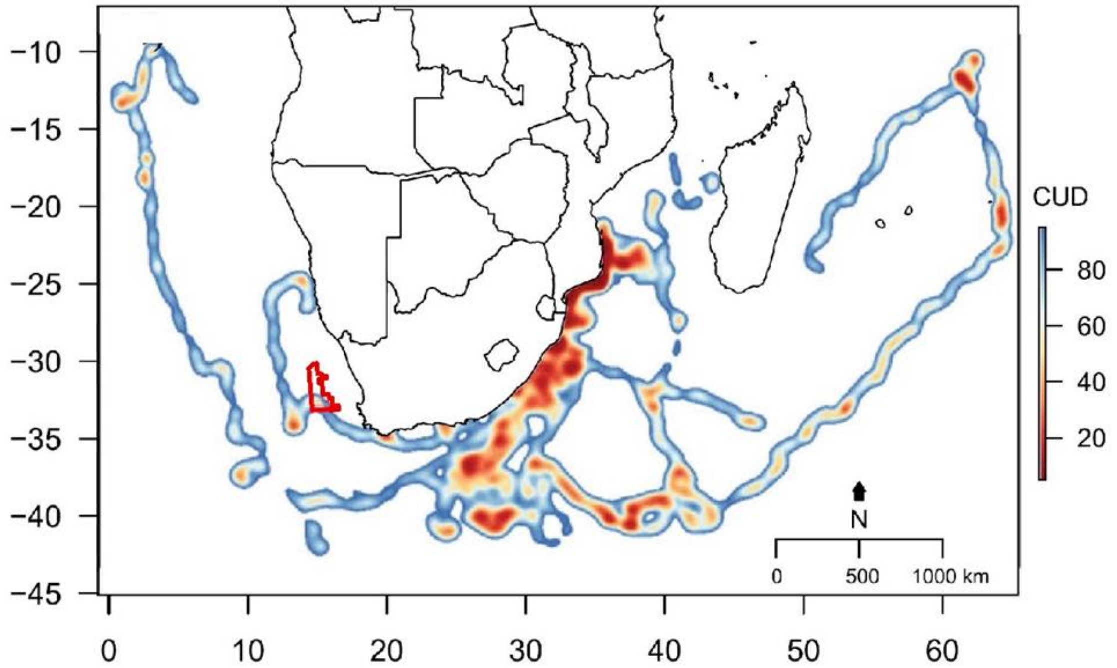


FIGURE 7-26: LICENCE BLOCK DWOB IN RELATION TO THE MIGRATION CORRIDORS OF LEATHERBACK TURTLES IN THE SOUTH-WESTERN INDIAN OCEAN

Note: Relative use (CUD, Cumulative Utilization Distribution) of corridors is shown through intensity of shading: light, low use; dark, high use. Adapted from Harris *et al.* 2018

[15] *SASTN Meeting – Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.*

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays *et al.* 2004). **Their abundance in the study area is unknown but expected to be low.** Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. Leatherback Turtles are listed as 'Critically endangered' 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). The 2017 South African list of Threatened and Endangered Species (TOPS) similarly lists the species as 'Critically endangered', whereas on the National Assessment (Hughes & Nel 2014) leatherbacks were listed as 'Endangered', whereas Loggerhead and green turtles are listed globally as 'Vulnerable' and 'Endangered', respectively, whereas on TOPS both species are listed as 'Endangered'. As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

7.4.3.6. Seabirds

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 15 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the southern Ocean. **The species classified as being common in the southern Benguela, and likely to occur in Deep Western Orange Basin Block,** are listed in Table 7-4. The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. **Most of the pelagic species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), and are therefore likely to occur in the proposed Area of Interest, with highest population levels during their non-breeding season (winter).** Pintado petrels and Prion spp. show the most marked variation here. Support vessels and possible helicopter flights may, however, encounter more coastal seabirds when *en route* between the drilling unit and the port or airport. On the South Coast, 60 seabird species are known, or thought likely to occur. These can be categorised into three categories: 'breeding resident species', 'non-breeding migrant species' and 'rare vagrants' (Shaughnessy 1977; Harrison 1978; Liversidge & Le Gras 1981; Ryan & Rose 1989).

TABLE 7-4: PELAGIC SEABIRDS COMMON IN THE SOUTHERN BENGUELA REGION AND THEIR CONSERVATION STATUS

Common Name	Species name	Global IUCN	Regional Assessment
Shy Albatross	*Thalassarche cauta*	Near Threatened	Near Threatened
Black-browed Albatross	*Thalassarche melanophrys*	Least concern	Endangered
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Endangered	Endangered
Indian Yellow-nosed Albatross	*Thalassarche carteri*	Endangered	Endangered
Wandering Albatross	*Diomedea exulans*	Vulnerable	Vulnerable
Southern Royal Albatross	*Diomedea epomophora*	Vulnerable	Vulnerable
Northern Royal Albatross	*Diomedea sanfordi*	Endangered	Endangered
Sooty Albatross	*Phoebetria fusca*	Endangered	Endangered
Light-mantled Albatross	*Phoebetria palpebrata*	Near Threatened	Near Threatened
Tristan Albatross	*Diomedea dabbenena*	Critically Endangered	Critically Endangered

Common Name	Species name	Global IUCN	Regional Assessment
Grey-headed Albatross	*Thalassarche chrysostoma*	Endangered	Endangered
Giant Petrel sp.	*Macronectes halli/giganteus*	Least concern	Near Threatened
Southern Fulmar	*Fulmarus glacialoides*	Least concern	Least concern
Pintado Petrel	*Daption capense*	Least concern	Least concern
Blue Petrel	*Halobaena caerulea*	Least concern	Near Threatened
Salvin's Prion	*Pachyptila salvini*	Least concern	Near Threatened
Arctic Prion	*Pachyptila desolata*	Least concern	Least concern
Slender-billed Prion	*Pachyptila belcheri*	Least concern	Least concern
Broad-billed Prion	*Pachyptila vittata*	Least concern	Least concern
Kerguelen Petrel	*Aphrodroma brevirostris*	Least concern	Near Threatened
Greatwinged Petrel	*Pterodroma macroptera*	Least concern	Near Threatened
Soft-plumaged Petrel	*Pterodroma mollis*	Least concern	Near Threatened
White-chinned Petrel	*Procellaria aequinoctialis*	Vulnerable	Vulnerable
Spectacled Petrel	*Procellaria conspicillata*	Vulnerable	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Least concern	Least concern
Sooty Shearwater	*Puffinus griseus*	Near Threatened	Near Threatened
Flesh-footed Shearwater	*Ardenna carneipes*	Near Threatened	Least concern
Great Shearwater	*Puffinus gravis*	Least concern	Least concern
Manx Shearwater	*Puffinus puffinus*	Least concern	Least concern
Little Shearwater	*Puffinus assimilis*	Least concern	Least concern
European Storm Petrel	*Hydrobates pelagicus*	Least concern	Least concern
Leach's Storm Petrel	*Oceanodroma leucorhoa*	Vulnerable	Critically Endangered
Wilson's Storm Petrel	*Oceanites oceanicus*	Least concern	Least concern
Black-bellied Storm Petrel	*Fregetta tropica*	Least concern	Near Threatened
White-bellied Storm Petrel	*Fregetta grallaria*	Least concern	Least concern
Pomarine Jaeger	*Stercorarius pomarinus*	Least concern	Least concern
Subantarctic Skua	*Catharacta antarctica*	Least concern	Endangered
Parasitic Jaeger	*Stercorarius parasiticus*	Least concern	Least concern
Long-tailed Jaeger	*Stercorarius longicaudus*	Least concern	Least concern
Sabine's Gull	*Larus sabini*	Least concern	Least concern
Lesser Crested Tern	*Thalasseus bengalensis*	Least concern	Least concern
Sandwich Tern	*Thalasseus sandvicensis*	Least concern	Least concern
Little Tern	*Sternula albifrons*	Least concern	Least concern
Common Tern	*Sterna hirundo*	Least concern	Least concern
Arctic Tern	*Sterna paradisaea*	Least concern	Least concern
Antarctic Tern	*Sterna vittata*	Least concern	Endangered

Note: Species reported from Block DWOB by MMOs are highlighted (CapMarine Environmental 2020).
Source: Crawford *et al.* 1991; Sink *et al.* 2019

Fifteen species of seabirds breed in southern Africa, including Cape Gannet, African Penguin, African Black Oystercatcher, four species of Cormorant, White Pelican, three Gull and four Tern species (Table 7-5). The breeding areas are distributed around the coast with islands being especially important. The closest breeding islands to the Deep Western Orange Basin are Bird Island in Lambert's Bay, the Saldanha Bay islands, Dassen Island, Robben Island and Seal Island approximately 200 km, 150 km, 175 km, 200 km and 250 km to the east and southeast of the southern section of the Deep Western Orange Basin Block, respectively. The number of successfully breeding birds at the particular breeding sites varies with food abundance. Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km). Cape Gannets, which breed at only three locations in South Africa (Bird Island Lamberts Bay, Malgas Island and Bird Island Algoa Bay) are known to forage within 200 km offshore (Dundee 2006; Ludynia 2007; Grémillet *et al.* 2008; Crawford *et al.* 2011), and African Penguins have also been recorded as far as 60 km offshore. **The Deep Western Orange Basin Block lies on the western extent of Cape Gannet foraging and distribution areas and well offshore of African Penguin foraging and distribution areas, but overlaps with the foraging ranges of various pelagic bird species, particularly Wandering Albatross and Atlantic Yellow-nosed Albatross (Figure 7-27). Cape Cormorant and Bank Cormorant core usage areas lie well inshore of the Deep Western Orange Basin Block** (BirdLife South Africa 2021; Harris *et al.* 2022).

TABLE 7-5: BREEDING RESIDENT SEABIRDS PRESENT ALONG THE SOUTH-WEST COAST AND THEIR CONSERVATION STATUS

Common Name	Species Name	Global IUCN	National Assessment
African Penguin*	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher*	*Haematopus moquini*	Near Threatened	Least Concern
White-breasted Cormorant	*Phalacrocorax carbo*	Least Concern	Least Concern
Cape Cormorant*	*Phalacrocorax capensis*	Endangered	Endangered
Bank Cormorant*	*Phalacrocorax neglectus*	Endangered	Endangered
Crowned Cormorant*	*Phalacrocorax coronatus*	Near Threatened	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Least Concern	Vulnerable
Cape Gannet*	*Morus capensis*	Endangered	Endangered
Kelp Gull	*Larus dominicanus*	Least Concern	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern	Least Concern
Hartlaub's Gull*	*Larus hartlaubii*	Least Concern	Least Concern
Caspian Tern	*Hydroprogne caspia*	Least Concern	Vulnerable
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern	Endangered
Damara Tern*	*Sterna balaenarum*	Vulnerable	Vulnerable

Note: Species reported from Block DWOB by MMOs are highlighted (CapMarine Environmental 2020).
* denotes endemicity
Source: CCA & CMS 2001; Sink *et al*. 2019

Interactions with commercial fishing operations, either through incidental bycatch or competition for food resources, is the greatest threat to southern African seabirds, impacting 56% of seabirds of special concern. Crawford *et al.* (2014) reported that four of the seabirds assessed as Endangered compete with South Africa's fisheries for food: African Penguins, Cape Gannets and Cape Cormorants for sardines and anchovies, and Bank Cormorants for rock lobsters (Crawford *et al.* 2015). Populations of seabirds off the West Coast have recently shown significant decreases, with the population numbers of African Penguins currently only 2.5% of what the population was 80 years ago; declining from 1 million breeding pairs in the 1920s, 25 000 pairs in 2009 and 15 000 in 2018 (Sink *et al.* 2019). For Cape Gannets, the global population decreased from about 250 000 pairs in the 1950s and 1960s to approximately 130 000 in 2018, primarily as a result of a >90% decrease in Namibia's population in response to the collapse of Namibia's sardine resource. In South Africa, numbers of Cape Gannets have increased since 1956 and South Africa now holds >90% of the global population. However, numbers have recently decreased in the Western Cape but increased in Algoa Bay, mirroring the southward and eastward shift of sardine and anchovy. Algoa Bay currently holds approximately 75% of the South African Gannet population.

Cape cormorants and Bank cormorants showed a substantial decline from the late 1970s/early 1980s to the late 2000s/early 2010s, with numbers of Cape cormorants dropping from 106 500 to 65 800 breeding pairs, and Bank cormorants from 1 500 to only 800 breeding pairs over that period (Crawford *et al.* 2015).

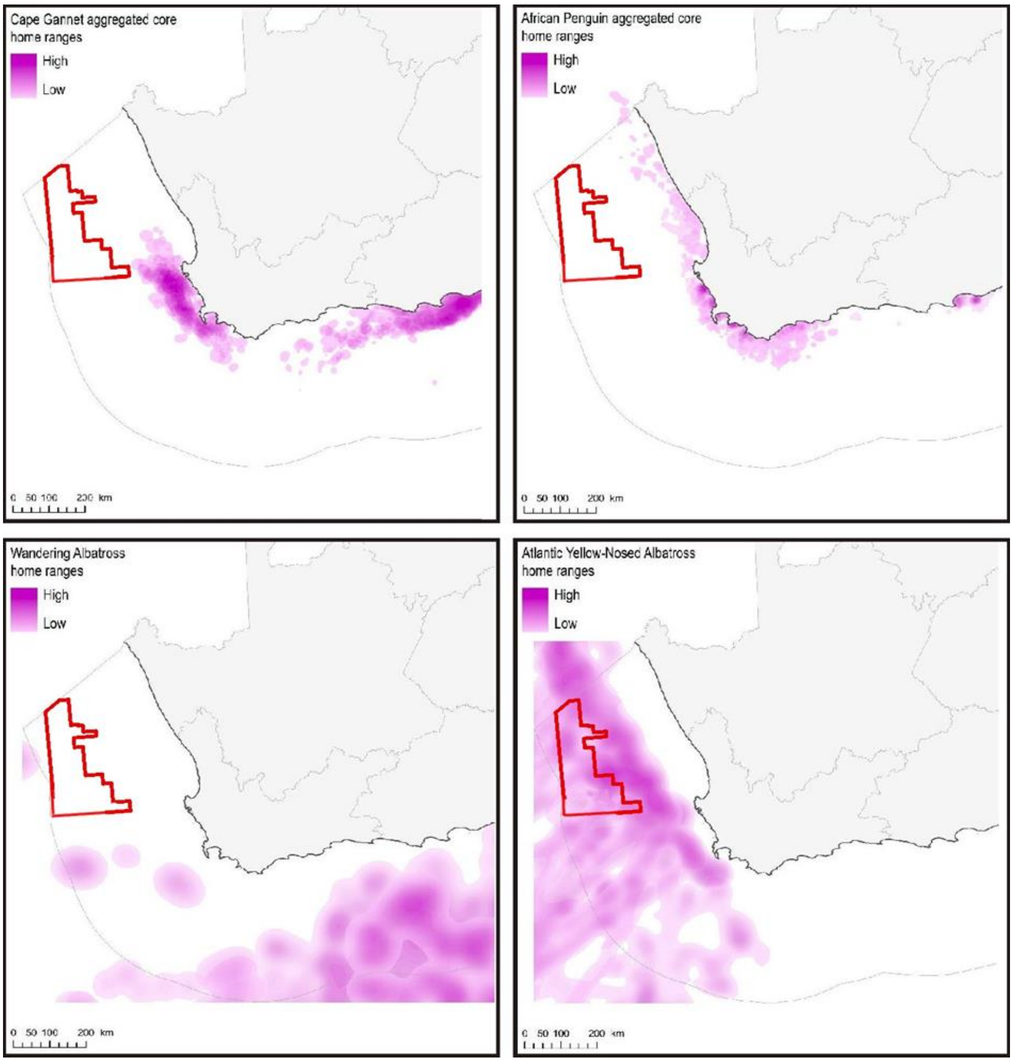


FIGURE 7-27: BLOCK DWOB IN RELATION TO AGGREGATE CORE HOME RANGES OF CAPE GANNET (TOP LEFT), AFRICAN PENGUIN (TOP RIGHT) FOR DIFFERENT COLONIES AND LIFE-HISTORY STAGES, AND FORAGING AREAS OF WANDERING ALBATROSS (BOTTOM LEFT) AND ATLANTIC YELLOW-NOSED ALBATROSS (BOTTOM RIGHT)

Note: For foraging areas, darker shades are areas of higher use and where foraging areas from different colonies overlap Adapted from Harris et al. 2022.

Demersal and pelagic longlining are key contributors to the mortality of albatrosses (Browed albatross 7%, Indian and Atlantic Yellow-Nosed Albatross 3%), petrels (white-chinned petrel 66%), shearwaters and Cape Gannets (2%) through accidental capture (bycatch and/or entanglement in fishing gear), with an estimated annual mortality of 450 individuals of 14 species for the period 2006 to 2013 (Rollinson *et al.* 2017). Other threats include predation by mice on petrel and albatross chicks on sub-Antarctic islands, predation of chicks of Cape, Crowned and Bank Cormorants by Great White Pelicans, and predation of eggs and chicks of African Penguins, Bank, Cape and Crowned Cormorants by Kelp gulls. Disease (avian flu), climate change (heat stress and environmental variability) and oil spills are also considered major contributors to seabird declines (Sink *et al.* 2019).

7.4.3.7. Marine Mammals

The marine mammal fauna occurring off the southern African coast includes several species of whales and dolphins and one resident seal species. Thirty-five species or sub-species/populations of whales and dolphins are known (based on historic sightings or strandings records) or likely (based on habitat projections of known species parameters) to occur in the waters of the South-West Coast (Table 7-6). Of the species listed, the blue whale is considered 'Critically Endangered', fin and sei whales are 'Endangered' and one is considered vulnerable (IUCN Red Data list Categories). Altogether 17 species are listed as 'data deficient' underlining how little is known about cetaceans, their distributions and population trends. The offshore areas have been particularly poorly studied with most available information from deeper waters (>200 m) arising from historic whaling records prior to 1970. In the past ten years, passive acoustic monitoring and satellite telemetry have begun to shed light on current patterns of seasonality and movement for some large whale species Best 2007; Elwen *et al.* 2011; Rosenbaum *et al.* 2014; Shabangu *et al.* 2019; Thomisch *et al.* 2019) but information on smaller cetaceans in deeper waters remains poor. Records from marine mammal observers on seismic survey vessels have provided valuable data into cetacean presence although these are predominantly during summer months (Purdon *et al.* 2020). Information on general distribution and seasonality is improving but data population sizes and trends for most cetacean species occurring on the west coast of southern Africa is lacking.

The Deep Western Orange Basin Block extends from Cape Columbine to South African/Namibian border from roughly the 500 m isobath to ~3 600 m water depth. Oceanographically this area lies largely within the cool waters of the Benguela Ecosystem and receives some input from the warm Agulhas Current as well as the warm waters of the South Atlantic. **In terms of cetacean distribution patterns, the area thus covers a broad range of habitats and species associated with each of those water masses may occur within the target area.** Records from stranded specimens show that the area between St Helena Bay (~32° S) and Cape Agulhas (~34° S, 20° E) is an area of transition between Atlantic and Indian Ocean species and includes records from Benguela associated species such as dusky dolphins, Heaviside's dolphins and long finned pilot whales, and those of the warmer east coast such as striped and Risso's dolphins (Findlay *et al.* 1992). Species such as rough toothed dolphins, Pan-tropical spotted dolphins and short finned pilot whales are known from the southern Atlantic. Owing to the uncertainty of species occurrence offshore, species that may occur there have been included here for the sake of completeness.

The distribution of cetaceans 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 on **the continental slope (200 – 2 000 m) making this the most species rich area for cetaceans and also high in density** (De Rock *et al.* 2019; SLR data). Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across 1 000s of km. **The most common species within the project area (in terms of likely encounter rate not total population sizes) are likely to be the long-finned pilot whale, common dolphin, sperm whale and humpback whale.**

TABLE 7-6: CETACEANS OCCURRENCE OFF THE SOUTH WEST COAST OF SOUTH AFRICA, THEIR SEASONALITY, LIKELY ENCOUNTER FREQUENCY WITH PROPOSED EXPLORATION ACTIVITIES AND SOUTH AFRICAN 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	Data Deficient
Dwarf sperm whale	*Kogia sima*	VHF	Edge	Yes	Year round	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Beradius arnouxii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*	HF	No	Yes	Year round	Data Deficient	Data Deficient

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Blainville's	*Mesoplodon densirostris*	HF	No	Yes	Year round	Data Deficient	Data Deficient
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 brydei (subspp)*	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. brydei*	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	?	Year round	Least Concern	Least Concern
Humpback sp.	*Megaptera novaeangliae*	LF	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	LF	Yes	Yes	Spring/Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	LF	Yes	No	Year round, ONDJFMA	Least Concern	Least Concern

Notes:

- Species recorded by Marine Mammal Observers (MMOs) in Block DWOB are highlighted (CapMarine Environmental 2020).
- Marine animals do not hear equally well at all frequencies within their functional hearing range. Based on the hearing range and sensitivities, Southall *et al (*2019) have categorised noise sensitive marine mammal species into six underwater hearing groups: low-frequency (LF), high-frequency (HF) and very high-frequency (VHF) cetaceans, Sirenians (SI), Phocid carnivores in water (PCW) and other marine carnivores in water (OCW).

Adapted from Child *et al.* 2016

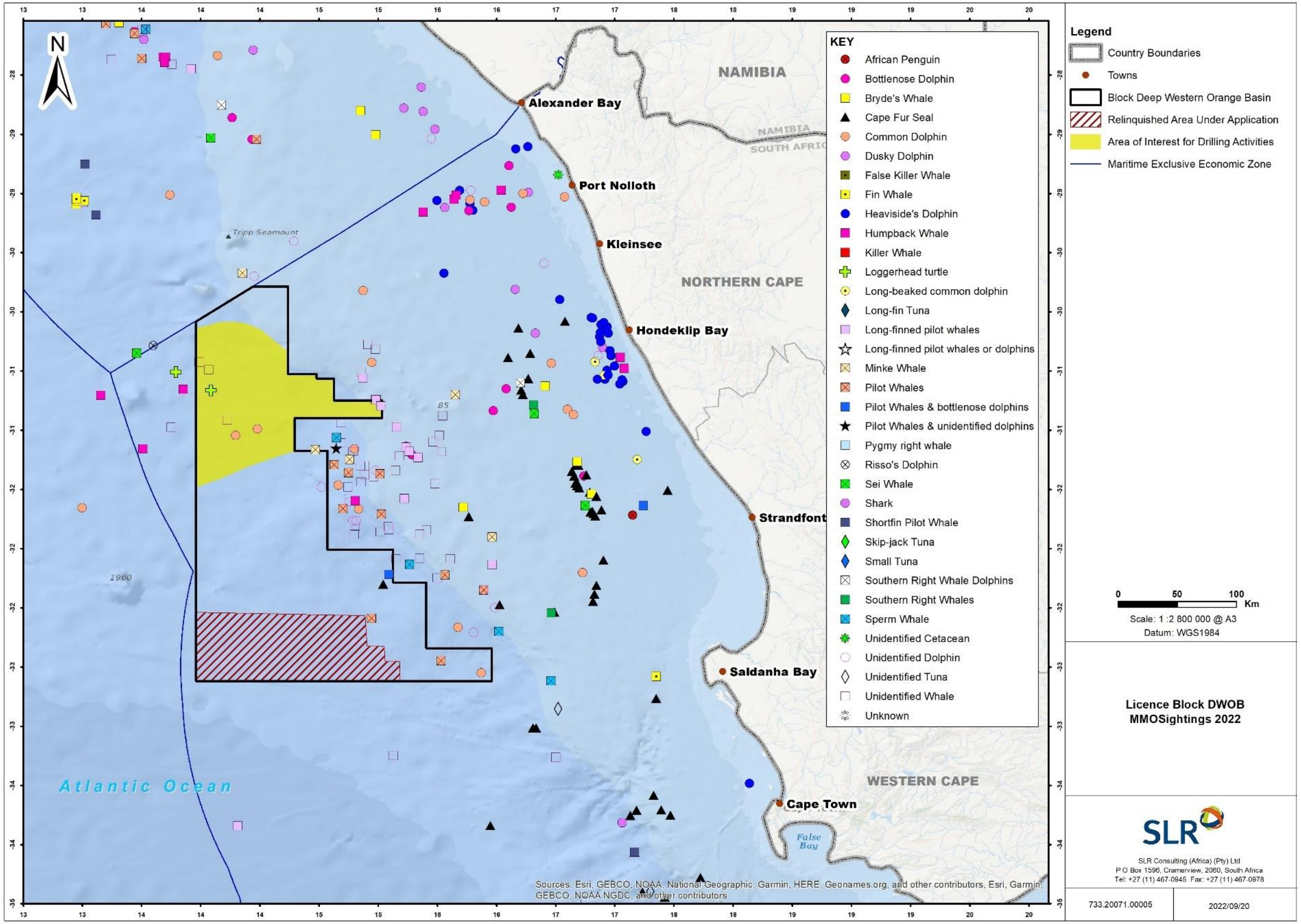


FIGURE 7-28: DISTRIBUTION AND MOVEMENT OF CETACEANS ALONG THE WEST AND SOUTH COASTS OF SOUTH AFRICA COLLATED BETWEEN 2001 AND 2020

Note: Figure depicts separate MMO sightings from seismic surveys undertaken between 2001 and 2020, including the 2020 3D seismic survey within the Area of Interest.

Source: SLR

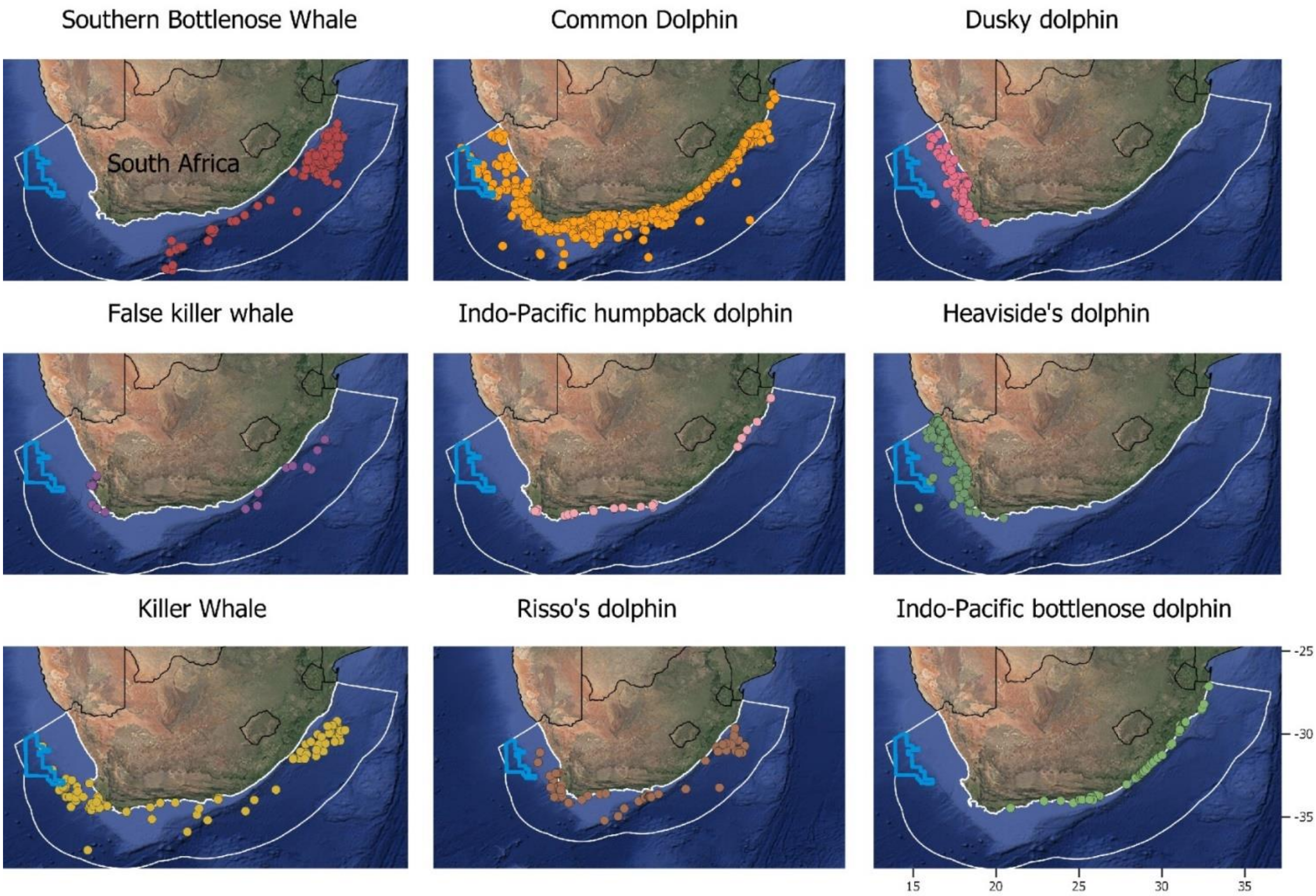


FIGURE 7-29: BLOCK DWOB IN RELATION TO PREDICTED DISTRIBUTIONS FOR NINE ODONTOCETE SPECIES OFF THE COAST OF SOUTH AFRICA

Adapted from: Purdon *et al.* 2020a.

Cetaceans are comprised of two taxonomic groups, the mysticetes (filter feeders with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term 'whale' is used to describe species in both groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontoceti, family Delphinidae and are thus dolphins). Due to differences in sociality, communication abilities, ranging behavior and acoustic behavior, these two groups are considered separately.

Table 7-6 lists the cetaceans likely to be found within the project area, based on all available data sources but mainly: Findlay *et al.* (1992), Best (2007), Weir (2011), De Rock *et al.* (2019), Purdon *et al.* (2020a, 2020b, 2020c), and unpublished records held by Sea Search and those held by SLR Consulting and shared for this report. Figure 7-28 shows distribution of cetaceans along the West and South Coasts between 2001 and 2020 based on MMO records, while Figure 7-29 shows predicted distributions of several odontocete species off the South African Coast. The majority of data available on the seasonality and distribution of large whales in the project area is the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (e.g. migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although almost all data is limited to that collected on the continental shelf close to shore. A review of the distribution and seasonality of the key cetacean species likely to be found within the project area is provided below.

7.4.3.7.1. Mysticete (Baleen) Whales

The majority of mysticetes whales fall into the family Balaenopeteridae. **Those occurring in the area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales.** The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters. **All of these species show some degree of migration either to or through the latitudes encompassed by the broader project area when *en route* between higher latitude (Antarctic or Subantarctic) feeding grounds and lower latitude breeding grounds.**

Depending on the ultimate location of these feeding and breeding grounds, seasonality may be either unimodal, usually in winter months (June-August, e.g. minke and blue whales), or bimodal (e.g. May to July and October to 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. Table 7-7 summarises the seasonality of expected baleen whale occurrence in the project area.

TABLE 7-7: SEASONALITY OF BALEEN WHALES (MYSTICETES) IN THE BROADER PROJECT AREA

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

Note: Based on data from multiple sources, predominantly commercial catches (Best 2007) and data from stranding events (NDP unpubl. data).
Note: Values of High (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

Because of the complexities of the migration patterns, each species is discussed separately below.

- **Bryde's whales:** Two genetically and morphologically distinct populations of Bryde's whales live off the coast of southern Africa (Best 2001; Penry 2010). The "offshore population" lives 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 in January - March. The "inshore population" of Bryde's whale lives mainly on the continental shelf and Agulhas Bank, and is unique amongst baleen whales in the region by being non-migratory. The inshore population has recently been recognised as its own (yet to be named) sub species (*Balaenoptera brydei edeni*, Penry *et al.* 2018) with a total population for this subspecies of likely fewer than 600 individuals. 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 up the West Coast and into Namibia during the winter months (Best 2007). The offshore stock was subjected to heavy whaling in the mid-20th century (Best 2001) and there are no current data on population size or stock recovery therefrom and is currently listed as 'Data deficient' (offshore population) and Vulnerable (inshore population) on the

South African Red List. The inshore stock is regarded as extremely vulnerable and listed as such on the South African red list as it regularly suffers losses from entanglement in trap fisheries and has been subject to significant changes in its prey base due to losses and shifts in the sardine and small pelgic stocks around South Africa. **Encounters in the offshore waters of the licence Block are unlikely.**

- **Sei whales:** Almost all information is based on whaling records 1958-1963, most from shore-based catchers operating within a few hundred km of Saldanha Bay. At this time the species was not well differentiated from Bryde's whales and records and catches of the two species intertwined. There is no current information on population recovery, abundance or much information on distribution patterns outside of the whaling catches and the species remains listed as 'Endangered' on the South African Red List. Sei whales feed at high latitudes (40-50˚S) during summer months and migrate north through South African waters to unknown breeding grounds further north (Best 2007). Their migration pattern thus shows a bimodal peak with numbers west of Saldanha Bay being highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most occurring deeper than 1 000 m (Best & Lockyer 2002). A recent survey to Vema Seamount ~1 000 km west of Cape Town during October to November 2019, encountered a broadly-spread feeding aggregation of over 30 sei and fin whales at around 200 m water depth (Elwen *et al.* in prep). This poorly surveyed area (roughly 32˚S, 15˚E) is just to the Northwest of the historic whaling grounds suggesting this region remains an important feeding area for the species. **As sei whales have been reported by MMOs to the east and adjacent to the Deep Western Orange Basin Block, encounters in the licence area are possible.**

- **Fin whales:** Fin whales were historically caught off the West Coast of South Africa, with a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. However, the location of the breeding ground (if any) and how far north it is remains a mystery (Best 2007). Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). The occasional single whale has been reported during humpback whale research in November in the southern Benguela, and a feeding aggregation of ~30 animals was observed in November 2019 ~200 km west of St Helena Bay in ~2 000 m of water. Current sightings records support the bimodal peak in presence observed from whaling data (but with some chance of year-round sightings) with animals apparently feeding in the nutrient rich Benguela during their southward migration as is observed extensively for humpback and right whales (see below) there is clearly is a chance of encounters year round. There are no recent data on abundance or distribution of fin whales off western South Africa. **The sighting of a fin whale was reported by MMOs during a 3D seismic survey in the Deep Western Orange Basin Block (CapFis 2013a). Encounters in the licence area are thus possible.**

- **Blue whales:** Although Antarctic blue whales were historically caught in high numbers off the South African West Coast, with a single peak in catch rates during July in Namibia and Angola suggesting that these latitudes are close to the northern migration limit for the species in the eastern South Atlantic (Best 2007). Although there were only two confirmed sightings of the species in the area between 1973 and 2006 (Branch *et al.* 2007), evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Tomisch *et al.* 2016) and off western South Africa (Shanbangu *et al.* 2019) and in northern Namibia between May and July (Thomisch 2017) support observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia (water depth >1 000 m) confirm their existence in the area and occurrence in Autumn months (April to June). **Blue whales have previously been sighted by MMOs in the Deep Western Orange Basin Block (CapFish 2013a) although the chance of encounters is considered low.** As the species is 'Critically Endangered' all precautions must be taken to avoid impact.

- **Minke whales**: Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*) and the dwarf minke whale (*B. acutorostrata* subsp.); both species occur in the Benguela (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge (Namibia) shows acoustic presence in June - August and November - December (Thomisch *et al.* 2016), supporting a bimodal distribution in the area. 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 minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. 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 project area, although sightings have been reported in the general project area (SLR data). Thus, encounters within the Deep Western Orange Basin Block may occur.**

- 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 southern and central Namibia being the northern most for the species (Leeney *et al.* 2013). Its distribution off the West Coast of South Africa is thus likely to be **limited to the cooler shelf waters of the main Benguela upwelling areas and encounters within the Deep Western Orange Basin Block** may thus occur.

- **The most abundant baleen whales in the Benguela are southern right whales and humpback whales.** Both species have long been known to feed in the Benguela Ecosystem and numbers since 2000 have grown substantially. The feeding peak in the Benguela is spring and early summer (October – February) and follows the 'traditional' South African breeding season (June – November) and its associated migration (Johnson *et al.* 2022). Some individual right whales are known to move directly from the south coast breeding area into the west coast feeding area where they remained for several months (Barendse *et al.* 2011; Mate *et al.* 2011). Increasing numbers of summer records of both species, from the southern half of Namibia suggest that animals may also be feeding in the Lüderitz upwelling cell (NDP unpubl. data).

- **Humpback whales:** 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). Until recently it was believed that that these breeding grounds were functionally separate from those off east (Mozambique-Kenya-Madagascar), with only rare movements between them (Pomilla & Rosenbaum 2005) and movements to other continental breeding grounds being even more rare. Recent satellite tagging of animals between Plettenberg Bay and Port Alfred during the northward migration, showed them to turn around and end up feeding in the Southern Benguela (Seakamela *et al*. 2015) before heading offshore and southwards using the same route as whales tracked off Gabon and the West Coast of South Africa. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. Furthermore, three separate matches have been made between individuals off South Africa and Brazil by citizen scientist photo-identification (www.happywhale.com). This included whales from the Cape Town and Algoa Bay-Transkei areas. Analysis of humpback whale breeding song on Sub-Antarctic feeding grounds also suggests exchange of singing male whales from western and eastern South Atlantic populations (Darling & Sousa-Lima 2005; Schall *et al.* 2021; but see also Darling *et al.* 2019; Tyarks *et al*. 2021).

In southern African coastal waters, the northward migration stream is larger than the southward peak (Best & Allison 2010; Elwen *et al.* 2014), suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards. On the southward migration, many humpbacks 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.* 2014; 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). The only available abundance estimate put the number of animals in the West African breeding population (Gabon) to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased substantially since this time at about 5% per annum (IWC 2012; see also Wilkinson 2021). The number of humpback whales feeding in the southern Benguela has increased substantially since estimates made in the early 2000s (Barendse *et al.* 2011). Since ~2011, 'supergroups' of up to 200 individual whales have been observed feeding within 10 km from shore (Findlay *et al.* 2017) with many hundred more passing through and whales are now seen in all months of the year around Cape Town. It has been suggested that the formation of these super-groups may be in response to anomalous oceanographic conditions in the Southern Benguela, which result in favourable food availability, thereby leading to these unique humpback whale feeding aggregations (Dey *et al.* 2021; see also Avila *et al.* 2019; Meynecke *et al.* 2020; Cade *et al.* 2021). **Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area, ranging from the coast out beyond the shelf, with year round presence but numbers peaking during the northward migration in June – February and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem. Humpback whale sightings have been reported by MMOs during a 2012 3D seismic survey in the Deep Western Orange Basin Block (CapFish 2013a).** 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 South African west 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 a similar event off Brazil in 2010 (Siciliano *et al.* 2013) was linked to possible infectious disease or malnutrition. Unusual mortality events of humpback whales between 2016 and 2022 have similarly been reported along the US Atlantic Coast from Maine to Florida (https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2022-humpback-whale-unusual-mortality-event-along-atlantic-coast). The West African population may be undergoing similar stresses in response 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.

- **Southern right whales**: 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.* 2011). 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, and still growing 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 Namibia (Roux *et al.* 2001, 2015; de Rock *et al.* 2019) and Mozambique (Banks *et al.* 2011).

Some southern right whales move from the South Coast breeding ground directly to the West Coast feeding ground (Mate *et al.* 2011). **When departing from feeding ground all satellite tagged animals in that study took a direct south-westward track, which would take them across the southern portion of Deep Western Orange Basin Block.** Mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding (Peters *et al.* 2005). While annual surveys have revealed a steady population increase since the protection of the species from commercial whaling, the South African right whale population has undergone substantial changes in breeding cycles and feeding areas (Van Den Berg *et al.* 2020), and numbers of animal using our coast since those studies were done – notably a significant decrease in the numbers of cow-calf-pairs following the all-time record in 2018, a marked decline of unaccompanied adults since 2010 and variable presence of mother-calf pairs since 2015 (Roux *et al.* 2015; Vermeulen *et al.* 2020). The change in demographics are indications of a population undergoing nutritional stress and has been attributed to likely spatial and/or temporal displacement of prey due to climate variability (Vermeulen *et al.* 2020; see also Derville *et al.* 2019; Kershaw *et al.* 2021; van Weelden *et al.* 2021). Recent sightings (2018-2021) confirm that there is still a clear peak in numbers on the West Coast (Table Bay to St Helena Bay) between February and April. **Given this high proportion of the population known to feed in the southern Benguela, and current numbers reported, it is highly likely that several hundreds of right whales can be expected to pass through the southern portion of the Deep Western Orange Basin Block when migrating southwards from the feeding areas between April and June. No sightings were, however, reported during the 2012/13 3D seismic survey in Deep Western Orange Basin Block undertaken between 29 October 2012 and 19 February 2013 (CapFish 2013a).**

7.4.3.7.2. Odontocetes (toothed) whales and dolphins

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging (see Figure 7-29). Those in the region can range in size from 1.6-m long (Heaviside's dolphin) to 17 m (bull sperm whale).

- **Sperm whales**: Most information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 when over 10 000 whales were taken, (Best 1974; Best 2007) although passive acoustic monitoring (Shabangu & Andrew 2020) and sightings from MMOs are beginning to provide insights into current behaviour. 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 live in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come onto the shelf in water 500 - 200 m deep (Best 2007). They are considered to be relatively abundant globally (Whitehead 2002), although no estimates are available for South African waters. Seasonality of historical 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). Analysis of recent passive acoustic monitoring data from the edge of the South African continental shelf (800 – 1 000 m water depth, roughly

80 km WSW of Cape Point) confirms year-round presence. Sperm whales have also been regularly identified by Marine Mammal Observers (MMOs) working in this area. Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually, however, the regular echolocation clicks made by the species when diving make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM). **Sperm whales were the most commonly reported species sighted by MMOs and detected with PAM during 2D and 3D seismic surveys undertaken in the Deep Western Orange Basin Block (CapFish 2013a, 2013b).**

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 (>200 m) off the shelf of the southern African West Coast. **Beaked whales** are all considered to be true deep water species usually being seen in waters in excess of 1 000 – 2 000 m deep (see various species accounts in Best 2007). **Presence in the project area may fluctuate seasonally, but insufficient data exist to define this clearly.** Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often *en masse,* have been recorded in association with naval mid-frequency sonar (Cox *et al.* 2006; MacLeod & D'Amico 2006) and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler (Cox *et al.* 2006). Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, the existing evidence clearly shows that animals change their dive behaviour in response to acoustic disturbance (Tyack *et al.* 2011), and all possible precautions should be taken to avoid causing any harm. **Sightings of beaked whales in the project area are expected to be very low.**

- **Pygmy and Dwarf Sperm Whales**: The genus *Kogia* currently contains two recognised species, the pygmy (*K. breviceps*) and dwarf (*K. sima*) 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). Their abundance and population trends in South African waters are unknown (Seakamela *et al*. 2021). Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic, although their narrow-band high frequency echolocation clicks make them detectable and identifiable (at leas to the genus) using passive acoustic monitoring equipment. The majority of what is known about the distribution and ecology of Kogiid whales in the southern African subregion is derived mainly from stranding records (e.g. Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013, but see also Moura *et al*. 2016). *Kogia* **species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the Deep Western Orange Basin Block at low levels.** 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 approximately 1 000 m.

  During 2020 the incidence of kogiid strandings between Strandfontein on the West Coast and Groot Brak River on the South Coast (n=17), was considerably higher than the annual average during the previous 10 years (n=7). The dwarf sperm whale (*K. sima*) accounted for 60% of these strandings, of which most were recorded during autumn and winter. These seasonal stranding patterns are consistent with previously published accounts for the South African coast. In 2020, 40% of the total strandings were recorded in winter and 15% during summer. The occurrence of strandings throughout the year may, however, indicate the presence of a resident population with a seasonal distributiuon off the South Coast in autumn and winter (Seakamela *et al*. 2020, 2021). The cause of the strandings is unknown.

- **Killer whales:** Killer whales in South African waters were referred to a single morphotype, Type A, although recently a second 'flat-toothed' morphotype that seems to specialise in an elasmobranch diet has been identified but only 5 records are known all from strandings (Best *et al.* 2014). Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off South Africa (Best *et al.* 2010, Elwen *et al.* in prep), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.* 2010). Historically sightings were correlated with that of baleen whales, especially sei whales on their southward migration. In more recent years – their presence in coastal waters (e.g., False Bay) has been strongly linked to the presence and hunting of common dolphins (Best *et al.* 2010; Sea Search unpublished data) and great white sharks (Towner *et al.* 2022). Further from shore, there have been regular reports of killer whales associated with long-line fishing vessels on the southern and eastern Agulhas Bank, and the Cape Canyon to the south-west of Cape Point. **Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the project area at low levels.**

- **False killer whale:** Although the false killer whale is globally recognized as one species, 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). False killer whales are more likely to be confused with the smaller melon-headed or pygmy killer whales with which they share all-black colouring and a similar head-shape, than with killer whales. 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 recorded close to shore (Findlay *et al.* 1992). They usually occur in groups ranging in size from 1 - 100 animals (Best 2007). 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, all between St Helena Bay and Cape Agulhas). **There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007). Encounters within the project area may occur.**

- **Pilot Whales**: Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it but moving inshore to follow prey (primarily squid) (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.** The distinction between long-finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species confined to the southwest Indian Ocean (Best 2007), **it is likely that the majority of pilot whales encountered in the project area will be long-finned.** There are many **confirmed sighting of pilot whales along the shelf edge of South Africa and Namibia including within the project area since 2010 (de Rock *et al.* 2019; Sea Search unpublished data, SLR data, CapFish 2013a, 2013b).** Observed group sizes range from 8-100 individuals (Seakamela *et al*. 2022). **Pilot whales were commonly sighting by MMOs and detected by PAM during 2D and 3D seismic surveys in the Deep Western Orange Basin Block (CapFish 2013a, 2013b).** A recent tagging study showed long-finned pilot whale movements within latutudes of 33-36°S, along the shelf-edge from offshore of Cape Columbine to the Agulhas Bank, with concentrations in canyon areas, especially around the Cape Point Valley, and to a lesser degree around the Cape Canyon. It is postulated that the pilot whales target prey species in these productive areas (Seakamela *et al*. 2022).

- **Common dolphin**: 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 MMO sightings suggest presence to 1 000 m or more (SLR data, Sea Search data). Group sizes of common dolphins can be large, averaging 267 (± *SD* 287) for the South Africa region (Findlay *et al.* 1992). 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 in the Northern Cape or deeper than 2 000 m are of the short-beaked form**. Sightings of common dolphins were reported by MMOs during the 2012/13 3D seismic survey in the Deep Western Orange Basin Block (CapFish 2013a). Encounters in the licence area are thus likely to occur.**

- **Dusky dolphin:** In water <500 m deep, dusky dolphins are likely to be the most frequently encountered small cetacean as they are very "boat friendly" and often approach vessels to bowride**. The species is resident year round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep** (Findlay *et al.* 1992). A recent abundance estimate from southern Namibia calculated roughly ~3 500 dolphins in the ~400 km long Namibian Islands Marine Protected area (Martin *et al.* 2020), at a density of 0.16 dolphins/km^2 and similar density is expected to occur off the South African coast where they are regularly encountered in nearshore waters between Cape Town and Lamberts Bay (Elwen *et al.* 2010; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlay *et al.* 1992). **Encounters in the offshore waters of the licence area are unlikely.**

- **Heaviside's dolphins**: Heaviside's dolphins are relatively abundant in the Benguela ecosystem region with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen *et al.* 2009) and ~1 600 in the ~400 km long Namibian Islands Marine Protected Area (Martin *et al.* 2020). This species occupies waters from the coast to at least 200 m depth, (Elwen *et al.* 2006; Best 2007; Martin *et al.* 2020), and may show a diurnal onshore-offshore movement pattern (Elwen *et al.* 2010a, 2010b), as they feed offshore at night. **Heaviside's dolphins are resident year round but will mostly occur inshore of the Deep Western Orange Basin Block.**

- **Bottlenose dolphin**: Two species of bottlenose dolphins occur around southern Africa. The smaller Indo-Pacific bottlenose dolphin (*aduncus* form) occurs exclusively to the east of Cape Point in water usually less than 50 m deep and generally within 1 km of the shore (Ross 1984; Ross *et al.* 1987). The larger common bottlenose dolphin (*truncatus* form) is widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. 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. **Encounters in the offshore waters of the Deep Western Orange Basin Block are likely to be low.**

- **Risso's Dolphin**: A medium sized dolphin with a distinctively high level of scarring and a proportionally large dorsal fin and blunt head. Risso's dolphins are distributed worldwide in tropical and temperate seas and show a general preference for shelf edge waters <1 500 m deep (Best 2007; Purdon *et al.* 2020a, 2020b). Many sightings in southern Africa have occurred around the Cape Peninsula and along the shelf edge of the Agulhas bank. **Presence within the Deep Western Orange Basin Block is possible.**

- **Other Delphinids:** Several other species of dolphins that might occur in deeper waters at low levels include the pygmy killer whale, southern right whale dolphin, rough toothed dolphin, pantropical spotted dolphin and striped dolphin (Findlay *et al.* 1992; Best 2007). **Nothing is known about the population size or density of these species in the project area but encounters are likely to be rare.**

- **Beaked whales:** These whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. They are all considered to be true deep water species usually being seen in waters in excess of 1 000 – 2 000 m deep (see various species accounts in Best 2007). With recorded dives of well over an hour and in excess of 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals (Tyack *et al.* 2011). All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007). The long, deep dives of beaked whales make them difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives. Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often *en masse,* have been recorded in association with mid-frequency naval sonar (Cox *et al.* 2006; MacLeod & D'Amico 2006) and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler (Southall *et al.* 2008; Cox *et al.* 2006; DeRuiter *et al.* 2013). Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, existing evidence suggests that animals change their dive behaviour in response to acoustic disturbance (Tyack *et al.* 2011), showing a fear-response and surfacing too quickly with insufficient time to release nitrogen resulting in a form on decompression sickness. Necropsy of stranded animals has revealed gas embolisms and haemorrhage in the brain, ears and acoustic fat - injuries consistent with decompression sickness (acoustically mediated bubble formation) (Fernandez *et al.* 2005). Beyond decompression sickness, the fear/flee response may be the first stage in a multi-stage process ultimately resulting in stranding (Southall *et al.* 2008; Jepson *et al.* 2013). This type of stranding event has been linked to both naval sonar and multi-beam echosounders used for commercial-scale side scan sonar (Southall *et al.* 2008). Thus, although hard to detect and avoid, beaked whales are amongst the most sensitive marine mammals to noise exposure and all cautions must be taken to reduce impact. **Sightings of beaked whales in the project area are expected to be very low.**

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

7.4.3.8. Seals (Pinnipeds)

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 7-30). The South African population, which includes the West Coast colonies, was estimated at ca. 725 000 individuals in 2020. This is about 40% of the total southern African population, which has previously been estimated at up to 2 million (Seakamela *et al*. 2022). Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas),* subantarctic fur seal (*Arctocephalus tropicalis),* crabeater *(Lobodon carcinophagus)* and leopard seals (*Hydrurga leptonyx)* (David 1989).

There are a number of Cape fur seal breeding colonies within the broader study area: at Bucchu Twins near Alexander Bay, at Cliff Point (~17 km north of Port Nolloth), at Kleinzee (incorporating Robeiland), Strandfontein Point (south of Hondeklipbaai), Paternoster Rocks and Jacobs Reef at Cape Columbine, Vondeling Island, Robbesteen near Koeberg and Seal Island in False Bay. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). **The closest breeding**

colonies to the Deep Western Orange Basin Block are at Bucchu Twins, Cliff Point, Kleinzee, Strandfontein Point and Cape Columbine located between 150 km and 250 km inshore of the Deep Western Orange Basin Block.

Non-breeding colonies and haul-out sites occur at Doringbaai south of Cliff Point, Rooiklippies, Swartduin and Noup between Kleinzee and Hondeklipbaai, at Spoeg River and Langklip south of Hondeklip Bay, on Bird Island at Lambert's Bay, at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. **These colonies all fall well inshore and to the east of the Deep Western Orange Basin Block.**

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), with bulls ranging further out to sea than females (Figure 7-31). Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish. Benthic feeding to depths of nearly 200 m for periods of up to 2 minutes has, however, also been recorded (Kirkman *et al.* 2015).

The timing of the annual breeding cycle is very regular, occurring between November and January, after which the breeding colonies break up and disperse. 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).

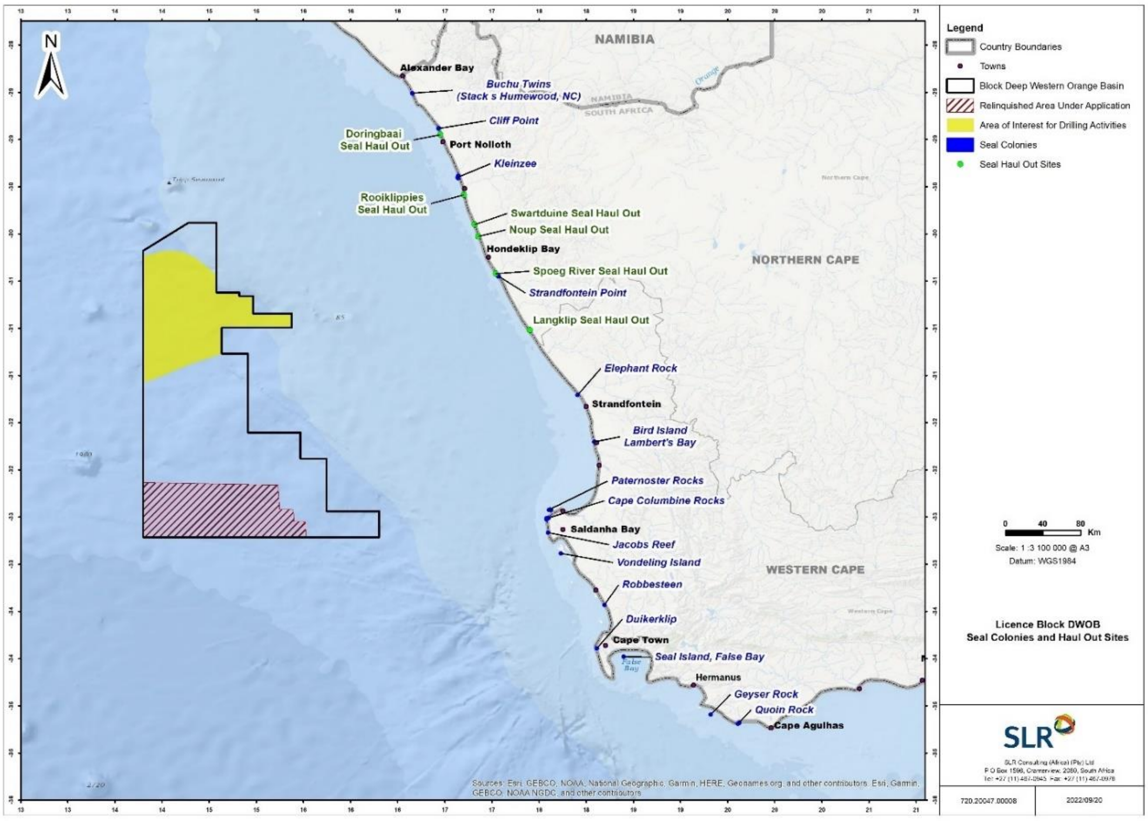


FIGURE 7-30: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO SEAL COLONIES AND HAUL OUT SITES

Source: Shapefiles (seal colonies) obtained from Dr Linda Harris, Coastal and Marine Research Institute, 2022

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status is not regarded as threatened. The Cape Fur Seal population in South Africa is regularly monitored by the Department of Forestry, Fisheries and Environment (DFFE) (e.g. Kirkman *et al.* 2013). The overall population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population (Kirkman *et al.* 2013).

An unprecedented mortality event was recorded in South Africa 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).

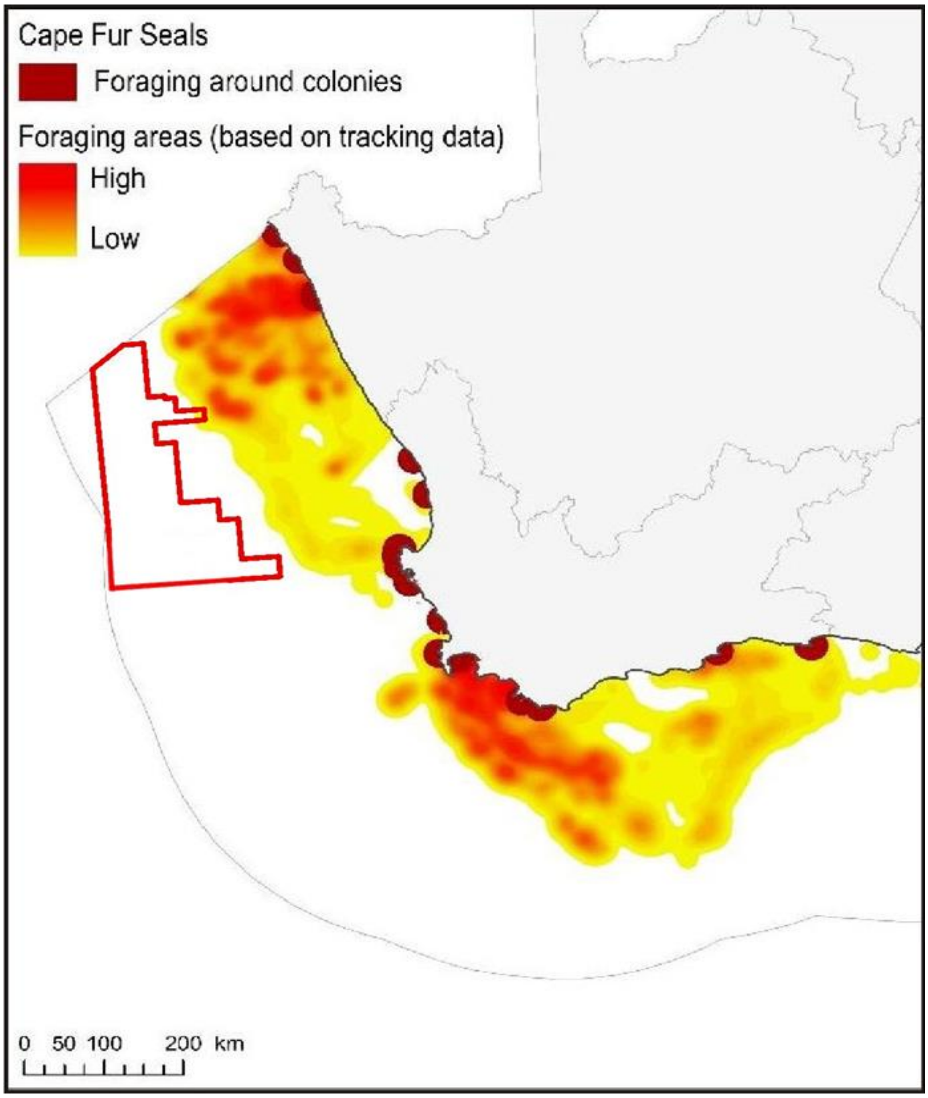


FIGURE 7-31: BLOCK DWOB IN RELATION TO SEAL FORAGING AREAS ON THE WEST AND SOUTH COASTS

Adapted from Harris *et al.* 2022

7.4.4. Coastal Communities

The coastline of the broader project area is characterised by a mixture of intertidal sandy beaches and rocky shores, but also estuaries, rocky subtidal habitats and kelp beds. These were categorised into ecosystem types by Sink et al. (2019) and assigned a threat status depending on their geographic extent and extent of ecosystem degradation. Table 7-8 summarises the threat status of these ecosystem types in the broader project area.

A general description of intertidal and shallow subtidal habitats on the South-west Coast is provided below.

TABLE 7-8: THREAT STATUS OF THE INTERTIDAL AND SHALLOW SUBTIDAL ECOSYSTEM TYPES IN THE PROJECT'S AREA OF INFLUENCE

Ecosystem Type	2019 Threat Status
Agulhas Boulder Shore	Near threatened
Agulhas Dissipative Intermediate Sandy Shore	Least Concern
Agulhas Dissipative Sandy Shore	Near threatened
Agulhas Exposed Rocky Shore	Vulnerable
Agulhas Exposed Stromatolite Rocky Shore	Vulnerable
Agulhas Intermediate Sandy Shore	Least Concern
Agulhas Island	Vulnerable
Agulhas Kelp Forest	Vulnerable
Agulhas Mixed Shore	Near threatened
Agulhas Reflective Sandy Shore	Vulnerable
Agulhas Sheltered Rocky Shore	Endangered
Agulhas Stromatolite Mixed Shore	Vulnerable
Agulhas Very Exposed Rocky Shore	Vulnerable
Agulhas Very Exposed Stromatolite Rocky Shore	Near threatened
Cape Bay	Endangered
Cape Boulder Shore	Vulnerable
Cape Exposed Rocky Shore	Vulnerable
Cape Island	Endangered
Cape Kelp Forest	Vulnerable
Cape Mixed Shore	Vulnerable
Cape Sheltered Rocky Shore	Endangered
Cape Very Exposed Rocky Shore	Near threatened
Eastern Agulhas Bay	Vulnerable
False and Walker Bay	Vulnerable
Namaqua Exposed Rocky Shore	Vulnerable
Namaqua Kelp Forest	Vulnerable
Namaqua Mixed Shore	Vulnerable
Namaqua Sheltered Rocky Shore	Vulnerable
Namaqua Very Exposed Rocky Shore	Vulnerable
Southern Benguela Dissipative Intermediate Sandy Shore	Least Concern
Southern Benguela Dissipative Sandy Shore	Least Concern
Southern Benguela Intermediate Sandy Shore	Near threatened
Southern Benguela Reflective Sandy Shore	Endangered
St Helena Bay	Vulnerable
Western Agulhas Bay	Endangered

Source: Sink *et al.* 2019

7.4.4.1. Intertidal Sandy Beaches

Sandy beaches are one of the most dynamic coastal environments. With the exception of a few beaches in large bay systems (such as St Helena Bay, Saldanha Bay, Table Bay), the beaches along the South African West Coast are typically highly exposed. Exposed sandy shores consist of coupled surf-zone, beach and dune systems, which together form the active littoral sand transport zone (Short & Hesp 1985). The composition of their faunal communities is largely dependent on the interaction of wave energy, beach slope and sand particle size, which is termed beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan *et al.* 1993). Generally, **dissipative beaches** are relatively wide and flat with fine sands and low wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities. **Reflective beaches** in contrast, have high wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf-zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities. **Intermediate beach** conditions exist between these extremes and have a very variable species composition (McLachlan *et al.* 1993; Jaramillo *et al.* 1995, Soares 2003). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of e.g. kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch & Griffiths 1988). As a result of the combination of typical beach characteristics, and the special adaptations of beach fauna to these, beaches act as filters and energy recyclers in the nearshore environment (Brown & McLachlan 2002).

The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone (see Figure 7-32). Due to the exposed nature of the coastline in the study area, most beaches are of the intermediate to reflective type.

The **upper beach dry zone (supralittoral)** is situated above the high water spring (HWS) tide level, and receives water input only from large waves at spring high tides or through sea spray. This zone is characterised by a mixture of air breathing terrestrial and semi-terrestrial fauna, often associated with and feeding on kelp deposited near or on the driftline. Terrestrial species include a diverse array of beetles and arachnids and some oligochaetes, while semi-terrestrial fauna include the oniscid isopod *Tylos granulatus*, and amphipods of the genus *Talorchestia*.

The **mid-beach retention zone and low-beach saturation zone (intertidal zone or mid-littoral zone)** has a vertical range of about 2 m. This mid-shore region is characterised by the cirolanid isopods *Pontogeloides latipes*, *Eurydice* (*longicornis*=) *kensleyi*, and *Excirolana natalensis*, the polychaetes *Scolelepis squamata*, *Orbinia angrapequensis*, *Nepthys hombergii* and *Lumbrineris tetraura*, and amphipods of the families Haustoridae and Phoxocephalidae. In some areas, juvenile and adult sand mussels *Donax serra* may also be present in considerable numbers.

The **surf zone (inner turbulent and transition zones)** extends from the Low Water Spring mark to about -2 m depth. The mysid *Gastrosaccus psammodytes* (Mysidacea, Crustacea), the ribbon worm *Cerebratulus fuscus* (Nemertea), the cumacean *Cumopsis robusta* (Cumacea) and a variety of polychaetes including *Scolelepis squamata* and *Lumbrineris tetraura*, are typical of this zone, although they generally extend partially into the midlittoral above. In areas where a suitable swash climate exists, the gastropod *Bullia digitalis* (Gastropoda, Mollusca) may also be present in considerable numbers, surfing up and down the beach in search of carrion.

The **transition zone** spans approximately 2 - 5 m depth beyond the inner turbulent zone. Extreme turbulence is experienced in this zone, and as a consequence this zone typically harbours the lowest diversity on sandy beaches. Typical fauna include amphipods such as *Cunicus profundus* and burrowing polychaetes such as *Cirriformia tentaculata* and *Lumbrineris tetraura.*

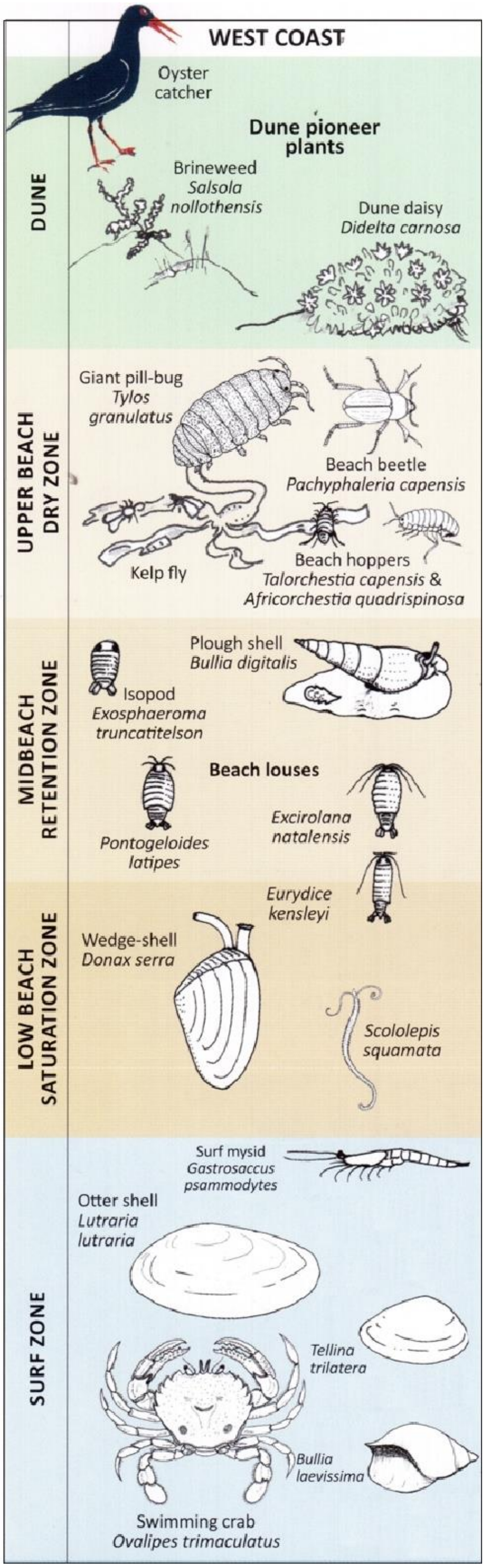


FIGURE 7-32: SCHEMATIC REPRESENTATION OF THE WEST COAST INTERTIDAL BEACH ZONATION

Adapted from Branch & Branch 2018

The **outer turbulent zone** extends beyond the surf zone and below 5 m depth, where turbulence is significantly decreased and species diversity is again much higher. In addition to the polychaetes found in the transition zone, other polychaetes in this zone include *Pectinaria capensis*, and *Sabellides ludertizii*. The sea pen V*irgularia schultzi* (Pennatulacea, Cnidaria) is also common as is a host of amphipod species and the three spot swimming crab *Ovalipes punctatus* (Brachyura, Crustacea).

7.4.4.2. Intertidal Rocky Shores

Several studies on the west coast of southern Africa have documented the important effects of wave action on the intertidal rocky-shore community. Specifically, wave action enhances filter-feeders by increasing the concentration and turnover of particulate food, leading to an elevation of overall biomass despite low species diversity (McQuaid & Branch 1985, Bustamante & Branch 1995, 1996a, Bustamante *et al.* 1997). Conversely, sheltered shores are diverse with relatively low biomass, and only in relatively sheltered embayments does drift kelp accumulate and provide a vital support for very high densities of kelp trapping limpets, such as *Cymbula granatina* that occur exclusively there (Bustamante *et al.* 1995). In the subtidal, these differences diminish as wave exposure is moderated with depth.

West Coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities: The Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones. These biological zones correspond roughly to zones based on tidal heights (Figure 7-33). Tolerance to the physical stresses associated with life on the intertidal, as well as biological interactions such as herbivory, competition and predation interact to produce these five zones.

The uppermost part of the shore is the **supralittoral fringe**, which is the part of the shore that is most exposed to air, perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny periwinkle *Afrolittorina knysnaensis*, and the red alga *Porphyra capensis* constituting the most common macroscopic life.

The **upper mid-littoral** is characterised by the limpet *Scutellastra granularis*, which is present on all shores. The gastropods *Oxystele variegata*, *Nucella dubia*, and *Helcion pectunculus* are variably present, as are low densities of the barnacles *Tetraclita serrata*, *Octomeris angulosa* and *Chthalamus dentatus*. Flora is best represented by the green algae *Ulva* spp.

Toward the lower **Mid-littoral or Lower Balanoid zone**, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds with a variable representation of: green algae – *Ulva* spp, *Codium* spp.; brown algae – *Splachnidium rugosum*; and red algae – *Aeodes orbitosa*, *Mazzaella (=Iridaea) capensis*, *Gigartina polycarpa* (=*radula*), *Sarcothalia* (=*Gigartina*) *stiriata*, and with increasing wave exposure *Plocamium rigidum* and *P. cornutum*, and *Champia lumbricalis*. The gastropods *Cymbula granatina* and *Burnupena* spp. are also common, as is the reef building polychaete *Gunnarea capensis*, and the small cushion starfish *Patiriella exigua*. On more exposed shores, almost all of the primary space can be occupied by the dominant alien invasive mussel *Mytilus galloprovincialis*. First recorded in 1979 (although it is likely to have arrived in the late 1960's), it is now the most abundant and widespread invasive marine species spreading along the entire West Coast and parts of the South Coast (Robinson *et al.* 2005). *M. galloprovincialis* has partially displaced the local mussels *Choromytilus meridionalis* and *Aulacomya ater* (Hockey & Van Erkom Schurink 1992), and competes with several indigenous limpet species (Griffiths *et al.* 1992; Steffani & Branch 2003a, b). Recently, another alien invasive has been recorded, the acorn barnacle *Balanus glandula*, which is native to the west coast of North America where it is the most common intertidal barnacle. The presence of *B. glandula* in South Africa was only noticed a few years ago as it had always been confused with the native barnacle *Cthamalus dentatus* (Simon-Blecher *et al.* 2008). There is, however, evidence that it has been in South Africa since at least 1992 (Laird & Griffith 2008). At the time of its discovery, the barnacle was recorded from 400 km of coastline from Elands Bay to Misty Cliffs near Cape Point (Laird & Griffith 2008). Thus, it is likely that it occurs inshore of the Deep Western Orange Basin Block. When present, the barnacle is typically abundant at the mid zones of semi-exposed shores.

Along the **sublittoral fringe**, the large kelp-trapping limpet *Scutellastra argenvillei* dominates forming dense, almost monospecific stands achieving densities of up to 200/m^2 (Bustamante *et al.* 1995). Similarly, *C. granatina* is the dominant grazer on more sheltered shores, also reaching extremely high densities (Bustamante *et al.* 1995). On more exposed shores *M. galloprovincialis* dominates. There is evidence that the arrival of the alien *M. palloprovincialis* has led to strong competitive interaction with *S. argenvillei* (Steffani & Branch 2003a, 2003b, 2005). The abundance of the mussel changes with wave exposure, and at wave-exposed locations, the mussel can cover almost the entire primary substratum, whereas in semi-exposed situations it is never abundant. As the cover of *M. galloprovincialis* increases, the abundance and size of *S. argenvillei* on rock declines and it becomes confined to patches within a matrix of mussel bed. As a result exposed sites, once dominated by dense populations of the limpet, are now largely covered by the alien mussel. Semi-exposed shores do, however, offer a refuge preventing global extinction of the limpet. In addition to the mussel and limpets, there is variable representation of the flora and fauna described for the lower mid-littoral above, as well as the anemone *Aulactinia reynaudi*, numerous whelk species and the sea urchin *Parechinus angulosus*. Some of these species extend into the subtidal below.

The invasion of west coast rocky shores by another mytilid, the small *Semimytilus algosus*, has been noted (de Greef *et al.* 2013). It is hypothesized that this species has established itself fairly recently, probably only in the last ten years. Its current range extends from the Groen River mouth in the north to Bloubergstrand in the south. Where present, it occupies the lower intertidal zone, where they completely dominate primary rock space, while *M. galloprovincialis* dominates higher up the shore. Many shores on the West Coast have thus now been effectively partitioned by the three introduced species, with *B. glandula* colonizing the upper intertidal, *M. galloprovincialis* dominating the mid-shore, and now *S. algosus* smothering the low-shore (de Greef *et al.* 2013).

7.4.4.3. Rocky Subtidal Habitat and Kelp Beds

Biological communities of the rocky sublittoral on the southwest coast can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora, and an offshore zone below 10 m depth dominated by fauna. This shift in communities is not knife-edge, and rather represents a continuum of species distributions, merely with changing abundances.

From the sublittoral fringe to a depth of between 5 and 10 m, the benthos is largely dominated by algae, in particular two species of kelp. The canopy forming kelp *Ecklonia maxima* extends seawards to a depth of about 10 m. The smaller *Laminaria pallida* forms a sub-canopy to a height of about 2 m underneath *Ecklonia*, but continues its seaward extent to about 30 m depth, although further north up the west coast increasing turbidity limits growth to shallower waters (10-20 m) (Velimirov *et al.* 1977; Jarman & Carter 1981; Branch 2008). *Ecklonia maxima* is the dominant species in the south forming extensive beds from west of Cape Agulhas to north of Cape Columbine, but decreasing in abundance northwards. *Laminaria* becomes the dominant kelp north of Cape Columbine and thus in the project area, extending from Danger Point east of Cape Agulhas to Rocky Point in northern Namibia (Stegenga *et al.* 1997; Rand 2006).

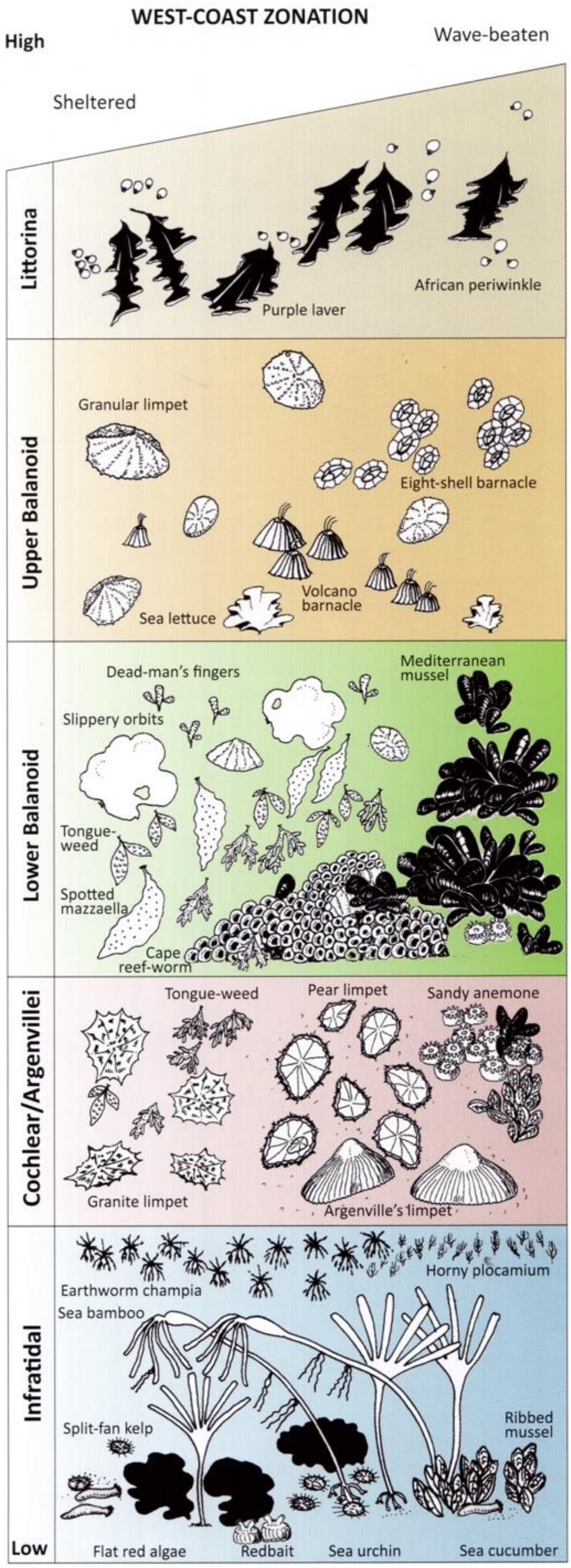


FIGURE 7-33: SCHEMATIC REPRESENTATION OF THE WEST COAST INTERTIDAL ROCKY SHORE ZONATION

Adapted from Branch & Branch 2018

Kelp beds absorb and dissipate much of the typically high wave energy reaching the shore, thereby providing important partially-sheltered habitats for a high diversity of marine flora and fauna, resulting in diverse and typical kelp-forest communities being established. Through a combination of shelter and provision of food, kelp beds support recruitment and complex trophic food webs of numerous species, including commercially important rock lobster stocks (Branch 2008).

Growing beneath the kelp canopy, and epiphytically on the kelps themselves, are a diversity of understorey algae, which provide both food and shelter for predators, grazers and filter-feeders associated with the kelp bed ecosystem. Representative under-storey algae include *Botryocarpa prolifera*, *Neuroglossum binderianum*, *Botryoglossum platycarpum*, *Hymenena venosa* and *Rhodymenia* (=*Epymenia*) *obtusa*, various coralline algae, as well as subtidal extensions of some algae occurring primarily in the intertidal zones (Bolton 1986). Epiphytic species include *Polysiphonia virgata*, *Gelidium vittatum (=Suhria vittata)* and *Carpoblepharis flaccida*. In particular, encrusting coralline algae are important in the under-storey flora as they are known as settlement attractors for a diversity of invertebrate species. The presence of coralline crusts is thought to be a key factor in supporting a rich shallow-water community by providing substrate, refuge, and food to a wide variety of infaunal and epifaunal invertebrates (Chenelot *et al.* 2008).

The sublittoral invertebrate fauna is dominated by suspension and filter-feeders, such as the mussels *Aulacomya ater* and *Choromytilus meriodonalis*, and the Cape reef worm *Gunnarea capensis*, and a variety of sponges and sea cucumbers. Grazers are less common, with most herbivory being restricted to grazing of juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin *Parechinus angulosus*, with lesser grazing pressure from limpets, the isopod *Paridotea reticulata* and the amphipod *Ampithoe humeralis*. The abalone *Haliotis midae*, an important commercial species present in kelp beds south of Cape Columbine is naturally absent north of there. Key predators in the sub-littoral include the commercially important West Coast rock lobster *Jasus lalandii* and the octopus *Octopus vulgaris*. The rock lobster acts as a keystone species as it influences community structure *via* predation on a wide range of benthic organisms (Mayfield *et al.* 2000). Relatively abundant rock lobsters can lead to a reduction in density, or even elimination, of black mussel *Choromytilus meriodonalis*, the preferred prey of the species, and alter the size structure of populations of ribbed mussels *Aulacomya ater*, reducing the proportion of selected size-classes (Griffiths & Seiderer 1980). Their role as predator can thus reshape benthic communities, resulting in large reductions in taxa such as black mussels, urchins, whelks and barnacles, and in the dominance of algae (Barkai & Branch 1988; Mayfield 1998).

Of lesser importance as predators, although numerically significant, are various starfish, feather and brittle stars, and gastropods, including the whelks *Nucella* spp. and *Burnupena* spp. Fish species commonly found in kelp beds off the West Coast include hottentot *Pachymetopon blochii*, two tone finger fin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis*, rock suckers *Chorisochismus dentex* and the catshark *Haploblepharus pictus* (Branch *et al.* 2010).

There is substantial spatial and temporal variability in the density and biomass of kelp beds, as storms can remove large numbers of plants and recruitment appears to be stochastic and unpredictable (Levitt *et al.* 2002; Rothman *et al.* 2006). Some kelp beds are dense, whilst others are less so due to differences in seabed topography, and the presence or absence of sand and grazers.

7.4.4.4. Estuaries

Location of estuaries on the West / South-West and South Coasts and their conservation status are summarised in Figure 7-34**.** Estuaries along the West Coasts generally fall within the Cool Temperate bioregion. There are three perennial river mouths that are always open to the sea and have estuarine systems in their lower reaches:

the Orange, Olifants and Berg Rivers. The Berg River Estuary has the largest and most diverse associated saline and freshwater wetlands compared to all other permanently open estuaries in South Africa. Langebaan is an estuarine lagoon comprising shallow intertidal sand banks and deeper channels that experience tidally driven input of nutrient rich, upwelled water from the sea and groundwater input in the upper reaches. Together, this creates an ecologically productive system that supports long-standing fisheries. Other estuaries include the Verlorenvlei and Klein estuarine lakes. The numerous smaller estuaries along the West Coast are intermittently, or seasonally, open (Holgat, Buffels, Swartlintjies, Bitter, Spoeg, Groen, Brak, Sout and Jakkals Rivers).

Predominantly open estuaries, estuarine lagoons and estuarine bays are particularly important for recruitment for some inshore linefish species and are the most vulnerable to marine pollution events as they receive tidal inflows almost constantly.

Estuarine habitats are highly variable environments with salinity, temperature pH and other variables change with the tides, seasons and climatic conditions. Changes in the extent of water coverage and flow may alternately expose estuarine organisms to desiccation and scouring floods. This high variability has led to a high degree of specialisation within estuaries.

The smaller estuaries are generally wave-dominated, with little freshwater inflow to maintain inlet stability and over 75% of South African estuaries close periodically due to wave-driven sandbar formation. If these periods persist for lengthy time periods, warm, hypersaline conditions can form (van Niekerk *et al.* 2019), which are unfavourable to most estuarine fauna. Toxic algal blooms are also common under these conditions and increase the likelihood of fish and invertebrate mortality.

There are 64 estuarine systems along the West Coast between the Orange River and Cape Agulhas (SANBI 2018). Approximately 75% of the Cool Temperate bioregion estuarine ecosystem (West Coast) types are 'Critically Endangered' or 'Endangered', while 13% are considered 'Vulnerable' (Table 7-9). Of the estuaries on the West Coast, the **Orange River wetlands, Verlorenvlei and Langebaan are proclaimed as Ramsar Sites.** Although Langebaaan falls within a National Parks (National Protected Areas Register 2020), the Orange and Verlorenvlei estuaries do not have formal protection.

Approximately 176 estuarine associated plant species are known within South Africa, with 56 species associated with salt marsh habitat. Salt marsh dominates the vegetation in the cool temperate estuaries along the West coast. The Langebaan and Olifants estuaries support large salt marsh habitat, with the combined area of inter- and supratidal habitat of 1 350 ha and 1 010 ha, respectively. There is a high degree of endemism with only 66 estuarine plant species occurring in five or more estuaries nationally (van Niekerk *et al.* 2019).

The vulnerable freshwater mullet *Pseudomyxus capensis* is one of the few marine fish species that spawns at sea but makes extensive use of the estuarine environment as a nursery area. Endemic to South Africa it occurs predominantly from Kosi Bay to Table Bay but has recently been recorded in a few estuaries on the West Coast as far north as the Orange River indicating that it may be expanding its range in response to climate change. The razor clam *Solen capensis* is endemic to estuaries in the cool temperate bioregions in South Africa, occurring from the Olifants Estuary on the West Coast to St Lucia on the East Coast.

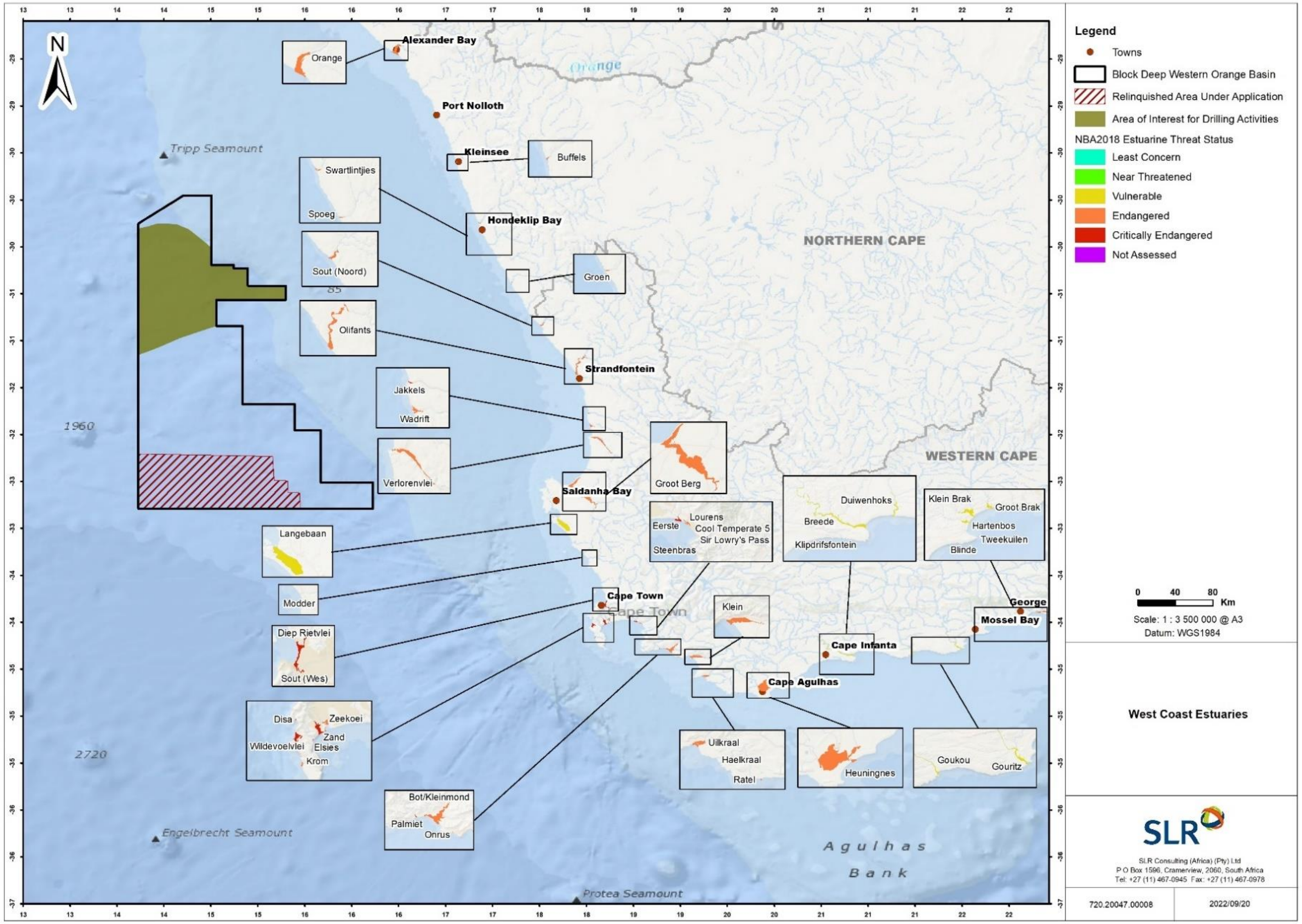


FIGURE 7-34: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF THREATENED ESTUARINE ECOSYSTEMS OF THE WEST/ SOUTH-WEST COAST

Adapted from Van Niekerk *et al.* 2019

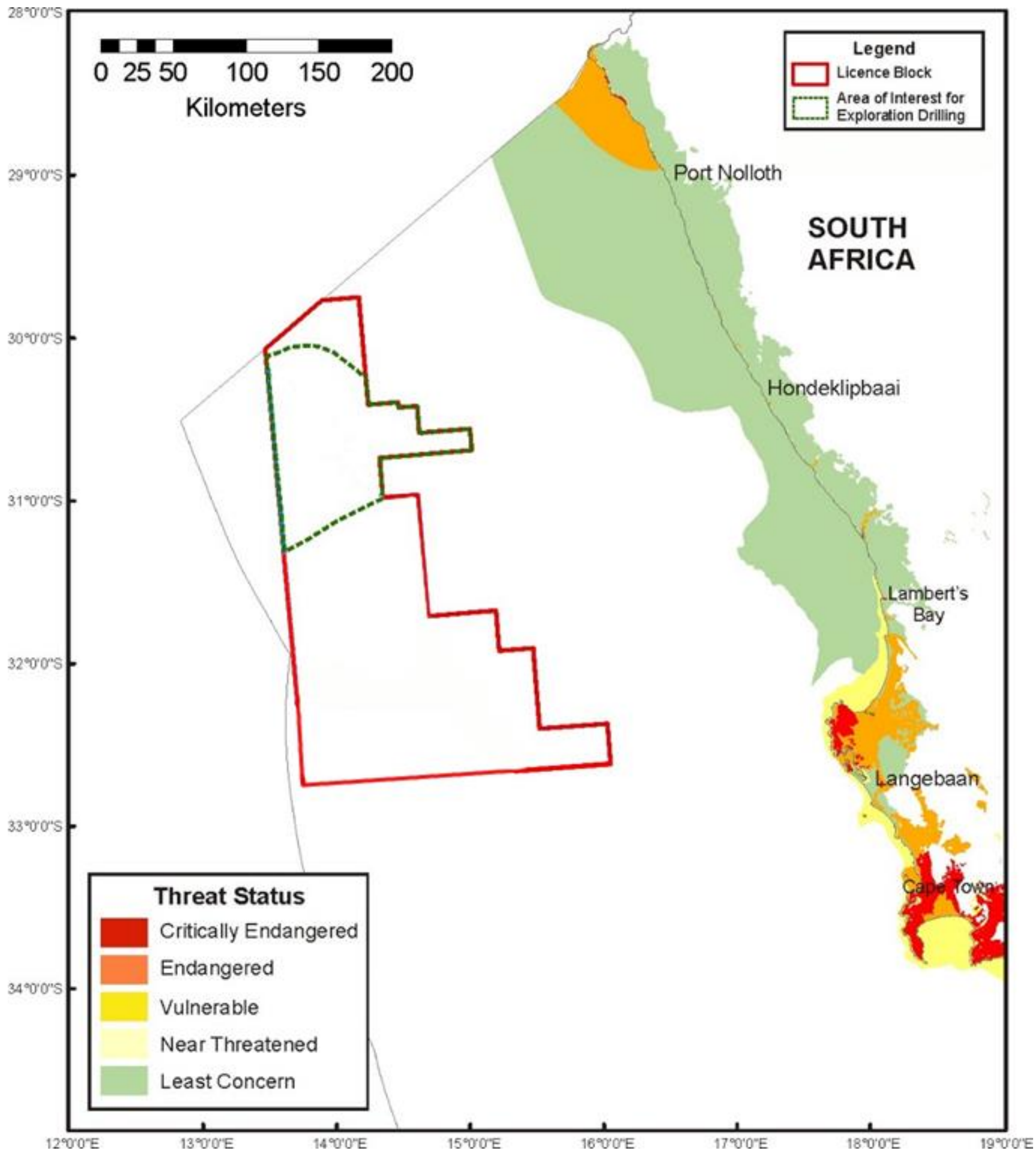


FIGURE 7-35: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF THREATENED COASTAL ECOSYSTEM TYPES ALONG THE WEST COAST

Adapted from Harris *et al.* 2019

Even the common species in the West and Southwest Coast estuaries have ranges restricted to southern Africa; sand and mud prawns *Callichirus krausii* and *Upogebia africana* are limited to southern Africa, while the freshwater sand-shrimp (*Paleamon capensis*) is endemic to South Africa (van Niekerk *et al.* 2019). Turpie *et al.* (2012) and Hockey *et al.* (2005) also list 35 bird species that are likely to be dependent on estuaries, many of which occur throughout the West and Southwest Coast. Estuaries are highly productive systems and offer rich feeding grounds, warmer temperatures and sheltered habitat for many organisms. The high productivity is exploited by many line-fish and harvested invertebrate species either as a nursery or later in life either directly through habitat availability or indirectly through the contribution to overall coastal productivity (van Niekerk *et al.* 2019). Turpie *et al.* (2017) estimated the contribution of the estuarine nursery function as R960 million in 2018 terms (equivalent to over R1 billion in 2020) to the South African economy, with the highest value attributed to the estuaries of the south Western and Eastern Cape.

TABLE 7-9: THREAT STATUS OF THE ESTUARIES IN THE BROADER PROJECT AREA FROM NAMIBIAN BORDER TO CAPE AGULHAS

Estuary	2018 Threat Status	Estuary	2018 Threat Status
Orange	Endangered	Krom	Endangered
Buffels	Endangered	Silwermyn	Critically Endangered
Swartlintjies	Endangered	Zand	Critically Endangered
Spoeg	Endangered	Zeekoei	Endangered
Groen	Endangered	Eerste	Critically Endangered
Sout (noord)	Endangered	Lourens	Endangered
Olifants	Endangered	Sir Lowry's Pass	Endangered
Jakkals	Critically Endangered	Steenbras	Least Concern
Wadrift	Endangered	Rooiels	Endangered
Verlorenvlei	Endangered	Buffels (Oos)	Endangered
Groot Berg	Endangered	Palmiet	Critically Endangered
Langebaan	Vulnerable	Bot/Kleinmond	Endangered
Diep/Rietvlei	Critically Endangered	Onrus	Endangered
Sout (Wes)	Critically Endangered	Klein	Endangered
Disa	Critically Endangered	Uilkraals	Endangered
Wildevoëlvlei	Critically Endangered	Ratel	Endangered
Schuster	Endangered	Heuningnes	Endangered

Note: Only true estuaries, not micro-systems are listed.
Source: Van Niekerk *et al.* 2019

7.4.4.5. Coastal Sensitivity

Harris *et al.* (2019) compiled a GIS habitat map for the entire South African coastline, which identified that 60% of coastal ecosystem types are threatened, thereby having proportionally three times more threatened ecosystem types than the rest of the country. The spatial distribution of threatened coastal ecosystem types in the broader project area is illustrated in Figure 7-35. Coastal sensitivity would need to be taken into consideration in the event of an oil spill.

7.5. MARINE PROTECTED AND SENSITIVE AREAS

Numerous conservation areas and a coastal Marine Protected Area (MPA) exist along the coastline of the Western Cape, although none overlap with the Deep Western Orange Basin Block.

7.5.1. Marine Protected Areas

'No-take' MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) are absent northwards from Cape Columbine (Emanuel *et al.* 1992; Lombard *et al.* 2004). This resulted in substantial portions of the coastal and shelf-edge marine biodiversity in the area being assigned a threat status of 'Critically Endangered', 'Endangered' or 'Vulnerable' in the 2011 National Biodiversity Assessment (NBA) (Lombard *et al.* 2004; Sink *et al.* 2012).

Using biodiversity data mapped for the 2004 and 2011 NBAs a systematic biodiversity plan was developed for the West Coast (Majiedt et al. 2013) with the objective of identifying both coastal and offshore priority areas for

MPA expansion. Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. To this end, nine focus areas were identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas were carried forward during Operation Phakisa, which identified potential offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African Exclusive Economic Zone (EEZ) to 5%. The approved MPAs within the broad project area are shown in Figure 7-36. **Although the Deep Western Orange Basin Block overlaps with the Orange Shelf Edge MPA, the Area of Interest for drilling specifically avoids both this MPA and the associated EBSA (see later). These are described briefly below.**

Coastal Marine Protected Areas

- The **Namaqua National Park MPA** provides the first protection to habitats in the Namaqua bioregion, including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape hakes, and the coastal areas support kelp forests and deep mussel beds, which serve as important habitats for the West Coast rock lobster. This 500 km^2 MPA was proclaimed in 2019, both to boost tourism to this remote area and to provide an important baseline from which to understand ecological changes (e.g. introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.

- The **Rocher Pan MPA**, which stretches 500 m offshore of the high water mark of the adjacent Rocher Pan Nature Reserve, was declared in 1966. The MPA primarily protects a stretch of beach important as a breeding area to numerous waders. It is located in St Helena Bay.

- The **West Coast National Park**, which was established in 1985 incorporates the Langebaan Lagoon and Sixteen Mile Beach MPAs, as well the islands Schaapen (29 ha), Marcus (17 ha), Malgas (18 ha) and Jutten (43 ha). Langebaan Lagoon was designated as a Ramsar site in April 1988 under the Convention on Wetlands of International Importance especially as Waterfowl Habitat. The lagoon is divided into three different utilization zones namely: wilderness, limited recreational and multi-purpose recreational areas. The wilderness zone has restricted access and includes the southern end of the lagoon and the inshore islands, which are the key refuge sites of the waders and breeding seabird populations respectively. The limited recreation zone includes the middle reaches of the lagoon, where activities such as sailing and canoeing are permitted. The mouth region is a multi-purpose recreation zone for power boats, yachts, water-skiers and fishermen. However, no collecting or removal of abalone and rock lobster is allowed. The length of the combined shorelines of Langebaan Lagoon MPA and Sixteen Mile Beach is 66 km. The uniqueness of Langebaan lies in its being a warm oligotrophic lagoon, along the cold, nutrient-rich and wave exposed West Coast.

- The **Table Mountain National Park (TMNP) MPA** was declared in 2004, and includes 996 km^2 of the sea area and 137 km of coastline around the Cape Peninsula from Moullie Point in the North to Muizenberg in the south. Although fishing is allowed in the majority of the MPA (subject to Department of Agriculture, Forestry and Fisheries (DAFF) permits, regulations and seasons), the MPA includes six 'no-take' zones where no fishing or extractive activities are allowed. These 'no-take' zones are important breeding and nursery areas for a wide variety of marine species thereby providing threatened species with a chance to recover form over-exploitation.

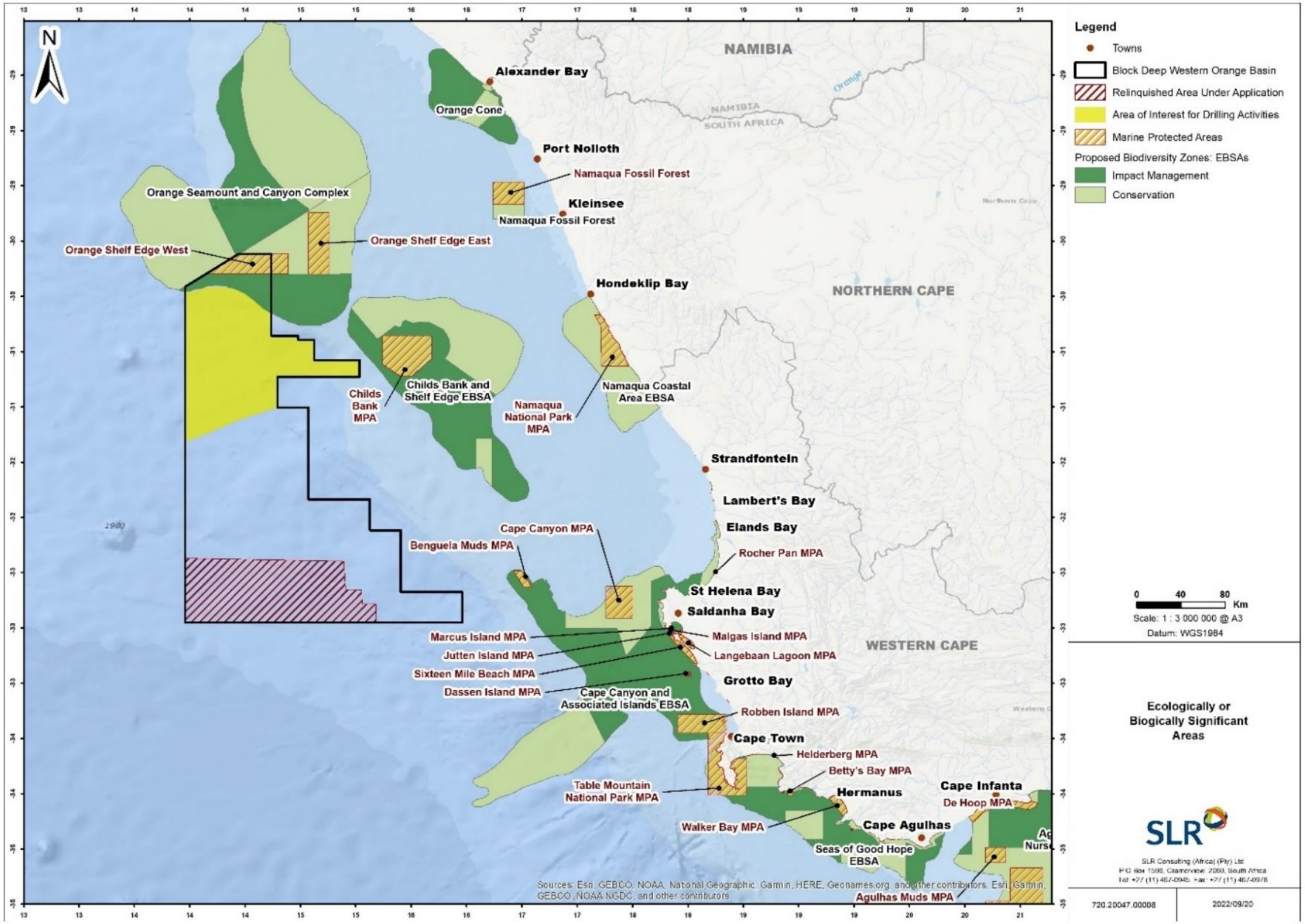


FIGURE 7-36: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO MPAS AND ESBAS ALONG THE WEST COAST

Adapted from MARISMA EBSA Workstream 2020

Offshore Marine Protected Areas

- The **Orange Shelf Edge MPA** covers depths of between 250 m and 1 500 m and is unique as it has to date never been trawled. Proclaimed in 2019, this MPA provides a glimpse into what a healthy seabed should look like, what animals live there and how the complex relationships between them support important commercial fish species such as hake, thereby contributing fundamentally towards sustainable fisheries development. This MPA also protects the pelagic habitats that are home to predators such as blue sharks, as well as surface waters where thousands of seabirds such as Atlantic yellow-nosed albatrosses feed.

- The 1 335 km^2 **Child's Bank MPA**, located inshore of Block DWOB, supports seabed habitats inhabited by a diversity of starfish, brittle stars and basket stars, many of which feed in the currents passing the bank's steep walls. Although trawling has damaged coral in the area, some pristine coral gardens remain on the steepest slopes. The Child's Bank area was first proposed for protection in 2004 but was only proclaimed in 2019, after reducing its size to avoid petroleum wellheads and mining areas. The MPA provides critical protection to these deep sea habitats (180 - 450 m) as they allow for the recovery of important nursery areas for young fish.

- The **Benguela Muds MPA**, is the smallest of the South African offshore MPAs. At only 72 km^2 the muddy habitats located in this area are created by sediment washed down the Orange River and out to sea. These mud habitats are of limited extent and were considered 'critically endangered' on South Africa's deep continental margin of the west coast (Sink *et al.* 2014). The MPA represents the least trawled stretch of muddy seabed on the west coast.

- The **Namaqua Fossil Forest MPA,** which lies well inshore of Block DWOB, provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an Ecologically and Biologically Significant Area (EBSA). The 1 200 km^2 MPA protects the unique fossil forests and the surrounding seabed ecosystems and including a new species of sponge previously unknown to science.

- The **Cape Canyon** is a deep and dramatic submarine canyon carved into the continental shelf and extending to a maximum depth of 3 600 m. The 580 km^2 MPA was proclaimed in 2019 and protects the upper part of the canyon where depths range from 180 to 500 m. Underwater footage has revealed a rich diversity of seafans, hermit crabs and mantis shrimps, with hake, monk and john dory resident on the soft canyon floor. Rocky areas in the west of the canyon support fragile rocky habitat, but the area also includes sandy and muddy habitats, which have been trawled in the past. Interaction of nutrient-rich bottom water with a complex seascape results in upwelling, which in turn provides productive surface waters in which seabirds, humpback whales and Cape fur seals feed. The MPA lies well inshore of Block DWOB, approximately 270 km southeast of the Area of Interest.

- The 612 km^2 **Robben Island MPA** was proclaimed in 2019 to protect the surrounding kelp forests - one of the few areas that still supports viable stocks of abalone. The island harbours the 3rd largest penguin colony, with the breeding population peaking in 2004 at 8 524, but declining since. The island also holds the largest numbers of breeding Bank Cormorant in the Western Cape (120 pairs in 2000) and significant populations of Crowned Cormorant, African Black Oystercatcher (35 breeding pairs in 2000), Hartlaub's Gull and Swift Tern.

Sensitive Areas

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna off the edge of the continental shelf, the marine component of the 2018 National Biodiversity Assessment (Sink *et al.* 2019), rated the South Atlantic bathyal and abyssal unconsolidated habitat types that characterise depths beyond 500 m, as being of 'Least concern' (see Figure 7-13), reflecting the great extent of these habitats in the South African Exclusive Economic Zone (EEZ). However, those ecosystem types occurring along the shelf edge (-500 m) and Cape Canyon are considered 'Vulnerable', with isolated portions being rates as 'Endangered' (Cape Upper Canyon and Southern Benguela Muddy Shelf Edge), and 'Critically Endangered' (Brown's Bank Rocky Shelf Edge). The Deep Western Orange Basin Block is dominated by ecosystems rated as 'Least Concern' by the 2018 National Biodiversity Assessment.

Despite the development of the offshore MPA network, most of the ecosystem types in the Deep Western Orange Basin Block (i.e. Southeast Atlantic Upper, Mid and Lower Slopes, Cape Basin Abyss) are currently considered 'not protected' or 'poorly protected' and further effort is needed to improve protection of these threatened ecosystem types (Sink *et al.* 2019) (Figure 7-37). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the Southeast Atlantic Upper- and Mid-Slope are poorly protected receiving only 0.2-10% protection, whereas the Southeast Atlantic Lower Slope receives no protection at all (Sink *et al.* 2019). Expanding the size of the Orange Shelf Edge MPA to form a single MPA along the South African Border could improve protection of these threatened habitats.

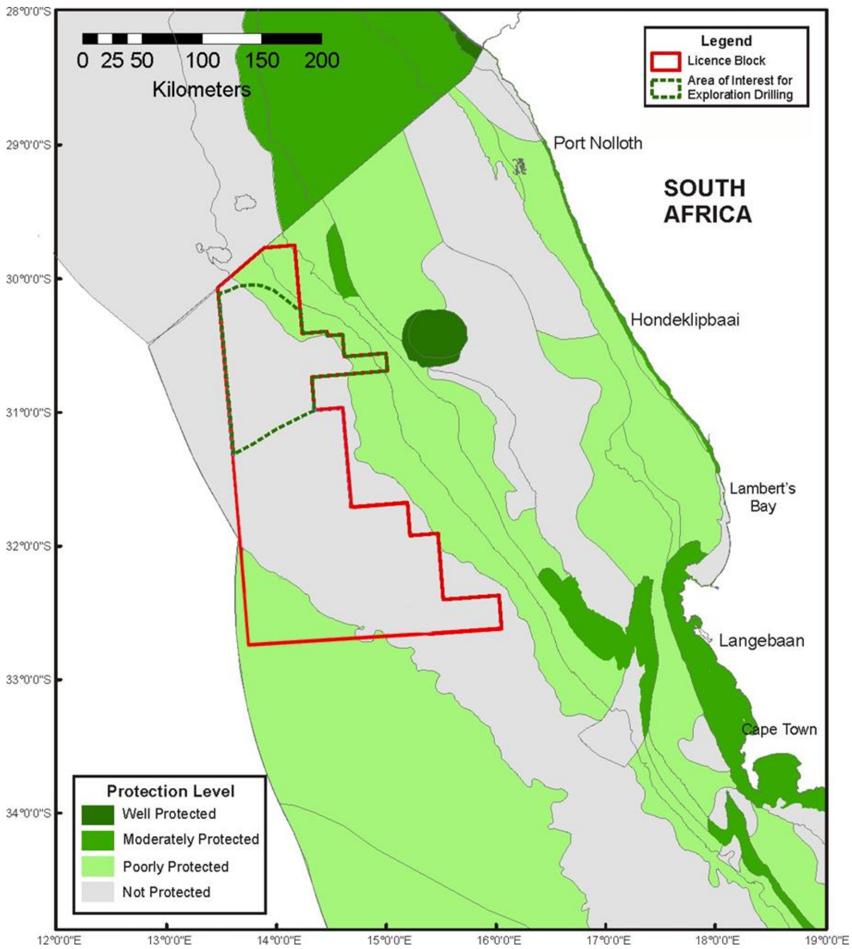


FIGURE 7-37: BLOCK DWOB IN RELATION TO PROTECTION LEVELS OF 150 MARINE ECOSYSTEM TYPES.

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

7.5.2. Sanctuaries

Sanctuaries are considered a type of management area within South Africa's multi-purpose expanded MPA network in which access and/or resource use is prohibited. Sanctuaries in the vicinity of the project area in which restrictions apply are the McDougall's Bay, Stompneusbaai, Saldanha Bay, Table Bay and Hout Bay rock lobster sanctuaries, which are closed to commercial exploitation of rock lobsters. These sanctuaries were originally proclaimed early in the 20th century under the Sea Fisheries Act of 1988 as a management tool for the protection of the West Coast rock lobster (Mayfield *et al.* 2005). They lie well inshore or to the south of the Deep Western Orange Basin Block.

7.5.3. Ecological or Biological Significant Areas

As part of a regional Marine Spatial Management and Governance Programme (MARISMA 2014-2020), the Benguela Current Commission (BCC) and its member states identified a number of EBSAs both spanning the border between Namibia and South Africa and along the South African West, South and East Coasts, with the intention of implementing improved conservation and protection measures within these sites. The principal objective of the EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. These EBSAs currently carry no legal status.

The impact management and conservation zones within the EBSAs are under review and currently constitute a subset of the biodiversity priority areas map (see Section 7.5.4) where "EBSA conservation zones" equate to Critical Biodiversity Areas (CBAs), whereas "EBSA impact management zones" equate to Ecological Support Area (ESAs). The relevant sea-use guidelines accompanying the CBA areas would apply.

South Africa currently has 12 EBSAs identified solely within its jurisdiction with a further three having been proposed[16]. It also shares eight trans-boundary EBSAs with other countries (Namibia (3) and Mozambique (2)) and/or high seas (3). The EBSAs within the Project's area of influence are shown in Figure 7-36. The text and figures below are based on the EBSA status presented in MARISMA EBSA Workstream 2020 (there has been no change to the shapefile since this time).

Although the DWOB Licence Block overlaps with one EBSA (namely the Orange Seamount and Canyon Complex EBSA), the Area of Interest for proposed exploration drilling avoids this EBSA (see Figure 7-38). The Orange Seamount and Canyon Complex EBSA, occurs 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

[16] The delineations are final and currently under review with DFFE: Oceans and Coasts. Once signed off there they will be submitted to the subsidiary body on scientific, technical and technological advice (SBSTTA) of the CBD. The original boundaries have already been internationally adopted (*pers. comm*. Harris & Holness, MARISMA).

moderate Atlantic temperatures (SST mean = 18.3°C) and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf.

There are also a number of EBSAs in the indirect area of influence to the south and east of the Deep Western Orange Basin Block. These are described briefly below.

- The **Orange Cone** transboundary EBSA is a transboundary EBSA, spanning the mouth of the Orange River (approximately 610 km north of the Area of Interest). 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 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 (RAMSAR site) by South Africa, and is an Important Bird and Biodiversity Area. This EBSA lies ~200 km to the northeast of the Deep Western Orange Basin Block at its closest point.

- The **Namaqua Fossil Forest** EBSA 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 approximately 545 km north of the Area of Interest). 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 colonized 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. This EBSA lies approximately 175 km to the northeast of the Deep Western Orange Basin Block at its closest point.

- The **Childs Bank and Shelf Edge** EBSA is a unique submarine bank feature rising from -400 m to -180 m on the western continental margin on South Africa (approximately 10 km east of the Area of Interest and Licence Block). 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.

- The **Namaqua Coastal Area** EBSA encompasses the Namaqua Coastal Area MPA and is characterized by high productivity and community biomass along its shores (approximately 160 km east of the Area of Interest). The area is important for several threatened ecosystem types represented there, including two ‘Endangered’ and four ‘Vulnerable’ ecosystem types, and is important for conservation of estuarine areas and coastal fish species.

- The **Cape Canyon and Associated Islands** EBSA includes the Benguela Muds MPA and the Cape Canyon, which is thought to hosts fragile habitat-forming species. The area is considered important for pelagic fish, foraging marine mammals and several threatened seabird species and serves to protect nine ‘Endangered’ and 12 ‘Vulnerable’ ecosystem types, and two that are ‘Near Threatened’. There are several small coastal MPAs within the EBSA. The Deep Western Orange Basin Block lies approximately 38 km westward of this EBSA at its closest point but approximately 210 km southeast of the proposed Area of Interest.

- The proposed **Seas of Good Hope EBSA** is located at the coastal tip of Africa, wrapping around Cape Point and Cape Agulhas. It extends from the coast to the inner shelf, and includes key islands (Seal Island, Dyer Island and Geyser Rocks), two major bays (False Bay and Walker Bay), and is of key importance for threatened species and habitats. The threatened habitats include coastal, inshore and inner shelf ecosystem types. The important life-history stages supported by the area are breeding and/or foraging grounds for a myriad of top predators, including sharks, whales, and seabirds, some of which are threatened species. This EBSA is also the place where the Benguela and Agulhas Currents meet. This EBSA lies over 200 km to the southeast of the Deep Western Orange Basin Block at its closest point.

- The **Benguela Upwelling System** EBSA is a transboundary EBSA and 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.

7.5.4. Biodiversity Priority Areas

The National Coastal and Marine Spatial Biodiversity Plan[17] comprises a map of Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained. The intention is that the CBA Map (CBAs and ESAs) and sea-use guidelines inform the MSP Conservation Zones and management regulations, respectively.

The Deep Western Orange Basin Block overlaps with areas mapped as Protected Area, Critical Biodiversity Area 1 (CBA 1) Natural, CBA 1 Restore, Critical Biodiversity Area 2 (CBA 2) Natural, CBA 2 Restore and Ecological Support Area (ESA). There is, however, no overlap of the Area of Interest for proposed exploration drilling with CBA 1 Natural & Restore and CBA 2 Natural & Restore areas. In the Area of Interest for Seismic acquisition approximately 12.2 % is covered by CBA 1: natural and 26.6% by CBA 2: natural (Figure 7-38). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there are often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and / or will be larger areas.

Regardless of how CBAs are split, CBAs are generally areas of low use and with low levels of human impact on the marine environment, but can also include some moderately to heavily used areas with higher levels of human impact. Given that some CBAs are not in natural or near-natural ecological condition, but still have very high biodiversity importance and are needed to meet biodiversity feature targets, CBA 1 and CBA 2 were split into two types based on their ecological condition.

[17] The latest version of National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released in April 2022) (Harris *et al.* 2022). The Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g., environment, fishing, transport (shipping), petroleum, mining, and others. It is relevant for the Marine Spatial Planning Working Group where many of these departments are participating in developing South Africa's emerging marine spatial plans. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, EIA practitioners, organisations working in the coast and ocean, civil society, and the private sector.

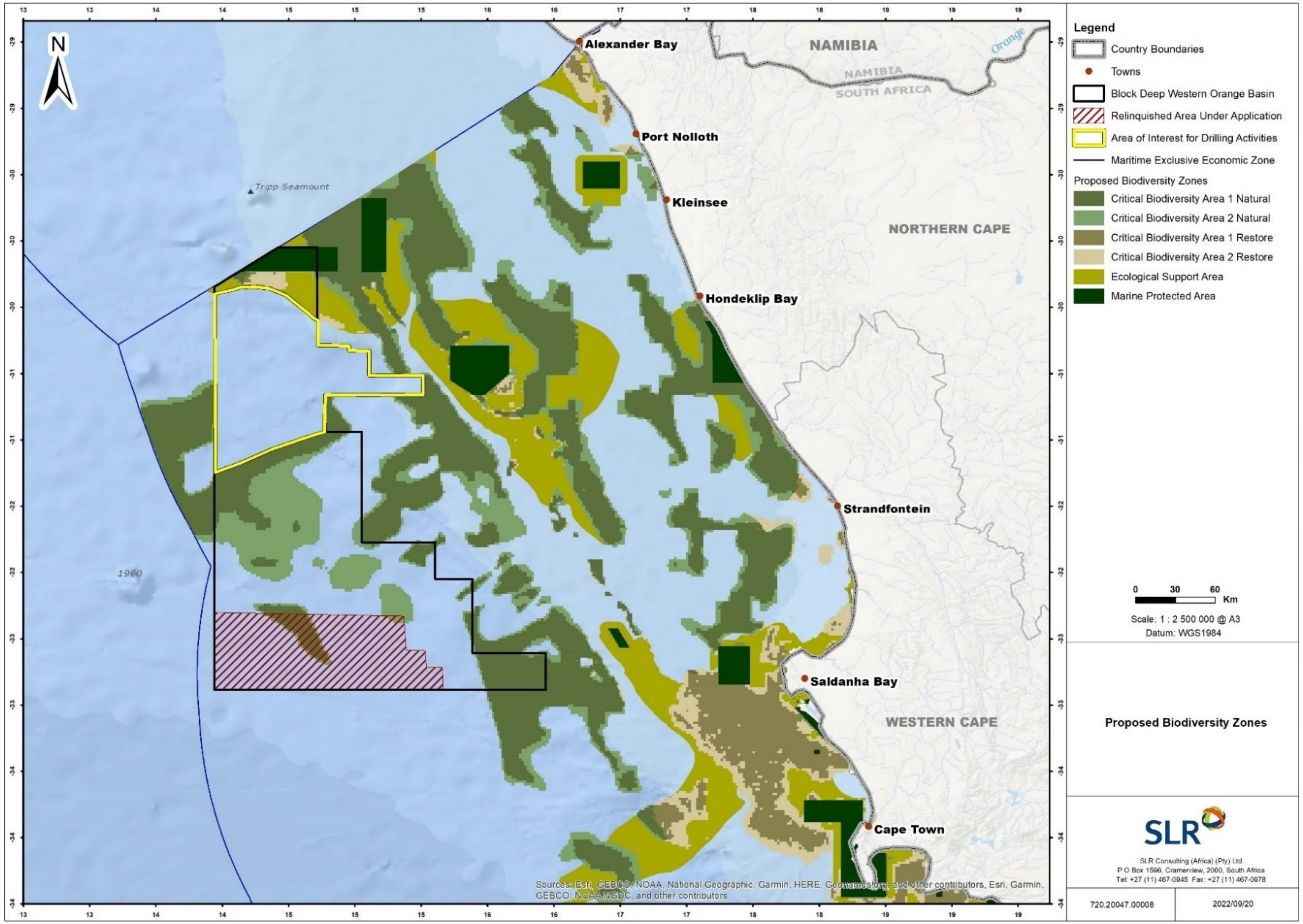


FIGURE 7-38: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAS)

Adapted: Harris *et al.* 2022

CBA Natural sites have natural / near-natural ecological condition, with the management objective of maintaining the sites in that natural / near natural state; and CBA Restore sites have moderately modified or poorer ecological condition, with the management objective to improve ecological condition and, in the long-term, restore these sites to a natural/near-natural state, or as close to that state as possible. ESAs include all portions of EBSAs that are not already within MPAs or CBAs, and a 5-km buffer area around all MPAs (where these areas are not already CBAs or ESAs), with the exception of the eastern edge of Robben Island MPA in Table Bay where a 1.5-km buffer area was applied (Harris *et al.* 2022).

Activities within these management zones are classified into those that are "compatible", those that are "not compatible", and those that have "restricted compatibility". Non-invasive (e.g. seismic surveys) and invasive (e.g. exploration wells) exploration activities are classified as having "restricted compatibility". Activities with restricted compatibility require a detailed assessment to determine whether the recommendation is that they should be permitted (general), permitted subject to additional regulations (consent), or prohibited, depending on a variety of factors. Table 9 in Harris et al. (2022) states that as part of the site-specific, context-specific assessment “particularly careful attention would need to be paid in areas containing irreplaceable to near-irreplaceable features where the activity may be more appropriately evaluated as not permitted. The ecosystem types in which the activities take place may also be a consideration as to whether or not the activity should be permitted, for example. Where it is permitted to take place, strict regulations and controls over and above the current general rules and legislation would be required to be put in place to avoid unacceptable impacts on biodiversity features. Examples of such regulations and controls include: exclusions of activities in portions of the zone; avoiding intensification or expansion of current impact footprints; additional gear restrictions; and temporal closures of activities during sensitive periods for biodiversity features.” Petroleum production is, however, classified as "not compatible" in CBAs, but may be compatible, subject to certain conditions, in ESAs (Harris et.al. 2022).

7.5.5. Important Bird Areas (IBAs)

There are numerous coastal Important Bird Areas (IBAs) in the general project area (Table 7-10) (https://maps.birdlife.org/marineIBAs). These are all located outside of the Deep Western Orange Basin Block.

Various marine IBAs have also been proposed in South African territorial waters, with a candidate marine IBA suggested off the Orange River mouth and a further candidate marine IBA suggested in international waters west of the Cape Peninsula (Figure 7-39). **The Deep Western Orange Basin Block does not overlap with any of these proposed marine IBAs.**

7.5.6. RAMSAR Sites

A Ramsar site is considered 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 convention entered into force in South Africa on 21 December 1975. It provides for national action and international cooperation regarding the conservation of wetlands, and wise sustainable use of their resources. South Africa currently has 27 sites designated as Ramsar Sites, with a surface area of 571 089 hectares. The coastal RAMSAR sites in the Area of Interest are provided in Table 7-11 below and presented in Figure 7-40.

TABLE 7-10: LIST OF CONFIRMED COASTAL IMPORTANT BIRD AREAS (IBAS) AND THEIR CRITERIA LISTINGS

Site Name	IBA Criteria
Orange River Mouth Wetlands (ZA023)	A1, A3, A4i, A4iii
Olifants River Estuary (ZA078)	A3, A4i
Verlorenvlei Estuary (ZA082)	A4i
Berg River Estuary (ZA083)	A4i
West Coast National Park and Saldanha Bay Islands (ZA 084) (incorporating Langebaan RAMSAR site)	A1, A4i, A4ii, A4iii
Dassen Island (ZA088)	A1, A4i, A4ii, A4iii
Robben Island (ZA089)	A1, A4i, A4ii, A4iii
Rietvlei Wetland: Table Bay Nature Reserve (ZA090)	A1, A4i
Boulders Beach (ZA096)	A1
False Bay Nature Reserve (ZA095)	A1, A4i, A4iii

Note: Those incorporating or listed as RAMSAR sites are shaded.

A1. Globally threatened species
A2. Restricted-range species
A3. Biome-restricted species

A4. Congregations
i. applies to 'waterbird' species
ii. This includes those seabird species not covered under i.
iii. modelled on criterion 5 of the Ramsar Convention for identifying wetlands of international importance. The use of this criterion is discouraged where quantitative data are good enough to permit the application of A4i and A4ii.

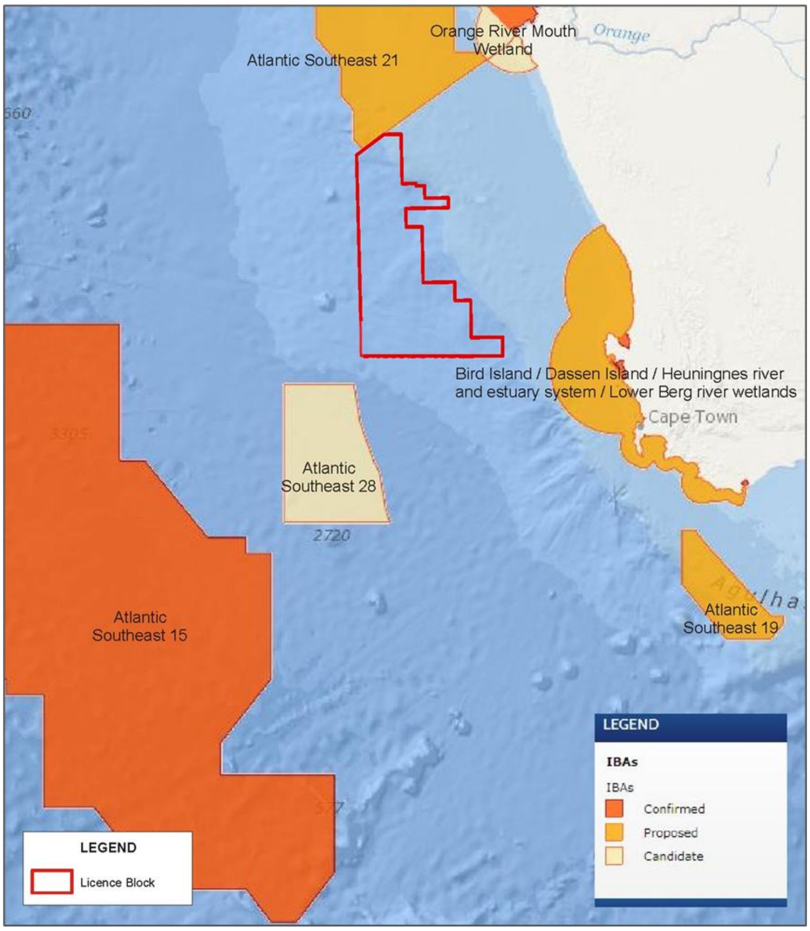


FIGURE 7-39: BLOCK DWOB (RED POLYGON) IN RELATION TO COASTAL AND MARINE IBAS

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

TABLE 7-11: LIST OF COASTAL RAMSAR SITES IN THE AREA OF INFLUENCE OF THE DEEP WESTERN ORANGE BASIN BLOCK

Name	Size (ha)	Province	Description
Orange River Mouth	2 000	Northern Cape	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.
Verlorenvlei	1 500	Western Cape	Ramsar site no. 525. One of the largest lakes (and one of South Africa's few coastal freshwater lakes), with associated scrub, shrubland, dune systems, marshland and reedbeds representing a transition zone between two plant communities. The site is an important feeding area for rare pelicans and fish, for moulting and breeding birds, as well as for staging wading birds.
Langebaan	6 000	Western Cape	Ramsar site no. 398. National Park. A large, shallow marine lagoon, includes islands, reedbeds, sand flats, saltmarshes and dwarf shrubland. The lagoon is an important nursery area for a number of fish species and supports a diverse and ecologically important algal and shoreline biota. Important for wintering and staging wading birds, and the numerous breeding birds include the largest colony of gulls in South Africa.
Dassen Island Nature Reserve	737	Western Cape	Ramsar site no. 2 383. The Dassen Island Nature Reserve, lying off the Western Cape Province, is the second-largest coastal island on the South African continental shelf. It is within the Benguela upwelling ecosystem, which lifts cold, nutrient-rich water to the surface. Sandy inner shelf, rocky mid-shelf mosaic, island shore and kelp forest are the main habitat types. Dassen Island is covered by Cape seashore vegetation and a number of cetacean species are found in the surrounding seas. The Site is an Important Bird Area providing habitat for significant numbers of seabird and shorebird species, including 10 of the 15 seabirds endemic to southern Africa, and numerous Palearctic and sub-Antarctic migrants. It provides safe breeding refuge for threatened species such as the African penguin and Cape cormorant and other coastal birds.
False Bay Nature Reserve	1 542	Western Cape	Ramsar site no. 2 219. The False Bay Nature Reserve is a unique area on the Cape Flats, situated between False Bay and Table Bay, consisting of about 50% permanent wetland and 49% terrestrial vegetation including the critically endangered Cape Flats Sand Fynbos and Cape Flats Dune Strandveld and some sand beaches. The False Bay Nature Reserve contains two lakes, Rondevlei (protected area reserve) and Zeekoevlei. Serving as a reservoir of biodiversity, the False Bay Nature Reserve supports important populations of mammals and is home to over 60% of the bird species in the South-western Cape (228 species). About 256 species of indigenous plants grow on the site.

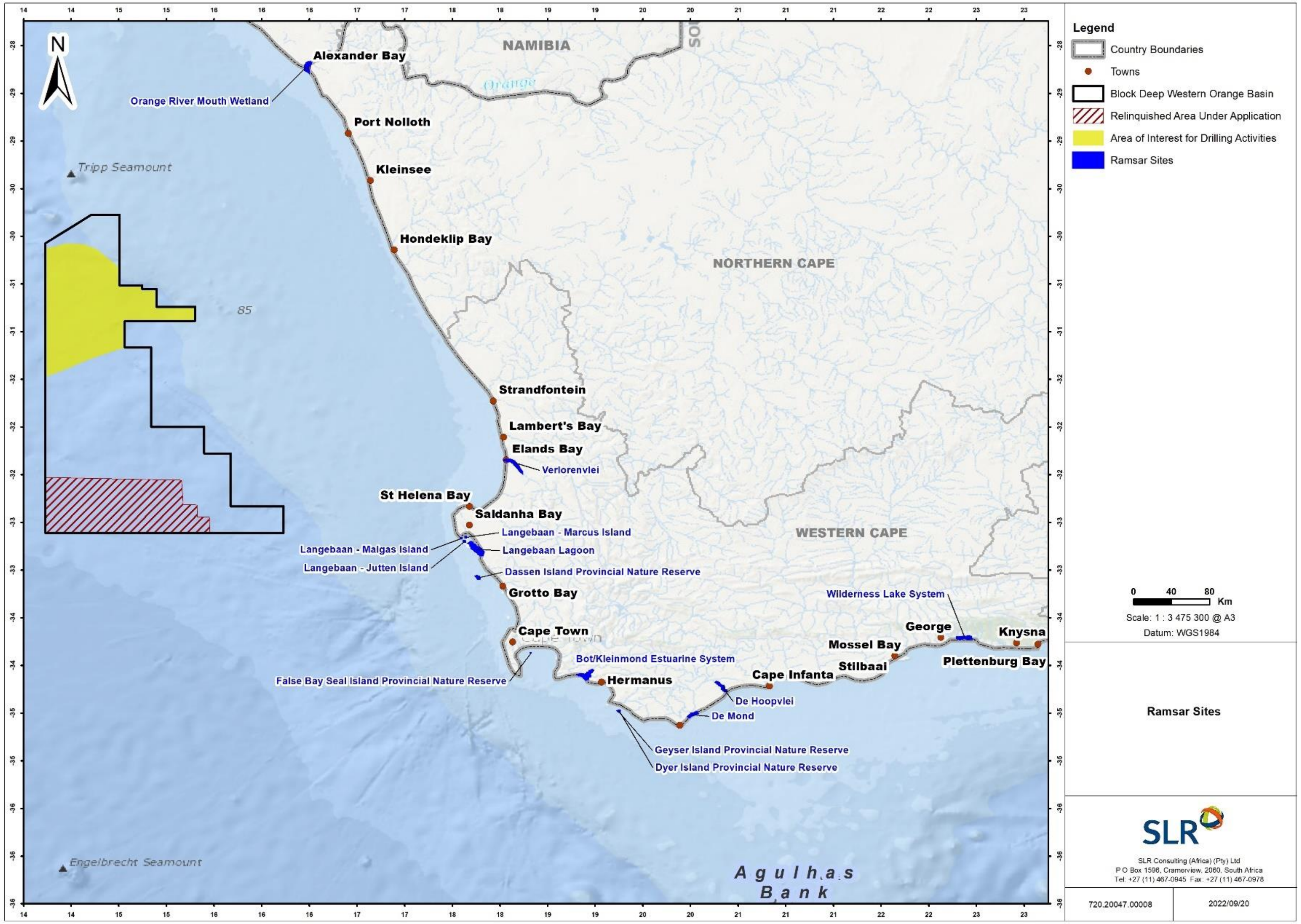


FIGURE 7-40: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO RAMSAR SITES WITHIN THE PROJECT'S AREA OF INFLUENCE

Source: https://soer.environment.gov.za/soer/CMSWebSite/GISdata.aspx (2022)

7.5.7. Important Marine Mammal Areas (IMMAs)

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas, IMMAs are identified on the basis of four main scientific criteria, namely (A) species or population vulnerability, (B) distribution and abundance, (C) key life cycle activities and (D) special attributes (see Table 7-12). IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs (see Figure 7-41), **none of which overlap with the area of interest for proposed exploration well drilling.** The three IMMAs include (www.marinemammalhabitat.org):

- **Southern Coastal and Shelf Waters of South Africa IMMA** (166 700 km^2): This IMMA extends from the Olifants River mouth to the mouth of the Cintsa River on the Transkei Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (Criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2), as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2), including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, Humpback whales, Killer whales and Southern Right whales.
- **Cape Coastal Waters IMMA** (6 359 km^2): This IMMA extends from Cape Point to Woody Cape at Algoa Bay. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.
- **South East African Coastal Migration Corridor IMMA** (47 060 km^2): This IMMA extends from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of southern hemisphere Humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. This IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and Killer whale.

TABLE 7-12: IMMA SELECTION CRITERIA

Criterion	Description
Criterion A	**Species or Population Vulnerability: Areas containing habitat important for the survival and recovery of threatened and declining species**
Criterion B	**Distribution and Abundance**
Sub-criterion B1	Small and Resident Populations: Areas supporting at least one resident population, containing an important proportion of that species or population, that are occupied consistently.
Sub-criterion B2	Aggregations: Areas with underlying qualities that support important concentrations of a species or population.
Criterion C	**Key Life Cycle Activities**
Sub-criterion C1	Reproductive Areas: Areas that are important for a species or population to mate, give birth, and/or care for young until weaning.
Sub-criterion C2	Feeding Areas: Areas and conditions that provide an important nutritional base on which a species or population depends.
Sub-criterion C3	Migration Routes: Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.
Criterion D	**Special Attributes**
Sub-criterion D1	Distinctiveness: Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.
Sub-criterion D2	Diversity: Areas containing habitat that supports an important diversity of marine mammal species.

Source: https://www.marinemammalhabitat.org/immas/imma-criteria/

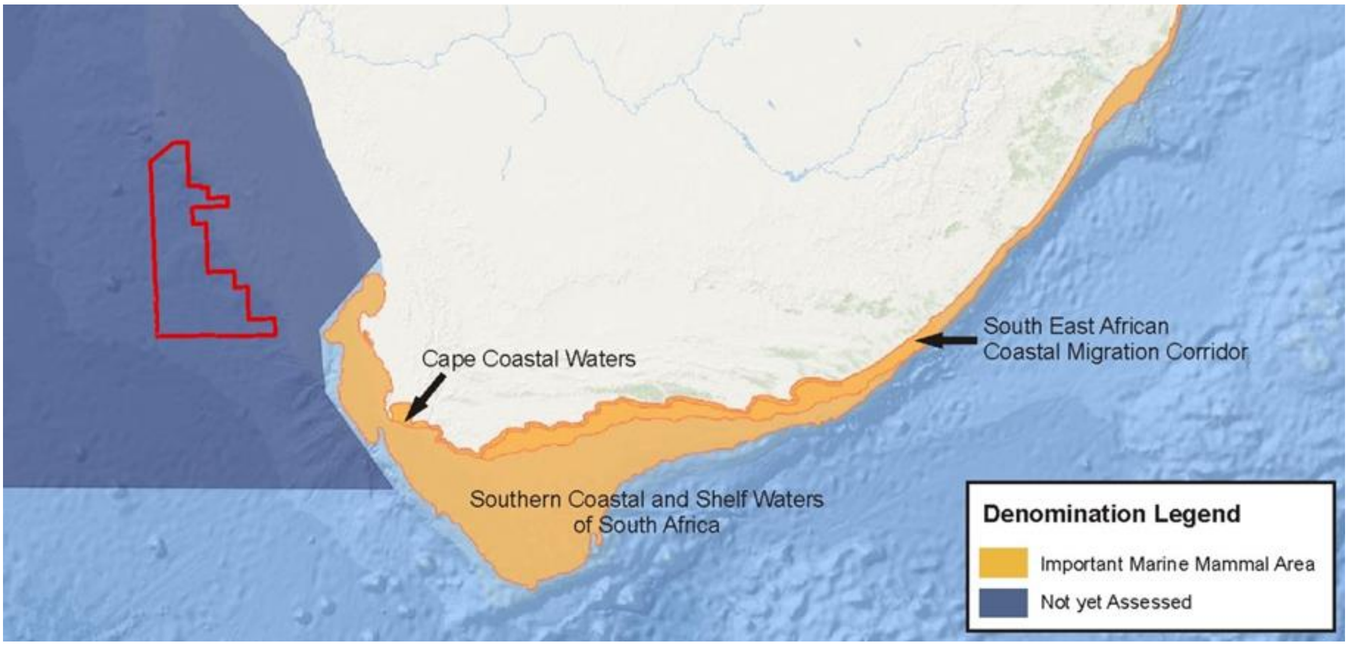


FIGURE 7-41: BLOCK DWOB (RED POLYGON) IN RELATION TO COASTAL AND MARINE IMMAS
(SOURCE: WWW.MARINEMAMMALHABITAT.ORG/IMMA-EATLAS/).

7.6. ECOLOGICAL NETWORK CONCEPTUAL MODEL

Figure 7-42 provides a simplified conceptual model for the nearshore and offshore receiving environment on the West Coast illustrating key variables, processes, linkages, relationships, dependencies and feed-back-loops.

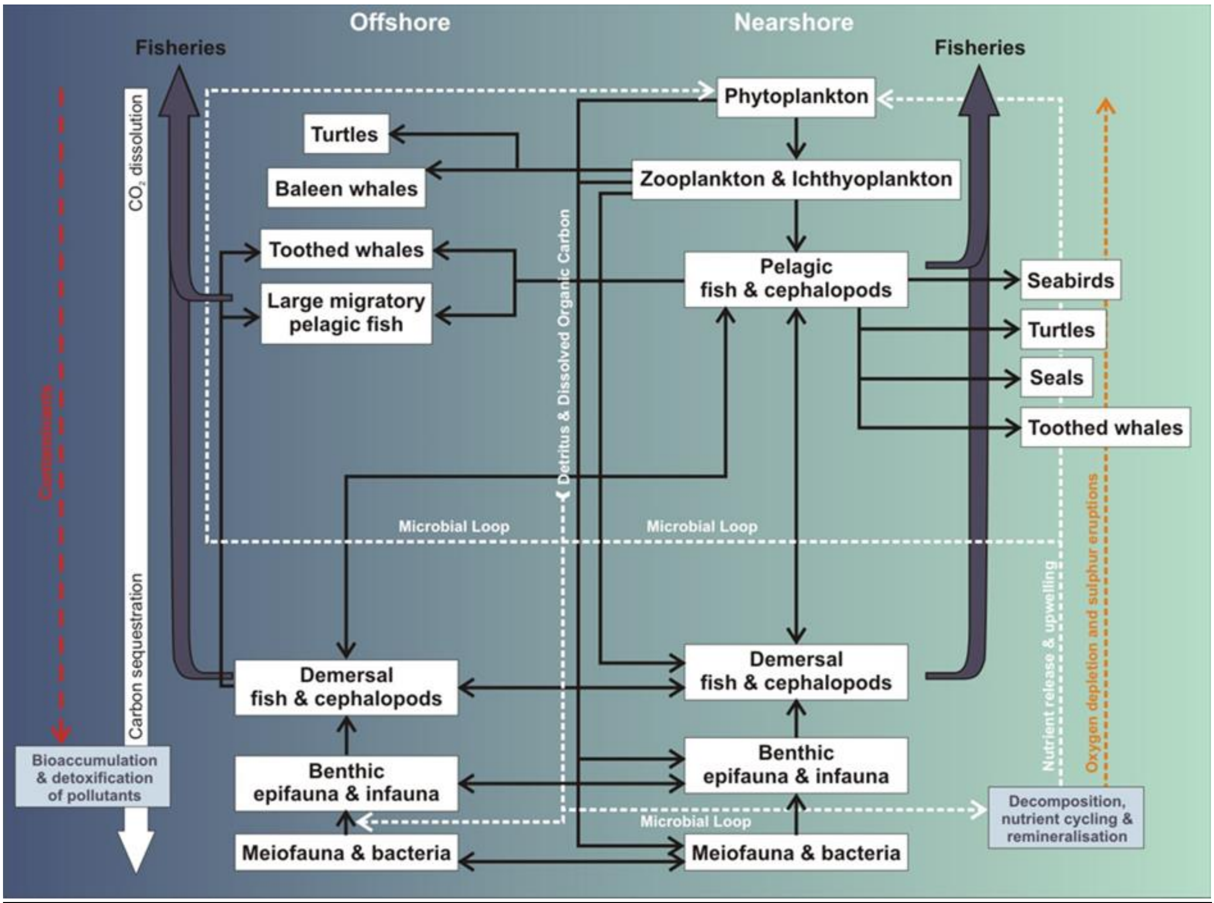


FIGURE 7-42: SIMPLIFIED NETWORK DIAGRAM INDICATING THE INTERACTION BETWEEN THE KEY ECOSYSTEM COMPONENTS OFF THE SOUTH-WEST AND WEST COASTS

Source: Pisces

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.

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 deepwater fish stocks.

Ecosystem functions of the offshore deepwater 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.

With growing evidence of the ecosystem-wide effects of seismic noise (Nieukirk et al. 2012; Kavanagh et al. 2019; Kyhn et al. 2019) and the potential consequences of sub-lethal anthropogenic sounds affecting marine animals at multiple levels (e.g., behaviour, physiology, and in extreme cases survival), there is increasing recognition for the need to consider the effects of anthropogenic noise at population and ecosystem level. The sub-lethal effects of sound exposure may seem subtle, but small changes in behaviour can lead to significant changes in feeding behaviour, reductions in growth and reproduction of individuals (Pirotta et al. 2018) and can have effects that go beyond a single species, which may cause changes in food web interactions (Francis et al. 2009; Hubert et al. 2018; Slabbekoorn & Halfwerk 2009).

For example, the intensified upwelling events associated with the Cape Canyon, provide highly productive surface waters, which power feeding grounds for cetaceans and seabirds (www.environment.gov.za/dearesearchteamreturnfromdeepseaexpedition). 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 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

This section provides an overview of the national and regional context of the project's area of influence covering West Coast coastline. This area encompasses the entire approximate coastline that extends between Cape Town in the Western Cape and extends into the Northern Cape of South Africa. In addition, greater focus is given to the areas which have been identified as possible onshore supply bases. The fishing sectors are discussed under Section 7.8.

7.7.1. Institutional Arrangements

South Africa is a parliamentary republic with a three branched system of government – comprising of the legislative (Parliament), executive (the president, ministers and their departments), and judiciary. The government is also divided into three spheres, namely the national, provincial and local level.

South Africa is divided into nine provinces (with the indirect area of influence extending over the Western Cape and Northern Cape Provinces) and each province has its own executive and legislative branches. Local governments consist of either District Municipalities (which have shared powers with Local Municipalities) and Metropolitan Municipalities.

The functions of the District Municipalities primarily concern key service delivery areas such as water, sanitation, electricity, municipal health services and other district-wide functions, while also providing an overall co-ordination function between local municipalities. They are also ordinarily the competent authority for air quality, including the granting of AELs under the NEM: AQA. Local Municipalities play a key role in terms of integrated planning, town planning and basic service provision (including water, sanitation, public transport, infrastructure, etc.).

7.7.2. Administrative Structure

The various metropolitan, districts and local municipalities within the Project's indirect area of influence is shown in Figure 7-43 and Table 7-13.

TABLE 7-13: COASTAL MUNICIPALITIES WITHIN THE PROJECT'S INDIRECT AREA OF INFLUENCE

Province	District Municipalities (Coastal only)	Local Municipalities (Coastal only)
Northern Cape	Namakwa	Richtersveld
		Nama Khoi
		Kamiesberg
Western Cape	West Coast	Matzikama
		Cederberg
		Berg River
		Saldanha Bay
		Swartland
	City of Cape Town (Metropolitan)	City of Cape Town
	Overberg	Theewaterskloof
		Overstrand

Province	District Municipalities (Coastal only)	Local Municipalities (Coastal only)
		Cape Agulhas
		Swellendam
	West Coast	Swartland
		Saldanha Bay
		Bergrivier
		Cederberg
		Matzikama

7.7.3. Settlement Distribution

The significant key populated areas include the City of Cape Town (a major metropolitan area and port), Municipalities and Saldanha Bay (a secondary town and port), with the latter located in the West Coast District Municipality. The Namakwa District Municipality is located further from major metropolitan areas or major towns and is sparsely populated with much smaller coastal towns.

The City of Cape Town Metropolitan Municipality is densely populated metropolitan area, while the remainder of the West Coast coastline is characterised by sparse development with sporadic settlements and limited infrastructure. The exception is the West Coast Peninsula, which is located just over 100 km north of Cape Town. This area which includes the active port of Saldanha Bay, and several historic and fishing towns, including Vredenburg, Langebaan, Paternoster and St Helena Bay. Several other small towns are scattered along the coastline between Cape Town (in the south) and Alexandra Bay (in the north), which have small populations (averaging between 300 – 2000 people).

7.7.4. Population Demographics

Cape Town (City of Cape Town Metropolitan Municipality) is a major metropolitan area in South Africa, which in 2019 support an estimated population of 4 131 722 (Statistics South Africa, 2020). Cape Town is the second largest metropolitan area in South Africa (after Johannesburg).

The population size of the entire West Coast District Municipality is estimated at 455 881 persons (West Coast District Municipality 2020) and the Namakwa District has an approximate population of 132 000 (Namakwa District Municipality 2020). Saldanha Bay Local Municipality has the second highest population in the West Coast District with a population size of 119 132 in 2019 (Saldanha Bay Local Municipality 2020). The population density of the City of Cape Town is estimated at 1 530 persons per square kilometre. The largely rural Namakwa District is the lowest at 1.1 persons per square kilometre with the Overberg District Municipality with 21 persons per square kilometre.

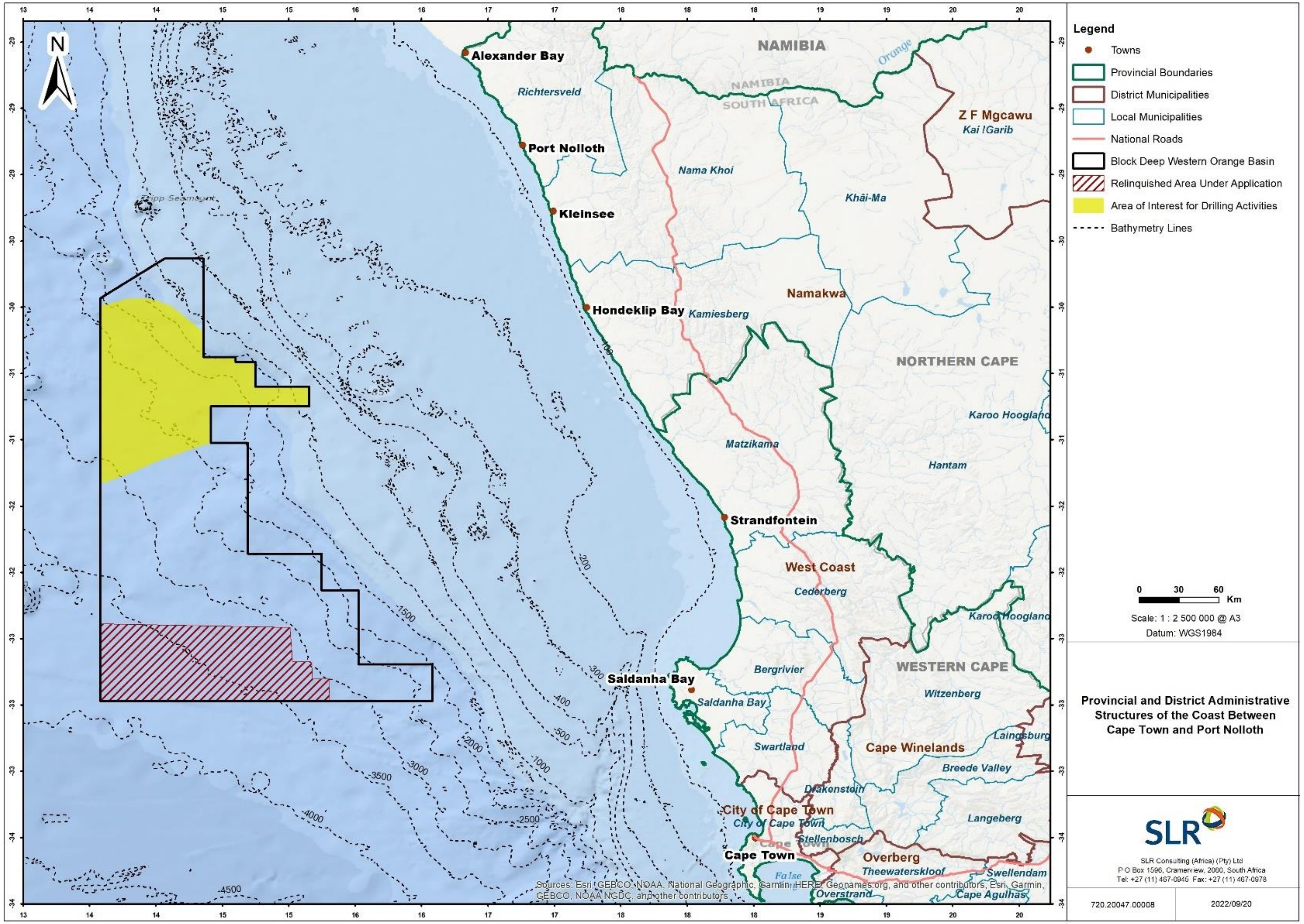


FIGURE 7-43: BLOCK DWOB AND THE AREA OF INTEREST IN RELATION TO DISTRICT AND LOCAL MUNICIPALITIES, KEY CITIES AND TOWNS ALONG THE WEST COAST

7.7.5. Age and Gender

The age cohorts for the study area are as set out in Table 7-14 (as per the 2016 Statistics South Africa Community Survey). The West Coast District, City of Cape Town and Western Cape reflect a similar distribution of the population through the age groups. The population of the Namakwa District is home to a somewhat larger cadre of persons that are defined as slightly older than the West Coast District and Cape Town. This could be due to young people leaving the Northern Cape to find education and employment in more developed and populated areas such as Cape Town. The population profile within the study area is, on the whole, marginally older when compared to South Africa.

The national gender ratio for South Africa is 51% female and 49% male. Similar figures are noted for the Western Cape Municipalities with the City of Cape Town Metropolitan, West Coast District Municipality, and Overberg District Municipality at 50.8% females and 49.2% males, 50.2% females and 49.8% males, 50.1% females and 49.9% males, respectively.

The Namakwa District, however, has a slightly higher proportion of males at 50.4% to 49.6% female (Statistics SA 2020). The reason for this may be due to the mining activities in the inland areas of district which would attract a higher proportion of men for employment.

TABLE 7-14: AGE AND GENDER PROFILE

Province	District	Percentage of Total Population			
		Children (0-14 yrs)	Youth (15-34 yrs)	Adults (35-64 yrs)	Elderly (+65 yrs)
Western Cape	City of Cape Town	26%	33%	34%	6%
	West Coast	26%	35%	33%	6%
	Overberg	26.1	32.9	33.3	7.7
Northern Cape	Namakwa	22%	33%	31%	14%
South Africa		30%	36%	28%	5%

Source: Statistics SA 2020

7.7.6. Education

In terms of education, the distribution of educational attainment for the study area by those aged above 20 years of age is as set out in Table 7-15 (as recorded by the Statistics South Africa 2016 Community Survey).

The more densely populated urban centre of the Western Cape (affected by the proposed project) in the coastal district is the City of Cape Town and, has a higher completed secondary schooling or have a tertiary education than the population of the more rural Overberg District. Only 25% of the population of the latter has completed secondary school compared to 35-36% in the more urbanised districts.

TABLE 7-15: EDUCATIONAL ACHIEVEMENT RATES

District	Percentage of Population Above the Age of 20					
	None	Incomplete Primary	Complete Primary	Incomplete Secondary	Complete Secondary	Higher
City of Cape Town	2.1	6.7	4.2	37.1	35.0	14.8
West Coast	12.2	22.7	5.6	31.7	19.6	6.1
Overberg	3.3	12.7	7.0	38.3	28.5	10.1
Namakwa	4.4	12.6	8.1	39.4	24.0	9.1

Source: Statistics SA 2020

7.7.7. Employment

Unemployment and underemployment are chronic issues in South Africa. In the third quarter of 2016, the narrow unemployment rate for South Africa was estimated at 27.1% (Statistics South Africa 2020). However, including discouraged work seekers, this proportion rises to 36.3%. Although current estimates are not yet available, the unemployment rate is expected to rise significantly once the impacts of the COVID-19 lockdown are fully apparent. Current estimates are unreliable given the impact of lockdowns that increased the unemployment rate but were followed by relatively sharp rises in employment growth.

In the Western Cape, the recorded narrow unemployment rate for 2019 was 19.3% (Statistics South Africa 2020). For the City of Cape Town, the rate was estimated at 24.8% in 2019 (City of Cape Town 2020) and for West Coast District Municipality it was 10.7% in 2018 (West Coast District Municipality 2020). Unemployment for the Western Cape has been steadily rising over the last decade. In part this is due to in-migration of work seekers from other areas but is also linked to the poor performance of the national economy.

In the Northern Cape, the unemployment rate for the Namakwa District was 25% in 2018 (Namakwa District Municipality 2020).

7.7.8. Health

The 2016 Community Health survey covered a number of key health indicators. The full immunisation coverage rate[18] for children under the age of one in the City of Cape Town in 2016 was 82.2%, which is higher than the Western Cape rate of 79.9%. The immunisation rate in Overberg District has decreased from 86.4% in 2015 to 71.5% in 2016. The full immunisation rate for children within the West Coast District is general low but increased from 54.3% 2017 to 59.1% in 2018 (Western Cape 2019). The rate of immunisation in the City of Cape Town is higher than the West Coast, but decreased slightly between 2017 and 2018 from 72.6 to 71.6 percent (Western Cape 2019).

The City of Cape Town achieved the Province's target of reducing neonatal deaths to 6 per 1 000 live births by 2019. The neonatal mortality rate for the Overberg District increased from 7.7 (per 1 000 live births) in 2014 to

[18] This indicator shows the percentage of children younger than one year who are fully immunised. "Full immunisation" refers to children having received all the required doses of vaccines given in the first year of life (Source: http://childrencount. uct.ac.za/indicator.php?domain=5&indicator=28).

10 in 2015, thereafter decreasing to 6.3 in 2016. The neonatal mortality rate (per 1 000 live births) improved from 9.2 in 2017 to 6.4 in 2018 within the West Coast District; however, remained high and increased for this period from 9.1 to 9.6 in the City of Cape Town (Western Cape 2019). The low birth weight indicator increased slightly from 13.4% in 2017 to 13.8% in 2018 in the West Coast District, while the City of Cape Town remained constant at 13.9% (Western Cape 2019).

A total of 14% of all babies born in the City of Cape Town and the Western Cape as a whole in 2016 were considered to be underweight. Approximately 12% of all babies born in the Overberg District facilities were born with low birth weight; the lowest for all districts recorded in 2016.

The malnutrition rate for the City of Cape Town was recorded as 1.8% for 2018. Overberg's malnutrition rate worsened from 1.5 (per 1,000 children) in 2014 to 2.4 in 2015 and subsequently improved to 1.6 in 2016. The number of malnourished children under the age of five in the West Coast District in 2017 was 1.7 per 100 000 persons, worsening to 2.1 in 2018, whereas malnutrition improved slightly for this period from 1.2 to 1.1 in the City of Cape Town (Western Cape 2019).

HIV/AIDS and Tuberculosis (TB) are considered the two of the most significant health issues affecting adults (and therefore the labour force) within South Africa, and specifically the Western Cape. Access to treatment, such as antiretroviral treatments (ART), assist with improving quality and length of life for a number of patients living with HIV.

The West Coast District had 43 ART clinics/treatment site and 11 255 registered patients receiving treatment (Western Cape 2019). The total number of patients receiving ARTs increased significantly from 2017 to 2018 by a total of 1053 patients (or 10%); however, the number new patients receiving ARTs decreased by 7% (from 2015 to 2018), potentially indicating a decrease in the number of HIV infections or that less people are being tested (Western Cape, 2019).

TB is closely related to HIV and AIDS and accounted for 7.6% of premature deaths within the Western Cape in 2016 (Western Cape, 2019). In the West Coast District, patients with TB accounted for 8.8% (3,611) of the total patient load within the Western Cape and were treated at 75 TB clinics or treatment centres around the District (Western Cape, 2019).

With respect to health facilities, the West Coast District had 62 primary healthcare clinics in 2018, 7 district hospitals, and one community day centre (Western Cape, 2019). Whereas the City of Cape Town had a total number of 132 primary healthcare facilities – 81 fixed primary healthcare clinics, 42 community day centres as well as 9 community health centres (Western Cape 2017).

7.7.9. Poverty Rates

The deteriorating financial health of households and individuals under the weight of economic pressures, specifically between 2011 and 2015, has resulted in an increase in the poverty levels, according to the Poverty Trends in South Africa in 2017 (Funding Practice Alliance 2017). This has been exacerbated by the 2020/2021 COVID-19 pandemic and its impacts, but the consequences are not yet statistically correlated. The report cites rising unemployment levels, low commodity prices, higher consumer prices, lower investment levels, household dependency on credit, and policy uncertainty as the key contributors to the economic decline in recent times. Poverty levels were generally regarded as not improving in the study area in general.

The upper poverty line is defined by StatsSA as the level of consumption at which individuals are able to purchase both sufficient food and non-food items without sacrificing one for the other. This variable measures the number of individuals living below that particular level of consumption for the given area and is balanced directly to the official upper poverty rate as measured by StatsSA. For 2019, the upper bound poverty line was defined as R1 227 per person per month (Statistics SA 2019).

The Western Cape has the lowest upper poverty line head count of 33.2% compared to the national average for 2016 of 49.2%. However, as a percentage of the total population (considering population growth) people living in poverty have decreased from 50.89% to 50.70% between 2006 and 2016.

The National Development Plan has set a target of reducing income inequality in South Africa from a Gini coefficient[19] of 0.7 in 2010 to 0.6 by 2030. In 2016 it was recorded nationally as being 0.628. The Cape Town City Gini coefficient is 0.61 (2016). Available figures indicate that the Overberg District's income inequality has steadily increased from 2011 onward, reaching 0.60 in 2016. Income inequality in the West Coast District has increased between 2012 and 2018, with the Gini coefficient increasing from 0.560 in 2012 to 0.595 in 2018 (Western Cape 2019). The Gini coefficient for the Garden Route District was estimated to be 0.61 in 2016. The Gini coefficient for the Namakwa District was 0.566 in 2018, however this remains largely favourable compared to the larger Northern Cape Province and South Africa in general, as both had a more unequal spread of income amongst their residents (at 0.604 and 0.63 respectively) (Namakwa District Municipality 2020).

7.7.10. Economic and Industrial Profile

The City of Cape Town's economy contributed 71.8 % to the Western Cape's total Gross Domestic Product (GDP) in 2016. The national economy maintained an average annual growth rate of 2.9% since 2005, whereas the Western Cape's growth across this period was 3.0%. The largest contributor to GDP within the Metro in 2015 was the Tygerberg planning district, an area dominated by finance, insurances, real estate, and business services. The fastest growing area within the City of Cape between 2005 and 2015 was the Blaauwberg planning district, growing at a rate of 4.2% which was considerably higher than the Metro's average across the same period. Overall, the primary sector contributed only 1.5% of the GDP for the City of Cape Town in 2015 (with agriculture, forestry and fishing being 1.3%). The secondary sector (mostly manufacturing) contributed 23.6% of the GDP. The tertiary sector contributed 74.9% with finances and insurances, as well as real estate making up 27.8%. This was followed by wholesale, retail, catering and accommodation (16.9%).

The West Coast District contributed 5.2 % (R29.8 billion) to the Western Cape's economy in 2017 (West Coast District 2020). The top three contributors to the District GDP in 2019 were (1) agriculture, forestry and fishing (20.9% of District GDP), (2) manufacturing (21.4% of District GDP), and (3) wholesale, retail trade, catering and accommodation (15.2% of District GDP) (West Coast District Municipality 2020). Combined, these three sectors contributed R17.1 billion (or 57.5%) to the West Coast District's economy, estimated to be worth R29.812 billion in 2017 (West Coast District Municipality 2020). The trend between 2008 and 2017 shows that the agriculture, forestry and fishing sector registered the highest annual average growth rates (4.3%), followed by the construction sector (3.4%) and the and the finance, insurance, real estate and business services sector (3.2%) (West Coast District Municipality 2020). The primary direct economic benefits of coastal resources within the

[19] The Gini coefficient is a measure of statistical dispersion intended to represent the income inequality or wealth inequality within a nation or any other group of people.

West Coast District include port activities within the Saldanha Bay Port, small scale fisheries, recreational fishing and coastal tourism (West Coast District Municipality 2019).

The Overberg District is the Western Cape's second smallest economy with a 3.5% contribution to the Provincial GDP in 2015. The top three economic sectors are clustered in the tertiary and secondary economic sectors, and include the finance, insurance, real estate and business services, the wholesale and retail trade, catering and accommodation and the manufacturing sectors. The primary sector contributed 9.9% with the secondary sector 23.8% (mostly manufacturing) and the tertiary sector 66.3%.

The Namakwa District Municipality contributed only 11% to the Northern Cape Province GDP with the main economic sectors being agriculture and tourism, with potential for growth in the mining and aquaculture sectors (Namakwa District Municipality 2020).

7.7.11. Tourism and Recreation

The wider project area falls into the broadly termed City of Cape Town and West Coast tourism areas in the Western Cape, and Namakwa region in the Northern Cape.

Both domestic and international tourism is a central economic activity for the Western Cape Province and the City of Cape Town. The province supported 1.6 million international tourist arrivals in 2016, and 2.1 million from the domestic tourism market. This resulted in a total generated income of R 18.1 billion in foreign spend and R 2.5 billion in domestic tourism spend (WESGRO N.D.). This has declined dramatically since the COVID-19 pandemic has restricted tourist traffic and foreign tourism in the year March 2020 – March 2021 was virtually nil. Cape Town has a relatively high share of domestic tourists (67%) compared to international tourists (32%) (WESGRO N.D.).

Across all three regions the top tourism and recreational activities include outdoor activities, scenic drives, visits to national parks, culture and heritage, beaches, food and wine. Coastal tourism and recreational activities and services are found primarily in and around Cape Town, while the Langebaan/Saldanha Bay area has the second highest concentration of tourism activities. Small pockets of coastal tourism are found scattered along the entire length of the West Coast in small towns dotted along the coastline. The Port of Cape Town contains the Victoria and Albert Waterfront (V&A Waterfront), which is a major international tourism and recreational destination. The Waterfront supports multi-use shopping, marine recreation and tourism activities through an estimated 396 businesses and the employment of 23 000 people (V&A Waterfront 2018). It also plays host to an average of 1.7 million visitors per month, which increases to over 2.5 million during the summer months and peak domestic and international tourist seasons.

Coastal destinations within the West Coast District attract 26.3% to 31.3% of foreign tourists visiting the West Coast area, and 68.7% to 71.7% of domestic tourists (West Coast District Municipality 2019). Key coastal activities include whale watching, water sports at Langebaan Lagoon, and scenic drives and views. The cold Atlantic Ocean waters and often severe weather means that swimming and other water sports (outside of the protected Langebaan Lagoon) are scarce.

In addition, boat cruises, whale watching, shark cage diving and offshore recreational fishing are important activities along the entire coastline and are undertaken as both personal recreation, as well as commercial operators. There is no definitive list of such commercial operators, however they will be widely distributed along the entire coast. Commercial operators will likely be found at formal clubs (including multiple clubs in Saldanha

Bay, Langebaan and Cape Town). Private recreational fishers will however be able to access the coastline from multiple registered boat-launch sites along the coast.

The tourism market in the Northern Cape Province is less developed but is one of the fastest growing contributors to the province's economy with an annual tourism spend of R850 million in 2013 (Northern Cape 2018). The Namakwa District, with its sparse population and small towns attracts the more adventurous tourists. Inland attractions, such as the wildflowers in the spring, geological and historical landmarks, and cultural features are key for tourism in this area, as the cold and windy coastline deters people from coastal recreational activities. Costal tourism is limited to the fishing towns of Hondeklipbaai, Kleinzee and Port Nolloth. Large distances between centres and a lack of infrastructure, tourist attractions and activities hinder active tourism growth in this area.

7.7.12. Private / Public Services, Facilities and Roads

The West Coast outside of major metropolitan or urbanised areas is generally poorly serviced in terms of both public and private services and facilities, including as road networks. The City of Cape Town and the Saldanha Bay are exceptions. As major metropolitan area, the City of Cape Town is well serviced, with a good standard of infrastructure and facilities. Saldanha Bay has roads and public infrastructure around the main centre and immediately neighbouring towns on the West Coast Peninsula. Further north, however, the level of infrastructure declines significantly, with only major arterial roads and unpaved secondary roads servicing the sparsely populated region. The small settlements along the coast have some limited services, such as post offices and police stations, however, these types of services are sporadic.

7.7.13. Ports

TEEPSA proposes to use either the port of Cape Town or Saldanha Bay for the provision of supplies. The general characteristics of these ports is presented below.

7.7.13.1. Port of Cape Town

The Port of Cape Town is one of eight commercial seaports in South Africa and is operated by TNPA. The Port primarily supports the shipment of containerised and bulk goods with an installed capacity to handle 1.1 million TEUs[20] of containers per annum, as well as an additional 2.1 million tonnes of dry bulk, 1.5 million tonnes of break bulk, and 3.4 million kilolitres of liquid bulk per annum (Transnet, 2019). The handling of bulk goods is supported across 18 berths at the Port.

The Port also plays a key role in supporting local commercial fisheries including several commercial fishing rights holders that include inshore and offshore demersal trawl fisheries. The Port of Cape Town includes berthing for fishing vessels, as well as the Cross Berth Cold Storage that handles the import and storage of fresh and frozen fish and fish products (Ports Regulator 2015/2016).

7.7.13.2. Port of Saldanha Bay

The Port of Saldanha Bay handles two major commodities, namely iron ore (export) and crude oil imports, which makes the port the primary dry bulk and liquid bulk for the Northern and Western Cape Provinces (Transnet

[20] A TEU (twenty-foot equivalent unit) is a measure of volume in units of twenty-foot long containers.

2019). The port handles approximately 70 million tonnes of cargo per annum of which approximately 86 % is the export of iron ore (Transnet 2019).

The Port of Saldanha Bay is a natural deep-water harbour, which consists of a 3 km long, man-made causeway which splits the port into Big Bay on the eastern side and Small Bay on the west (Transnet 2019). The layout includes:

- An iron ore stockyard and the reclamation dam located on the Big Bay coastline and a Mossgas Quay is located on the Small Bay coastline.
- The main jetty structure located at the end of the causeway consists of the dry bulk and liquid bulk terminals.
- The Break Bulk Terminal and the Offshore Supply Base are located directly north of the dry bulk terminal, on the causeway which connects with the shore.
- The Small Craft Harbour is located further westwards and is connected to Marcus Island by means of an artificial breakwater.
- An LPG facility, including a multi-buoy mooring, and a sub-sea and land-based sub-surface pipeline connected to a storage facility outside port limits.

There are a number of initiatives underway to support the ports viability and growth in the market. The strategic objectives for the Port of Saldanha is to leverage the port's competitive advantages based on a Phase 2 iron ore expansion berth, the reconfiguration of the oil jetty, the development of an offshore supply base, the development of the Mossgas jetty marine manufacturing facility, and the provision of one new berth for ship repair facilities (Transnet 2019).

7.7.14. Human Rights

South Africa has a well-established and globally recognised Constitution and institutions dedicated to the protection of human rights (specifically the Human Rights Commission). Human rights are primarily framed under Chapter 2 – Bills of Right in the Constitution, and it is ingrained in all laws promulgated that they must be consistent with the Constitution. The Human Rights Commission Act of 1994 establishes a legal commission to monitor - pro-actively and by way of complaints brought before it - violations of human rights and redress for such violations.

South Africa's Human Rights Commission has a history of active protection and monitoring of human rights notably with respect to large and high-profile developments such as mining. In addition, with a very active legal industry and strong social and formal media presence, South Africans are sensitive and responsive to potential human rights abuses and the collective knowledge around the package of rights is well understood. South Africa has an extremely empowered civil society that is well acquainted with human right's issues and the means by which redress can be pursued. The media in South Africa operates in a free, albeit proactively self-regulated, manner.

Under the Constitution, which requires the protection of the environment and human health as a fundamental right (Article 24 of the Bill of Rights), any significant pollution event can potentially be construed as a human rights violation. This would depend on the nature of such event and impacts posed to affected persons and the extent to which reparations are managed. While no human rights impacts are expected from day-to-day operations of the project activities, pre-existing resistance to the oil and gas sector in general that ignites mass opposition against the proposed exploration activities may also be construed as a human rights related issue.

7.7.15. Labour Rights

South Africa also has strict labour laws that are enforced by the State, labour unions, and local NGO's. Unfair labour practices are frequently challenged and upheld through the work of the Council for Conciliation, Mediation and Arbitration (CCMA). Under national labour law, basic employment rights (including minimum wage, working hours, unfair labour practice, working conditions, occupational health, and safety) are in place as well as the right to collectively organise. The role of collective bodies and unions have substantive political power in South Africa and have a very strong profile in terms of active protection and monitoring of labour rights notably with respect to large and high-profile developments and private entities.

South Africa's strong labour rights profile is founded on well-established national constitution and labour laws, which in turn are largely aligned with International Labour Organisation (ILO) conventions. ILO conventions to which South Africa is a signatory are listed in Section 2.3.

The risks associated with TEEPSA operations with respect to potential human and labour rights abuses are considered low provided that there is compliance with South African legislation and the ILO conventions. The activities do not require expropriation of any land or assets, or displacement of people or communities from any private or common resources.

7.7.16. Civil Society

Civil society is an umbrella term for a community, groups of people or organisations that represent a wide range of interests and normally operate outside of the government or private spheres. South Africa has a long and continuing history of strong civil society that covers both social and environmental interests and as of 2020 there were an estimated 228 822 Non-Profit Organisations (NPOs) registered in South Africa, of which 23 492 registered in the Western Cape (Parliamentary Monitoring Group[21]).

Civil society groups and non-profit organisations have a powerful social media profile and are able to form and coalesce around particular interests. Such groups do not necessarily function in specific areas, but many will have an international, national and local presence with offices in the major metropolitan areas. This includes organisations such as the World Wildlife Fund (WWF), SANBI, Wildlife and Environment Society South Africa (WESSA), Birdlife Africa, and WildTrust, as well as numerous academic and private institutions. While not locally based, such groups are expected to have substantial interest in the exploration activities as well as general oil and gas sector development in the future.

7.8. FISHERIES ACTIVITIES

South Africa has a coastline that spans two ecosystems over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species.

Approximately 14 different commercial fisheries sectors currently operate within South African waters and are all active in the indirect area of influence, including:

[21] https://pmg.org.za/committee-meeting/30312/

- Demersal trawl;
- Mid-water trawl;
- Hake demersal longline;
- Shark demersal longline;
- Small pelagic purse-seine;
- Large pelagic longline;
- Tuna pole;
- Commercial or Traditional linefish;
- West Coast rock lobster;
- South Coast rock lobster;
- Squid jig;
- Small-scale fisheries;
- Beach-seine and gillnet fisheries (netfish); and
- Aquaculture / Mariculture (including abalone, mussels, oysters, seaweed and finfish).

Each of these sectors, as well as fisheries research, recreational and illegal fishing, are described in more detail below (note: catch and effort data were sourced from DFFE by CapMarine).

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Gqeberha are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklipbaai, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors.

7.8.1. Demersal Trawl

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. The fishery is separated into an offshore sector targeting deep-water hake (*Merluccius paradoxus)* and an inshore sector targeting shallow-water hake (*M. capensis*) and Agulhas sole (*Austroglossus pectoralis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 Billion, or 40.5% of the total value of all fisheries combined. The 2021 Total Allowable Catch (TAC) for hake was set at 139 109 tonnes, of which 84% and 6% is allocated to the offshore and inshore trawl sectors, respectively (the remaining 10% is allocated to the hake demersal longline sector).

The fishery is restricted by permit condition to operating within the confines of an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively.

The **offshore fishery** is comprised of approximately 45 vessels operating from most major harbours on both the West and South Coasts where the fishing grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours. Most effort occurs in water of depth between 300 m and 600 m. Monk-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea trawlers may not fish in waters shallower than 110 m or within five nautical miles of the coastline.

The **inshore fishery** consists of approximately 31 vessels, which operate on the South Coast mainly from the harbours of Mossel Bay and Gqeberha. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. Vessels also target sole close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Hake is targeted further offshore in traditional grounds between 100 m and 200 m depth in fishing grounds known as the *Blues* located on the Agulhas Bank.

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening (see Figure 7-44). The configuration of trawling gear is similar for both offshore and inshore vessels; however, inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels, which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port.

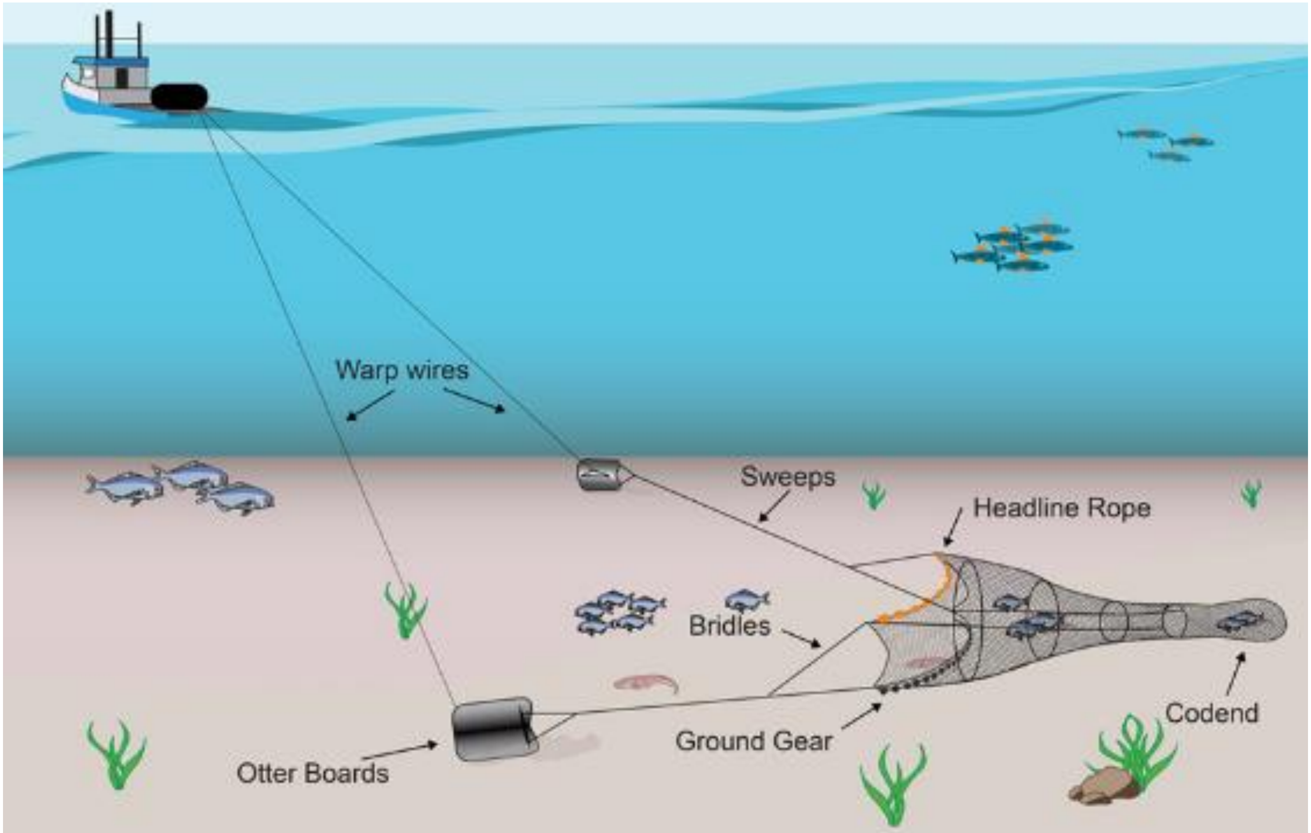


FIGURE 7-44: TRAWL GEAR TYPICALLY USED BY DEMERSAL TRAWLERS TARGETING HAKE

Source: http://www.afma.gov.au/portfolio-item/trawling

Figure 7-45 shows the demersal trawling effort in relation to DWOB Licence Block and Area of Interest for proposed exploration drilling area. In the vicinity of the DWOB Licence Block, trawling occurs inshore of the 1000 m depth contour and **there is no overlap of demersal trawl fishing area with the DWOB Licence Block**.

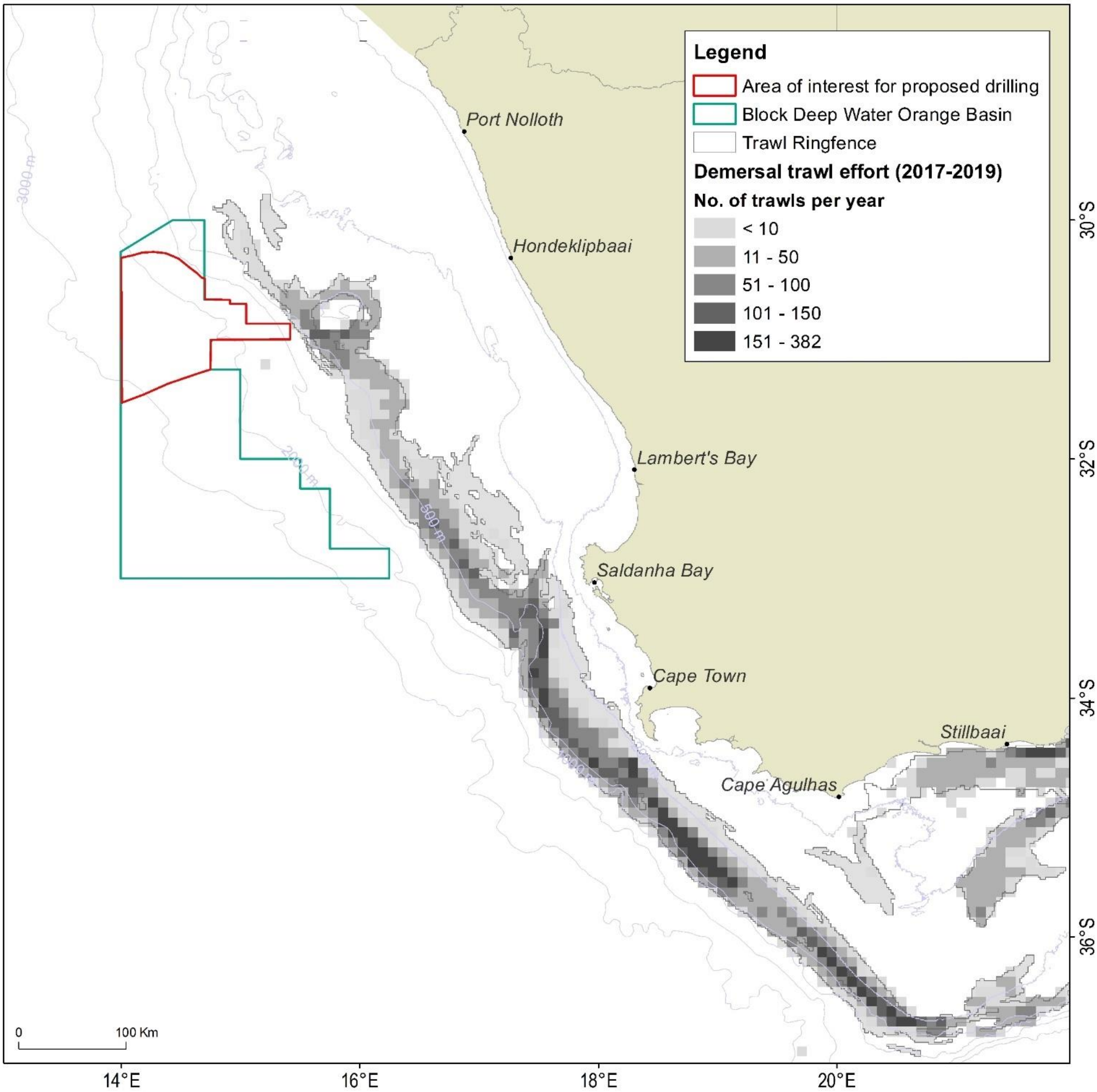


FIGURE 7-45: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF DEMERSAL TRAWL EFFORT (2017-2019)

Note: effort is shown as the number of fishing hours at a gridded resolution of 5x5 minutes (each grid block covers an area of approximately 86 km^2). Source: CapMarine

7.8.2. Mid-Water Trawl

The mid-water trawl fishery targets adult Cape horse mackerel (*Trachurus capensis*), which aggregate in highest concentration on the Agulhas Bank (South Coast) compared to the West Coast. Shoals of commercial abundance are found in limited areas and the spatial extent of mid-water trawl activity is relatively limited when compared to that of demersal trawling.

Fishing grounds are located into three main areas on the shelf edge of the South and East coasts:

1. Between 22°E and 23°E at a distance of approximately 70 nm offshore from Mossel Bay;

2. Between 24°E to 27°E at a distance of approximately 30 nm offshore; and
3. South of the Agulhas Bank between 21°E and 22°E.

These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. Since 2017, DFFE has permitted experimental fishing to take place westward of 20°E.

Figure 7-46 shows the spatial extent of grounds fished by midwater trawlers in relation to Block DWOB and the Area of Interest for proposed exploration drilling area. **There is no overlap of demersal trawl fishing area with the DWOB Licence Block**

At present, the midwater trawl fleet comprises a single, large midwater trawler (the FV Desert Diamond, which lands about 70% of horse mackerel trawl catches) and a number of smaller hake trawlers carrying both hake and horse mackerel Rights (the so-called “dual Rights vessels”) that allow them to opportunistically target horse mackerel with mid-water gear additional to their normal hake fishing operations using demersal trawl gear.

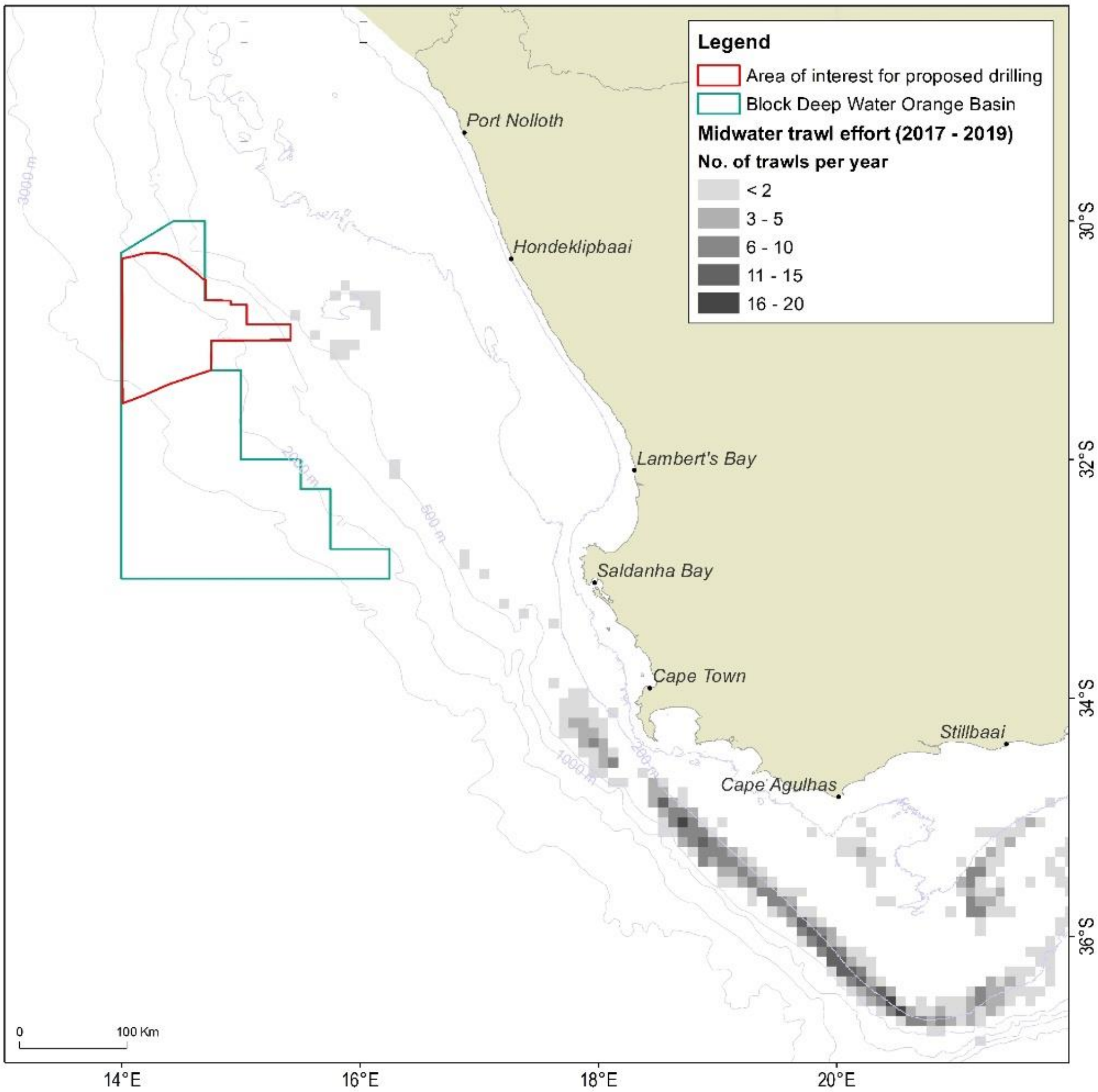


FIGURE 7-46: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF MID-WATER TRAWL EFFORT TARGETING HORSE MACKEREL (2017-2019)

Note: The location of the start of each trawl over the period 2017 to 2019 is shown in respect to commercial grid blocks (labelled). Depth contours indicated (100 m to 3000 m).
Source: CapMarine

Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and codend (see Figure 7-47). Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break. Mid-water trawling can occur at any depth between the seabed and the surface of the sea without continuously touching the bottom. However, in practice, mid-water trawl gear does occasionally come into contact with the seafloor.

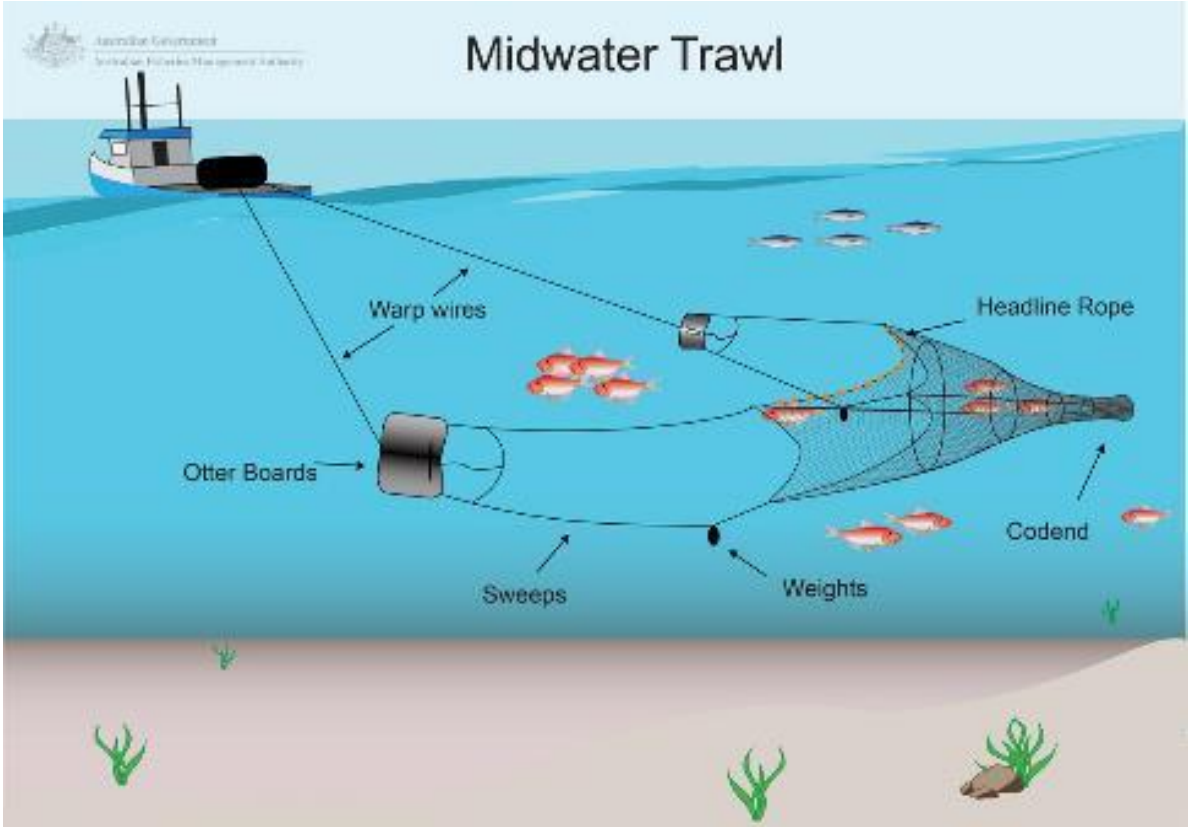


FIGURE 7-47: TYPICAL CONFIGURATION OF MID-WATER TRAWL GEAR

Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

7.8.3. Hake Demersal Longline

The demersal longline fishing technique is used to target bottom-dwelling species of fish. Like the demersal trawl fishery the target species are the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8 113 tonnes of hake was landed with a wholesale value of R319.2 million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tonnes were reported in 2018. Fishing takes place along the West and South East coasts in areas similar to those targeted by the demersal trawl fleet.

The hake longline footprint extends down the West Coast from approximately 150 km offshore of Port Nolloth. It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank.

Figure 7-48 shows the spatial distribution of hake demersal longline effort in relation to the licence block and proposed drilling area. **There is no overlap of the demersal longline fishing area with the DWOB Licence Block.**

There are approximately 64 vessels licenced within the sector, operating from all major harbours, including Cape Town, Hout Bay, Mossel Bay and Gqeberha. Secondary points of deployment include St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Plettenberg Bay and Cape St Francis. Vessels based in Cape Town and Hout Bay operate almost exclusively on the West Coast (west of 20° E).

Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) (see Figure 7-49). Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete.

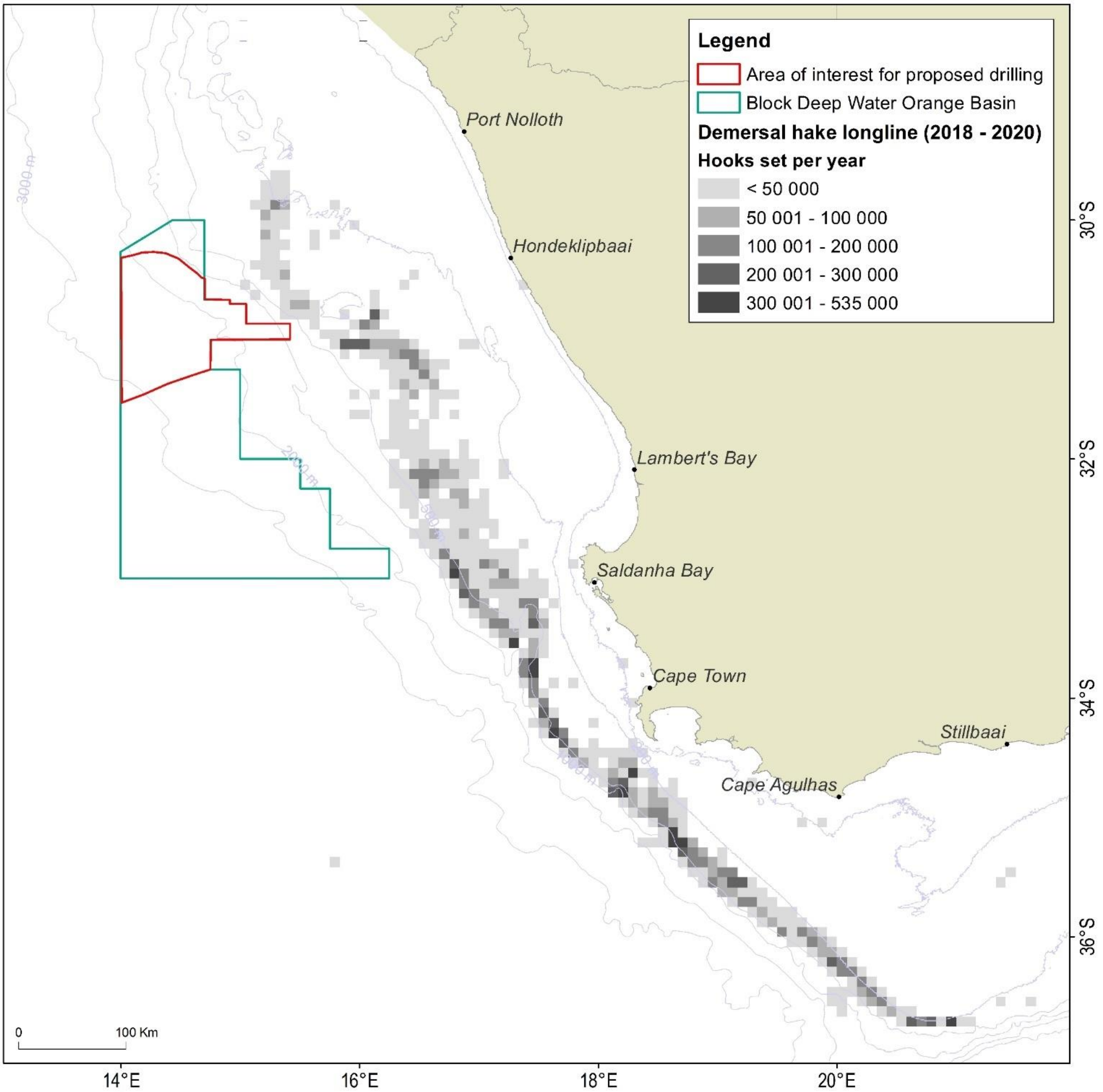


FIGURE 7-48: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF HAKE DEMERSAL LONGLINE EFFORT (2018-2020)

Source: CapMarine

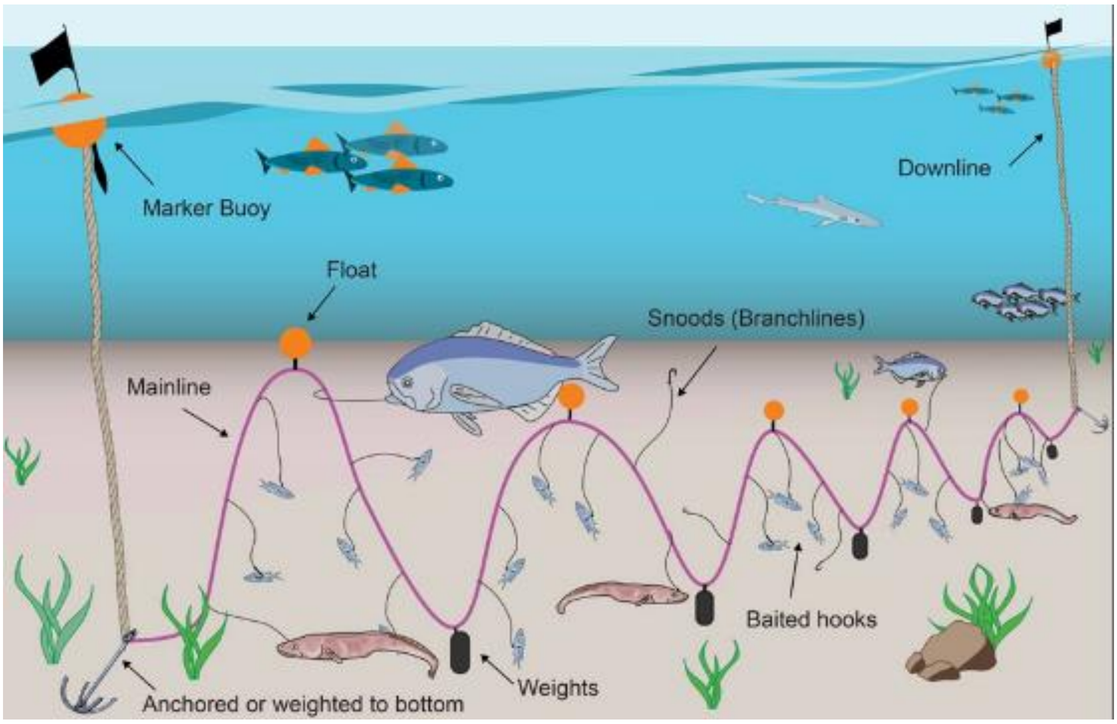


FIGURE 7-49: TYPICAL CONFIGURATION OF DEMERSAL (BOTTOM-SET) HAKE LONGLINE GEAR

Source: http://www.afma.gov.au/portfolio-item/longlining

7.8.4. Small Pelagic Purse-Seine

The South African small pelagic purse seine fishery is the largest fishery by volume and the second most important in terms of value (after the demersal trawl fishery). The two main targeted species are sardine and anchovy, with some rights holders also targeting round herring (red-eye), with associated by-catch of round chub mackerel and horse mackerel.

Small pelagic fish species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. The total combined catch of anchovy, sardine and round herring landed by the small pelagic fishery has decreased by 45% from 395 000 t in 2016 to 219 000 t in 2019, due mainly to a substantial decrease in the catch of anchovy from 262 000 t in 2016 to only 166 000 t in 2019. Despite this decline, the average combined catch over the last five years of 322 000 t is only slightly lower than the long-term (1949–2019 - see Figure 7-50) average annual catch of 334 000 t. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion, or 22% of the total value of all fisheries combined.

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m. The majority of the fleet operate on the West / South-West Coasts at St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay, with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Gqeberha. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. The sardine-directed fleet concentrates effort in a broad area extending from Lambert’s Bay, southwards past Saldanha and Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Gqeberha. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert’s Bay to Kleinbaai (near Gansbaai) and similarly the intensity of this fishery is dependent on fish availability and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed from Lambert's Bay to south of Cape Point. This fishery may extend further offshore than the sardine and anchovy-directed fisheries.

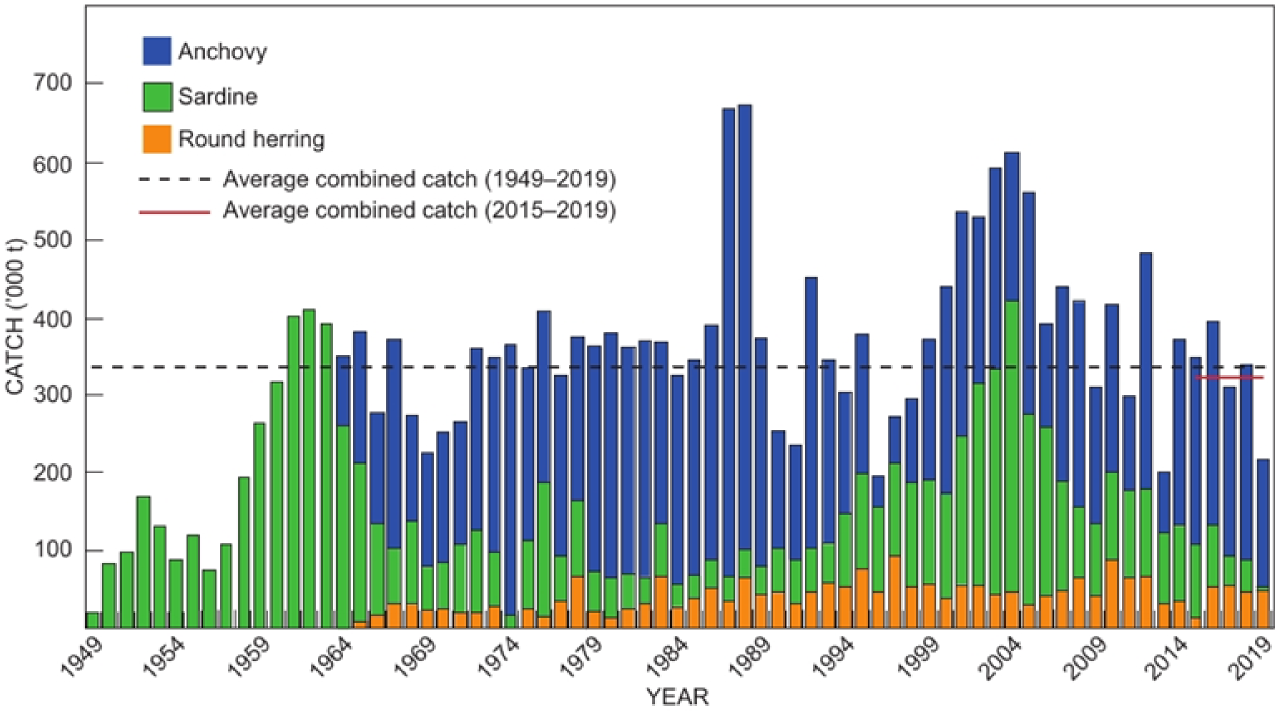


FIGURE 7-50: NATIONAL ANNUAL COMBINED CATCH OF ANCHOVY, SARDINE AND ROUND HERRING (1949-2019)

Notes: The average combined catch since the start of the fishery (1949-2019; black dashed line) and for the past five years (2015-2019; red solid line).
Source: DFFE 2021

Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km. Figure 7-51 shows the spatial extent of fishing grounds in relation to the licence block and Area of Interest for proposed exploration drilling. **There is no overlap of the small pelagic purse seine fishing area with the DWOB Licence Block.**

The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Seasonality of catches is shown in Figure 7-52 with an increase in fishing effort and landings evident during the winter months.

The targeted pelagic fish species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 m to 90 m (see Figure 7-53). Netting walls surround aggregated fish, preventing them from diving downwards. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

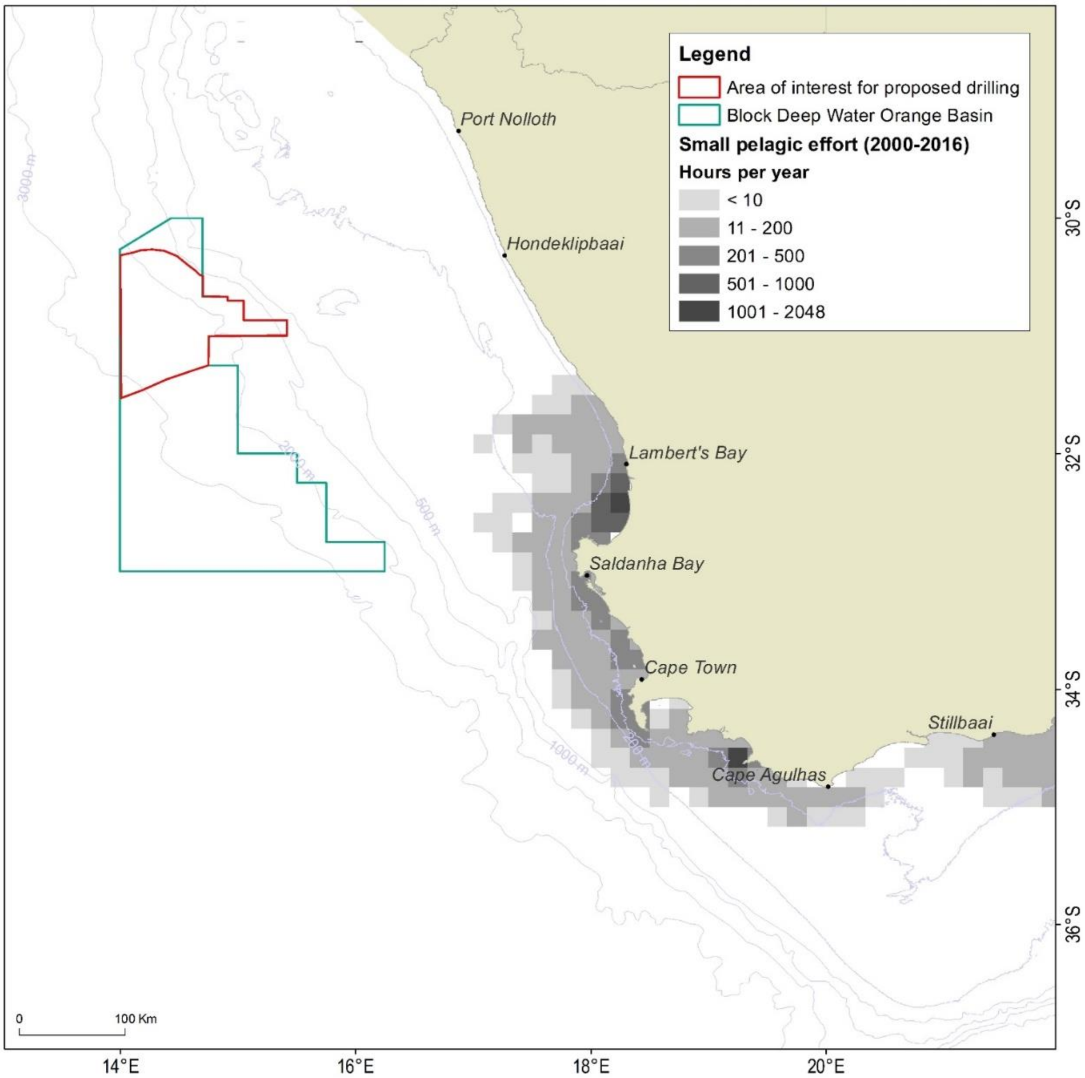


FIGURE 7-51: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF PURSE-SEINE EFFORT TARGETING SMALL PELAGIC SPECIES (2000-2016)

Source: CapMarine

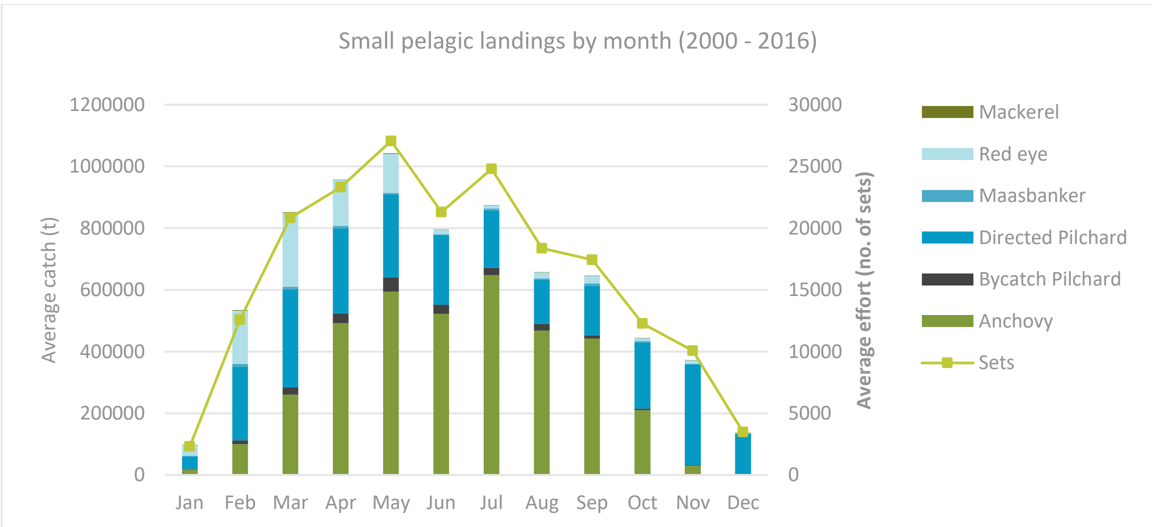


FIGURE 7-52: GRAPH SHOWING MONTHLY CATCH (TONNES) AND EFFORT (NUMBER OF SETS) REPORTED FOR THE SMALL PELAGIC PURSE-SEINE FLEET OVER THE PERIOD 2000 TO 2016 (CUMULATIVE)

Source: CapMarine

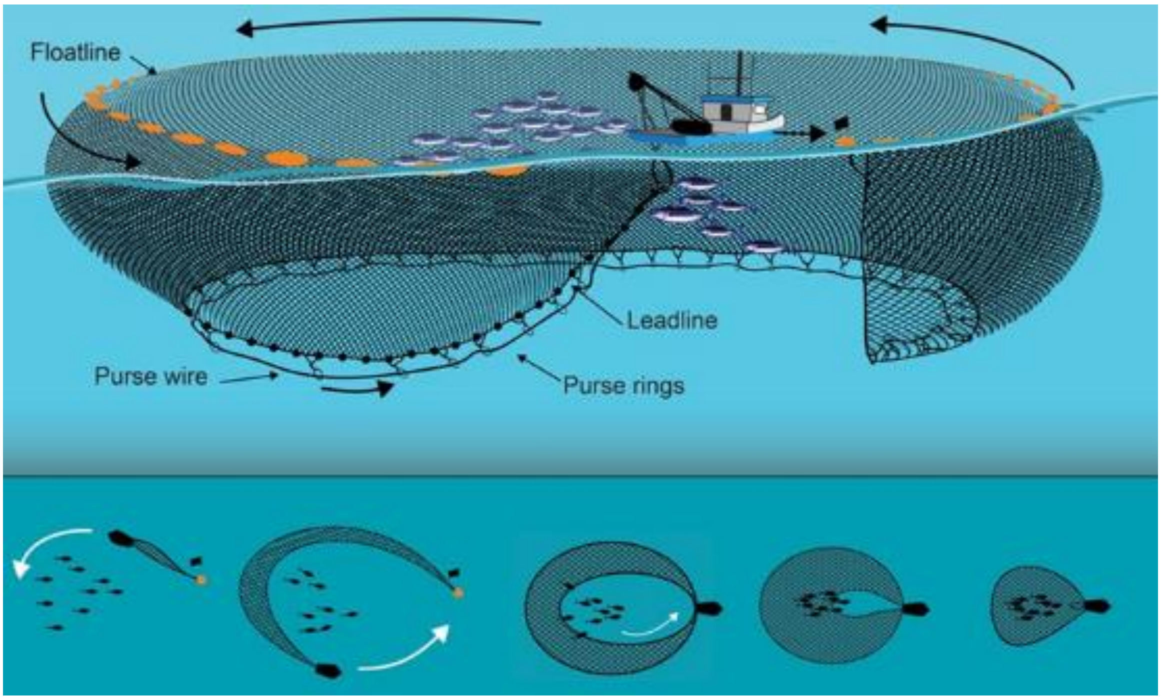


FIGURE 7-53: TYPICAL CONFIGURATION AND DEPLOYMENT OF A SMALL PELAGIC PURSE-SEINE FOR TARGETING ANCHOVY AND SARDINE AS USED IN SOUTH AFRICAN WATERS

Source: http://www.afma.gov.au/portfolio-item/purse-seine

7.8.5. Large Pelagic Longline

The target species within the South African pelagic longline sector are albacore tuna, yellowfin tuna, bigeye tuna, swordfish and shark species. Due to the highly migratory nature of these species, stocks straddle the EEZ of a number of countries and international waters. As such they are managed as a "shared resource" amongst various countries.

The wholesale value of catch landed by the sector in 2017 was R 154.2 million, or 1.6% of the total value of all fisheries combined, with landings of 2 541 tonnes (2017) and 2 815 tonnes (2018). Total catch and effort figures reported by the large pelagic longline fishery for the years 2000 to 2018 are shown in Figure 7-54.

The fishery operates year-round with a relative increase in effort during winter and spring shown by foreign-flagged longline vessels (see Figure 7-55b). The numbers of hooks set by foreign vessels peak between May and October each year, whereas local vessels fish throughout the year, with marginally fewer hooks set in January and February than other months (see Figure 7-55b).

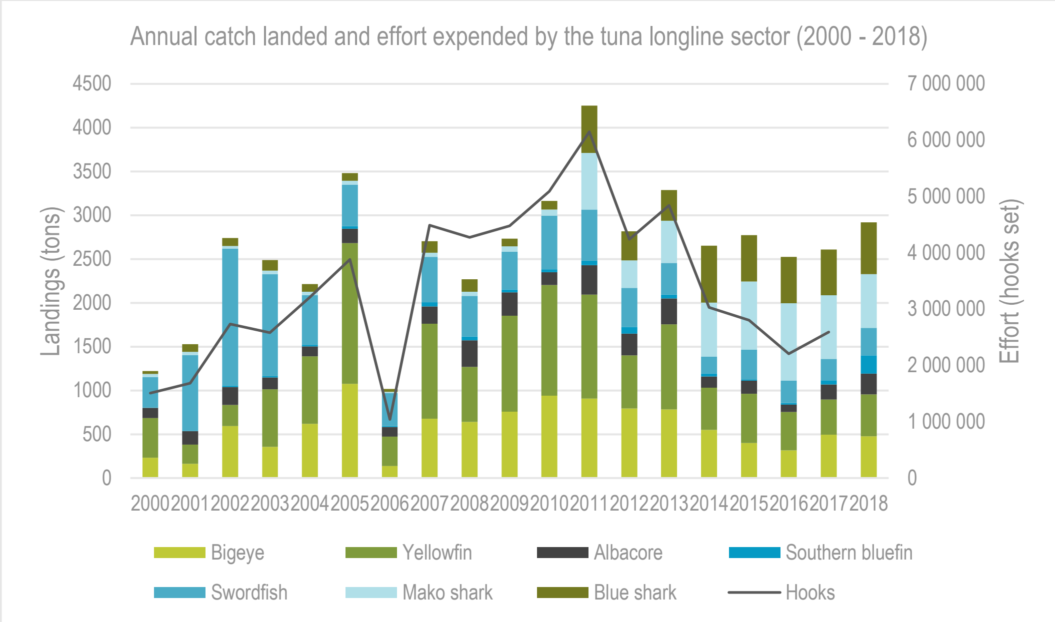


FIGURE 7-54: INTER-ANNUAL VARIATION OF CATCH LANDED AND EFFORT EXPENDED BY THE LARGE PELAGIC LONGLINE SECTOR IN SOUTH AFRICAN WATERS AS REPORTED TO THE TWO REGIONAL MANAGEMENT ORGANISATIONS, ICCAT AND IOTC (2000 - 2018)

Source: DFFE, 2019

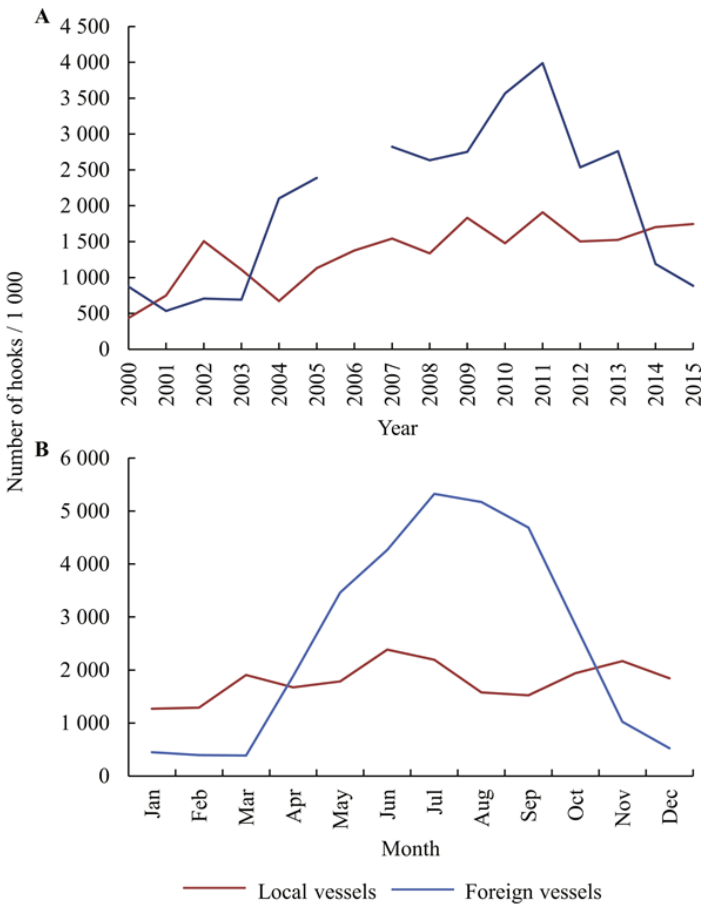


FIGURE 7-55: NUMBERS OF HOOKS SET PER (A) YEAR (2000–2015) AND (B) PER CALENDAR MONTH, AS REPORTED BY LOCAL AND FOREIGN PELAGIC LONGLINE VESSELS

Source: Jordaan *et al.* 2018

The geographical distribution of fishing effort by local and foreign pelagic longline vessels between 2000 and 2015 is shown in Figure 7-56. Local vessels fish in all four areas (West, South-West, South and East), but in the East their range is limited to the northern half of the area, near a landing site at Richards Bay. Foreign vessels fish mainly in the Indian Ocean, with the bulk of all hooks set in the South (58%) and East (33%) areas, and the remaining 9% in the Atlantic (West and South-West areas). Foreign vessels set an average of 2 493 ± 597 (SD) hooks per line, compared to only 1 282 ± 250 hooks per line used by local vessels.

Figure 7-57 shows the spatial extent of pelagic longline fishing grounds in relation to the licence block and Area of Interest for proposed exploration drilling. **Over the period 2017 to 2019 (cumulative local and foreign fleets), an average of 149 lines per year were set within DWOB yielding 191 tonnes of catch. This is equivalent to 7.14% of the overall catch and 8.36% of the overall effort reported nationally by the sector. Fishing activity takes place over the entire Area of Interest for proposed exploration drilling but is concentrated towards the shelf break. Over the period 2017 to 2019, an average of 68 lines per year were set within the AOI yielding 84 tonnes of catch. This is equivalent to 3.14% and 3.84% of the overall catch and effort, respectively.**

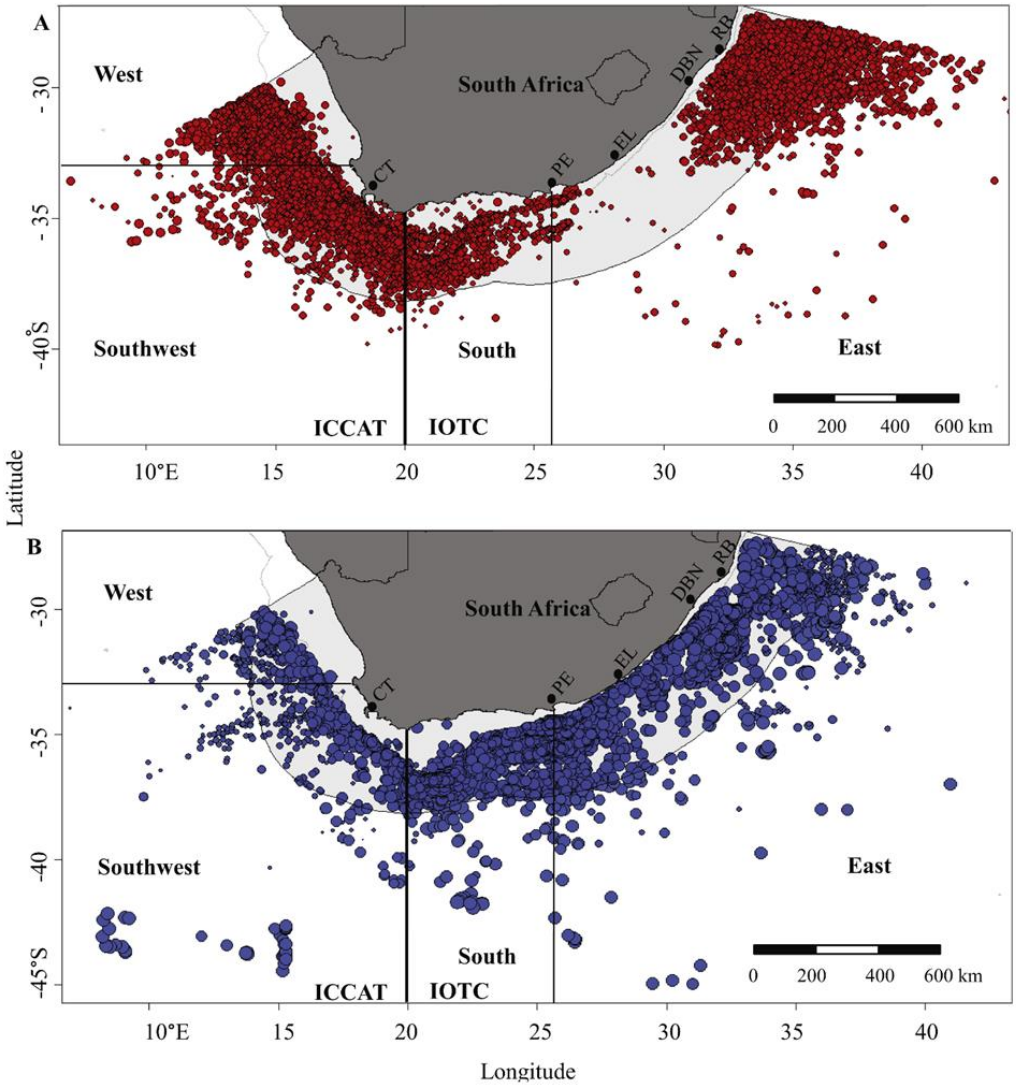


FIGURE 7-56: GEOGRAPHICAL DISTRIBUTION OF FISHING EFFORT BY (A) LOCAL AND (B) FOREIGN PELAGIC LONGLINE VESSELS BETWEEN 2000 AND 2015

Notes: Bubble size is proportional to the numbers of hooks set per line. Data based on logbook data provided by vessel skippers.

Source: Jordaan *et al.* 2018

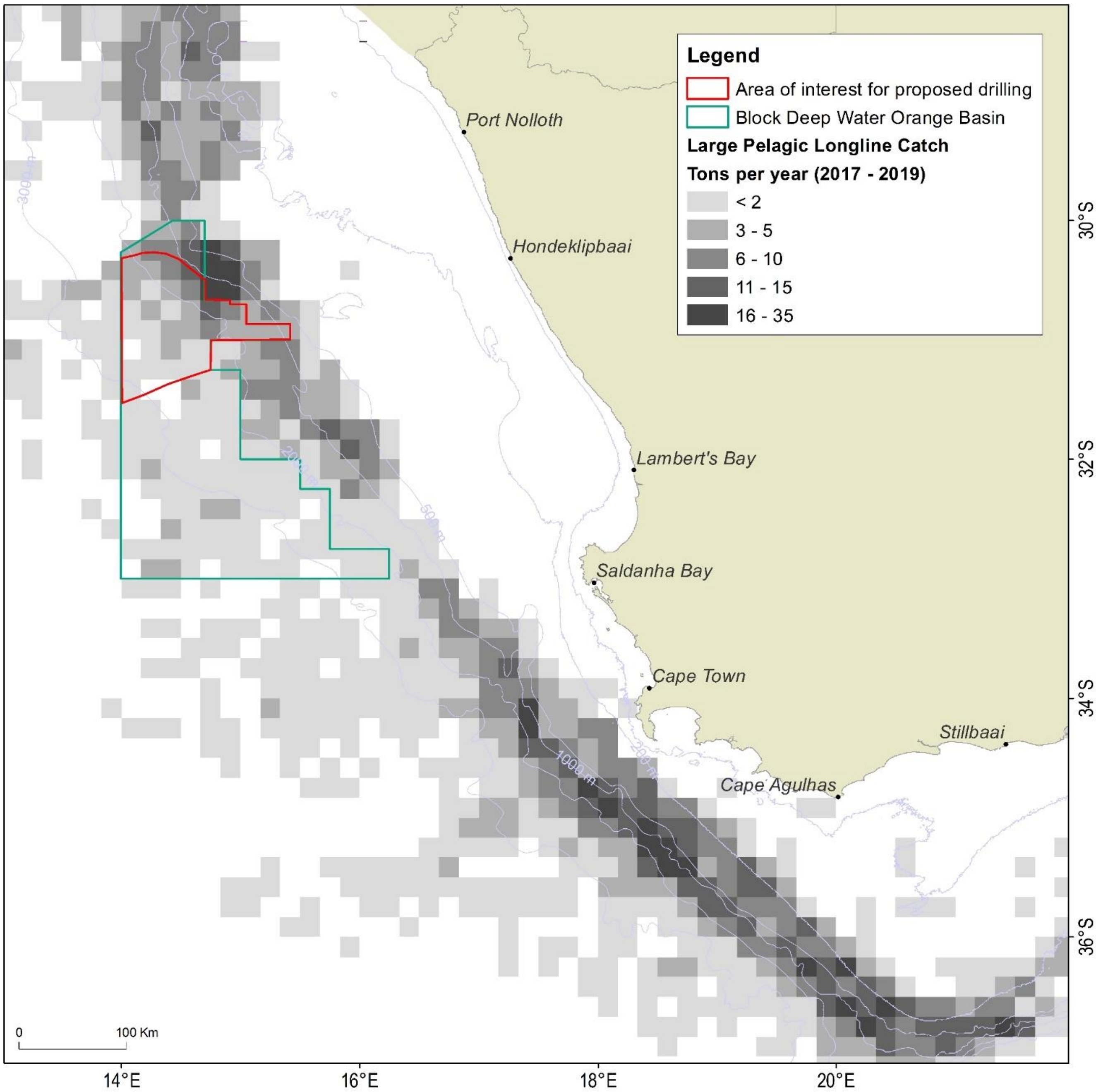


FIGURE 7-57: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF PELAGIC LONGLINE CATCH (2017-2019)

Source: CapMarine

Pelagic longline vessels set a drifting mainline, which are up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via “buoy-lines”, which are spaced approximately 500 m apart along the length of the mainline (see Figure 7-58). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks its position for later retrieval by the fishing vessel. 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. During hauling a vessel’s manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

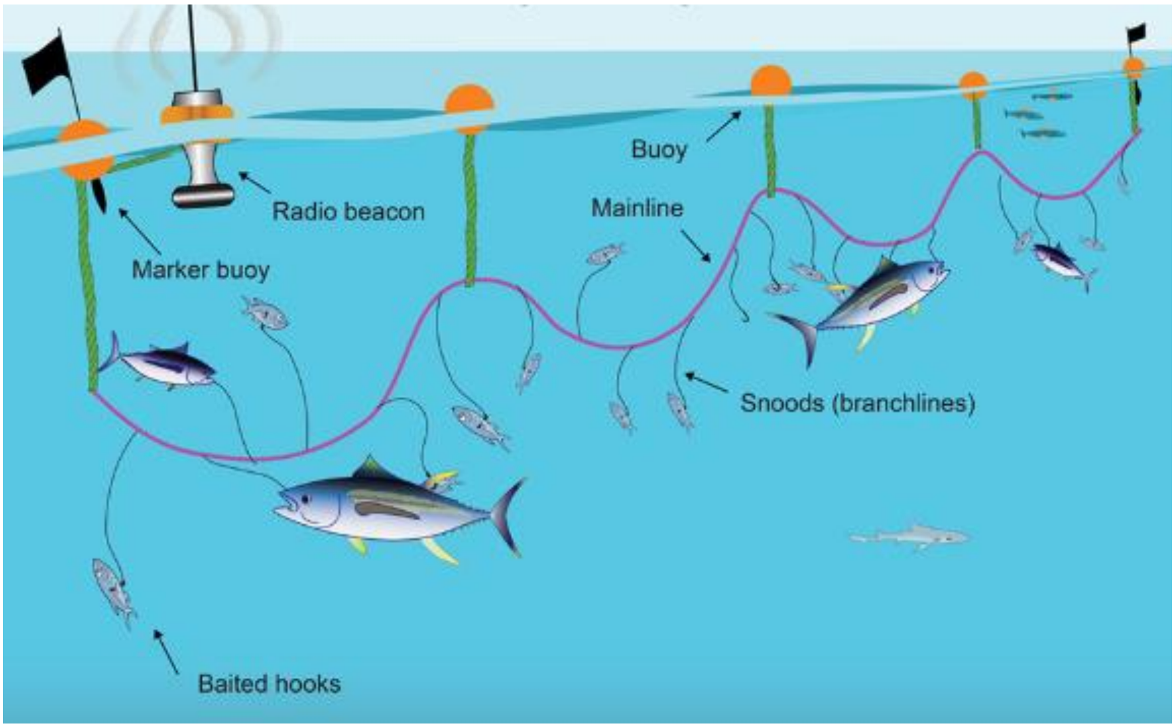


FIGURE 7-58: TYPICAL LARGE PELAGIC LONGLINE GEAR SOURCE

Source: http://www.afma.gov.au/portfolio-item/longlining

7.8.6. Tuna Pole

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore. Other catch species include yellowfin tuna, bigeye tuna and skipjack tuna. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Due to the seasonality of tuna in South Africa's waters the tuna pole fishery is also allowed access to snoek and yellowtail. Landings of albacore for 2018 amounted to 2471 tonnes, with a wholesale value of R124 million, or 1.2% of the total value of all fisheries combined.

The active fleet consists of approximately 92 pole-and-line vessels, which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. Vessels normally operate within a 100 nm (185 km) radius of these locations with effort concentrated in the Cape Canyon area (South-West of Cape Point) and up the West Coast to the Namibian border with South Africa.

Fishing activity for tuna occurs along the entire West Coast beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore of Saldanha Bay. Snoek-directed fishing activity is coastal and seasonal in nature – taking place inshore of the 100 m depth contour during the period March to July.

Figure 7-59 shows the location of fishing activity in relation to Block DWOB and Area of Interest for proposed exploration drilling. The block lies adjacent to favoured fishing grounds but catch and effort within the block itself is relatively low. Effort expended within the licence block averaged 58 fishing hours per year and catch within the licence block averaged 4.3 tons per year. This is equivalent to 0.2 % and 0.1 %, respectively, of the total effort and catch figures for the sector on a national scale. **There are therefore very low levels of fishing activity reported within the DWOB Licence Block by the tuna pole fishery.**

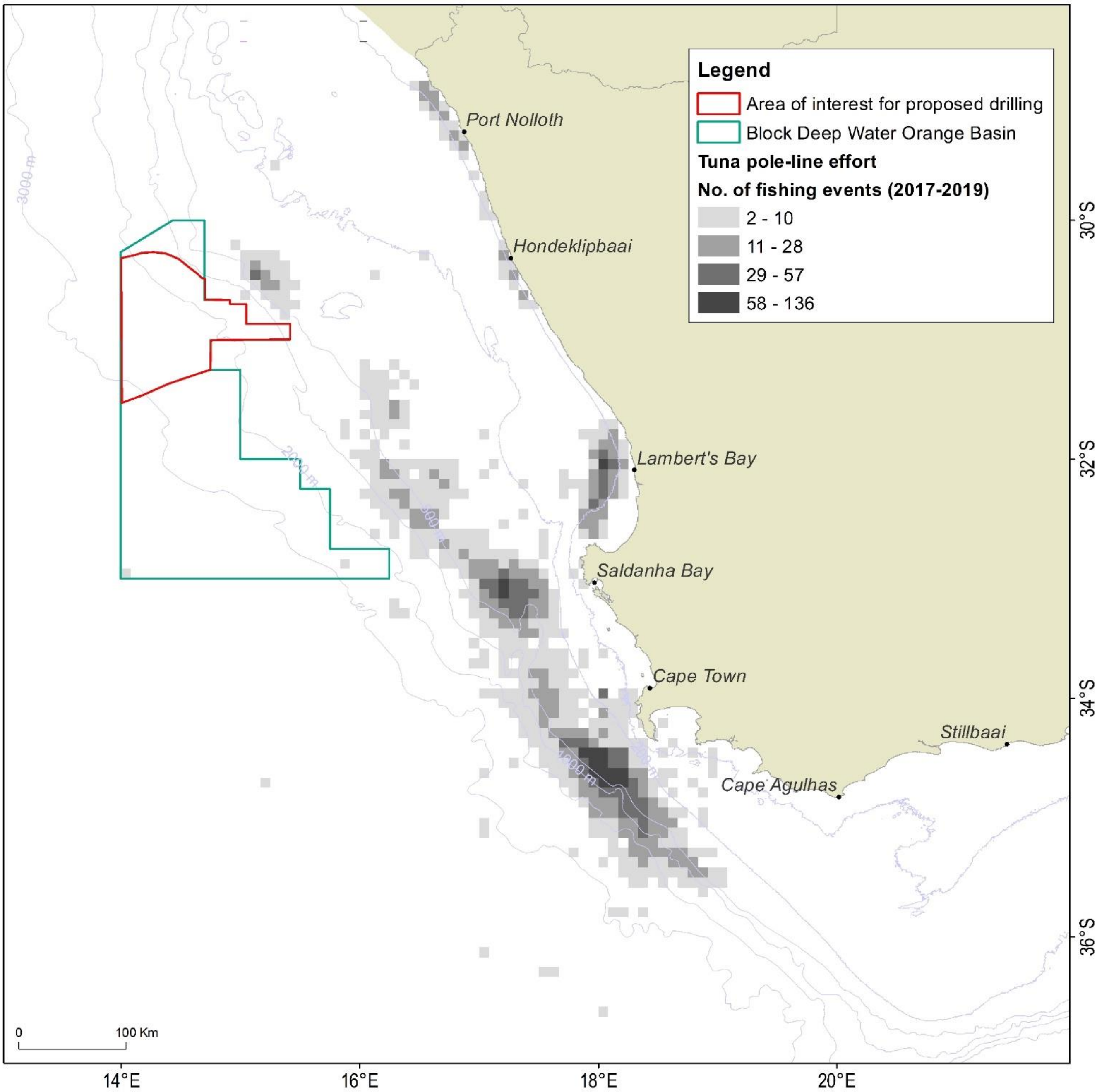


FIGURE 7-59: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF TUNA POLE EFFORT (2017-2019)

Source: CapMarine

Whilst vessels are at sea, the majority of time is spent searching for fish with actual fishing events taking place over a relatively short period of time. Sonars and echo sounders are used to locate schools of tuna. At the start of fishing, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface, thereby attracting tuna to the surface. Live bait is flung out to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the 2 m to 3 m poles are fitted with a short length of fishing line leading to a hook. Hooked fish are pulled from the water and many tonnes can be landed in a short period of time. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 7-60).

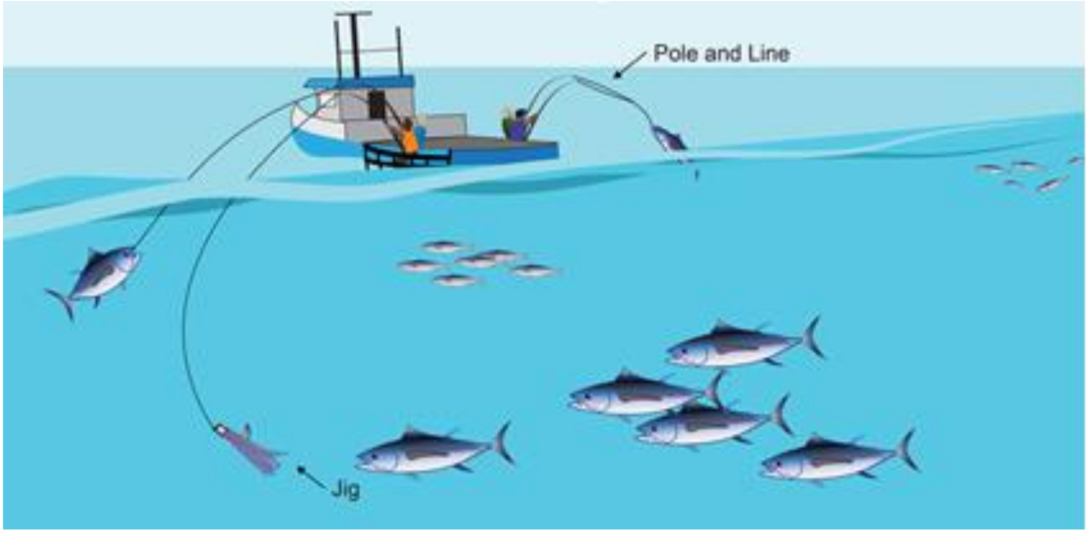


FIGURE 7-60: SCHEMATIC DIAGRAM OF POLE AND LINE OPERATION
Source: http://www.afma.gov.au/portfolio-item/minor-lines

7.8.7. Commercial or Traditional Linefish

This sector has its origins from the recreational sector. Essentially recreational linefishers commercialised resulting in a systematic decline in the “linefish" stocks. The Minister of Fisheries in the 1980’s reformed the sector. This was done by creating a small commercial linefish sector, as well as introducing a moratorium on exploiting many species that were collapsed or near collapse. The commercial linefish sector now only allows a limited number of key species to be exploited.

The commercial or traditional linefish fishery is South Africa’s third most important fishery in terms of total tonnes landed and economic value. It is a long-standing, **nearshore fishery** targeting approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. Within the Western Cape, the predominant catch species is snoek while other species such as Cape bream (hottentot), geelbek, kob and yellowtail are also important. Towards the East Coast the number of catch species increases and includes resident reef fish, pelagic migrants and demersal migrants. In 2017, the wholesale value of catch was reported as R122.1 million.

The fishery is widespread along the country’s shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. Zone A extends from Port Nolloth to Cape Infanta, Zone B extends from Cape Infanta to Port St Johns and Zone C covers the KwaZulu-Natal region. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape (covering Zones A and B). Fishing takes place throughout the year but there is some seasonality in catches.

Vessels range in length between 4.5 m and 11 m and the offshore operational range is restricted by vessel category to 40 nm (75 km). Fishing effort at this outer limit is sporadic, with most activity within 15 km of a launch site. There are an estimated 455 commercial vessels consisting of approximately 3 450 crew operating extensively around the coast with 425 rights holders. In addition to the commercial vessels there are many more ski boats that are used in the recreational sector, which may be launched from a number of slipways and harbours. Figure 7-61 shows the spatial extent of traditional linefish grounds in relation to Block DWOB and Area of Interest for proposed exploration drilling. **The DWOB Licence Block does not coincide with the fishery.**

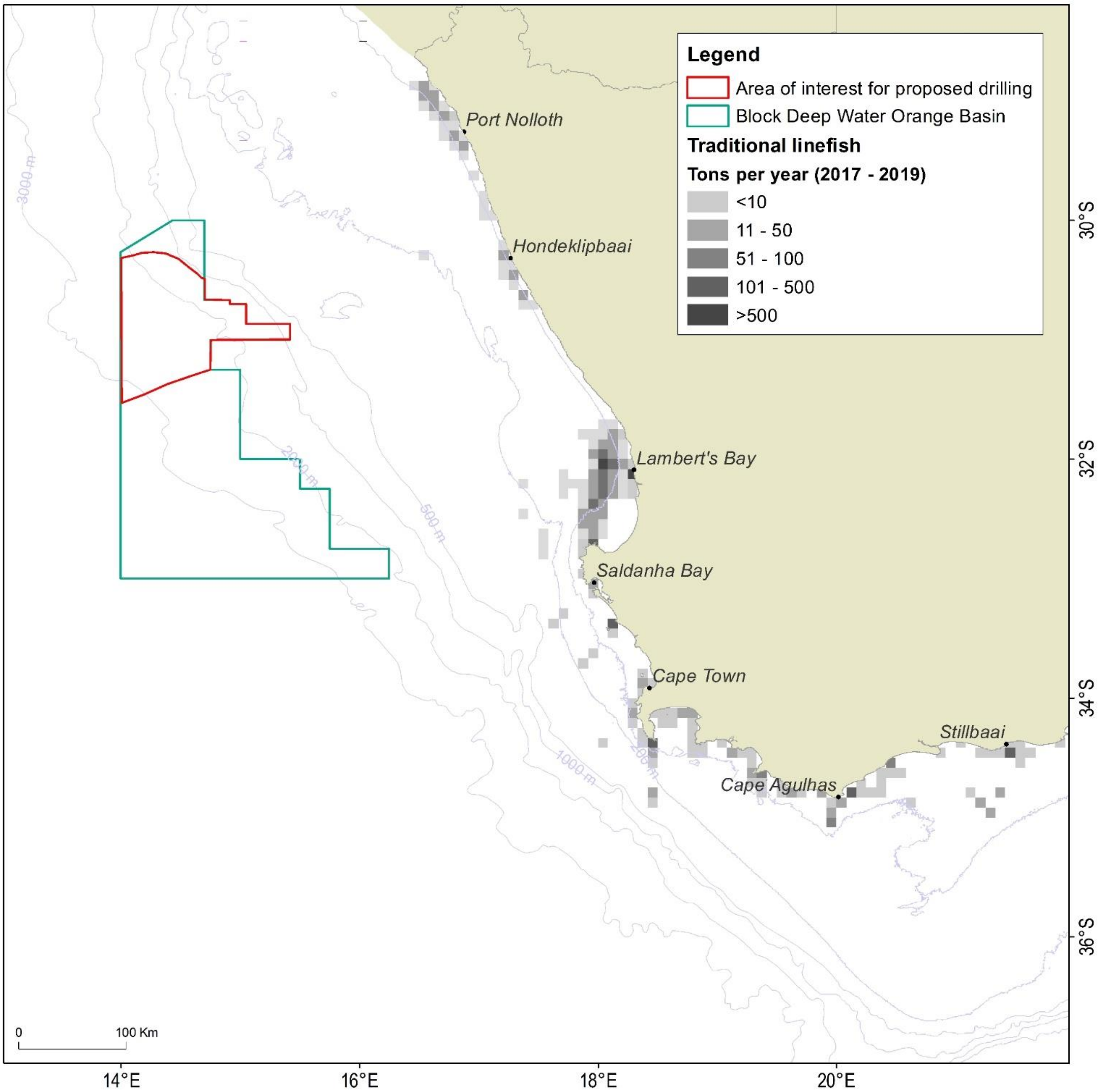


FIGURE 7-61: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF COMMERCIAL OR TRADITIONAL LINEFISH CATCH (2017-2019)

Source: CapMarine

7.8.8. West Coast Rock Lobster

The West Coast rock lobster (*Jasus lalandii*) is a valuable resource along West Coast and consequently an important income source for West Coast fishermen. The resource occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. Fishing grounds stretch from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape.

The resource is managed geographically in various management zones, with TACs set annually for the different management zones. The fishery is comprised of four sub-sectors – commercial offshore, commercial nearshore, small-scale and recreational, all of which have to share from the same national TAC, which set at 837 tonnes for 2020/21. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones. Average monthly landings over the period 2006 to 2020 are shown in Figure 7-62.

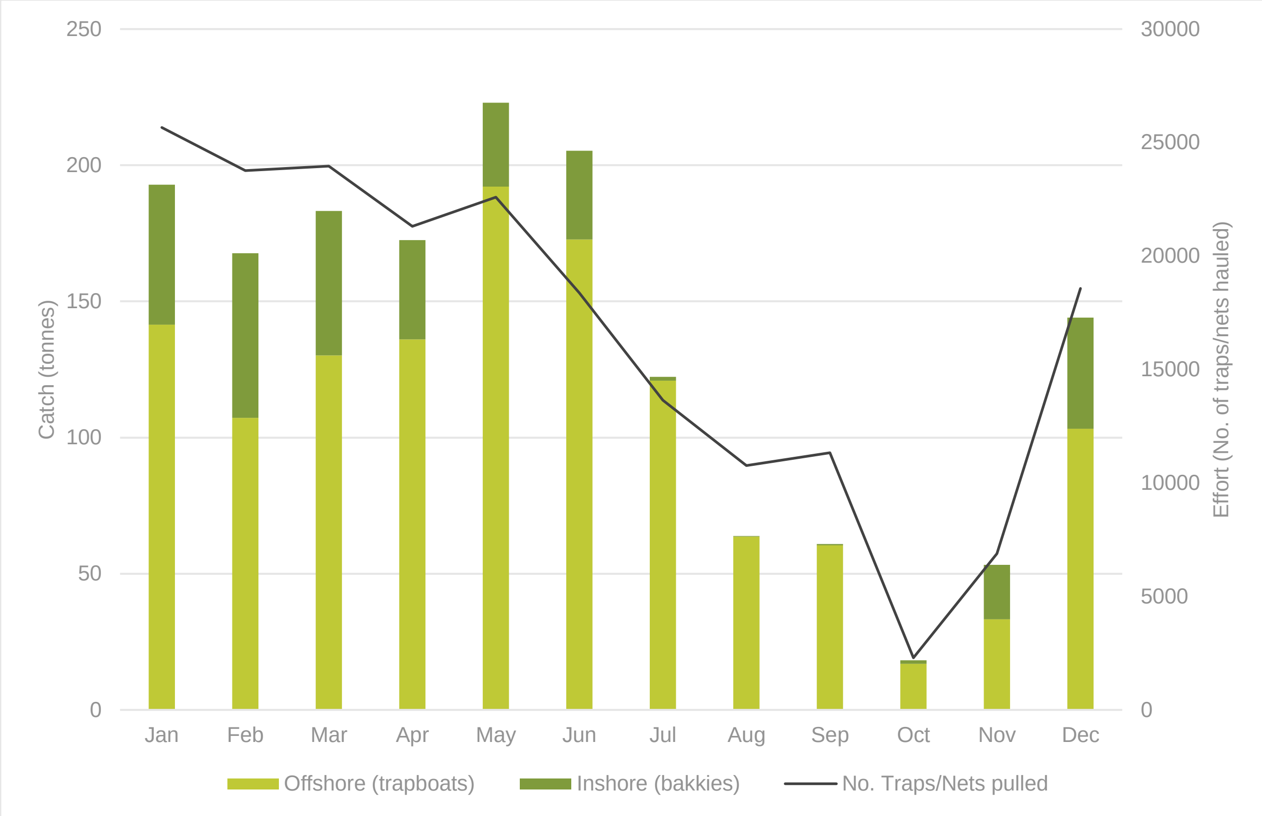


FIGURE 7-62: GRAPH SHOWING THE AVERAGE MONTHLY CATCH AND EFFORT REPORTED BY THE OFFSHORE AND INSHORE ROCK LOBSTER SECTORS (2006-2020)

Source: CapMarine

The commercial offshore sector operates at a depth range of approximately 30 m to 100 m, making use of traps consisting of rectangular metal frames covered by netting. These traps are set at dusk and retrieved during the early morning. Approximately 138 vessels participate in the offshore sector.

The commercial nearshore sector makes use of hoop nets to target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 – 30 m. These are deployed from a fleet of small dinghies/bakkies which operate from the shore and coastal harbours. Approximately 653 boats participate in the sector.

The DWOB Licence Block lies greater than 145 km west of the fishing grounds and there is no overlap of fishing grounds with the licence block.

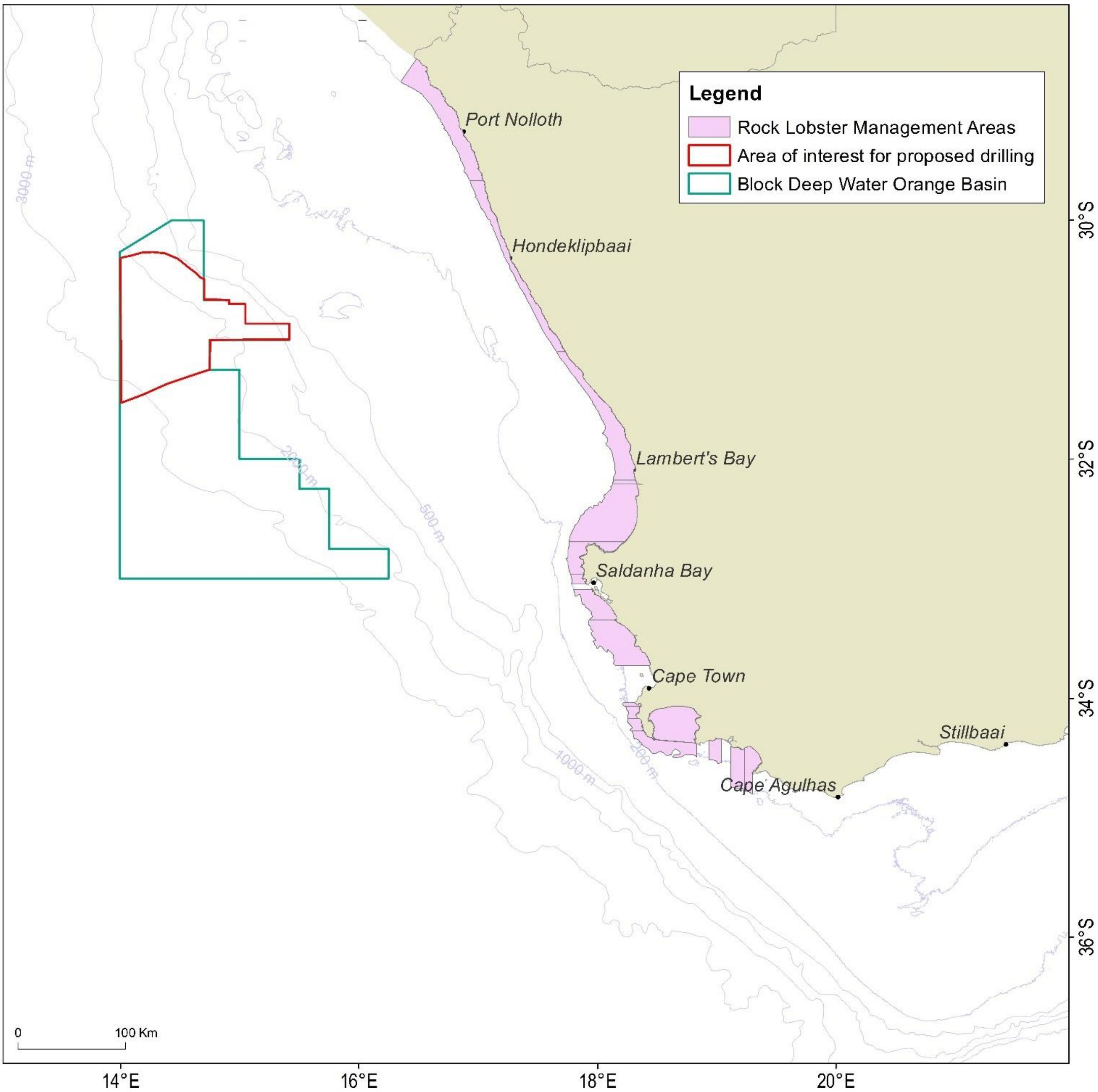


FIGURE 7-63: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF WEST COAST ROCK LOBSTER CATCH (2006-2020)

Source: CapMarine

7.8.9. White Mussels

White mussels are found in the intertidal zone of sandy beaches ranging from northern Namibia to the Eastern Cape of South Africa. Their abundance is highest along the West Coast because of the higher plankton production in that area compared with the rest of the South African coast, which is associated with upwelling of the Benguela Current. **Harvesting of white mussels is limited to seven areas along the West Coast** (see Figure 7-64), **the closest of which (between Paternoster) is located approximately 150 km to the east of the DWOB Licence Block and 300 km southeast of the proposed Area of Interest for Drilling.**

Since 2007 this commercial sector has been managed by means of a Total Allowable Effort (TAE) allocation of seven Right Holders (a Right Holder may have up to seven “pickers”), each harvesting within only one of the seven fishing areas along the West Coast. In 2013, the fishing Rights allocation process (FRAP 2013) for this fishery started and new Rights were granted in addition to those of some of the previous Right Holders. After an appeal process, 26 commercial Rights were confirmed in 2015, until December 2020. The Interim Relief sector was started in 2007 and during the 2013/2014 season, 1 995 Interim Relief permits were issued for the Western and Northern Cape combined. This sector is subject to a limit of 50 mussels per person per day. The recreational sector is also limited by a daily bag limit of 50 mussels per person per day.

It should be noted that not all the areas allocated are being harvested, and that the largest component of the overall catch of white mussels is that of the recreational sector, but these catches are not monitored.

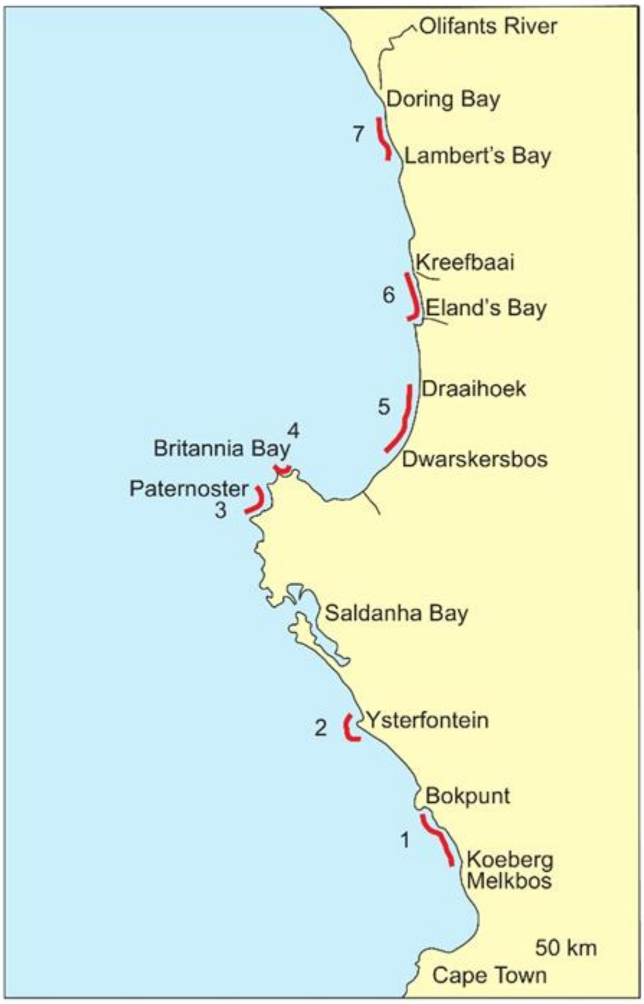


FIGURE 7-64: AREAS ALLOCATED FOR COMMERCIAL HARVESTING OF WHITE MUSSEL ALONG THE WEST COAST OF SOUTH AFRICA

Source: DFFE 2020

7.8.10. Abalone

Abalone (*Haliotis midae*) are widely distributed around the South African coastline, from St Helena Bay on the West Coast to just north of Port St Johns on the East Coast. Once a lucrative commercial fishery, earning up to approximately R100 million annually at the turn of the century, rampant illegal harvesting and continued declines in the abundance of the resource resulted in the prohibition of recreational harvesting since 2003/4 and a total closure of the commercial fishery during the 2008/9 season. In 2010 the commercial fishery was reopened with an annual quota of 150 tonnes; however, this was reduced in 2013/14 to 96 tonnes and further reduced in 2019/2020 to 50.5 tonnes. Currently the fishery is commercial, however, DFFE proposes that 50% of the TAC be apportioned to small-scale fisheries, from 2021 (DFFE Government Gazette No. 1129, 23 October 2020).

Landings of abalone (kg), effort (hours) and catch per unit effort (CPUE) are managed by harvesting area (zones A to G) (see Figure 7-65). **Wild abalone may only be harvested by quota holders and are harvested by divers during specified harvesting seasons. The collection range is assumed to be from the coastline to 20 m depth contour, thus well inshore of the licence block and Area of Interest for proposed exploration well drilling.**

In order to sustain and protect wild populations of abalone, they are bred in abalone farms along the South African coast. Land-based flow-through systems using pumped seawater are the most common abalone farming systems used in South African. Today there are 18 abalone farms along the South African coast, from Saldanha in the West Coast and along the South Coast up to the East Coast.

FIGURE 7-65: ABALONE FISHING ZONES A TO G, INCLUDING SUB-ZONES, AND DISTRIBUTION OF ABALONE (INSET)

Note: The experimental fisheries (2010/11-2013/14) on the western and eastern sides of False Bay and in the Eastern Cape are also shown. These areas within False Bay, included in the commercial fishery recommendations for 2017/18, are referred to as Sub-zone E3 and Sub-zone D3.
Source: DFFE 2020

7.8.11. Abalone Ranching

Abalone ranching is "where hatchery-produced seed are stocked into kelp beds outside the natural distribution" (Troell *et al.* 2006). Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat (larvae) specifically for seeding of abalone in designated ranching areas (Anchor Environmental 2012). The potential to increase this seeded area to 175 km has been made possible through the issuing of "Abalone Ranching Rights" (Government Gazette, 20 August 2010 No. 729) in four concession zones for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016) (see Figure 7-66). To date, seeding has only taken place in Zones 3 and 4, and not Zones 1 or 2. The maximum depth of seeding is considered to be approximately 10 m within each of the zones. **The**

DWOB licence block and Are of Interest for well drilling is situated 180 km southwest of ranching zone 4 located offshore of Hondeklip Bay (see Figure 7-66).

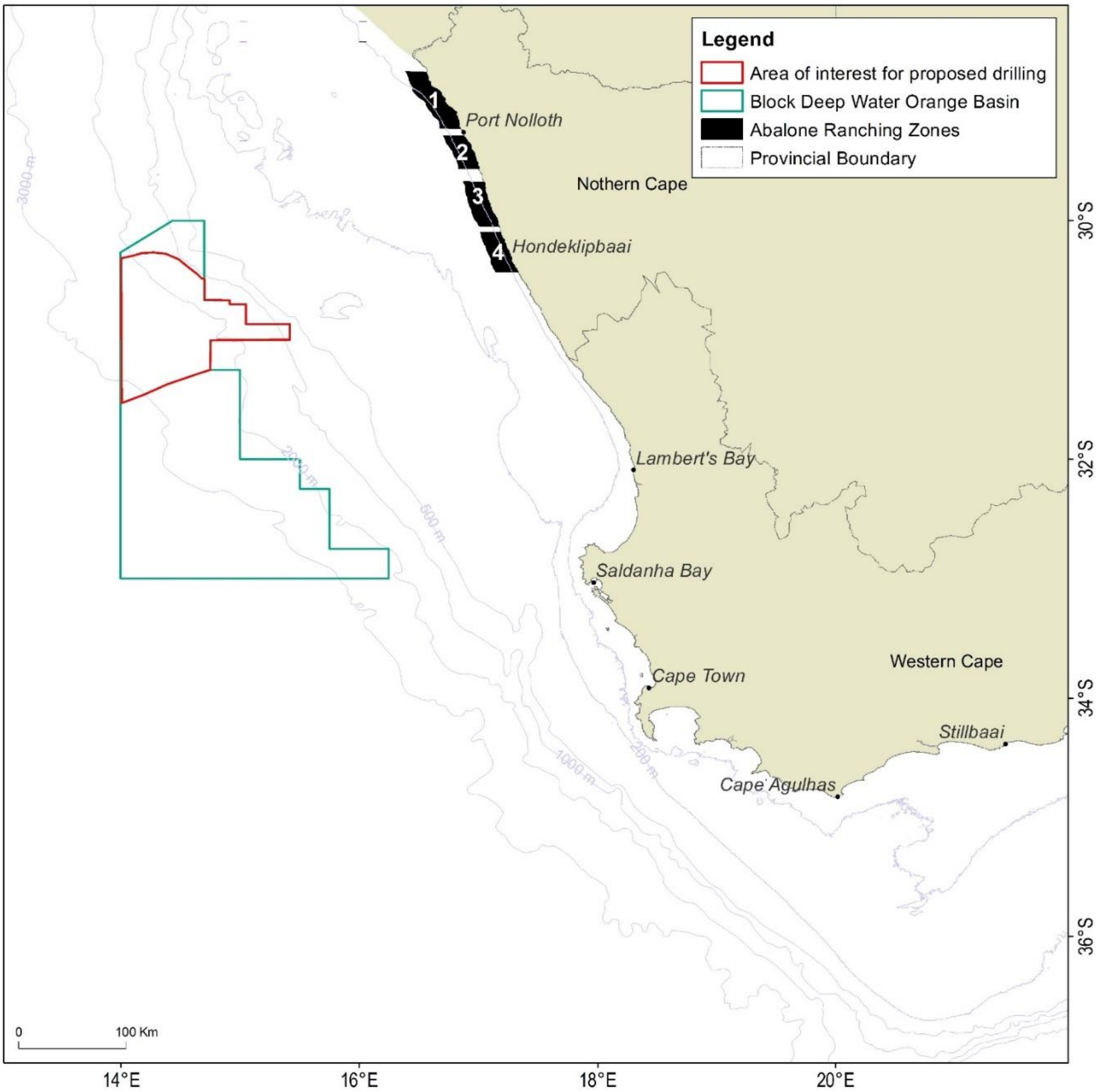


FIGURE 7-66: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO ABALONE RANCHING CONCESSION AREAS 1 – 4

Source: CapMarine

7.8.12. Beach-Seine and Gillnet Fisheries ("Netfish" Sector)

There are a several active beach-seine and gillnet operators throughout South Africa (collectively referred to as the “netfish” sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South Coasts. These fishermen utilise 1 373 registered and 458 illegal nets and report an average catch of about 1 600 tonnes annually, constituting 60% harders (also known as mullet), 10% St Joseph shark and 30% "bycatch" species such as galjoen, yellowtail and white steenbras. Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and gill-net fisheries respectively off the West Coast to 48 and 5 kg·net-day^{-1} off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast (Lamberth *et al.* 1997).

The fishery is managed on a TAE basis with a fixed number of operators in each of 15 defined areas (see Figure 7-67 for the fishing areas). The number of Rights Holders operating on the West Coast from Port Nolloth to False bay is listed as 28 for beach-seine and 162 for gillnet (DAFF 2021). Permits are issued solely for the capture of harders, St Joseph and species that appear on the 'bait list'. The exception is False Bay, where Right Holders are allowed to target line fish species that they traditionally exploited.

The beach-seine fishery operates primarily on the West Coast between False Bay and Port Nolloth (Lamberth 2006) with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Fréon *et al.* 2010). Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and length of the haul. Nets range in length from 120 m to 275 m. Fishing effort is coastal and net depth may not exceed 10 m (DAFF 2014b).

The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m (da Silva *et al.* 2015) and are set in waters shallower than 50 m. The spatial distribution of effort is represented as the annual number of nets per kilometre of coastline.

The range of gillnets (50 m) and that of beach-seine activity (20 m) will not overlap with the licence block and the Area of Interest for proposed exploration drilling (see Figure 7-64).

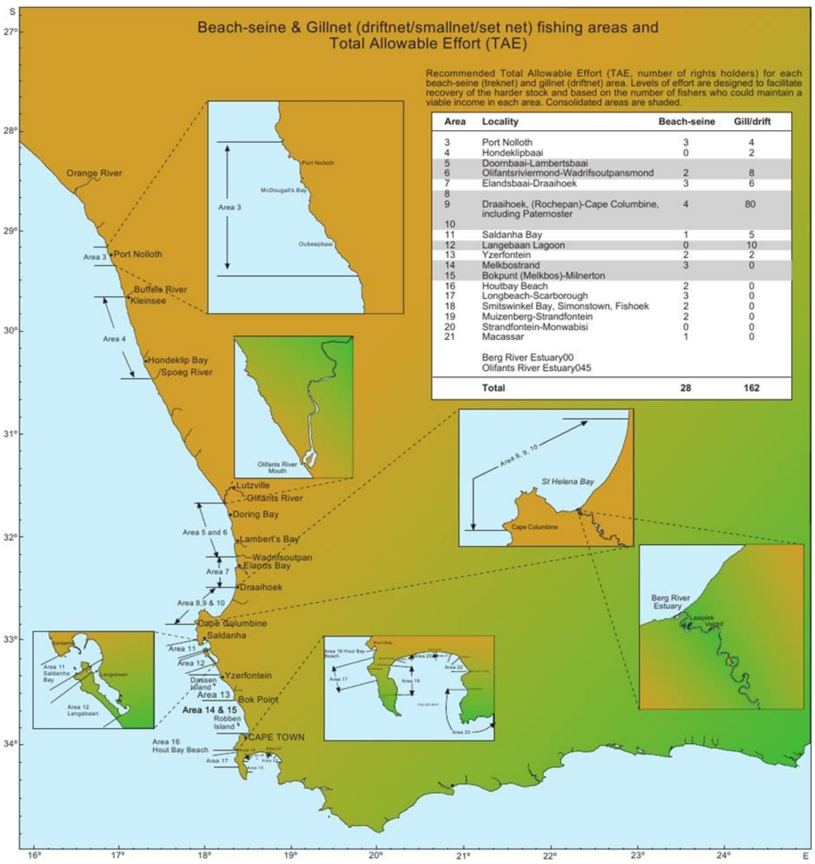


FIGURE 7-67: BEACH-SEINE AND GILLNET FISHING AREAS AND TAE

Source: DAFF 2014

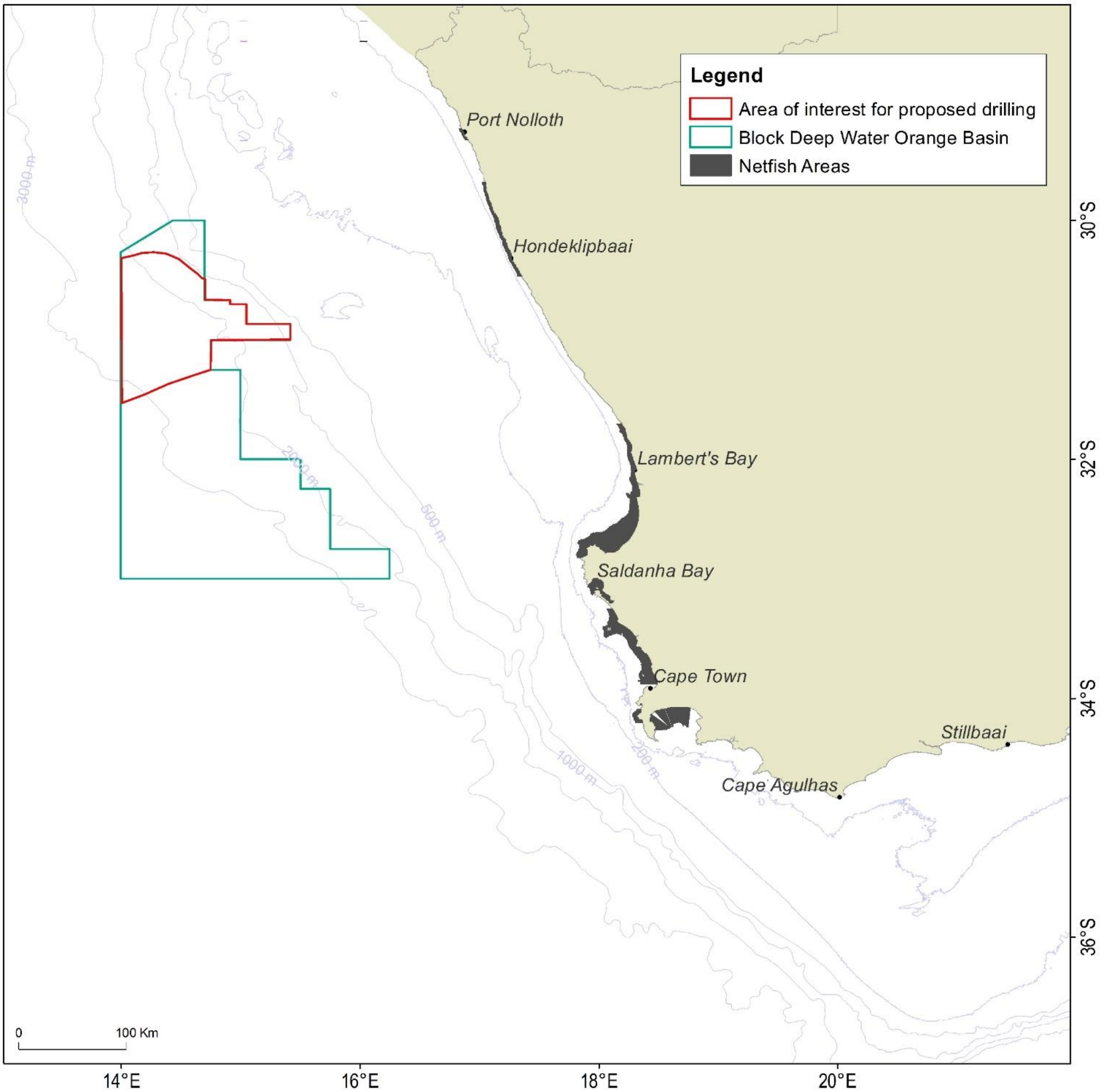


FIGURE 7-68: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE NETFISH (GILLNET AND BEACH-SEINE) FISHING AREAS

Source: DAFF 2016/17

7.8.13. Seaweed

The South African seaweed industry is based on the commercial collection of kelps (*Ecklonia maxima* and *Laminaria pallida*) and red seaweed (*Gelidium spp.*) as well as small quantities of several other species. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast red seaweeds were collected in Saldanha Bay and St Helena Bay, but there has been no commercial activity there since 2007. *Gelidium* species are harvested in the Eastern Cape (DAFF 2014a).

The seaweed sector employs approximately 1 700 people, 92% of whom are historically disadvantaged persons. Much of the harvest is sun-dried, milled and exported for the extraction of alginate. Fresh kelp is also harvested in large quantities in the Western Cape as feed for farmed abalone. This resource, with a market value of about

R6 million is critically important to local abalone farmers. Fresh kelp is also harvested for high-value plant-growth stimulants that are marketed locally and internationally.

The South African coastline is divided between Port Nolloth and Port St Johns into 23 harvesting areas. Fourteen commercial seaweed harvesting rights are currently allocated and each concession area is limited to one right-holder for each functional group of seaweed (e.g., kelps, *Gelidium spp*. and *Gracilarioids*). **The Area of Interest for the proposed exploration drilling lies offshore of Kelp collection areas** (see Figure 7-69) **and the depth range at which divers can harvest kelp.**

Over the period 2000 to 2017, an average of 4560 tonnes per annum of dry harvested kelp (beach cast) and 367 tonnes per annum of wet harvested kelp were reported within collection areas 5 to 11. An additional 1 397 tonnes per annum of kelp was harvested for fertilizer. Amounts harvested within these collection areas amounts to approximately 98.5% of the total kelp harvests, nationally.

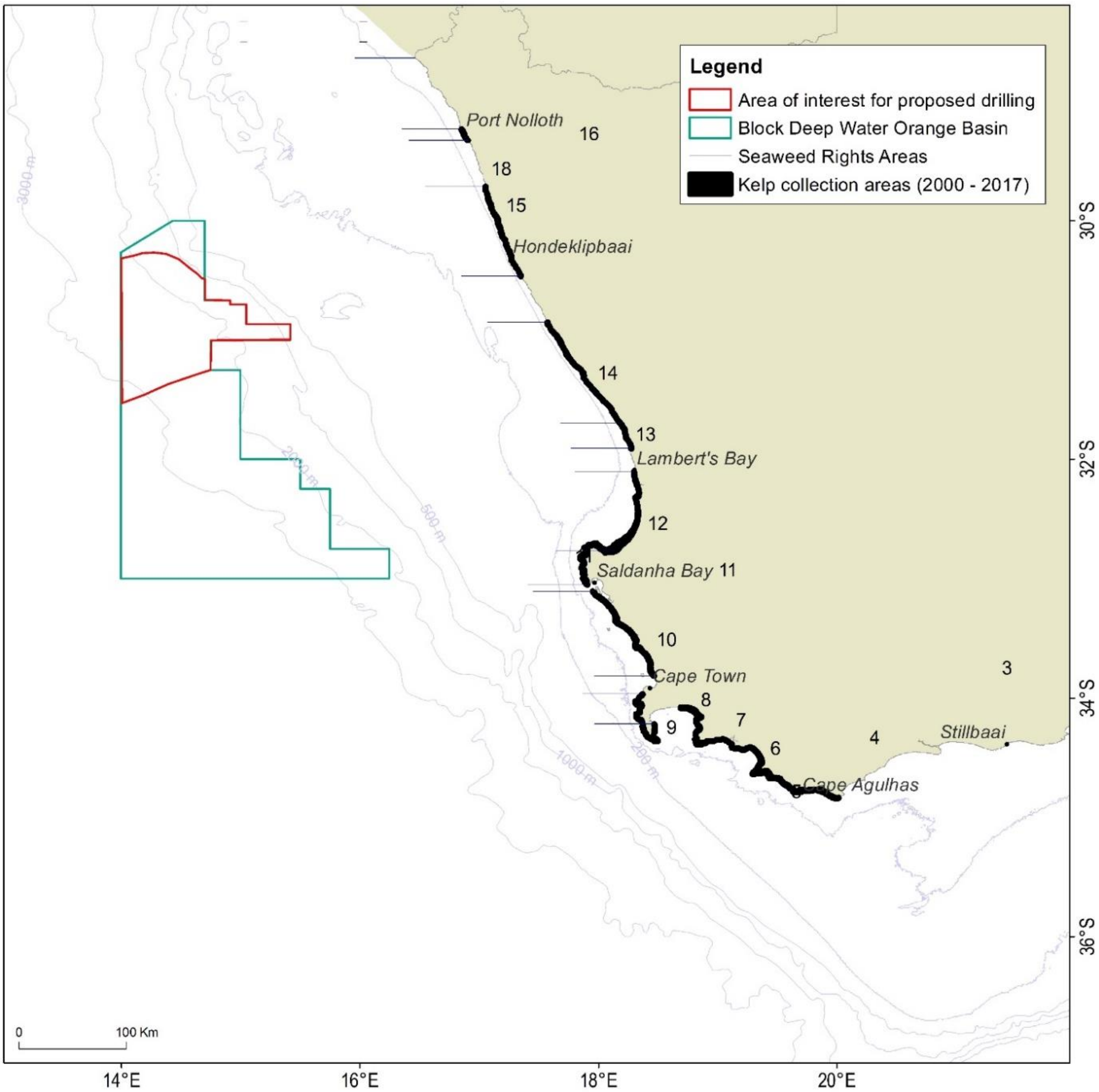


FIGURE 7-69: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO SEAWEED RIGHTS AREAS (NUMBERED) AND KELP COLLECTION AREAS

Source: DAFF 2016/17

7.8.14. Aquaculture / Mariculture

In support of the Government's Operation Phakisa to implement the National Development Goals and boost economic growth, a Strategic Environmental Assessment (SEA) was undertaken in 2019 (CSIR 2019) for the purpose of identifying and assessing aquaculture development zones (ADZs) to streamline and accelerate authorisation of aquaculture projects. Eight ADZs were proposed around South Africa's coastline of which Five lie on the West Coast: Hermanus-Arniston, Orange-Hondeklip Bay, Strandfontein- Lamberts Bay, Velddrif-Saldanha and Western Cape zones (see Figure 7-70). A rapid increase in the type and scale of aquaculture is expected over the next few years (DFFE 2019).

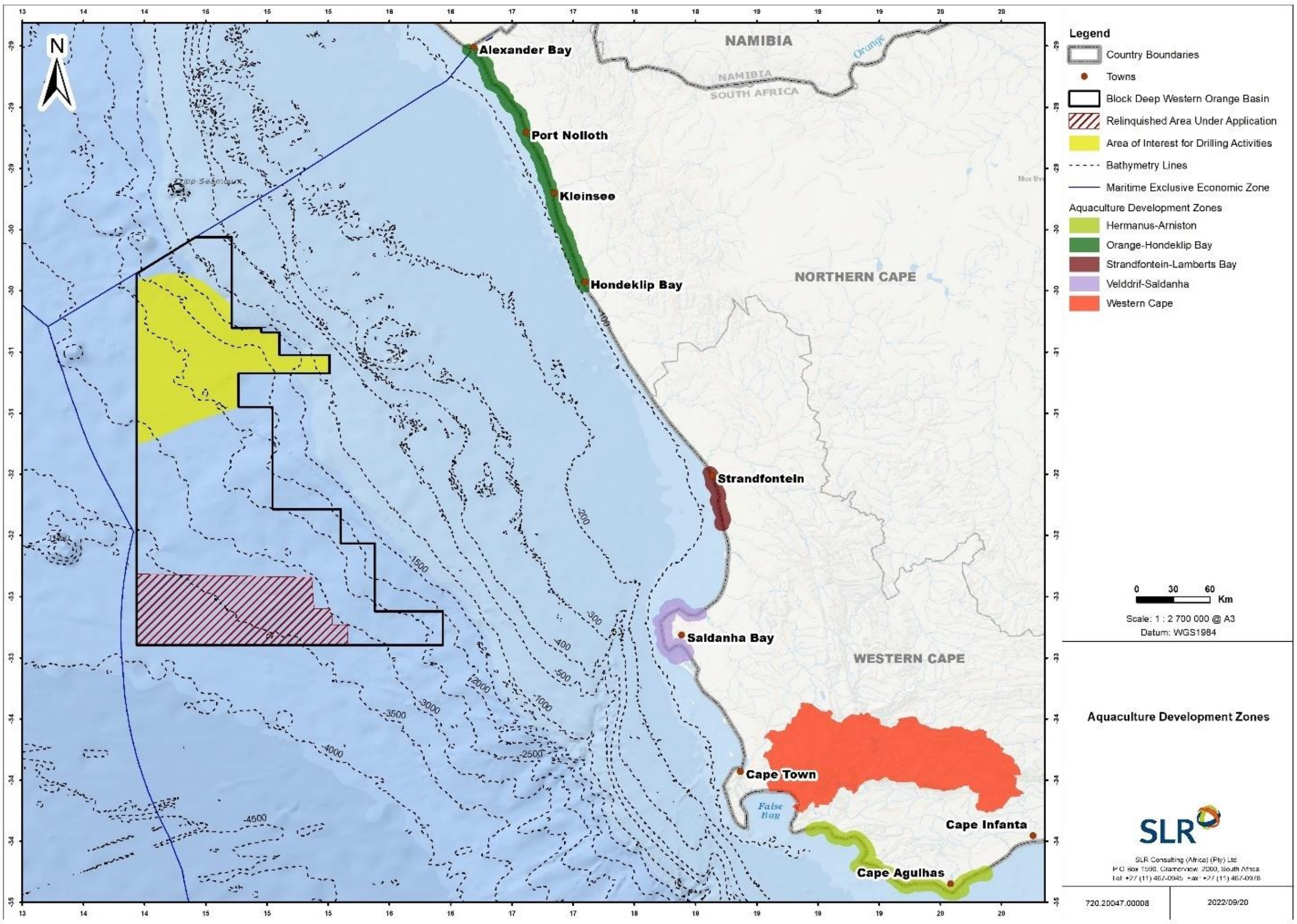


FIGURE 7-70: PROPOSED MARINE AQUACULTURE DEVELOPMENT ZONES (ADZS)
Source: DFFE 2019

Currently, 39 aquaculture farms operate in South Africa, with 5 located along the South Coast. Several farms produce multiple products, while 20 aquaculture operations produce abalone (some also produce seaweed as a by-product), 14 produce mussels, 12 produce oysters and five produce finfish, one of which is for the ornamental aquarium fish market (DFFE 2019).

Finfish currently farmed include dusky kob and yellowtail and the exotic salmonids (Atlantic salmon, Coho salmon and king salmon). The indigenous shellfish species currently being farmed include abalone, black mussel and oysters while alien shellfish farmed include brown mussel, Mediterranean mussel, Pacific oyster, two clam species (*Mactra glabrata*, *Venerupis corrugatus*), the scallops (*Argopecten purpurat*us and *Pecten sulciostatus*) (DFFE 2019). Abalone are typically farmed in land-based tanks with 'pump ashore' technology, while other shellfish are farmed on rafts or longlines offshore. Finfish are farmed in sea-based cages or land-based re-circulation systems (DFFE 2016).

Most of the farms are presently experimental or of a small-scale commercial nature and collectively produced only 3 592 tonnes in 2015 with 3 309 tonnes (92%) produced in the Western Cape. Mussels currently provide the highest biomass at 1 479 (Massy, *et al.* 2019). It may be expected that the scale of production at individual farms will increase over time along with the number of farms and the variety of products within the ADZ's, particularly of finfish (DFFE 2019).

Aquaculture operations located inshore of the Area of Interest for proposed exploration drilling are Orange-Hondeklip Bay zone, while the Strandfontein- Lamberts Bay and Velddrif- Saldanha zones are inshore of the whole DWOB Block itself.

7.8.15. Small-Scale Fisheries

The concept of Small-Scale Fisheries (SSF) is a relatively new addition to the fisheries complexity in South Africa. The concept has its origin in a global initiative supported by the Food and Agricultural Organisation of United Nations (FAO). In South Africa, there is a long history of coastal communities utilising marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a SSF sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the SSF Policy, which was gazetted in May 2019 under the Marine Living Resources Act, 1998 (No. 18 of 1998) and is only now (2021/22) in an advanced process of implementation. It is a challenging process that has been exacerbated by the conflict and overlap with another fisheries-related process of fishing rights allocations (known as Fishery Rights Allocation Process or "FRAP"). Neither process have, as of February 2022, been concluded and the issues at stake are highly politicised. The SSF does, however, overlap with other historical fisheries in South Africa and there are also legal challenges where the SSF rights allocations conflict with other established commercial fishing sectors, most notably the commercial squid fishing sector.

SSF fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes[22]. These fishers traditionally operate on nearshore fishing grounds to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing / harvesting techniques are labour intensive[23]. Many communities living along the coast have, over time, developed local

[22] There is no formal designation of artisanal (or subsistence) fishing in South Africa, which is generally considered as fishing or resource extraction for own use. As fisheries have evolved and the commercial benefit realised, subsistence fishers have increasingly moved to commercialisation aimed at supporting their livelihoods. This group can now, therefore, also include shore and boat-based anglers and spear-fishers who target a wide range of line fish species, some of which are also targeted by commercial operations, skin divers who collect rock lobsters and other subtidal invertebrates, bait collectors (mussels, limpets, red bait) and non-subsistence collectors of intertidal organisms. The high value of many intertidal and subtidal resources (e.g. rock lobster, abalone and mussels) has resulted in an increase in their production through aquaculture and small-scale harvesting in recent years (Clark, Hauk, Harris, Salo, & Russell 2010).

[23] The equipment used by small scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps.

systems of rules to guide their use of coastal waters (customary law). These fishers are generally localised and do not range far beyond the areas in which they reside.

SSF resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner. The SSF is to be implemented along the coast in series of community co-operatives. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations and show a historical dependence on deriving the major part of their livelihood from traditional fishing operations.

More than 270 communities have registered an Expressions of Interest with the DFFE. The location of these coastal communities and the number of fishers per community are shown in Figure 7-71. DFFE has split SFF by communities into district municipalities and local municipalities.

- In the **Northern Cape**, communities are grouped into the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities and there are **103 registered fishers** in the province.
- **Western Cape** districts include 1) West Coast (Berg River, Saldanha Bay, Cederberg, Matzikama and Swartland local municipalities; 2) Cape Metro; 3) Overberg (Overstrand and Cape Agulhas); and 4) Eden (Knysna, Bitou and Hessequa). In total there are **2 748 fishers registered** in the province.
- In the **Eastern Cape**, the communities are split up, broadly as 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. There are **5 154 fishers registered** in the province.
- **KwaZulu-Natal** has **2 008 registered small-scale fishers** divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude.

Approximately 10 000 small-scale fishers have been identified around the coast. **The licence block is situated offshore of the West Coast municipal district,** with 890 fishers registered with the relevant local municipalities extending between Saldanha Bay and Port Nolloth. These are the closest access points for participants in the small-scale fishing sector. At this point in time, no discreet co-operatives are active, except for on the West Coast in Port Nolloth.

The SSF Policy requires a multi-species approach to allocating rights, which entails the allocation of rights for a basket of species that may be harvested or caught within particular designated areas. Co-operatives can only request access to species found in their local vicinity. DFFE recommends five basket areas:

1. Basket Area A –Namibian border to Cape of Good Hope – 57 different resources;
2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources;
3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources;
4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources; and
5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

The mix of species to be utilised by small-scale fishers includes species that are exploited by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[24], abalone, KZN beach seine, netfish (gillnet and beach-seine), seaweed and white mussel. An apportionment of TAE/TACs for these species will be

[24] Hake handline is a small subsector of the hake fishery and requires a fishing right apportionment. The fishery has in recent years not been active because of resource availability. It is perceived as having potential for allocation as part of the SSF and as part of their “basket”.

transferred from existing commercial rights to SSF[25], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The SSF rights cover the nearshore area (defined in Section 19 of the Marine Living Resources Act, 1998 as being within close proximity of shoreline). SSF along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries, whereas communities on the South Coast are involved in traditional line, squid jig and oyster harvesting. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources (Clark, Hauk, Harris, Salo, & Russell 2010).

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important linefish species that are targeted by SSF operating nearshore along the West and South-West Coast of South Africa (refer to Section 7.8.7). Snoek is targeted by small-scale fishers during the snoek seasonal migration (between April and June), during which time they shoal nearshore and are, therefore, available by handline. Fishers also target West Coast rock lobster (*Jasus lalandii*) using hoopnets set by small “bakkies” on suitable reefs at a water depth of less than 30 m. Fishing activity may range up to 100 m water depth by the larger vessels that participate in the offshore commercial rock lobster trap sector (refer to Section 7.8.8). The harvesting of wild abalone along the West Coast is expected to range to a maximum water depth of 20 m (refer to Section 7.8.10).

The small-scale fisheries off the West Coast are unlikely to operate beyond a range of 15 km from the coastline, well in shore of the Area of Interest for proposed drilling.

7.8.16. Recreational Fishing

Recreational fishing is defined as non-commercial (not for profit). It is extensive around the coast and depends on vessel size. Offshore small recreational or pleasure vessels are limited by their certification – which varies from Category E (limited to a distance of 1 nautical mile from shore and 15 nautical miles from an approved launch site) to Category C (15 miles offshore), Category B (limited to day or night passages, but within 40 nautical miles of the coastline) to Category A (allowing for extended or ocean passage). Most recreational craft are Category C certified with some commercial recreational charter craft having a Category B certification. Thus, **most recreational or pleasure vessels would technically not be authorised to travel to the area of intertest for proposed exploration drilling.**

Recreational fishing includes subsets of numerous commercial, fisheries such as linefish, West and East Coast lobster, spearfishing, squid, abalone, crabs and many other species. Recreational fishers need permits and have restrictions on how much they can “take” seasonally and at anyone fishing event.

[25] DFFE proposes that, commencing January 2021, 50% of the overall TAE and TAC for the traditional linefish and abalone sectors, respectively, will be apportioned to small-scale fishing whereas 25% of the overall TAE for squid will be apportioned to small-scale fishing (DEFF 2020).

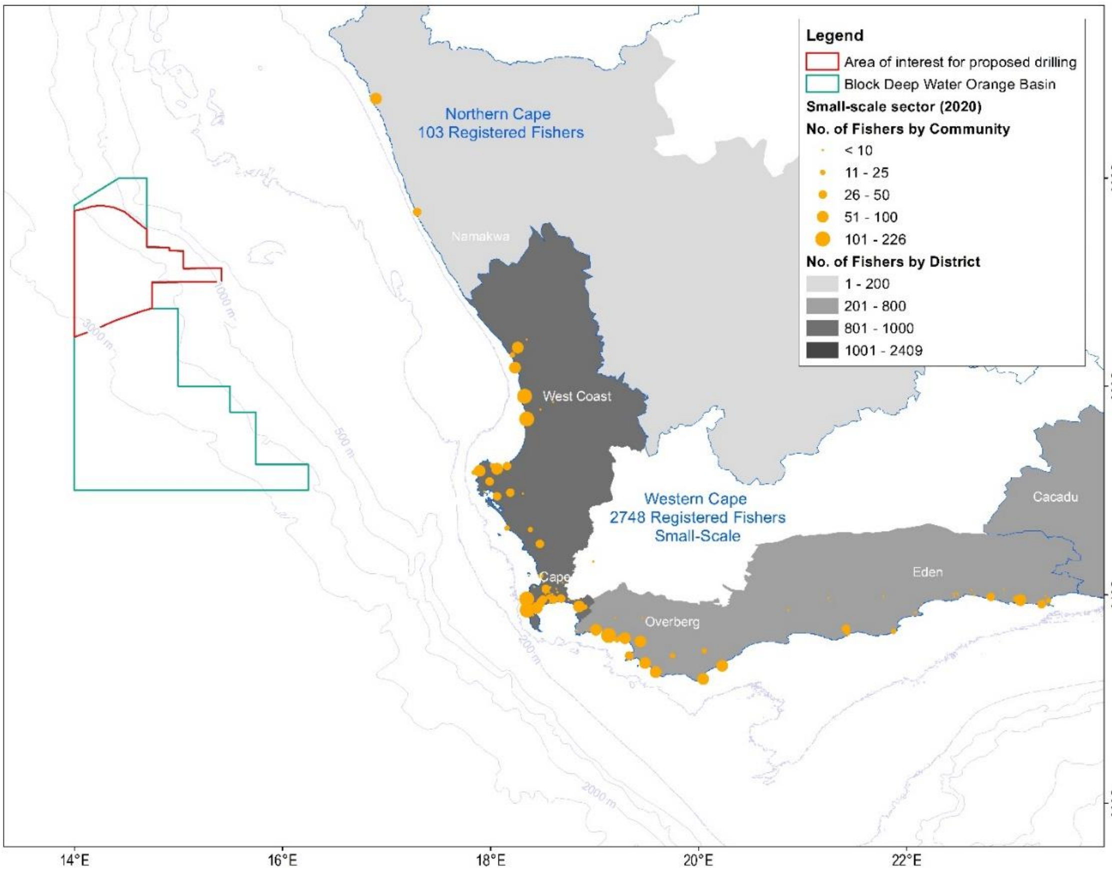


FIGURE 7-71: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF SMALL-SCALE FISHING COMMUNITIES ALONG THE WEST COAST

Source: CapMarine

7.8.17. Illegal, Unreported and Unregulated (IUU) Fishing

In 1977 South Africa declared its EEZ, 200 nautical miles seaward from the coastal baselines. Following the coming into force of the United Nations Convention on Law of the Sea, 1982 (UNCLOS) on 16 November 1994, South Africa passed the Maritime Zones Act, 1994 (No. 15 of 1994) affirming its rights and obligations within its EEZ. In light of this, South African strictly regulates fishing activity within its own EEZ and the area is regularly patrolled by a fleet of Offshore Environmental Protection Vessels operated by DFFE. The South African Navy also patrols offshore regions, whilst the South African Police Service patrols areas within its jurisdiction (within 24 nm of the coast). Legislation also requires all foreign fishing vessels entering the South African EEZ to apply for an EEZ permit and vessels are required to switch on their Automatic Identification System (AIS), which is monitored by the DFFE Vessel Monitoring System (VMS) operations room.

Considering that Block DWOB is situated predominantly offshore of the continental shelf in water depths exceeding 700 m, the risk of IUU fishing is, most likely, related to large pelagic longlining and large-scale tuna longline vessels. Vessels entering the EEZ to fish illegally, without reporting on its AIS, would be regarded with suspicion by other vessels operating legally in the area. Since Block DWOB is located near well established and strictly regulated fishing grounds (including tuna longline and tuna pole), any illegal fishing is unlikely to go unnoticed and any suspicious activity / vessels would more than likely be reported to the authorities.

Thus, whilst South Africa experiences difficulties with land-based coastal fish and abalone poaching activities, offshore areas are not considered viable for large-scale illegal fishing activity, especially in the Area of Interest for proposed exploration drilling.

7.8.18. Fisheries Research

7.8.18.1. Demersal Research Surveys

Trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. The West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January/February.

Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. On occasion, trawls are targeted in waters deeper than 1 000 m. Figure 7-72 shows the distribution of research trawls undertaken in relation to the licence block and area of interest.

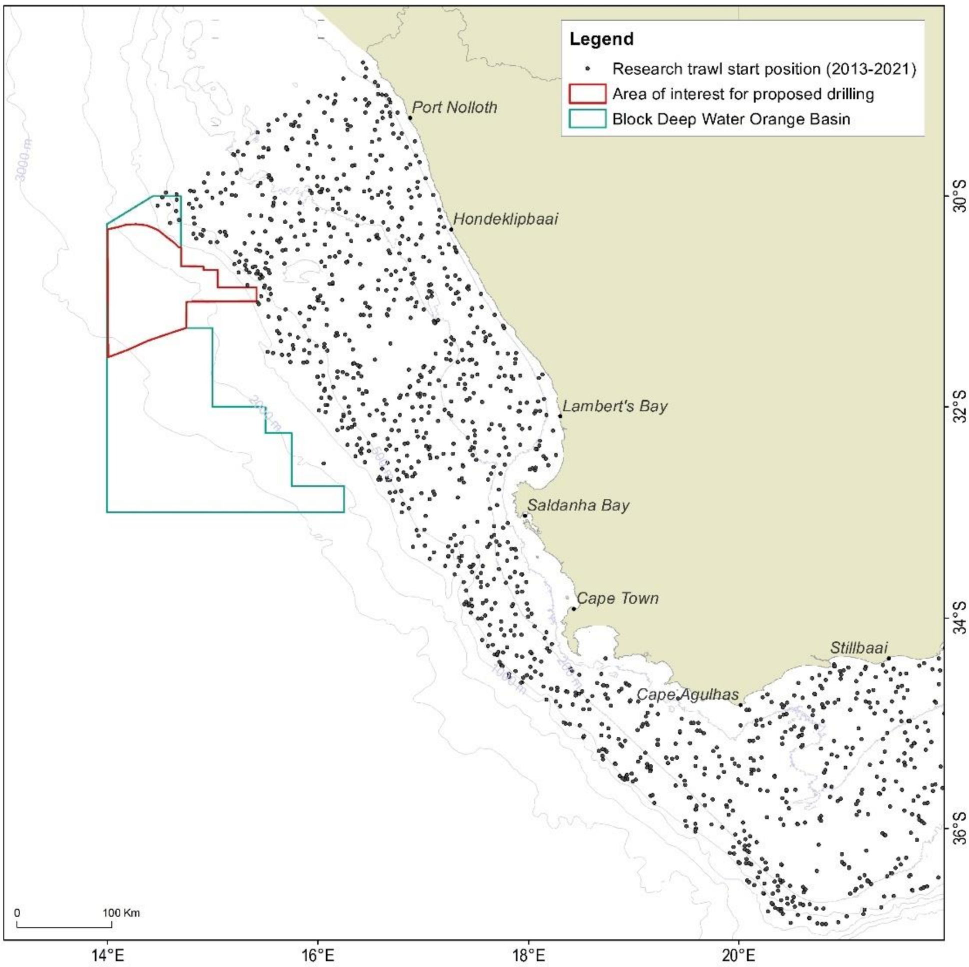


FIGURE 7-72: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO DEMERSAL RESEARCH SURVEYS (2013-2021)

Source: CapMarine

7.8.18.2. Small Pelagic Research Surveys

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June, while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements.

During these surveys, the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the survey vessel progresses systematically from the northern border southwards, around Cape Agulhas and on towards the east. Figure 7-73 shows the research survey transects undertaken by DFFE in November 2020 and May 2021 in relation to the licence block and area of interest.

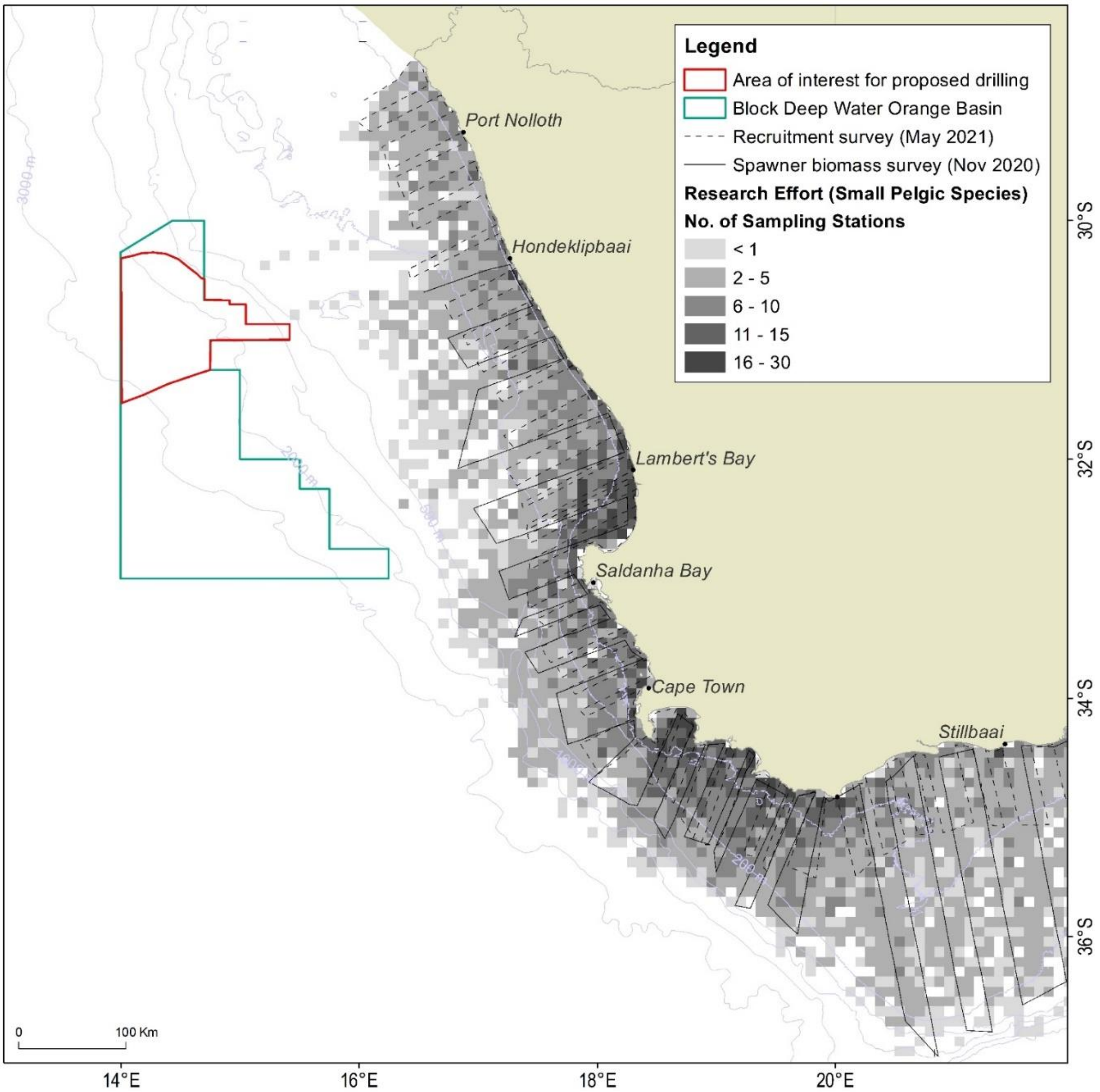


FIGURE 7-73: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO BIOMASS RESEARCH SURVEYS (NOVEMBER 2020 AND MARCH 2021)

Source: CapMarine

7.8.18.3. Summary of Fishing Activities in Project Area

Table 7-16 provides a list of fisheries sectors that operate off the West Coast and the seasonality of fishing effort by sector.

TABLE 7-16: SUMMARY OF SEASONAL VARIATION IN FISHING EFFORT EXPENDED BY EACH OF THE MAIN COMMERCIAL FISHERIES SECTORS OPERATING OFF THE WEST COAST OF SOUTH AFRICA.

Sector	Targeted Species	Fishing Intensity by Month within South African Exclusive Economic Zone (EEZ) H = high; M = Low to Moderate; N = None											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	Deepwater hake, shallow-water hake	H	H	H	H	H	H	H	H	H	H	H	H
Small Pelagic Purse-Seine	Anchovy, sardine, Red-eye round herring	M	H	H	H	H	H	H	H	H	H	H	M
Demersal Longline	Shallow-water hake	M	M	M	H	H	H	H	H	H	H	H	H
Pelagic Longline	Yellowfin tuna, big eye tuna, Swordfish, southern bluefin	M	M	M	H	H	H	H	H	H	H	H	H
Tuna Pole	Albacore	H	H	H	H	H	M	M	M	M	M	H	H
Traditional Linefish	Snoek, Cape bream, geelbek, kob, yellowtail	H	M	M	M	M	M	M	M	M	M	M	H
West Coast Rock Lobster	*Jasus lalandii*	M	M	M	M	M	M	M	M	M	N	M	M
Demersal species research survey	Demersal species	M	N	N	N	M	M	N	N	M	M	N	N
Small pelagic fisheries research survey	Anchovy, sardine, red-eye round herring	N	N	M	M	M	M	N	N	N	M	M	M

7.9. OFFSHORE MARINE AND COASTAL INFRASTRUCTURE AND ACTIVITIES

7.9.1. Marine Traffic and Transport

A large number of vessels navigate along the West, South and East Coasts on their way around the southern African subcontinent. The majority of shipping traffic is located on the outer edge of the continental shelf (between 22 and 44 km offshore) (see Figure 7-74), with traffic inshore of the continental shelf along the West Coast largely comprising fishing vessels. Therefore, **a significant amount of ship traffic can be expected to pass through the inshore portion of Block DWOB.** Project vessels travelling between the Area of Interest and the onshore logistics base could thus interfere with this key shipping route.

Important harbours along the West Coast include Cape Town, St Helena Bay and Saldanha Bay.

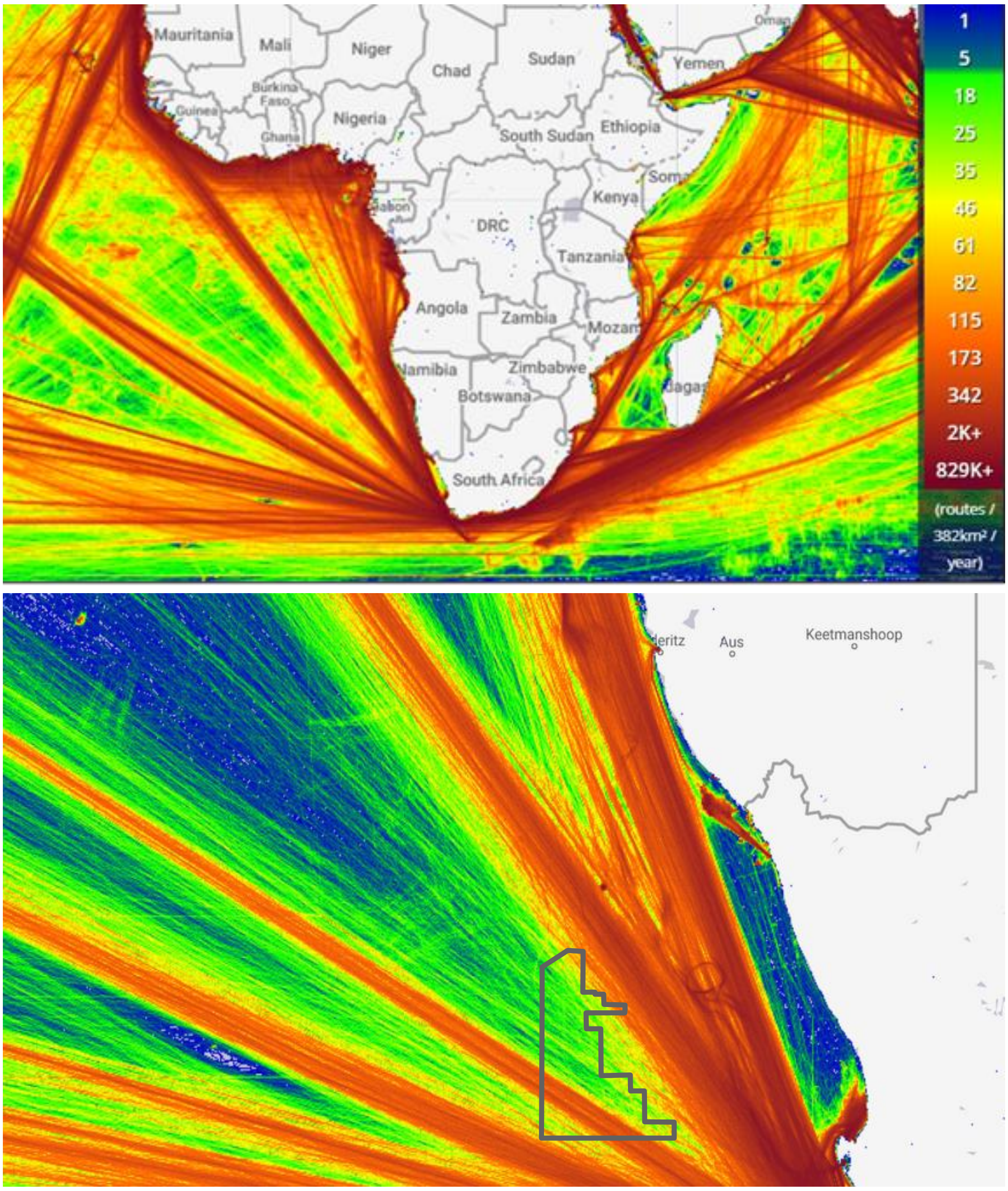


FIGURE 7-74: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO THE MAJOR SHIPPING ROUTES OFF THE WEST COAST

Source: http://www.marinetraffic.com/, accessed 26 May 2021

7.9.2. Exploration, Production and Mining

7.9.2.1. Oil and Gas Exploration and Production

Oil and gas exploration and production is currently undertaken in various licence blocks off the West, South and East coasts of South Africa (see Figure 7-75). **Approximately 358 wells have been drilled in the South African offshore environment to date** (based on shapefile provided by PASA in 2021), **the majority of which have been drilled off the South Coast on the Agulhas Bank.**

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) (off West Coast, towards the northeast of Block DWOB) **and Kudu Gas Field** (off southern Namibia) **have been identified for development. On the South Coast, PetroSA operates the F-A production platform**, which was brought into production in 1992. The F-A platform is located 85 km south of Mossel Bay in a water depth of 100 m. Gas and associated condensate from the associated gas fields are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA GTL plant located just outside the town of Mossel Bay. In September 2022, TEEPSA submitted a production right application for offshore Block 11B/12B.

7.9.2.2. Prospecting and Mining of Other Minerals

7.9.2.2.1. Glauconite and Phosphorite

Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and peletal phosphorite occur on the seafloor over large areas of the continental shelf on the West Coast and South Coasts (see Figure 7-6). These represent potentially commercial resources that could be considered for mining as a source of agricultural phosphate and potassium (Birch 1979a & b; Dingle *et al.* 1987; Rogers and Bremner 1991).

Two prospecting areas for marine phosphate are located off the West and South-West Coasts. Green Flash Trading received its prospecting rights for Areas 251 and 257 in 2012/2013. **Block DWOB and the area of interest for drilling partially overlaps with Area 251** (see Figure 7-76).

7.9.2.2.2. Diamonds

The Deep Western Orange Basin Block is located well offshore beyond the 500 m depth contour. Other users of the offshore areas include the commercial fishing industry (see CapFish 2021 – Fisheries Specialist Study), with marine diamond mining concessions generally being located inshore of the eastern portion of the Deep Western Orange Basin Block. Recreational activities along the coastline north of St Helena Bay are limited to the area around Lambert's Bay, Hondeklip Bay and Port Nolloth.

Marine diamonds are mined along the West Coast from just south of Lamberts Bay to the Orange River mouth. Twenty diamond mining concessions have been established along the West Coast with each concession divided into four zones from the coast seaward (a, b, c & d). **Block DWOB lies parallel to the vacant 'd' concession area** (Figure 7-76) **however, no deep-water diamond mining is currently underway in the South African offshore concession areas.** On the Namaqualand coast marine diamond mining activity is restricted to nearshore, diver-assisted operations from small, converted fishing vessels working in the a-concessions, which extend to 1 000 m offshore of the high-water mark. No deep-water diamond mining is currently underway in the South African offshore concession areas, although prospecting activities are ongoing. In Namibian waters, deep-water diamond mining by De Beers Marine Namibia is currently operational in the Atlantic 1 Mining Licence Area, immediately to the northeast of the DWOB Licence Block.

These mining operations are typically conducted to depths of 150 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. The vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread. Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

7.9.2.2.3. Heavy Mineral Sands

Heavy mineral sands containing, amongst other minerals, zircon, ilmenite, garnet and rutile may be found offshore of the West Coast. Tronox's Namakwa Sands is currently exploiting heavy minerals from onshore deposits near Brand-se-Baai (approximately 385 km north of Cape Town).

Belton Park Trading 127 (Pty) Ltd (BPT127) holds a mining right over sea concessions 2C and 3C off the West Coast which includes gold, heavy minerals, platinum group metals and sapphires. De Beers Consolidated Mines, with De Beers Marine (Pty) Ltd as the operator, also holds prospecting rights for these minerals over sea concession 6C. **These prospecting areas are located to the offshore of Block DWOB.**

7.9.2.2.4. Manganese Nodules

Rogers and Bremner (1991) reported that manganese nodules enriched in valuable metals occur in deep-water areas (>3 000 m) on the South and East coasts. However, the nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2%. **There is no current mining of manganese or phosphate resources offshore the West Coast**.

7.9.3. Anthropogenic Marine Hazards

Hazards on the seafloor are identified in the Annual Summary of South African Notices to Mariners No. 5 or are marked on charts from the South African Navy or Hydrographic. These include ammunition dump sites, undersea cables and offshore renewable energy projects.

7.9.3.1. Ammunition Dump Sites

From the 1970s to 1995, expired or unusable ammunition such as naval shells and other explosive and non-explosive ammunition were dumped in designated marine ammunition dumps. Apart from the potential hazard associated with disturbing unexploded ammunition, corrosion may have led to leaching of lead, copper and other pollutants to the marine environment and inadvertent detonation may be physically destructive and may lead to smothering of benthic sea life (Harris *et al.* 2019).

The lack of information on the type, tonnage and condition of the dumped ammunition requires that future exploration and planned infrastructure (e.g., underwater cables, renewable energy infrastructure, etc.) be cognisant of these sites and avoid unnecessary disturbance.

Other industrial uses of the marine environment include the intake of feed-water for mariculture, or diamond-gravel treatment, submarine telecommunications cables, ammunition dumps and hydrocarbon wellheads

(Figure 7-77). None of these activities should in any way be affected by sonar survey or exploration drilling activities offshore. There are a number of existing and proposed subsea fibreoptics cables that make landfall between Cape Town and Saldanha Bay, all of which pass through the Deep Western Orange Basin Block. Of the ammunition dump sites off the West Coast, none fall within the Deep Western Orange Basin Block.

7.9.3.2. Undersea cables

There are several submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 7-77), including:

- South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE): This cable system is divided into two sub-systems, SAT3/WASC in the Atlantic Ocean and SAFE in the Indian Ocean. The SAT3/WASC sub-system connects Portugal (Sesimbra) with South Africa (Melkbosstrand). From Melkbosstrand the SAT-3/WASC sub-system is extended via the SAFE sub-system to Malaysia (Penang) and has intermediate landing points at Mtunzini East South Africa, Saint Paul Reunion, Bale Jacot Mauritius and Cochin India (www.safe-sat3.co.za).
- West Africa Cable System (WACS): WACS is 14 530 km in length, linking South Africa (Yzerfontein) and the United Kingdom (London). It has 14 landing points, 12 along the western coast of Africa (including Cape Verde and Canary Islands) and 2 in Europe (Portugal and England) completed on land by a cable termination station in London.
- African Coast to Europe (ACE): The ACE submarine communications cable is a 17 000 km cable system along the West Coast of Africa between France and South Africa (Yzerfontein).
- Equiano: A private subsea cable funded by Google that will start in western Europe and run along the West Coast of Africa, between Portugal and South Africa, with branching units along the way. The first phase of the project, connecting South Africa (at Melkbosstrand) with Portugal, is expected to be completed in 2021.
- 2Africa: The 2Africa subsea cable aims to interconnect Europe (eastward via Egypt), the Middle East (via Saudi Arabia), and 21 landings in 16 countries in Africa (including South Africa). The system is expected to go live in 2023/4.

There is an exclusion zone applicable to the telecommunication cables 1 nm (approximately 1.9 km) each side of the cable in which no anchoring is permitted. **Four submarine cables pass through a Portion of Block DWOB and three submarine cables pass through the Area of Interest for proposed exploration drilling** (Figure 7-77).

7.9.3.3. Offshore renewable projects

No offshore renewable energy projects are active in South Africa currently. However, a study on offshore wind energy potential for the entire African continent indicated very good technical offshore wind energy potential for South Africa with **most of the offshore wind resources concentrated in coastal zones** (Elsner, 2019, cited in BSL, 2020).

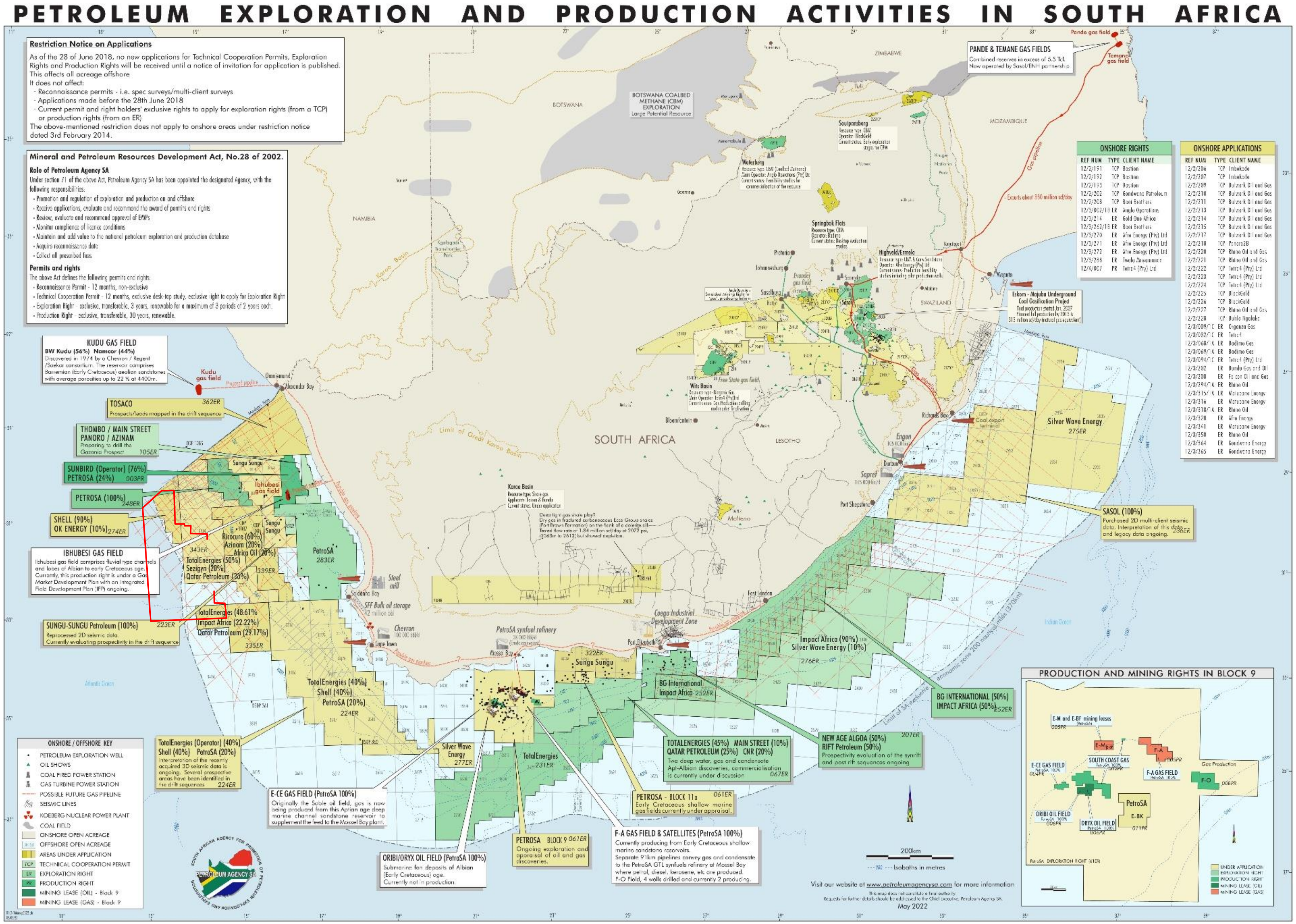


FIGURE 7-75: BLOCK DWOB IN RELATION TO OTHER PETROLEUM LICENCE BLOCKS OFF THE COAST OF SOUTH AFRICA

Source: https://www.petroleumagencysa.com/images/pdfs/Hubmap0522.pdf, accessed 19 July 2022

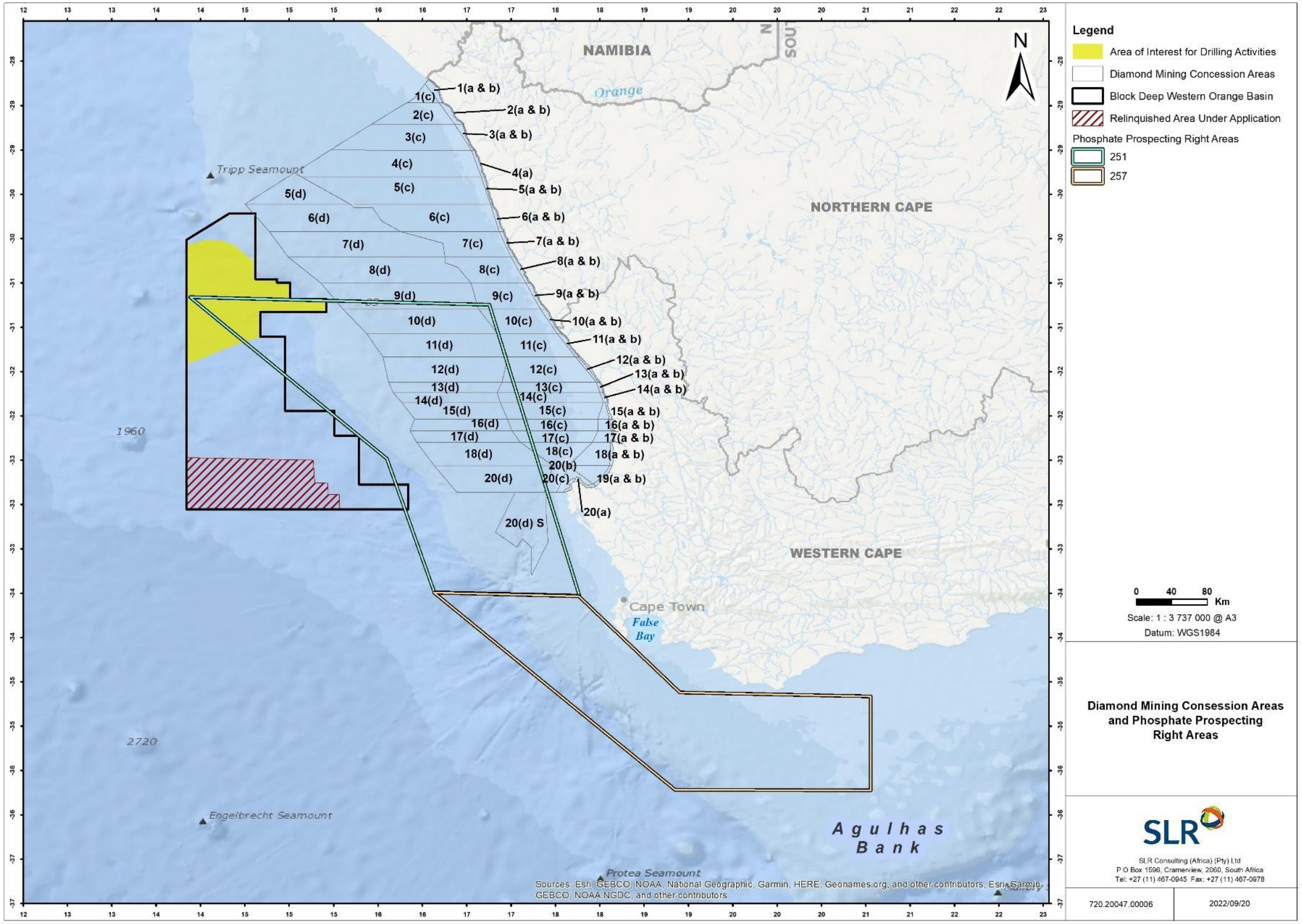


FIGURE 7-76: BLOCK DWOB IN RELATION TO DIAMOND MINING CONCESSION AREAS AND PHOSPHATE PROSPECTING RIGHT AREAS

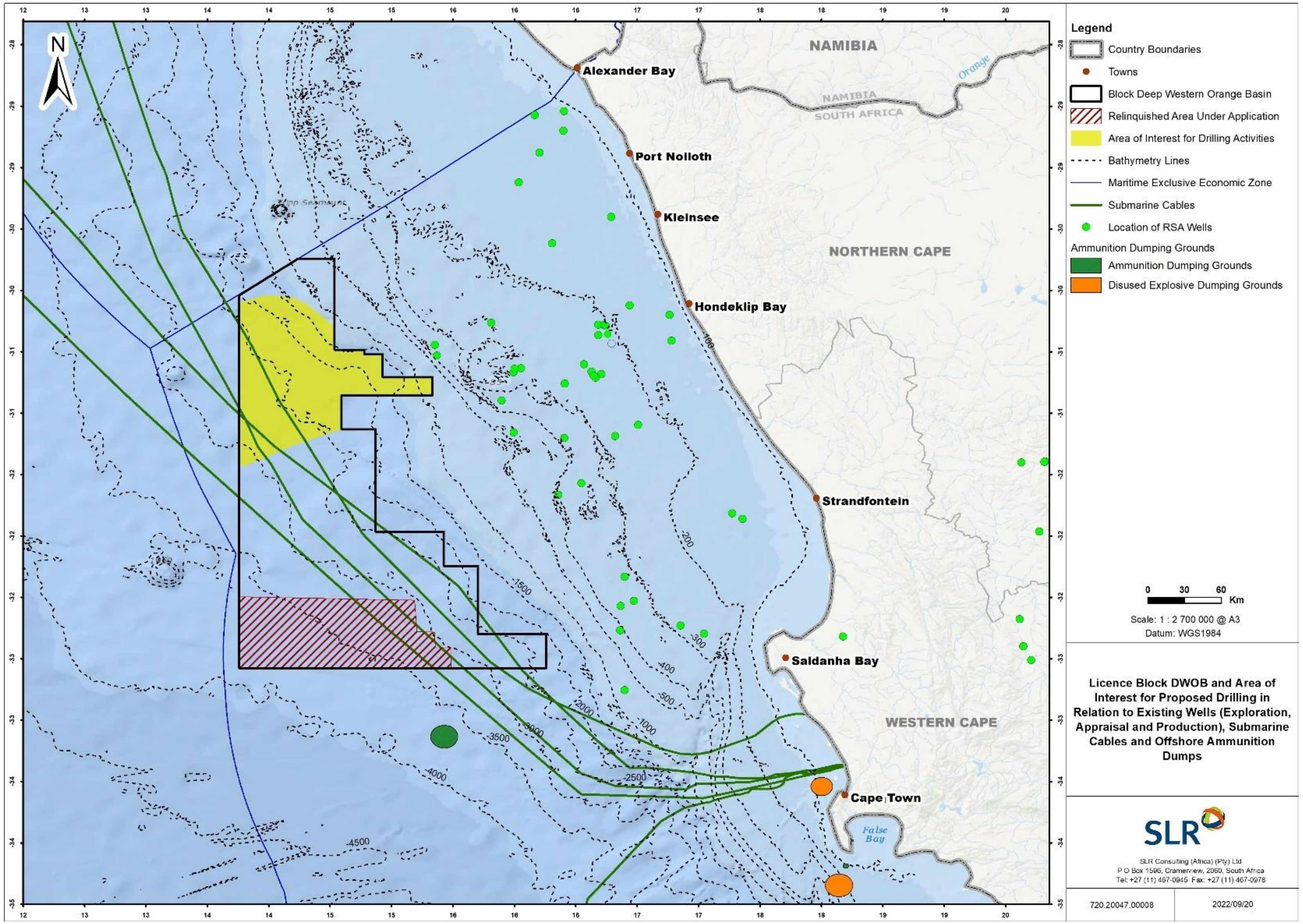


FIGURE 7-77: BLOCK DWOB AND AREA OF INTEREST IN RELATION TO MARINE INFRASTRUCTURE ALONG THE WEST COAST

Source: SAN Hydrographic Office

7.10. CULTURE HERITAGE AND SITES

South Africa is a multicultural country of approximately 60 million people. Its citizens speak more than 11 languages and hold a diversity of religious beliefs. These draw on the world's four major religions, as well as indigenous belief systems that contribute to the country's rich cultural heritage. Cultural heritage is globally defined as the cultural legacy passed from one generation to the next. It informs morality, sociality and biocultural relations. In heritage scholarship and conservation practice, a distinction is made between cultural and natural heritage. Heritage is also classified as either tangible or intangible. Tangible Cultural Heritage (TCH) includes sites, monuments, artifacts, and objects of cultural value. Intangible Cultural Heritage (ICH) consists of folklore, beliefs, values, rituals, symbolism, practices related to culture social attachment, as well as associated human sensory engagement with the coast and sea. Tangible and intangible heritage are not always divisible and, natural and cultural heritage may overlap. ICH is also found underwater, as part of the tangible heritage associated with maritime artefacts that remain on the sea floor after a shipwreck for example. In this regard and for **Block DWOB, there is need to consider the potential impacts on Areas Beyond National Jurisdiction (ABNJ), which DWOB will 'touch' on as its potential impacts can go beyond the South African EEZ.**

7.10.1. Shipwrecks

At least 2 400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s (Gribble 2018). More than 1 900 of these wrecks are more than 60 years old and are thus protected under the National Heritage Resources Act, 1999 by the National Heritage Resources Agency as archaeological resources. All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast. **According to the South African Heritage Resources Agency (SAHRA) there are between 45 and 50 shipwrecks located around Robben Island, approximately 20 shipwrecks between Cape Town and Milnerton and approximately 20 shipwrecks between Milnerton and Saldanha Bay. All these known shipwrecks are in waters shallower than 100 m** (Sean Berry, SAHRA, *pers comm*., 3 October 2012). It is, thus, possible that oil and gas exploration in this area could detect a wreck or shipping remains, thereby contributing to archaeological knowledge. Although the likelihood of disturbing a shipwreck at the project location is very low, it is possible. Since the preference is to have a level surface area to facilitate spudding and installation of the wellhead, pre-drilling seabed survey will be undertaken using a Remotely Operated Vehicle (ROV) to detect any obstacles (incl. rock outcrops, shipwrecks, etc.). Thus, it is highly unlikely that any shipwrecks will be impacted. Mitigation will be included in the ESMP that deals with the situation if a wreck is identified during the seabed survey. Mitigations includes:

- In the event that a shipwreck is discovered during a pre-drilling site survey, TEEPSA will adjust the well location to avoid any shipwrecks identified in pre-drilling ROV surveys, and
- If any historic shipwreck objects are found before or after drilling commencement, which could potentially be impacted by the activity, work in the directly affected area should cease until the SAHRA has been notified and the operator has complied with any additional mitigation as specified by the SAHRA.

7.10.2. Cultural Heritage and Spiritual Beliefs

Heritage conservation and management are complex because there are competing claims to culture and its preservation, as well as political pressure to inscribe dominant narratives of history. In addition, cultural groups are not socially pristine, meaning that, cultural boundaries are porous and result in cross-cultural exchange and reformulation of heritage practices and values. Furthermore, immigration is deepening cultural complexity, as new cultural groups arriving with their values and practices, engage with resident groups, further diversifying existing heritage.

South Africans have a very long relationship with the sea. Archaeological evidence in the form of shell middens which point to the exploitation by humans of marine resources around the South African coast, dates back into the Middle Stone Age, at least 30 000 years before the present and continues through the Later Stone Age and Iron Age (on the east coast) right up until, and beyond the arrival of Europeans on South African shores after the late 15th century. The available evidence suggests that the pre-colonial exploitation of marine resources and people's interaction with the sea was limited to the littoral and the intertidal zone. There is currently no archaeological evidence for the movement of pre-colonial people in South Africa in the marine environment, or the construction or use, prior to the arrival of Europeans, of watercraft in that environment (Tim Hart and John Gribble *pers. com.* 2022).

Since the beginning of the colonial presence in South Africa, there has been a tradition of boat-based fishing and marine resource exploitation and many of the small coastal communities have histories linked to this practice which date back many years. There has been a fishery based in Saldanha Bay since the early years of the Dutch settlement at the Cape, for example, and the small-scale fishers' village of Kassiesbaai at Arniston dates back to at least the early 19th century. There is thus a long tradition of boat-based colonial era fisheries with their attendant communities, particularly on the West Coast with its rich marine resources fed by the Benguela Current and within these communities there will have developed clear and strong traditions and beliefs related to their way of life (Tim Hart and John Gribble *pers. com.*).

coastal and oceanic ICH is holistic. It includes a variety of waterways that ultimately lead to the sea, these include: streams, rivers, pools, lakes and estuaries. These waterways are described as 'living' waters and are believed to play a critical role in spiritual and health management in indigenous (First Peoples and Nguni) groups specifically.

- The specific beliefs concerning these 'living' waters can be summarized as follows:
- That the waters contain the ancestral spirits of the cultural communities noted
- That the waters offer a spiritual domain to which people in the present realm can travel to (intentionally or otherwise) and from which they can return if the correct ritual activities are performed to ensure safe return.
- That while the lesser waterways such as streams, rivers and pools may contain a community's specific ancestral spirits, the ocean itself contains the ancestral spirits of the African continent and arguably the ancestral spirits of all humanity.
- That the ancestral spirits in the ocean reside on the seabed or seafloor
- That indigenous peoples should always approach the sea and coast, as well as lesser waterways with reverence and sometimes, fear.
- That belief in the ancestral world and the place of ancestors in waterways and other ecologically sacred places does not require a relinquishing of belief in an omnipresent God. The ancestors form part of a complex genealogy of which God is the head.
- That regular, consistent and frequent interaction take place with the coast and sea in order to secure the guidance and benevolence of ancestors, as well as spirits that reside in such living waters.

The impact on cultural and spiritual beliefs of both South Africa's coastal fishing communities and its indigenous peoples related to the sea will be investigated further in the Cultural Heritage Impact Assessment.

8. ENVIRONMENTAL AND SOCIO-ECONOMIC SCREENING AND KEY IMPACTS

This chapter provides a high-level screening of the interaction between the project activities and the receiving environment. It also presents a project-specific Aspects and Impacts Register, which has been developed to ensure that all environmental and social aspects of the proposed operation and the associated impacts are identified. Lastly, this chapter also presents the key impacts identified by the ESIA project team together with a summary of key impacts and possible mitigation measures.

This list of impacts will be updated once the Scoping Phase public participation process has been completed. Specialists will 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

Project activities described in Chapter 6 have been grouped into sub-groups where impacts are similar and expected to affect the same environmental features as a basis for assessing their potential interactions with biophysical, ecological and social receptors. The environmental and social interaction matrix prepared for the proposed project is presented in TABLE 8-1. The matrix provides a list of the project activities and allows for easy checking of interaction against components of the receiving environment. Each box denotes whether or not a proposed project activity will interact with the corresponding environmental or socio-economic receptor. Interactions are screened to have a "*minor negative interaction*", "*moderate / major negative interaction*" or "*positive interaction*" on the receptor.

Under normal exploration conditions, the majority of project activities are expected to have a minor negative interaction with the environment mainly due to the offshore location of the Area of Interest for proposed exploration drilling with the nearest inshore boundary located approximately 120 km from shore and the short drilling duration, which is expected to take approximately three (exploration well) to four (appraisal well) months to complete the physical drilling and testing of each well (excluding mobilisation and demobilisation). However, **drilling in or close proximity to sensitive hardground communities could result in a more significant negative interaction during initial well spudding (physical disturbance) and cuttings discharge (smothering).** The proposed drop core sampling would also be of short duration (three to five weeks) and any associated impacts would be confirmed to a very small surface area within the overall extent of the licence block. The proposed sonar survey campaign would also be of short duration (approximately three months).

The key project activities during normal operation that will be investigated are related to the discharge of ballast water during mobilisation, the drilling operation itself (specifically spudding of the well, discharge of cuttings and underwater noise generated from the drilling unit / vessel operations) and interference with fishing operations. **Although the probability of a well blow-out is extremely low[26], it nevertheless provides the greatest environmental risk during drilling operations.** Oil spilled in the marine environment would have an immediate detrimental effect on local and regional water quality, on marine fauna and possibly on livelihoods and tourism. **A large oil spill, assuming the worst-case scenario of coastal oiling, would have a high negative interaction with both the biophysical and socio-economic environment.** Section 8.6 screens out of impacts of little magnitude

[26] Global data maintained by Lloyds Register indicates that frequency of a blow-out from normal exploration wells is in the order of 1.43 x 10-4 per well drilled. In a South Africa context, 358 wells have been drilled in the offshore environment to date (based on shapefile provided by PASA in 2021) and no well blow-outs have been recorded.

(consequence), or are already covered by project controls, or where an issue does not warrant a full description and assessment of significance.

8.2. ASPECTS AND IMPACTS REGISTER

The project-specific Aspects and Impacts Register developed for the proposed project is presented in TABLE 8-2. This register lists all project activities and associated environmental aspects and impacts. It is prepared to further elaborate the impacts identified through the initial screening for potential interactions. For each of the project activities, different aspects[27] associated with the activity and their potential impacts[28] are tabulated. This systematic approach allowed for the planning of the scope of the specialist studies.

8.3. KEY ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

The key impacts related to the proposed project are listed below. These impacts will require specialist input in order to assess the significance thereof through application of the Impact Assessment methodology in Section 9.3.

8.3.1. Impacts on Marine and Coastal Ecology

The proposed exploration activities could result in the following potential impacts on marine and coastal ecology:

- Localised reduction in air quality due to emissions from the combustion of diesel fuel for generators and other machinery used to power the drilling operations and support vessels, aviation fuel for aircrafts and helicopters, and well flow testing (flaring);
- Localised reduction in water quality due to drilling discharges;
- Localised reduction in water quality due to normal discharges, as per MARPOL requirements, to the marine environment from a variety of sources, including deck drainage, machinery space drainage, sewage and galley wastes from the drilling unit and support vessels;
- Localised disturbance of and / or behavioural changes to marine and coastal fauna due to increased ambient noise and lighting from the drilling unit, support vessels and helicopter operations;
- Localised disturbance of and / or behavioural changes to marine fauna due to increased underwater noise from vessels, drilling and VSP;
- Sediment disturbance due to sampling, drilling activities and placement of infrastructure on the seafloor;
- Smothering and biochemical effects (e.g., direct toxicity and bioaccumulation) on relatively immobile or sedentary benthic species due to the discharge of cuttings, drilling fluid and cement during well drilling;
- Increased biodiversity and biomass on wellhead due to hard substrate habitat available for colonisation by benthic organisms;
- Introduction of alien invasive marine species through international vessels and equipment transfer and ballast water discharge; and
- Local and regional impacts on water quality, marine fauna and oiling of coastal habitats (including MPAs) and seabirds due to accidental oil spills during the proposed exploration drilling (normal operations, e.g., bunkering at sea), as well as the unlikely event of a blow-out.

27 An "aspect" is the element of an organisation's activities, products or services that can interact with the environment.

28 An "impact" is any change to the environment, whether adverse or beneficial, wholly or partially resulting from the organisation's activities, products or services.

TABLE 8-1: ENVIRONMENTAL AND SOCIAL INTERACTION MATRIX

Project Phase	Resource / Receptors — Project Activities	Sensitive receptors in the receiving environment																	
		Physical and Biological											Socio-Economic						
		Water Column (incl. Water Quality, Noise and Turbidity)	Atmosphere (including Air Emissions, Noise, Lighting)	Seabed Sediment and Profile	Fish & Plankton Communities	Benthic Habitats and Communities	Coastal/marine birds	Turtles and Marine Mammals	Seabed Features and Seamounts	Nearshore Habitats and Communities	Designated sensitive areas	Alien marine species	Fishing	Maritime Heritage / Cultural Heritage	Marine Traffic / Navigation	Public Health and Safety	Infrastructure and Services	Settlements, Tourism, Recreation, Sense of Place	Employment & Income
Planned Activities (Normal Operation)																			
Mobilisation	Onshore logistics base (including liquid mud plant)																		
	Appointment of specialist service providers and staff																		
	Procurement, importation and transportation equipment & materials																		
	Accommodation rental and local spend (e.g., food and supplies)																		
	Transit of drilling unit and supply vessels to drill site																		
	Discharge or exchange of ballast water																		
Operation	Presence and operation of drilling unit and support vessels (including waste management, water intake, air emissions and routine discharges to sea)															SO	SO	SO	
	Lighting from drill vessel																		
	Operation of helicopters																		
	Drop-core sampling operations, including the deployment of sampling tools																		
	Well drilling (including ROV site selection, installation of conductor pipes; wellhead, BOP and riser system, well logging and plugging)													SO		SO			
	Discharge of drill cuttings and drilling fluid and residual cement																		
	Vertical Seismic Profiling (VSP)/sonar acquisition																		
	Well (flow) testing and flaring including the possible discharge of treated produced water																		
Demobilisation	Abandonment of well on sea floor																		
	Demobilisation of drill unit & supply vessels															SO			
	Demobilisation of logistics base, services and work force																		
Unplanned Activities (Emergency Event)																			
All	Faunal strike / collisions																		
	Accidental hydrocarbon spills / releases (minor) (e.g., vessel accident, bunkering and pipe rupture)															SO			
Operation	Dropped objects / lost equipment																		
	Loss of well control / Blow-out																		

Key:

No Interaction	Minor Negative Interaction	Moderate-/ High Negative Interaction	Positive	SO — Screened Out

TABLE 8-2: ASPECTS AND IMPACTS REGISTER

Activity Phase	Activity	Aspect	Potential Impact
1. Mobilisation Phase	Onshore logistics base (including appointment of service providers, procurement of equipment & materials and accommodation)	Establishment of onshore logistics base	Possible pressure on local infrastructure
			Revenue or income for service providers
		Recruitment for short term jobs, mostly skilled	Short term job creation and earning of salaries
		Business opportunities	Income for local service providers
		Staff requirement for accommodation, hotel / B&B stays, subsistence and local supplies	Revenue or income for landlords and rental businesses
			Revenue for food and other retail suppliers
	Transit of drilling unit and supply vessels to drill site	Increased underwater noise levels from vessel transit	Disturbance to marine fauna
		Air emissions due to exhaust gases	Atmospheric pollution and contribution to GHG emissions
		Light emissions in marine environment	Disorientation and mortality of seabirds
		Routine discharges to sea and local reduction in water quality	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
	Discharge of ballast water and equipment transfer	Introduction / spread of invasive alien species	Loss of biodiversity
2. Operation Phase	Presence and operation of drill unit and support vessels (including waste management, water intake, air emissions and discharges to sea)	Increased underwater noise levels from vessel transit	Disturbance to marine fauna
		Air emissions due to exhaust gases	Atmospheric pollution and contribution to GHG emissions
		Safety zone around drilling unit	Disruption of local tourism, recreation and commercial shipping
			Reduced fishing grounds and catch
		Routine discharges to sea and local reduction in water quality	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
			Potential risks to public health and safety
		Alter visual, cultural, social and environmental qualities and characteristics	Disturbance of residents in coastal settlements / altered sense of place (including sites of spiritual, cultural and ritual importance)
	Lighting from drill unit	Light emissions in marine environment	Disturbance, disorientation and mortality of seabirds
			Physiological and behavioural effects on fish and cephalopods
	Operation of helicopters	Increase in ambient noise levels	Disturbance of coastal and marine fauna in sensitive and protected areas
			Faunal avoidance of key breeding areas (e.g., coastal birds and cetaceans)
			Abandonment of nests (birds) and young (birds and seals)
			Disturbance of residents in coastal settlements / altered sense of place
	Drop-core sampling operations, including the deployment of sampling tools	Sediment disturbance and removal	Increased sea water turbidity and disturbance of fish
			Physical damage to and mortality of benthic species / habitats
	Well drilling (including ROV site selection, installation of conductor pipes; wellhead, BOP, well plugging)	Disturbance of sediment due to equipment installation	Disturbance of seabed and benthos
	Well drilling (station holding for drill unit and support vessel)	Increased underwater noise levels on drilling site	Physiological effect on marine fauna
			Disturbance / behavioural changes to marine fauna
			Masking or interfering with other biologically important sounds
			Reduced fish catch and increased fishing effort

Activity Phase	Activity	Aspect	Potential Impact
2. Operation Phase	Discharge of cuttings, drilling fluid and residual cement (casing and plugging)	Accumulation of cuttings and cement on seafloor and sediment disturbance	Smothering of seabed and disturbance / mortality of benthic fauna
			Toxicity and bioaccumulation or other physiological effects on marine fauna
			Reduced physiological functioning of marine organisms
			Degradation of the seabed in terms of value with regard to spiritual, cultural and ritual importance.
		Sediment plume and water column disturbance	Increased water turbidity, reduced light penetration and physiological effects on marine fauna
	Vertical Seismic profiling	Increase in underwater noise levels	Physiological effect on marine fauna
			Disturbance / behavioural changes to marine fauna
			Masking or interfering with other biologically important sounds
	Sonar acquisition, including the deployment of sonar equipment (sources) and acquisition operations		Reduced fish catch and increased fishing effort
			Degradation the integrity of marine ecosystem in terms of value with regard to spiritual, cultural and ritual importance.
	Well (flow) testing	Flaring of gas and liquid hydrocarbons	Atmospheric pollution and contribution to GHGs
			Disturbance and disorientation of marine fauna due to flare lighting
			Effect on faunal health (toxic effects) due to hydrocarbon 'drop-out' during flaring
		Discharge of treated produced water	Effect on marine biota health or mortality
	Interaction with local economy	Jobs and business opportunities	Income and employment of local service providers and suppliers
			Impact on Local Economic Sectors (e.g., property and tourism)
		Use of local services and facilities	Pressure on local services and facilities
			Pressure on Local Integrated Planning
3. Demobilisation Phase	Abandonment of well (plugging well with cement)	Increased hard substrate on seafloor	Reduced fishing grounds (obstruction) or damage of demersal fishing gear
			Increased and modification of benthic biodiversity
	Demobilisation of drilling unit and support vessels from drill site	Air emissions from exhaust gases	Atmospheric pollution and contribution to GHG emissions
		Increased underwater noise levels from vessel transit	Disturbance to marine fauna
		Routine discharges to sea and local reduction in water quality during transit	Physiological effect on marine fauna
			Increased food source for marine fauna
			Increased predator - prey interactions
		Light emissions in marine environment	Disorientation and mortality of seabirds
	Demobilisation of logistics base, services and work force	Demobilisation of site staff	Reduction in staff income and local spend
4. Unplanned Activities	Faunal strikes	Collision with marine fauna	Physiological effect on marine fauna
	Accidental hydrocarbon spills / releases (minor) (e.g., vessel accident, bunkering and pipe rupture)	Loss of hydrocarbons to sea	Effect on faunal health (e.g., respiratory damage) or mortality (e.g., suffocation and poisoning)
			Exclusion of fisheries and displacement of targeted species
	Dropped objects / Lost equipment	Increased hard substrate on seafloor or obstruction in water column	Physiological injury or mortality to marine fauna
			Obstruction to or damage of fishing gear
	Loss of well control / well blow-out	Uncontrolled release of oil / gas from well	Effect on marine biota health (e.g., physiological damage) or mortality (e.g., suffocation and poisoning)
			Reduced commercial fishing grounds and fish catch, and increased fishing effort
			Oiling of coastal habitats and potential loss of recreation, tourism, marine activities and industries (including small-scale fisheries)
			Degradation of the coastline in terms of value with regard to spiritual, cultural and ritual importance.

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). The terms of reference for this assessment are presented in Section 9.2.2.2.

Input obtained from the technical modelling studies will be used to assess the potential impacts related to increased underwater noise, the discharge of drill cuttings and associated muds, as well as accidental oil spills on the marine ecosystem and biota, including sensitive marine areas (see Section 9.2.1).

The drilling discharges and oil spill modelling studies will use the available metocean (meteorology and oceanography) data to model the following:

- 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; and
- The trajectory, extent and fate of an unlikely large oil spill due to a well blow-out.

The underwater noise modelling study will aim to describe the likely background noise levels, determine noise transmission loss with distance from the drill site, and zones of impact relating to permanent or temporary injury and behavioural disturbance.

8.3.2. Impacts on Commercial and Small-Scale Fisheries

During normal operations, the proposed exploration activities could potentially affect fishing activities, as a result of fishing being excluded from the 500 m operational safety zones around the sampling vessel, drilling unit; increased underwater noise disturbance during drilling and VSP activities, and the abandonment of the wellheads on the seafloor. These activities could have an impact on commercial fisheries that operate in the area through the reduction in catch rates and/or an increase in fishing effort.

An oil spill can also result in several impacts on fishing (unplanned event), 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 determine the fishing effort and catch of all fisheries operating off the West Coast of South Africa within the Project's Area of Influence. It will also assess the impact that the proposed project will have on these sectors during normal drilling operations and upset conditions (small accidental spills and large blow-out) with input from the technical modelling studies. The terms of reference for the commercial fisheries impact assessment are presented in Section 9.2.2.3.

The fisheries impact assessment includes consideration of broad economic risks and impacts of the proposed exploration operations on key fishing sectors. The level of information that will provided on the economic aspects of potential impacts of normal operations on key fishing sector receptors is considered to be adequate to inform the assessment of impacts and to inform decision making in this regard.

8.3.3. Impacts on the Socio-Economic Environment

The proposed exploration activities could potentially result in some limited socio-economic positive impacts. Given the isolated nature of the exploration area and short duration, the potential for direct socio-economic negative impacts from normal operations is considered negligible outside of the short-term disruption of commercial fisheries (addressed in Section 8.3.2 above). More direct localised impacts are possible in relation to: (i) onshore operations at either the Port of Cape Town or Saldanha, (ii) movement of support vessels and helicopters from the logistics base to the drilling site, as well as (iii) in the unlikely event of a well blow-out or vessel collision.

Possible socio-economic impacts may include:

- Alteration in sense of place and cultural / spiritual reliance on the sea. Exploration operations may be perceived to result in changes to the natural environment and/or the local sense of place, as well as links to area or items of cultural, spiritual or ritual significance.
- Pressure on local services and facilities. The use of local service providers and suppliers, while considered an economic benefit, may also result in increased pressure on local providers or facilities if they do not have sufficient capacity to support the exploration or other activities. This may include both public services (hospitals, clinics, and emergency responses), as well as private services (accommodation, transport and others), but also consumption of products (i.e. food, consumables, etc.).
- Reduction in income and livelihood related to short-term disruption of commercial fisheries.
- Impact on local tourism, recreation and recreational fishing, and commercial shipping. The implementation of the safe operational zone around the drilling unit, as well as movement of the support vessel between the drill area and port, will effectively exclude vessels from portions of the drilling area at any one time. Thus, their presence presents a potential risk of interference with commercial, recreational and fishing boats and other marine recreational activities.
- Potential collision hazards with lost equipment drifting on the surface or in the water column, which may pose a public health and safety risk.
- An unlikely large oil spill (unplanned event) can also result in several socio-economic impacts, including:
  - Alteration of the coastline in terms of aesthetic and landscape appeal (sense of place).
  - Alteration of the coastline in terms of value with regard to spiritual, cultural and ritual importance.
  - Alteration of the coastline that supports a variety of commercial and private recreational and tourism activities.
  - Reduction in recreational activities, and small-scale and commercial fishing in the region, including all forms of near-shore and offshore fishing (e.g., exclusion areas for fishing, non-consumption due to toxicity, decline in recruitment of fish stocks).
  - Reduction in income for secondary and tertiary sectors that support tourism, recreational, fishing, and other coastal economies.
  - Pressure on national, regional, and local public services and facilities as part of any shoreline responses.
  - National, regional, and local collapse in public trust and increase in conflict related to environmental and social impacts from major spills.
  - Impacts on national GDP and economic growth.

Positive socio-economic impacts may include:

- Local employment income for service providers and suppliers: The exploration activities will result in limited local economic benefits due to the short-term and technical nature of the activity with respect to the use of local service providers or suppliers, which will result in direct and indirect positive impacts on employment and income. The demand for such local services will be largely limited to crew accommodation, meals, basic goods, and refuelling, provided at the onshore logistics base in Cape Town or Saldanha.

How the issues will be addressed in the ESIA:

A Socio-Economic Impact Assessment (SIA) will be commissioned to provide an overview of the social context of the project and determine the potential socio-economic impacts and benefits associated with the proposed exploration drilling activities, including unplanned events. The SIA will draw on information provided by the related technical modelling studies (e.g., oil spill modelling) and specialist studies (e.g., commercial fishing). The terms of reference for the SIA are presented in Section 9.2.2.4.

The SIA will include consideration of broad socio-economic impacts of the proposed additional exploration activities (normal operations) and an unplanned event (such as a well blow-out) on key economic sectors. The level of information that will provided on 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.

In addition, a cultural heritage impact assessment has been commissioned to investigate the intangible cultural heritage including spiritual beliefs of key coastal communities and their relation to the ocean within the Project's indirect Area of Influence. The assessment will investigate human cultural heritage and religious connections to the ocean and coasts, and how such practices and beliefs may be impacted by exploration in the area of indirect influence.

The collection of primary field data, which commenced during the Scoping phase (see Section 4.2), will be used to assess the potential impacts related to both normal operations and upset conditions on the stated variables (culture, spiritual aspects and religion).

8.3.4. Impacts on Air Quality and Climate Change

The well drilling activities will generate air emissions through the operation of the drilling unit; movement of vessels and helicopters, and the flaring of gas during well testing (if hydrocarbon resources are found). This will have localised air quality impacts and contribute towards greenhouse gas emissions. These impacts are described in further detail below.

- The release of gaseous pollutants, principally sulphur oxides (SOx), nitrogen oxides (NOx), carbon dioxide (CO_2) and carbon monoxide (CO), together with lesser quantities of particulate matter (PM_{10}/$PM_{2.5}$) and volatile organic compounds (VOCs), from the project vessels, helicopters and well test have the potential to cause reductions in local air quality close to the emissions source, which in turn could have health effects (e.g., respiratory effects).
- Some of the gaseous pollutants released from the project vessels and helicopters could also contribute to global GHG emissions. The main effects of climate change (including increased temperatures, changing weather patterns and sea level rise) are related to increased atmospheric CO_2 concentrations.

How the issues will be addressed in the ESIA:

A climate change and air emissions impact assessment will be undertaken to establish a greenhouse gas and criteria pollutant emissions inventory, model the dispersion of the pollutants and evaluate the significance of GHG emissions and non-GHG criteria pollutant emissions. The terms of reference for this study are presented in Section 9.2.2.6.

8.4. 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 summarised in Table 8-3 below, together with preliminary mitigation measures. 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.

TABLE 8-3: SUMMARY OF KEY IMPACTS AND PRELIMINARY MITIGATION

No.	Project Activity	Predicted Impacts	Preliminary Mitigation Measures / Project Controls
1.	**Normal Operations**		
1.1	Vessel operations and emissions to the atmosphere	• Contribution to greenhouse gases. • Reduction in local air quality, which in turn could have effects on health, etc.	• Optimise rig positioning, rig movement 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.
1.2	Operational discharges to sea (e.g., grey water, sewage, deck drainage)	• Local reduction in water quality and physiological effects on marine fauna.	• Compliance with MARPOL standards for discharges to sea. • Implementation of Waste & Discharge / Maintenance management plans
1.3	Discharge of ballast water	• Introduction of alien invasive species and harmful aquatic pathogens to the marine ecosystem.	• Compliance with requirements of the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments.
1.4	Helicopter operations and elevated airborne noise levels	• Disturbance of faunal species resulting in behavioural changes or displacement from important feeding or breeding areas • Disturbance / loss of sense of place.	• Minimum flying heights and flight paths to avoid sensitive habitats.
1.5	Seabed sampling	• Physical seabed disturbance on benthic fauna.	• Pre-drilling sampling surveys (with ROV) and implement buffer around sensitive hardgrounds and vulnerable habitats.
1.6	Drilling and discharge of drill cuttings	• Physical seabed disturbance on benthic fauna during spudding. • Smothering of benthic fauna/habitats by cuttings. • Increased sea water turbidity and water quality contamination.	• Pre-drilling site surveys (with ROV) and implement buffer around sensitive hardgrounds and vulnerable habitats. • Usage of low-toxicity drilling fluids and cement. • Monitor discharges.
		• Alteration of the seabed in terms of value with regard to spiritual, cultural and ritual importance.	• Stakeholder engagement and notification. • Implement, where necessary, a ritual event/s.

No.	Project Activity	Predicted Impacts	Preliminary Mitigation Measures / Project Controls
1.7	Generation of underwater noise from drilling and vessel activity and VSP	• Disturbance of marine fauna, particularly whales and dolphins, from exploration area.	• Pre-shoot watch by Marine Mammal Observer (MMO), including Passive Acoustic Monitoring (PAM). • Implement 'soft start' to VSP activities for slow ramp up of power output. • "Soft-start" procedures. • Shut-downs for animals in mitigation zone.
		• Displacement of fish and fishing.	• Stakeholder engagement and notification. • Navigational warning. • Fisheries Liaison Officer (FLO). • Grievance management.
1.8	Temporary safety zone around drilling unit	• Exclusion of fishing activities within 500 m safety zones during operational activities. • Reduction in catch rates and/or an increase in fishing effort.	• Stakeholder / vessel notification. • Navigational warning. • Fisheries Liaison Officer (FLO). • Vessel lighting and safety signals.
1.9	Well abandonment on seafloor	• Interference with trawling activities or fishing equipment.	• Over-trawlable abandonment cap. • Survey and accurately charted wellheads with the SAN Hydrographer.
1.0	Produced water discharge (if any)	• Local reduction in water quality and physiological effects on marine fauna.	• Onboard treatment of hydrocarbon component to <30 mg/l or ship to shore.
1.11	Procurement of local service providers and employment	• Procurement of local service providers for onshore base and helicopter transfers etc. • Employment of a limited number of staff (e.g., logistics base).	• TEEPSA local content policy. • Manage community expectations. • Stakeholder engagement.
1.12	Normal operations	• Alteration in sense of place and cultural / spiritual reliance on the sea.	• Stakeholder engagement. • Implement a ritual event/s that permits engagement with ancestral spirits and nature to alleviate potential and future negative impacts of non-consultation and poor cultural/nature respect.
2.	**Unplanned Events**		
2.1	Loss of equipment	• Potential disturbance and damage to seabed habitats and associated fauna within the equipment footprint. • Collision hazards for other vessels.	• Post drilling ROV survey. • Retrieve of lost objects / equipment, where practicable. • Notify SAN Hydrographer.
2.2	Vessel or equipment failure and bunkering of fuel	• Immediate detrimental effect on water quality, with the toxic effects	• Bunkering procedure. • Shipboard Oil Pollution Emergency Plan. • Emergency Response Plan. • Spill training and clean-up equipment.
2.3	Loss of well control / well blow-out	• Local and regional impacts on water quality, marine fauna and oiling of coastal habitats and marine fauna. • Exclusion of fisheries from polluted areas and gear damage. • Reduction in income for secondary and tertiary sectors that support tourism, recreational, fishing, and other coastal economies.	• Design and Technical Integrity. • Detailed Technical Risk Analysis. • Blow-out Preventer. • Well-specific response strategy and plans (Oil Spill Contingency Plan, Emergency Response Plan and Blow-Out Contingency Plan). • Cap and Containment Equipment. • Well-specific oil spill modelling. • Deploy and/or pre-mobilise shoreline response equipment. • Stakeholder engagement. • Implement, where necessary, a ritual event/s.

No.	Project Activity	Predicted Impacts	Preliminary Mitigation Measures / Project Controls
		• Alteration of the coastline in terms of value with regard to spiritual, cultural and ritual importance.	• Grievance management.

8.5. SUMMARY OF PROJECT ALTERNATIVES

A summary of the project alternatives considered during the project design, which will be considered further during the ESIA, is provided in Table 6-11. These are presented in alignment with the mitigation hierarchy, which is aimed at avoiding / preventing, minimising or managing significant negative impacts to as low as reasonably practicable (ALARP) and optimising and maximising any potential benefits of the proposed project. Avoidance measures are typically the most important way of minimising project impacts primarily through site selection or timing of activities.

8.6. SCREENING OUT OF INSIGNIFICANT IMPACTS

Table 8-4 provides for the screening out of impacts of little magnitude (consequence) where a linkage was identified in the interaction matrix, or are already covered by project controls, or where an issue does not warrant a full description and assessment of significance.

TABLE 8-4: SCREENING OUT OF INSIGNIFICANT IMPACTS

No.	Potential Impact	Reason Screened Out	Management/Mitigation
1	Increased pressure of logistics base on port infrastructure, airport or adjacent land users	The primary onshore logistics base will most likely be located at Cape Town (preferred alternative), but alternatively in Saldanha. The location of the onshore logistics base will ultimately be based on discussions with Transnet National Ports Authority and tenders from the Oil and Gas service provider industry. The logistics base will be located in a designated area zoned for industrial use and in accordance with spatial development plans. Therefore, no conflict with land users is expected. Selection of the locality would be on the basis of there being sufficient space and adequate facilities to accommodate the project. Each of the potential ports has existing facilities and operators which service the Oil and Gas industry. There would not be any requirement for the development of new facilities. The proposed operations would not constitute a significantly different or additional operation in the context of any of the potential ports. None of the required logistics/support operations are of such a nature, frequency or duration that they would place undue pressure on local infrastructure. Similarly, the selection of the base for air support (Cape Town) is on the basis of that there is adequate capacity to accommodate the project. The required air support operations are not of a nature, frequency or duration that they would place undue pressure on local infrastructure.	None.
2	Transport and disposal of waste at approved landfill sites	General waste landfill sites are located at the two onshore base options, Cape Town and Saldanha. Cape Town also has a hazardous landfill site are. 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 relatively small. The disposal of waste onshore will be fully traceable to ensure it is disposed at appropriately licenced waste facilities.	Audit / control implementation of the Waste Management Plan.
3	Health and safety of workers when handling solid waste	The services of an appropriately licenced waste contractor will be used to collect and transport all operational waste for recycling, treatment or disposal. The disposal of all waste onshore will be fully traceable to ensure it is disposed at appropriately licenced waste facilities.	Audit / control implementation of the Waste Management Plan.

No.	Potential Impact	Reason Screened Out	Management/Mitigation
		More generally, the consideration of occupational health and safety risks do not fall within the ambit of an ESIA. A range of other regulation is in place to cover these risks.	
4	Potential onshore land / water contamination due to onshore chemical and waste storage	Although the location of the logistics base is not confirmed, it will be located in an area suited to and designed for storage of chemicals, fuel and equipment, and for drainage of effluent and runoff (e.g., port area). Selection of the logistics base site would be on the basis that the location has adequate facilities for the storage and handling of chemicals and wastes. Each of the potential ports has existing facilities and operators which service the Oil and Gas industry.	Audit / control implementation of the Waste and Discharge Management Plan and the Chemical Management Plan.
5	Routine operational discharges from vessels and drilling unit on public health and safety	The Area of Interest for proposed exploration drilling is located approximately 60 km from the coast at its closest point and is thus far removed from any coastal receptors. The dominant current direction will also ensure that any discharges move mainly in a north-westerly direction away from coast. Given the offshore location of the survey and drill areas and the total volume of likely operational discharges (refer to Section 6.5.6), such discharges are expected to disperse rapidly to undetectable concentrations and are unlikely to have an impact on sensitive coastal receptors. There is no potential for accumulation of discharged substances leading to any detectable long-term impact.	Audit / control implementation of the Waste and Discharge Management Plan (which includes compliance with MARPOL standards).
6	Health and safety of workers due to radioactive sources	The target resources are not naturally radioactive, thus there is no consideration of risks from naturally occurring radioactive material. Where radioactive sources are used during well testing, they would be of minimal volumes and would be 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. The well testing does not generate radioactive wastes.	Designate competent person/s in charge and to handle radioactive devices. Follow radioactive sources procedure and comply with necessary regulations for the transport, storage, and handling of radioactive devices.
7	Radioactivity of drill cuttings	The target resources are not expected to be naturally radioactive, thus there is no need for the consideration of risks from naturally occurring radioactive material.	TEEPSA will consider the possibility of analysing Gamma ray results during logging and / or during cuttings treatment. If any issues with regard to radioactivity are detected, appropriate treatment and disposal will be undertaken.
8	Impact of drilling on possible marine heritage (shipwrecks)	As noted in Section 7.8, no wrecks are known to occur or have been identified within the Block DWOB. Although the likelihood of disturbing a shipwreck is very small, it is possible that the proposed exploration activities could detect a wreck or shipping remains, thereby contributing to archaeological knowledge. It should be noted that the final well location would be based on a number of factors, including an analysis of existing seismic data, the geological target, seafloor surface conditions and obstacles. The preference would be to have a level surface area to facilitate spudding and installation of the wellhead. Since the proposed drill location would be analysed for seabed obstacles, any visible wrecks would more than likely be detected and thereby avoided.	Adjust the well location to avoid any marine underwater cultural heritage (shipwrecks) identified in pre-drilling ROV surveys. If any historic shipwreck objects are found during the pre-drilling 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 SAHRA has been notified and the operator has complied with any additional mitigation as

No.	Potential Impact	Reason Screened Out	Management/Mitigation
			specified by the SAHRA, including any recommended buffer.
9	Visual impact	The proposed project is located more than 250 km offshore, and will be a temporary installation. For an observer at the coast at a height of 30 m and 100 m above sea level, the horizon is at a distance of 19.6 km and 36 km, respectively(https://en.wikipedia.org/wiki/Horizon#:~:text=For%20 an%20observer%20standing%20on%20a%20hill%20or%20tower %2030,36%20kilometres%20(22%20mi)). Thus, the proposed project will not be visible to any sensitive visual receptors from the coast. It should, however, be noted that the potential impact on the local sense of place will be assessed.	None.
10	Impact on disused marine ammunition dump	No disused marine ammunition dumps are located within the DWOB Licence Block (see Figure 7-77).	Well site to avoid any ammunition dump area. Adjust the well location to avoid any obstructions / objects identified in pre-drilling ROV surveys.
11	Hydrocarbon leak from plugged and abandoned well	Well plugging and abandonment are undertaken to ensure safe closure of a non-producing offshore wells. Wells are sealed, plugged, tested for integrity and abandoned according to international best practices. The ultimate goal of these measures is to provide permanent containment of the formation fluids and to prevent migration from the reservoir to the seabed, i.e., isolate permeable and hydrocarbon bearing formations. 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. Depending on the formations encountered, a well may be plugged at multiple locations. 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. The leakage of hydrocarbons from an abandoned well can be initiated through a compromised well barrier either by degradation overtime or natural seepage, or both. For the proposed activities up to ten wells may be drilled, but only those which encounter hydrocarbon-bearing formations could potentially leak. Although a leak from an abandoned well is unlikely, it could result in the release of large quantities oil or gas. The quantities released are, however, likely to be less than in the case of a well blow-out. The impacts associated with a well blow-out (i.e., the worst case) will be assessed in the ESIA.	As noted in Section 6.5.5, monitoring gauges to monitor pressure and temperature may be installed on appraisal wells where TEEPSA plan to return in the future for additional appraisal / production purposes.

9. PLAN OF STUDY FOR IMPACT ASSESSMENT

This Plan of Study for Impact Assessment is submitted in accordance with the requirements set out in Appendix 2(h) of the EIA Regulations 2014 (as amended), which sets out the proposed approach to the environmental impact assessment of the application. The contents for the Plan of Study for ESIA are set out in TABLE 9-1 with an indication of where each requirement is addressed in the report.

TABLE 9-1: SUMMARY OF STUDY REQUIREMENTS AND LOCATION IN THE SCOPING REPORT

Plan of Study Requirements (Appendix 2 (h) EIA Regulations 2014 (as amended in 2017))		Location in Report
(i)	*a description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity;*	Section 6.6 & 8.5
(ii)	*a description of the aspects to be assessed as part of the environmental impact assessment process;*	Sections 8.1-8.3
(iii)	*aspects to be assessed by specialists;*	Section 9.2
(iv)	*a description of the proposed method of assessing the environmental aspects, including a description of the proposed method of assessing the environmental aspects including aspects to be assessed by specialists;*	Section 9.3
(v)	*a description of the proposed method of assessing duration and significance;*	Sections 9.3.4.1 & 9.3.5
(vi)	*an indication of the stages at which the competent authority will be consulted;*	Chapter 4
(vii)	*particulars of the public participation process that will be conducted during the environmental impact assessment process;*	Sections 4.4
(viii)	*a description of the tasks that will be undertaken as part of the environmental impact assessment process;*	Section 9.1
(ix)	*identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored.*	Section 8.4

9.1. DESCRIPTION OF THE TASKS PLANNED FOR THE ASSESSMENT PHASE

If the final Scoping Report is accepted by DMRE, the ESIA phase will commence as shown in Figure 3-1. Any process conditions attached to the acceptance of the final Scoping Report will be implemented in the ESIA process.

An overview of the Assessment Phase and public consultation process, highlighting the tasks and activities, is provided in Chapter 3 and 4, respectively. An outline of the planned specialist investigations is included in Section 0 below.

The specialist findings, mitigation, recommendations and other relevant information will be integrated into an ESIA Report, in compliance with Appendix 3 of the EIA Regulations 2014 (as amended), and will include an Environmental and Social Management Programme (ESMP) compiled in terms of Appendix 4 of the EIA Regulations 2014, as amended. The ESMP will provide recommendations on how to establish, operate, maintain and close the proposed project throughout all relevant phases of the project activities. The aim of the ESMP will be to ensure that the project activities are managed to avoid or reduce potential negative environmental and social impacts and enhance potential positive environmental and social 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 and social 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 4.4.

9.2. TECHNICAL AND SPECIALIST STUDIES TO BE UNDERTAKEN

The terms of reference for the technical modelling studies and the specialist studies are presented in Section 9.2.1 and ⍰ 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 (namely noise, drilling discharges and oil spill) will not assess any potential impacts, but will 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 exploration 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 9.3). 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. In addition to the three technical modelling studies, an independent peer review of the Drilling Discharges and Oil Spill Modelling studies will also be undertaken.

9.2.1. Technical Modelling Studies

9.2.1.1. Drilling Discharges

The specific terms of reference for the drilling discharges study are as follows:

- Provide a description of the metocean conditions, such as winds and ocean currents in the licence area with specific reference to the Area of Interest for proposed exploration drilling.
- Model the transport, dispersion and bottom deposition of drill cuttings and associated mud discharged during drilling operations based on two drill discharge locations using the ParTrack model[29]. 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 protected areas (including MPAs and EBSAs); and

[29] The ParTrack modelling tool is proposed as it is among the best in class for drilling discharge modelling, considering its capabilities to determine the chemical and physical impact of the drilling discharge in the marine environment.

    - 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. These parameters and assumptions will be reviewed in the independent peer review study (see Section 9.2.1.4).

9.2.1.2. 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 the licence area with specific reference to the Area of Interest for proposed exploration drilling.
- Model the trajectory and fate of a 20-day crude oil blow-out (stochastic and deterministic) for a 90-day period based on two spill locations using the Oil Spill Contingency and Response (OSCAR) modelling tool[30]. 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, EBSAs and CBAs); and
    - Metocean dataset.

  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. These parameters and assumptions will be reviewed in the independent peer review study (see Section 9.2.1.4).

30 The OSCAR modelling tool is proposed as it is among the best in class for oil spill modelling, considering its capabilities to determine how the slick will drift and how oil components will interact with the marine environment.

9.2.1.3. 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 project area, 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:
  - Consider local metocean conditions for the DWOB Licence Block, including winds, waves, and currents, as well as other variables such as salinity31, temperature, hydrostatic pressure (depth), bathymetry, and the geo-acoustic parameters of the seafloor. Select the worst-case scenario for the modelling.
  - Undertake source signature modelling and source spectra estimates for the sonar sources.
  - For the VSP airgun array source, the source levels are proposed to be modelled using the Gundalf Designer software package32, 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 (PE) 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 ACCOBAMS guidelines.
- 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.

9.2.1.4. Peer Review

An independent peer review of drilling discharges and oil spill modelling studies will be undertaken. The terms of reference for this review are as follows:

- Review and comment on modelling methodology document including:
  - Metocean data to be used and how these data will be validated.
  - Oil and cuttings discharge scenarios including justification for these scenarios, i.e. oil type, discharge rate, spill duration, spill location within block, etc.

[31] Salinity will be included as one of the important variables to derive the sound speed profile.

[32] The Gundalf software is independently produced and is the result of years of research backed up by careful calibration against published measurement sources and is now in widespread use in the oil and gas industry (https://www.gundalf.com/).

  - Description of the models to be used including the physical processes included and numerical implementation.
  - Description of model post-processing including the thresholds to be applied (i.e. oil thickness, suspended sediment concentration, etc.) and example outputs.
- Review and comment on draft and final modelling reports and compile a peer review report.

9.2.2. Specialist Studies

9.2.2.1. General Terms of Reference for the Specialist Studies

The following general terms of reference will apply to all 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 project 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 consider the precautionary principle in 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 9.3).

9.2.2.2. Marine Ecology Impact Assessment

The specific terms of reference for the marine ecology impact assessment are as follows:

- Provide a general description of the marine fauna off the West Coast and Project's Area of Influence, based on current available literature.
- Describe the coastal and offshore habitats that are likely to be affected by exploration activities.
- Identify sensitive habitats and species that may be potentially affected by the proposed exploration activities.
- Describe seasonal and migratory occurrences of key marine fauna.
- Identify, describe and assess the significance of potential impacts of the proposed exploration 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 exploration programme.

9.2.2.3. Fisheries Impact Assessment

The specific terms of reference for the fisheries impact assessment are as follows:

- Provide a description of the fisheries sectors operating in South African coastal waters, focusing on the Project's 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 exploration 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.

9.2.2.4. 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 Project’s land-based activities (e.g., possible logistics bases which may be used by the project) using available data. This should be tailored to the extent of potential linkages and impacts of the project with the local population and nearby communities.
- Assess the likely social impacts and benefits (direct and indirect) associated with the proposed exploration activities, including potential adverse social consequences of impacts on fisheries and other offshore and maritime activities and sea users.
- Identify the social impacts of a major oil spill.
- 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.

The assessment of economic impacts as a result of **unplanned events** (such as a well blow-out) is challenging to accurately perform due to the many variables, assumptions and uncertainties that would be involved. The outputs of such an assessment are likely to be so broad that it would be of little direct value in informing the impact assessment process or the development of mitigation measures and ultimately decision-making.

It is acknowledged that the greatest potential risk of oil and gas exploration activities, in the marine environment, is the impact of an unplanned event such as a well blow-out. While such an event is highly unlikely, they have occurred across the globe with negative environmental, social and economic impacts. A key response to such unplanned events, is a well-specific Oil Spill Contingency Plan (OSCP) that is driven by well-specific oil spill modelling, intensive pre-planning and appropriate preparation.

The ESIA process includes the undertaking of detailed Oil Spill Modelling, which will include both Stochastic Modelling (which will present the probability of contamination above defined threshold values for sea surface and shoreline under different spill scenarios) and Deterministic Modelling (which will study the trajectory and fate of an individual oil slick (usually the worst-case trajectory identified in the stochastic simulation) in order to better understand how the oil spill progresses in the marine environment, estimate the amount of oil that could reach the coast depending on the weather conditions and oil weathering, as well as the minimum time to observe these impacts. This information will enable TEEPSA to establish practical and feasible oil spill response planning.

The ESMP will specify commitments on the approach to and key components of an OSCP. Framework documents for OSCP and Blow-Out Contingency Plan (BOCP), which give an indication of the typical content, will be included in the ESMP.

The management of compensation in the occurrence of an unplanned event (such as a well blow-out) falls outside of the scope of an ESIA process and will not be addressed directly in the ESIA phase. However, should an unplanned event occur, , a process of determining the economic effects and related compensation would be initiated. Such a process would typically involve government, insurers, the organisation responsible for the incident, industry organisations and the applicable legal system. TEEPSA will plan for and would implement responses in terms of the IPIECA-IOGP Good Practice Guide Series. The "Economic assessment and compensation for marine oil releases" (2015) is the primary reference document in this regard (https://www.ipieca.org/resources/good-practice/economic-assessment-and-compensation-for-marine-oil-releases). Further details on TEEPSA's commitment and approach will be provided in the Assessment Phase.

9.2.2.5. Cultural Heritage Impact Assessment

The specific terms of reference for the cultural heritage impact assessment are as follows:

- Conduct primary anthropological research in selected key communities within the indirect Area of Influence to describe, discuss and analyse the receiving environment and baseline conditions in the area, as these pertain to issues of culture, spiritual and religious uses of the sea and coast (note: this task commenced during the pre-application phase). This primary research will:
  - Identify the intangible cultural heritage impacts of the proposed project.
  - Identify knowledge gaps relating to cultural, spiritual and religious uses of the sea and coast.
  - Assist by way of qualitative assessment, the determination of prevalence, frequency, importance and commonality of cultural and spiritual uses of the oceans and coast. The qualitative assessment will include interview questions regarding frequency for example, of ritual practice, its relative importance in the overall cultural repertoire of the community, the prevalence/commonality of the practice in the selected area.
  - Identify management and practicable mitigation actions.
- Utilise both primary and secondary data collected to assess the potential intangible cultural heritage impacts of both normal operations and upset conditions on the heritages of indigenous, autochthonous and recently settled peoples, their spiritual and religious uses of / connections to the sea and coast and their cultural valuation of these assets.
- Identify mitigation measures to reduce potential negative impacts on aspects of culture and spiritual/religious uses of the sea and coast.

9.2.2.6. Climate Change and Air Emissions Impact Assessment

The specific terms of reference for the climate change and air emissions impact assessment are as follows:

- Establishment of a Greenhouse Gas Inventory, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).
- Establishment of Criteria Pollutant Emissions Inventory, including sulphur dioxide (SO_2) oxides of nitrogen (NOx), carbon monoxide (CO), volatile organic compounds (VOC) and particulate matter (PM).
- Screening of atmospheric dispersion modelling using SCREEN3 model[33] (a worst-case scenario). Predict air quality at closest shoreline due to the air emissions of criteria pollutants.
- Climate Change Statement evaluating the significance of GHG emissions, as well as non-GHG emissions.

9.3. PROPOSED METHOD FOR ASSESSING IMPACT SIGNIFICANCE

This section sets out the approach and method for the assessment of impacts for the proposed project and defines the terminology applied and the steps used to evaluate impact significance.

9.3.1. 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 project. Impacts are identified throughout the ESIA process by environmental and social assessment practitioners, from specialist studies and stakeholder engagement process, and refined as more detailed baseline information, modelling data or project design information is available.

For potentially significant impacts or those of stakeholder concern, the impact identification and evaluation process involves the following main steps:

9.3.1.1. Step 1: Define the Area of Influence

The Area of Influence of the project 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 project. Direct impacts of the project are typically located within a smaller area around the project 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 of the project. **The Area of Influence will be reassessed in the Assessment Phase based on the oil spill modelling results.**

9.3.1.2. Step 2: Identification of Potential Impacts

Potential impacts of a project are identified through a process of examining the potential for interactions between project activities and environmental and social receptors (or features). This requires consideration of the range of project activities across different phases of the project (planning, mobilisation, operation and decommissioning) and the potential for interactions on each of the environmental receptors, features or aspects

[33] SCREEN3 is a single source Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources, as well as concentrations in the cavity zone, and concentrations due to inversion break-up and shoreline fumigation (https://www.epa.gov/scram/air-quality-dispersion-modeling-screening-models#screen3).

occurring in the project Area of Influence. The results are then presented in an '**environmental and social interaction matrix' format** (see Table 8-1). For each project 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.

9.3.1.3. Step 3: Compile Impacts – Aspects Register

An Aspects-Impacts 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 project 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 project 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 Aspects-Impacts 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.

9.3.1.4. Step 4: Impact Evaluation

Evaluation of impact significance follows a stepwise process as set out below with reference to definitions in Section 9.3.2.

4a: Assign sensitivity ratings to receptors

The sensitivity of a receptor is defined on a scale of Very Low, Low, Moderate, High or Very High guided by the definitions for biophysical, ecological and social receptors in Section 0. These are derived from the baseline information, which shall be used to support the sensitivity ratings in the description of impact.

4b: Determine the impact magnitude (or consequence) ratings

Magnitude (or Consequence) is determined based on a combination of the "intensity", "duration" and "extent" of the impact following the designations set out in Section 0. Magnitude (or Consequence) is assigned to the **pre-mitigation impact** (i.e., before additional mitigation measures are applied, but taking into account embedded controls specified as part of the project description) **and residual impacts** after additional mitigation is applied.

4c: Determine impact significance rating

The significance of an impact is a function of the magnitude and the sensitivity of the impact determined using the matrix table in Section 9.3.5 and is assigned to the predicted impact **pre-mitigation and post-mitigation (residual)** after considering all possible feasible mitigation measures in accordance with the mitigation hierarchy.

4d: Applying the mitigation hierarchy

Identification of mitigation measures in accordance with the mitigation hierarchy is done throughout the ESIA process with emphasis placed on avoiding significant impacts where feasible. 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 Table 9-10 (see Section 0).

Certain avoidance mitigation measures may be identified early in the Scoping Phase and become 'embedded' into the project design and specified in the project description (e.g., drilling sites may be confirmed to avoid sensitive seafloor areas or the timing of drilling may avoid certain seasons). These embedded controls are not 'added' to the list of mitigation measures or used to determine the post-mitigation significance. Additional mitigation measures may be identified during the impact assessment process and those agreed with the proponent will be used to assess the post-mitigation significance ratings. These may include measures such as helicopters to avoid fly-over of islands at certain heights.

4e: Assign additional ratings to describe the impact

Qualifying ratings are assigned to criteria such as probability (or likelihood of the impact occurring), confidence (in the impact prediction), mitigation potential, extent of resource loss (as defined in Section 0), reversibility of impact and potential for cumulative impacts.

9.3.2. Definitions of Impact Types and Criteria Used

9.3.2.1. Impact Types

Table 9-2 below defines the criteria used to categorise and describe impacts.

TABLE 9-2: IMPACT CATEGORISATION AND DESCRIPTION

Term	Definition
Nature of Impact	The direction of impact and whether it leads to an adverse effect (negative), beneficial effect (positive) or no effect (neutral)
Positive	An impact that is considered to represent an improvement to the baseline conditions or introduces a positive change to a receptor.
Negative	An impact that is considered to represent an adverse change from the baseline conditions or receptor or introduces a new adverse effect.
Neutral	An impact that has no or negligible effect on the receptor.
Type	Cause and effect relationship between the project activity and the nature of effect on receptor
Direct	Impacts that result from a direct interaction between a proposed project activity and the receiving environment (e.g., effluent discharge and receiving water quality). Sometimes referred to as primary impacts.
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway. Sometimes referred to as secondary impacts.
Induced	A type of indirect impact resulting from factors or activities caused by the presence of the Project, but which are not always planned or expected (e.g., human in-migration along new access or for jobs creating increased demand on resources).
Residual	The impacts that remain after implementation of the project and all associated mitigation, and other environmental and social management measures.

9.3.2.2. Definitions of Impact Assessment Criteria and Categories Applied

Definitions of the criteria used in assessing impact significance and the assigned categories, and the additional criteria used to describe the impacts, are summarised in Table 9-3 below.

TABLE 9-3: DEFINITIONS OF IMPACT ASSESSMENT CRITERIA AND CATEGORIES

Criterion	Definition	Categories
Sensitivity	Sensitivity is a rating given to the importance and/ or vulnerability of a receptor (e.g., conservation value of a biodiversity feature or cultural heritage resource or social receptor.	Very Low Low Medium High Very High
Magnitude (or Consequence)	A term describing the actual change predicted to occur to a resource or receptor caused by an action or activity or linked effect. It is derived from a combination of Intensity, Extent and Duration and takes into account scale, frequency and degree of reversibility.	Very Low Low Medium High Very High
Intensity	A descriptor for the degree of change an impact is likely to have on the receptor which takes into account scale and frequency of occurrence.	Very Low Low Medium High
Extent	The spatial scale over which the impact will occur.	Site Local National Regional International / Transboundary
Duration	Time scale over which the consequence of the effect on the receptor/s will last. [Note that this does not apply to the duration of the project activity]. The terms 'Intermittent' and 'Temporary' may be used to describe the duration of an impact.	Short-term Medium-term Long-term Permanent
Probability	A descriptor for the likelihood of the impact occurring. Most assessed impacts are likely to occur, but Probability is typically used to qualify and contextualise the significance of unplanned events or major accidents.	Unlikely Possible Likely Highly Likely Definite
Confidence	A descriptor for the degree of confidence in the evaluation of impact significance.	Low Medium High Certain
Mitigation potential	A descriptor for the degree to which the impact can be mitigated to an acceptable level.	None Very Low Low Medium High
Loss of Irreplaceable resources	A descriptor for the degree to which irreplaceable resources will be lost, fragmented or damaged.	Low Medium High

Criterion	Definition	Categories
Reversibility	A descriptor for the degree to which an impact can be reversed.	Irreversible Partially Reversible Fully Reversible
Cumulative	A descriptor of the potential for an impact to have cumulative impacts to arise.	Unlikely Possible Likely

9.3.3. Determination of Sensitivity

Sensitivity is a term that covers the 'importance' (e.g., value of an ecological receptor or heritage resource) or 'vulnerability' (e.g., ability of a social receptor to cope with change) of a receptor to a project-induced change. It takes into account 'Irreplaceability' - measure of the value of, and level of dependence on, impacted resources to society and/ or local communities, as well as of consistency with policy (e.g., conservation) targets or thresholds.

Broad definitions of sensitivity ratings for social, ecological and physical/abiotic receptors are defined in Table 9-4 below. These are not exhaustive and may be modified on a case-by-case basis, as appropriate. Additional ratings can be developed for other receptors such as cultural heritage.

TABLE 9-4: SENSITIVITY CATEGORISATION AND DESCRIPTION

Sensitivity Rating	Definition
Social Receptors	Individuals, communities or groups of stakeholders
Very Low	Receptors who are not vulnerable or susceptible to project-related changes and have substantive resources and support to understand and anticipate Project impacts. Such receptors have the ability to avoid negative Project impacts, or to cope with, resist or recover from the consequences of a such an impact with negligible changes to their lives, or will derive little benefit or opportunities from the project.
Low	Receptors who have few vulnerabilities and are marginally susceptible to project-related changes but still have substantive resources and support to understand and anticipate a Project impact. Such receptors are able to easily adapt to changes brought about by the project with marginal impacts on their living conditions, livelihoods, health and safety, and community well-being, or will derive marginal benefits or opportunities from the project.
Medium	Receptors have some vulnerabilities and are more susceptible to project-related changes given they only have moderate access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not fully resilient to Project impacts but are generally able to adapt to such changes albeit with some diminished quality of life. For positive impacts, these receptors are likely to derive a moderate level of benefit or opportunities from the project.
High	Receptors are vulnerable and susceptible to project-related changes, and have minimal access to resources, support, or capacity to understand and anticipate a Project impact. Such receptors are not resilient to Project impacts and will not be able to adapt to such changes without substantive adverse consequences on their quality of life. For positive impacts, these receptors are likely to derive a substantial level of benefits or opportunities from the project.

Sensitivity Rating	Definition
Very High	Receptors are highly vulnerable and have very low resilience to project-related changes. By fact of their unique social setting or context, such receptors have a diminished or lack of capacity to understand, anticipate, cope with, resist or recover from the consequences of a potential impact without substantive external support. For positive impacts, receptors are likely to derive substantial benefits or opportunities from the project which could lead to significant and sustained improvement in their quality of life.
Ecological Receptor	Species, habitats or ecosystems including processes necessary to maintain ecosystem functions
Very Low	Species or habitats with negligible importance for biodiversity including habitats that are largely transformed or highly modified.
Low	Species or habitats listed as Least Concern (LC) on the International Union for Conservation of Nature (IUCN) Red List or on regional or national Red Lists and/or habitats or species which are common and widespread, of low conservation interest, or habitats which are degraded and qualify as 'modified habitat' under international definitions (e.g., IFC or World Bank standards).
Medium	Species, habitats or ecosystems listed as globally Vulnerable (VU) or Near Threatened (NT) on IUCN Red List; or listed as VU or NT on national or regional Red Lists, or which meet the IUCN criteria based on expert-driven biodiversity planning processes. It includes habitats that meet definitions of 'natural habitat'; or ecosystems with important functional value in maintaining the biotic integrity of these habitats or VU or NT species.
High	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN, or listed as EN/CR on national or regional Red Lists; or which meet IUCN criteria for range-restricted species[34] or which meet the definition of migratory and congregatory species[35], but which do <u>not</u> qualify as Critical Habitat based on IUCN Key Biodiversity Area thresholds[36]. It includes habitats or ecosystems which are important for meeting national conservation targets based on expert-driven national or regional systematic conservation planning processes, but which do not meet global IUCN thresholds. It can also include protected areas such as national parks, marine protected areas or ecological support areas designated for biodiversity protection containing species that are nationally or globally listed as EN or CR, or other designated areas important for the persistence of EN/CR species or habitats.
Very High	Species, habitats or ecosystems listed as globally Endangered (EN) or Critically Endangered (CR) by IUCN, or listed as EN/CR on expert-verified national or regional Red Lists; or which meet IUCN criteria for range-restricted or migratory /congregatory species and which meet IUCN thresholds for Key Biodiversity Areas. It includes habitats or ecosystems which are of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Habitats of high sensitivity may typically include legally protected areas that meet IUCN categories 1, 1a and 1b[37], or KBAs or Important Bird Areas (IBAs) with biodiversity features that meet the IUCN KBA criteria and thresholds.

[34] Restricted range species are those with limited Extent Of Occurrence (EOO) (GN74):

- For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50 000 square kilometres (km^2).
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100 000 km^2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart)

[35] Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem) (GN76). Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis.

[36] UCN, A Global Standard for the Identification of Key Biodiversity Areas, 2016.

[37] IUCN, "Protected Areas Category", https://www.iucn.org/theme/protected-areas/about/protected-area-categories

Sensitivity Rating	Definition
Physical Abiotic Receptors	**Water quality, sediment quality, air quality, noise levels**
Very Low	Receptors are highly resilient to project-induced change and changes remain undetectable and within any applicable thresholds.
Low	Receptors are resilient to project-induced change and changes, while detectable, are within the range of natural variation and remain within any applicable thresholds.
Medium	Receptors are moderately resilient to project-induced changes, but these changes are easily detectable, exceed the limit of the normal range of variation on an intermittent basis and / or periodically exceed applicable thresholds.
High	Receptors are vulnerable to project-induced change and changes are readily detectable, well outside the range of natural variation or occurrence, and regularly exceed any applicable thresholds.
Very High	Receptors are highly vulnerable to project-induced change and changes are easily detectable, fall well outside the range of natural variation or occurrence, and will continually exceed any applicable thresholds.

9.3.4. Determination of Magnitude (or Consequence)

9.3.4.1. Definitions of Criteria Used to Derive Magnitude (or Consequence)

The term ‘magnitude’ (or 'consequence') describes and encompasses all the dimensions of the predicted impact including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- degree of reversibility; and
- its geographical extent and distribution.

Taking the above into account, Magnitude (or Consequence) is derived from a combination of ‘Intensity’, ‘Duration’ and ’Extent’.

The criteria for deriving Intensity, Extent and Duration are summarised Table 9-5 below.

TABLE 9-5: CATEGORISATION AND DESCRIPTION FOR INTENSITY, EXTENT AND DURATION

Criteria	Rating	Description
Criteria for ranking of the INTENSITY of environmental impacts taking into account reversibility and scale	**VERY LOW**	Negligible change, disturbance or nuisance which is barely noticeable or may have minimal effect on receptors or affect a tiny proportion of the receptors.
	LOW	Minor (Slight) change, disturbance or nuisance which is easily tolerated and/or reversible in the short term without intervention, or which may affect a small proportion of receptors.
	MEDIUM	Moderate change, disturbance or discomfort caused to receptors or which is reversible over the medium term, and/or which may affect a moderate proportion of receptors.

Criteria	Rating	Description
	HIGH	Prominent change, or large degree of modification, disturbance or degradation caused to receptors or which may affect a large proportion of receptors, possibly entire species or community and which is not easily reversed.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	**SITE**	Impact is limited to the immediate footprint of the activity and immediate surrounds within a confined area.
	LOCAL	Impact is confined to within the project concession / licence area and its nearby surroundings.
	REGIONAL	Impact is confined to the region, e.g., coast, basin, catchment, municipal region, district, etc.
	NATIONAL	Impact may extend beyond district or regional boundaries with national implications.
	INTERNATIONAL	Impact extends beyond the national scale or may be transboundary.
Criteria for ranking the DURATION of impacts	**SHORT TERM**	The duration of the impact will be < 1 year or may be intermittent.
	MEDIUM TERM	The duration of the impact will be 1-5 years.
	LONG TERM	The duration of the impact will be 5-25 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	The impact will endure for the reasonably foreseeable future (>25 years) and where recovery is not possible either by natural processes or by human intervention.

9.3.4.2. Determining Magnitude (or Consequence) Ratings

Once the intensity, extent and duration are defined based on the definitions set out in Section 9.3.4.1, the magnitude (or Consequence) of negative and positive impacts is derived based on Table 9-6 below. It should be noted that there may be times when these definitions may need to be adjusted to suit the specific impact where justification should be provided. For instance, the permanent loss of the only known occurrence of a species in a localised area of impact can only achieve a "High" magnitude rating but could, in this instance, warrant a Very High rating. The justification for amending the rating should be indicated in the impact table.

TABLE 9-6: MAGNITUDE DETERMINATION

Magnitude (or Consequence) Rating	Description *
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium or long term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***;

Magnitude (or Consequence) Rating	Description *
	OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low or medium intensity*** at a ***local level*** and endure in the ***short term.*** OR **Zero to very low *intensity*** with any combination of extent and duration.

* Note: For any impact that is considered to be "Permanent" or "International" apply the "Long-Term" and "National" ratings, respectively. For impacts at the "Site" or "Local" level apply the "Local" level rating.

9.3.5. Determination of Impact Significance

9.3.5.1. Matrix to Derive Impact Significance

The significance of an impact is based on expert judgement of the sensitivity (importance or vulnerability) of a receptor and the magnitude (or consequence) of the effect that will be caused by a project-induced change.

In summary, the impact assessment method is based on the following approach:

Significance = Magnitude (or Consequence) x Sensitivity

Where Magnitude (or Consequence) = Intensity +Extent + Duration

Once ratings are applied to each of these parameters the matrix presented in Table 9-7 is used to derive Significance:

TABLE 9-7: MATRIX FOR DETERMINING SIGNIFICANCE

		SENSITIVITY				
		VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH
MAGNITUDE (OR CONSEQUENCE)	VERY LOW	NEGLIGIBLE	NEGLIGIBLE	VERY LOW	LOW	LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW	MEDIUM
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM	HIGH
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH	VERY HIGH
	VERY HIGH	HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

9.3.5.2. Definitions of Significance Ratings

Broad definitions of impact significance ratings are provided in Table 9-8 below. Impacts of 'High' and 'Very High' significance require careful evaluation during decision-making and need to be weighed up against potential long-term socioeconomic benefits of the project to inform project authorisation. Where there are residual biodiversity impacts of 'High' and 'Very High' significance this will require careful examination of offset feasibility and confirmation that an offset is possible prior to decision-making.

TABLE 9-8: DEFINITIONS OF SIGNIFICANCE RATINGS

Significance Rating	Interpretation
Very High	**Impacts** where an accepted limit or standard is far exceeded, changes are well outside the range of normal variation, or where long-term to permanent impacts of large magnitude (or consequence) occur to highly sensitive resources or receptors. For **adverse residual impacts** of very high significance, there is no possible further feasible mitigation that could reduce the impact to an acceptable level or offset the impact, and natural recovery or restoration is unlikely. The impact may represent a possible fatal flaw and decision-making will need to evaluate the trade-offs with potential social or economic benefits. **Positive** social impacts of very high significance would be those where substantial economic or social benefits are obtained from the project for significant duration (many years).
High	**Impacts** where an accepted limit or standard is exceeded; impacts are outside the range of normal variation or adverse changes to a receptor are long-term. Natural recovery is unlikely or may only occur in the long-term and assisted and ongoing rehabilitation is likely to is required to reduce the impact to an acceptable level. High significance **residual impacts** warrant close scrutiny in decision-making and strict conditions and monitoring to ensure compliance with mitigation or other compensation requirements. **Positive** social impacts of high significance would be those where considerable economic or social benefits are obtained from the project for an extended duration in the order of several years.
Medium	Moderate **adverse changes** to a receptor where changes may exceed the range of natural variation or where accepted limits or standards are exceeded at times. Potential for natural recovery in the medium-term is good, although a low level of residual impact may remain. Medium impacts will require mitigation to be undertaken and demonstration that the impact has been reduced to as low as reasonably practicable (even if the **residual impact** is not reduced to Low significance). **Positive** social impacts of medium significance would be those where a moderate level of benefit is obtained by several people or a community, or the local, regional or national economy for a sustained period, generally more than a year.

Significance Rating	Interpretation
Low	**Minor effects** will be experienced, but the impact magnitude (or consequence) is sufficiently small (with and without mitigation) and well within the range of normal variation or accepted standards, or where effects are short-lived. Natural recovery is expected in the short-term, although a low level of localised residual impact may remain. In general, impacts of low significance can be controlled by normal good practice but may require monitoring to ensure operational controls or mitigation is effective. **Positive** social impacts of low significance would be those where a few people or a small proportion of a community in a localised area may benefit for a few months.
Very Low	Very minor effects on resources or receptors are possible but the predicted effect represents a minimal change to the distribution, presence, function or health of the affected receptor, and **no mitigation is required**.
Negligible	Predicted impacts on resources or receptors of very low or low sensitivity are imperceptible or indistinguishable from natural background variations, and **no mitigation is required**.

9.3.6. Additional Assessment Criteria

Additional criteria that are taken into consideration in the impact assessment process and specified separately to further describe the impact and support the interpretation of significance, include the following:

- **Probability (Likelihood) of the impact occurring** (which is taken into account mainly for unplanned events);
- **Degree of Confidence in the impact prediction;**
- **Degree to which the impact can be mitigated;**
- **Degree of Resource Loss** (i.e. the extent to which the affected resource/s will be lost, taking into account irreplaceability); and
- **Reversibility** – the degree to which the impact can be reversed.
- **Cumulative Potential –** potential for cumulative impacts with other planned projects or activities.

Definitions for these supporting criteria are indicated in Table 9-9 below.

TABLE 9-9: CATEGORISATION AND DESCRIPTION OF ADDITIONAL ASSESSMENT CRITERIA

Criteria	Rating	Description
Criteria for determining the PROBABILITY of impacts	**UNLIKELY**	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 5% chance of occurring.
	POSSIBLE	Where the impact could occur but is not reasonably expected to occur i.e. 5-35% chance of occurring.
	LIKELY	Where there is a reasonable probability that the impact would occur, i.e. > >35 to ≤75% chance of occurring.
	HIGHLY LIKELY	Where there is high probability that the impact would occur i.e. >75 to <99% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. 100% chance of occurring.
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	**LOW**	Low confidence in impact prediction (≤ 35%)
	MEDIUM	Moderate confidence in impact prediction (between 35% and ≤ 70%)
	HIGH	High confidence in impact prediction (> 70%).
	CERTAIN	Absolute certainty in the impact prediction (100%)

Criteria	Rating	Description
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the residual impact.
	VERY LOW	Some mitigation is possible but will have marginal effect in reducing the residual impact or its significance rating.
	LOW	Some mitigation is possible and may reduce the residual impact, possibly reducing the impact significance.
	MEDIUM	Mitigation is feasible and will reduce the residual impact and may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the residual impact and impact significance rating.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE 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 REVERSIBILITY - the degree to which an impact can be reversed	**IRREVERSIBLE**	Where the impact cannot be reversed and is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS – the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects	**UNLIKELY**	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.

9.3.7. 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 project. These are commonly referred to as mitigation measures and are incorporated into the proposed project as part of the ESMP. Mitigation is aimed at preventing, minimising or managing significant negative impacts to as low as reasonably practicable (ALARP) and optimising and maximising any potential benefits of the proposed project. 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 9-10. 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.

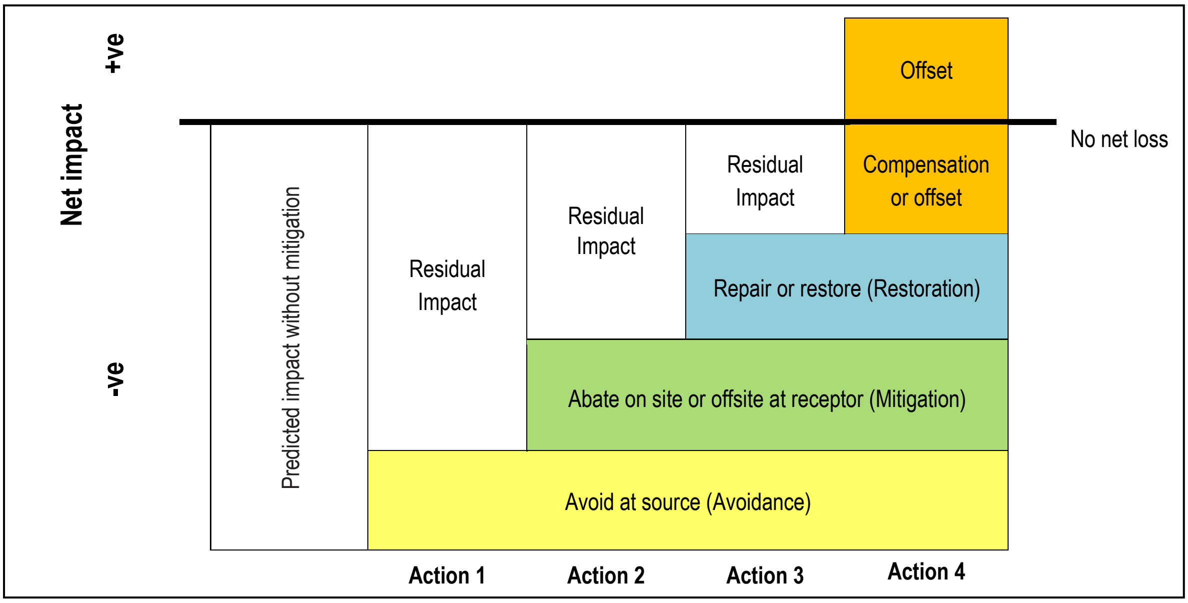


FIGURE 9-1: MITIGATION HIERARCHY

Adapted from: www.thebiodiversityconsultancy.com

TABLE 9-10: 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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