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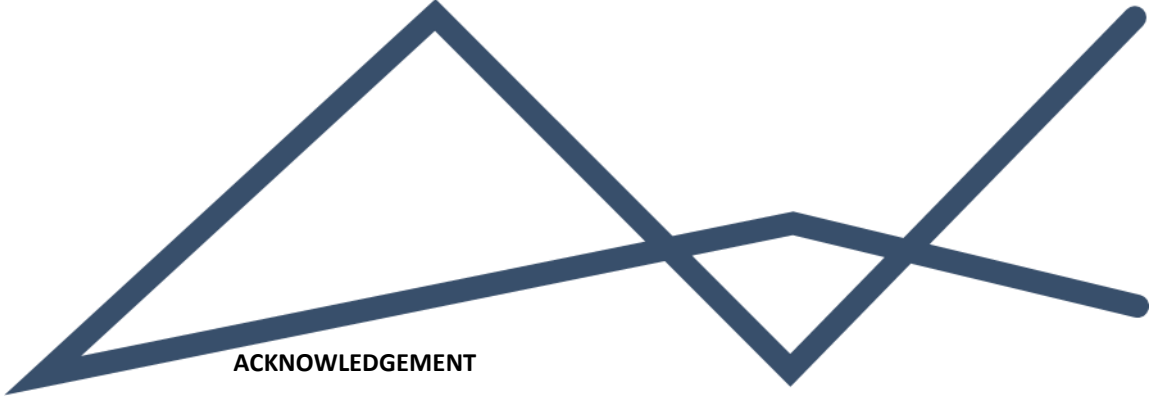
ENVIRONMENTAL MANAGEMENT PROGRAMME

PETROSA EXPLORATION LICENCE BLOCK 3A/4A



ACKNOWLEDGEMENT

The format and style of this EMP document was developed by Lwandle Technologies (Pty) Ltd who compiled the structure for the Operational EMP of each of PetroSA's offshore facilities. At the specific request of PetroSA, this format has been replicated for the Environmental Management Programme for Exploration and Geophysical Surveys in Block 3A/4A off the West Coast of South Africa.

TEAM: SUMMARY OF QUALIFICATIONS AND EXPERIENCE

EMPr AMENDMENT 2025: - **MONICA NIEHOF - EIMS**

Monica Niehof is an Environmental Assessment Practitioner (EAP) and environmental auditor. She is registered as an Environmental Assessment Practitioner (EAP), and she holds a Bachelor of Science Honours degree in Environmental Management from the University of South Africa. She has 13 years experience in the environmental field, during which compiling Construction and Operational Environmental Management Programmes (EMPrs) has been one of her main responsibilities. She has extensive experience in Environmental Impact Assessments, including for Environmental Authorisation (EA), Water Use License (WUL), Air Emission License (AEL) and Waste Management License (WML) applications, as well as auditing of EAs, AELs and other authorisations and licenses. Experience was gained in sectors including residential, retail, manufacturing, mining, energy, fuel infrastructure etc. Either being part of the EAP or auditing team, or as auditor and as Senior EAP. Clients included Municipalities, Private Companies, individuals, State Owned Entities etc.

ORIGINAL 2014 EMPr

TAMRYN HEYDENRYCH - JEFFARES AND GREEN

Tamryn Heydenrych completed a BSc undergraduate degree at the University of Cape Town (UCT) in 2005, majoring in Environmental and Geographical Science and Atmospheric Science and Oceanography and completed a BSc (Hons) in Physical Geography from UCT the following year. In 2007 she joined CCA Environmental (Pty) Ltd where she worked as an environmental consultant for five years, undertaking Basic Assessments, Scoping and Environmental Impact Assessments, Waste Management Licenses and compiling Construction and Operation Environmental Management Programmes. Tamryn also gained experience working as an Environmental Control Officer, conducting and producing site audits, on a number of projects in the Western Cape. In 2012 she joined Jeffares and Green (Pty) Ltd as a Senior Environmental Consultant. Tamryn has experience in a wide range of projects, including road rehabilitation projects, infrastructure-related projects (e.g. pipelines), housing / mixed-use developments, offshore oil and gas projects, wastewater treatment works and landfill site projects.

ANEL DANNHAUSER - JEFFARES AND GREEN

Anèl Dannhauser completed her BSc (Hons) at the University of Pretoria in Environmental Management and Analysis with a specific focus on soil and rehabilitation. Her interests lies within waste and water management, mining developments and rehabilitation projects.

Since 2008 she has been involved in a variety of projects including the establishment of commercial and industrial projects, infrastructure development with a specific focus on waste water treatment sites and road upgrades, mining developments (both greenfields and brownfields, coal, diamond, limestone, dolomite, quartzite and zinc operations) and renewable energy projects throughout most of South Africa. Her experience involves the compilation, revision, coordination and management of Basic Assessment Reports, Scoping Reports, Environmental Impact Assessments, Environmental Management Programmes, Integrated Water Use License Applications, Integrated Water and Waste Management Plans, Maintenance Management Plans and audit reports, inclusive of the public participation process. Anèl joined Jeffares & Green in 2014 as an Environmental Scientist.

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CHECKED:	Liam Whitlow		2025/05/15
AUTHORIZED:	Liam Whitlow		2025/05/15

REVISION AND AMENDMENTS

REVISION DATE:	REV #	DESCRIPTION
2014/09/16	ORIGINAL DOCUMENT	EMPr
2025/05/15	REVISION	EMPr Amendment- based on 2025 Environmental Audit – *Amendments in blue text*

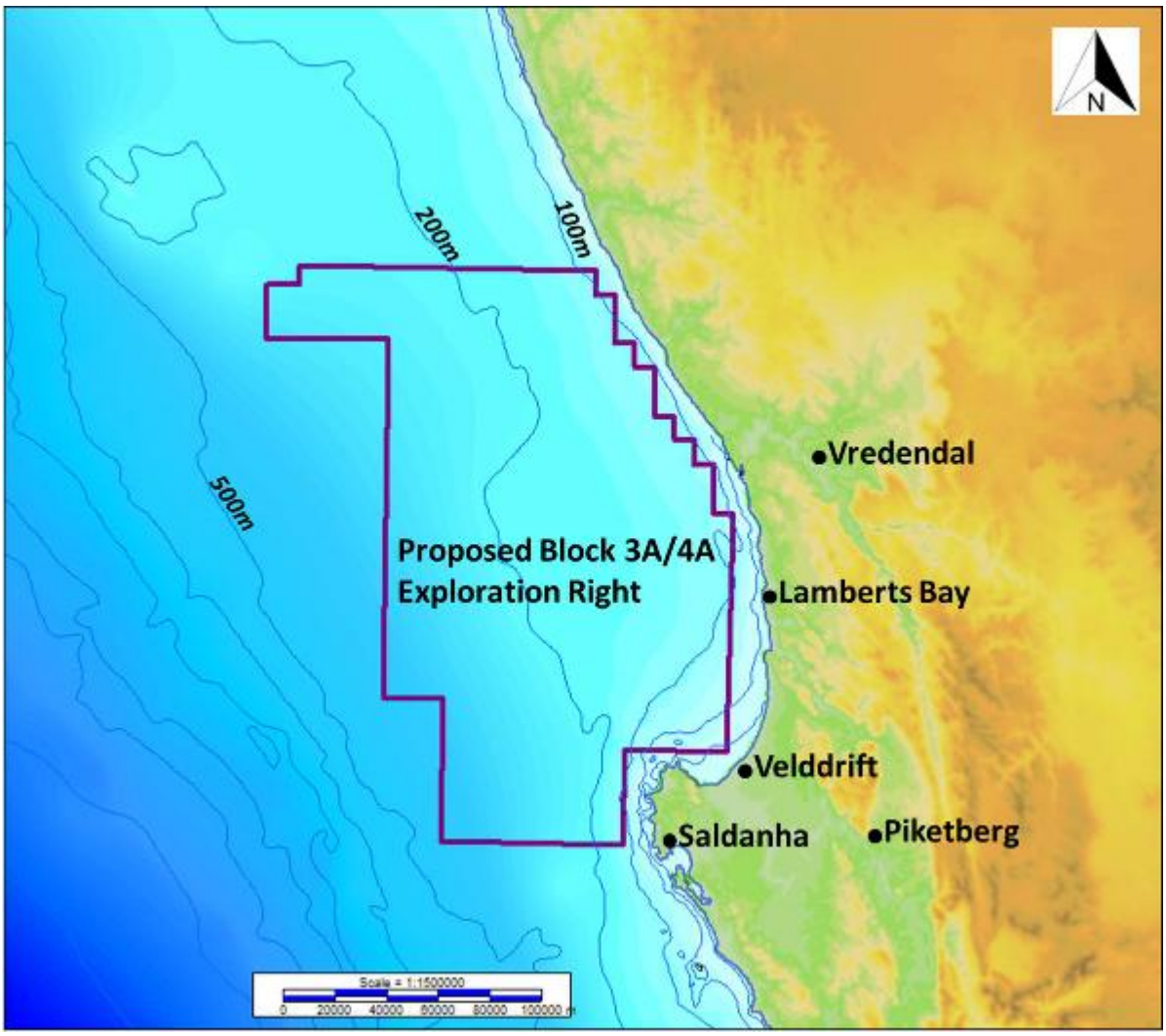
[1] The content of this EMPr was copied from the 2014 EMPr compiled by Jeffares and Green for Block 3A/4A. EIMS was appointed in 2025 to revise and amend this EMPr based on recommendations from an Independent Audit undertaken in 2025.

EXECUTIVE SUMMARY

INTRODUCTION

The Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd (PetroSA), with partner Sasol Petroleum International applied to the Petroleum Agency South Africa (PASA) for an Exploration Right to undertake exploration and geophysical surveys in Block 3A/4A off the West Coast of South Africa (see Figure below). Acting as South Africa's national oil company, PetroSA undertakes exploration and production of oil and natural gas, sells petrochemical products to South Africa´s major oil companies and exports petrochemical products to the international markets.

Block 3A/4A is a 25 332 km² license block located off the West Coast of South Africa in water depths ranging from 20 m to about 480 m.



Position of Block 3A/4A off the West Coast of South Africa

PetroSA submitted an Application for an Exploration Right to PASA, which was subsequently accepted on 5 June 2014. PetroSA was then required to submit an EMP[2] to PASA by 3 October 2014, which was approved in 2015.

The Initial Period of the Exploration Right and associated activities according to the approved work programme started on 5 February 2021 and lapsed on 4 February 2024. PetroSA submitted an application for renewal of this right on 1 February 2024 and is awaiting a decision. PetroSA is required to implement the exploration activities (as approved in the work programme) in accordance with the requirements of the approved Environmental Management Programme (EMPr) (Jeffares and Green, 2014). A Regulation 34 National Environmental Management Act (Act 107 of 1998-NEMA), Environmental Impact Assessment Regulations (GNR982)(EIA Regulations) compliance audit was conducted in April 2025. The findings of the audit included recommendations to amend the EMPr.

Environmental Impact Management Services (Pty) Ltd, was appointed by PetroSA to amend the Environmental Management Programme (EMPr) (i.e. Jeffares and Green, 2014), for submission to and approval by PASA. This EMPr reflects these amendments. All amendments are reflected in blue text for ease of reference.

PROCESS UNDERTAKEN

PUBLIC PARTICIPATION PROCESS

The following public participation has been undertaken to date:

- An Interested and Affected Party (I&AP) database was opened and will remain open for the duration of the project;
- Compilation of a Background Information Document (BID), which included an overview of the legislative requirements, summary of the project description and details regarding an opportunity for I&APs to comment on the project;
- The BID was released for a 21-day public review and comment period from 8 July 2014 to 29 July 2014 and a notification letter was sent to all I&APs on the project database;
- Two advertisements were placed in the following papers:
- Cape Times – 8 July 2014; and
- Weslander – 10 July 2014
- A total of four comments were received on the BID and advertisements. A Comments and Responses Report (CRR) 1 was compiled to respond to these comments;
- The EMP was made available for a 30 day comment period between 22 August 2014 and 22 September 2014. A copy of the EMP was made available at the following locations for review:
    - Saldanha Bay Public Library (30 Berg Street, Saldanha Bay); and
    - J&G website (www.jgi.co.za/public-participation).
- A Public Meeting was held on 9 September 2014 at the Saldanha Bay Protea Hotel. The meeting included a presentation on the proposed project and provided an opportunity for I&APs to ask questions about the proposed project. Meeting minutes were compiled.

[2] For the purposes of this document, the abbreviations 'EMP' and 'EMPr' shall be deemed to have the same meaning and may be used interchangeably.

- A total of 1 (one) comment was received on the EMP. A CRR 2 was compiled to respond to and address the comment raised.

Twelve (12) copies of the EMP has been provided to PASA for distribution to the relevant Authorities for comment.

SPECIALIST INPUT

Two specialist studies were undertaken between July and August 2014 in order to assess all the potential impacts and to guide the completion of the EMP. These two studies included the assessment on the impact on marine fauna (Dr Andrea Pulfrich – Pisces Environmental Services (Pty) Ltd) and the impact on the fishing industry (Mr Dave Japp/Ms Sarah Wilkenson – CapFish cc).

The specialists gathered relevant information, including information from similar studies, in order to inform the assessment of identified environmental impacts that may occur as a result of the proposed project in Block 3A/4A. Each specialist study provided an assessment for identified impacts and provided a number of recommendations and mitigation measures.

EMP REPORT COMPILATION

The EMP has originally been compiled in terms of Section 39 and Regulation 51 of the MPRDA. Information within the EMP has been gathered from the two specialist studies and other projects of a similar nature undertaken off the West Coast of South Africa, as the information presented as part of the project description and certain potential impacts are largely generic in nature. The specialist studies informed the overall assessment of the project and provided input into mitigation measures and recommendations that should be implemented in order to reduce any negative impacts that may occur during the project.

The EMPr is now updated to bring it in line with the NEMA and EIA Regulations, 2014.

EXPLORATION PROGRAMME

Initial Period Exploration Activities

The approved exploration work programme and EMPr for the initial period included the following exploration activities:

- Aerial gravity and magnetic surveys;
- Seismic surveys;
- High resolution bathymetry surveys;
- Seabed sampling; and
- Heatflow measurements.

These activities are described in Sections 1.5.1 to 1.5.10 of this report. None of the above activities have been conducted in the Initial Exploration Period.

A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from Airborne Gravity and Magnetic Survey to licencing of 2D seismic data. This was completed.

First Renewal Period Exploration Activities

Block 3A/4A is currently 25 332 km² in extent, but if PASA approves the renewal, the area will be 20 236.5 km². A renewal application was submitted on 1 February 2024 to conduct the following activities:

- Multibeam Bathymetry Survey;

- Seafloor Geochemical Survey and Sampling; and
- 3D Seismic Acquisition (contingent).

DESCRIPTION OF THE AFFECTED ENVIRONMENT

PHYSICAL ENVIRONMENT

Block 3A/4A lies along the continental shelf off the West Coast of South Africa which is largely wide and deep with a general North-North Western trend, widening north of Cape Columbine and reaching its widest point (180 km) off the Orange River.

As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. While sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water, this general pattern has been modified considerably by biological deposition and localised river input.

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. 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.

Block 3A/4A lies within the southern section of the Benguela Current with both north and south flowing currents due to the bay formation. The major feature of the cold Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks.

Much of the West Coast coastline of southern Africa is impacted by heavy south-westerly swells generated in the roaring forties, 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 South and South-South West direction. In common with the rest of the southern African coast, tides are semi-diurnal.

South Atlantic Central Water comprises the bulk of the seawater in the study area. During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production.

BIOLOGICAL OCEANOGRAPHY

Block 3A/4A is located in the cold temperate Namaqua Bioregion where the coastal wind-induced upwelling characterising the Western Cape coastline is the principal physical process which shapes the marine ecology of the southern Benguela region. While the Benguela system is characterised by the presence of cold surface water, high biological productivity and highly variable physical, chemical and biological conditions, there is a low marine species richness and low endemicity along the West Coast.

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).

The benthic biota of soft bottom substrates constitutes invertebrates that live on, or burrow within, the sediments, and are generally divided into megafauna (>10 cm), macrofauna (animals >1 mm) and meiofauna (<1 mm).

Other marine faunal species that could be located in Block 3A/4A are deep-water corals, various fish species, groups of fish species include demersal (those species that live and feed on or near the seabed) and pelagic communities (species that live and feed in the water column), Cephalopods, turtles, seabirds and marine mammals, such as seals, dolphins and a number of different whale species, with the most abundant whales in the area being the Humpback and Southern Right whales.

A number of potentially Vulnerable Marine Ecosystems have been identified off the West Coast of South Africa and some of these areas are located within Block 3A/4A and could be affected. The biodiversity data from these studies was used to identify nine focus areas off the West Coast. Of these nine focus areas, the Exploration Area overlaps with the southern portion of Child's Bank, offshore portions of the Rietpoort and north-western portion of the West Coast Consolidated focus areas.

The Exploration Area lies offshore of Marine Protected Areas along the West Coast.

HUMAN UTILISATION

The seven fisheries active in Block 3A/4A are the Small pelagic purse-seine, Demersal trawl, Demersal long- line, Pelagic long-line, Tuna pole, traditional line fish and the West Coast rock lobster sectors. The hake- directed trawl fishery is the most valuable sector of the South African fishing industry.

The major shipping lanes off the coast of South Africa are situated on the outer edge of the continental shelf, between 12 and 24 nautical miles offshore. Inshore shipping is largely confined to fishing vessels.

Exploration for oil and gas is currently undertaken off the entire coast of South Africa (i.e. East, South and West Coasts). Diamond prospecting and mining concessions are located within Block 3A/4A. Other minerals present off the West Coast include Glauconite pellets, peletal phosphorous, agricultural phosphate and potassium.

Archaeological sites are known to occur within the 24 nautical mile (nm) zone off the coast of South Africa, however, no known sites are located within Block 3A/4A.

CONCLUSION OF IMPACT ASSESSMENT

The main potential impacts of the proposed exploration activities relate to impacts on the marine environment and disruption to fishing activities. However, all potential activities would be in the short term and would be confined to the actual survey area. Potential impacts associated with normal vessel operations range from **INSIGNIFICANT TO VERY LOW** significance, with and without mitigation. Potential impacts on the marine environment range from insignificant to medium significance, without mitigation and **INSIGNIFICANT TO LOW** significance, with mitigation, while potential impacts on the other users of the sea range from **INSIGNIFICANT TO LOW** significance, both with and without mitigation. Although all potential impacts would be of a short-lived nature and thus temporary, resulting in a fairly low significance level, there are some potential impacts that may in fact be more significant. An impact assessment summary of the potential impacts of normal vessel operations, marine fauna and on other users of the sea is presented in the table below.

Table: Summary of significance ratings of potential impacts associated with 2D and 3D Seismic Surveys, High Resolution Bathymetry Survey, Seabed Sampling and Heatflow Measurements and Airborne Gravity and Magnetic Survey

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Impact of normal vessel operations		
Emissions		
Emission to the Atmosphere	**Very Low**	**Very Low**
Discharges / Disposal to the Sea		
Deck Drainage	**Very Low**	**Very Low**
Machinery Space Drainage	**Very Low**	**Very Low**
Sewage	**Very Low - Low**	**Very Low**
Galley Waste	**Very Low**	**Very Low**
Solid Waste	**Insignificant**	**Insignificant**
Noise		
Noise from Vessel Operations	**Very Low**	**Very Low**

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Impact on Marine Fauna		
SEISMIC SURVEYS		
Plankton and Ichthyoplankton		
Physiological injury and mortality	**Insignificant**	**Insignificant**
Marine Invertebrates		
Benthic Invertebrates: Mortality and/or physiological injury	**Insignificant**	**Insignificant**
Neritic Invertebrates: Mortality and/or physiological injury	**Very Low**	**Very Low**
Behavioural avoidance	**Very Low**	**Very Low**
Fish		
Demersal species: Mortality and/or physiological injury	**Insignificant**	**Insignificant**
Pelagic species: Mortality and/or physiological injury	**Low**	**Very Low**
Avoidance behaviour	**Medium**	**Low**
Masking of sounds	**Very Low**	**Very Low**
Reproductive success / spawning	**Insignificant**	**Insignificant**
Indirect impacts on food sources	**Very Low**	**Very Low**
Plunge-diving Seabirds		
Physiological injury to and avoidance behaviour	**Low**	**Very Low**
Avoidance behaviour in seabirds	**Low**	**Very Low**
Indirect impacts on food sources	**Very Low**	**Very Low**
Stranding and oiling	**Insignificant**	**Insignificant**
Turtles		
Physiological injury, collision and entanglement	**Low**	**Very Low**
Avoidance behaviour	**Low**	**Very Low**
Reproductive success	**Low - Medium**	**Very Low - Low**
Indirect impacts on food sources	**Very Low**	**Very Low**
Masking of sounds	**Insignificant**	**Insignificant**
IMPACT	**SIGNIFICANCE (WITHOUT MITIGATION)**	**SIGNIFICANCE (WITH MITIGATION)**
Whales and dolphins:		
Baleen whales		
Physiological injury	**Medium**	**Low**
Avoidance behaviour	**Medium**	**Low**
Masking of sounds	**Low**	**Very Low**
Indirect impacts on food sources	**Very Low**	**Very Low**
Toothed whales and dolphins		
Physiological injury	**Medium**	**Low**
Avoidance behaviour	**Very Low - Low**	**Very Low**
Masking of sounds	**Medium**	**Low**

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Indirect impacts on food sources	**Very Low**	**Very Low**
AIRBORNE GRAVITY AND MAGNETIC SURVEYS		
Birds		
Disturbance of roosting, nesting and feeding	**Low - Medium**	**Very Low**
Cetaceans		
Disturbance during breeding and mating	**Low - Medium**	**Very Low**
HIGH RESOLUTION BATHYMETRY SURVEY		
Marine Fauna		
Auditory and behavioural disturbance of cetaceans	**Very Low**	**Very low**
SEDIMENT SAMPLING AND HEATFLOW MEASUREMENTS		
Benthic Macro-fauna		
Injury and loss of benthic macrofauna through Drop-core sampling and Heat Flow Measurements	**Insignificant**	**Insignificant**
Impact on Other Users of the Sea		
Fisheries		
Demersal Trawl	**Very Low**	**Very Low**
Demersal Long-Line (Hake-Directed)	**Very Low**	**Very Low**
Large Pelagic Long-Line	**Insignificant**	**Insignificant**
Tuna Pole	**Low**	**Low**
Traditional Line-Fishing	**Insignificant**	**Insignificant**
Small Pelagic Purse-Seine	**Low**	**Low**
West Coast Rock Lobster	**Very Low**	**Very Low**
Fisheries Research		
Demersal fish resources and small pelagic species surveys	**Low**	**Low**
Marine Transport		
Marine Transport Routes	**Low**	**Low**
Other Mining-related Activities		
Marine prospecting, mining, exploration and production activities	**Very Low**	**Very Low**

RECOMMENDATIONS

The following section summarises the mitigation measures and recommendations for each component of the proposed exploration activities in order to reduce potential impacts on the marine and socio-economic (i.e. fishing activities) environments.

Various stipulations regarding compliance with survey timeframes have been made to avoid impacting both the sensitive marine fauna (specifically cetaceans) and the fishing sector (specifically the Tuna Pole and Purse- seine fisheries). These timeframes have been consolidated into the table and figure below for ease of reference. In Table 2.59 the green blocks are considered as feasible for surveying while orange blocks have certain restrictions in terms of the timing and type of surveys that can be undertaken. It should be noted that there is a difference between the marine surveys (seismic and bathymetry surveys as well as heatflow and seafloor sampling) and

the aerial gravity and magnetic surveys. During the months December to May, aerial magnetic and gravity surveys may be undertaken without having a limitation on survey timeframes. However, mitigation measures must be adhered to (e.g. avoid extensive flights parallel to the coast during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November), etc.). See Section 3.7.1.2 for details regarding areas to be taken into consideration during pre-flight path planning.

Table: Summary of timeframe restrictions in the proposed marine survey period of December to May*

MONTHS	CETACEANS	TUNA POLE	PURSE-SEINE	FISHERIES RESEARCH
December to February	Only undertake surveys in the northern section of Block 3A/4A north of the Cape Columbine area (32°30' S)	Avoid all surveys west of St Helena Bay between 32°30´S to 33°S and 16°45'E and 17°45´E	Surveys may take place anywhere in Block 3A/4A	Contact DFFE~~AFF~~ to establish when fisheries research will be conducted in Block 3A/4A – affected periods include the first half of December and the entire January
March	Surveys may take place anywhere in Block 3A/4A	Surveys may take place anywhere in Block 3A/4A	Surveys may take place anywhere in Block 3A/4A	Surveys may take place anywhere in Block 3A/4A
April	Surveys may take place anywhere in Block 3A/4A	Surveys may take place anywhere in Block 3A/4A	Avoid surveys southwards of 31°40'S and inshore of the 100m depth contour between April and July	Surveys may take place anywhere in Block 3A/4A
May	Surveys may take place anywhere in Block 3A/4A	Avoid all surveys west of St Helena Bay between 32°30´S to 33°S and 16°45'E and 17°45´E		Contact DFFE~~AFF~~ to establish when fisheries research will be conducted in Block 3A/4A from mid-May

** Only the months December to May have been included in the table above as these are the months that PetroSA proposes to undertake surveys, based on recommendations from the marine specialist.*

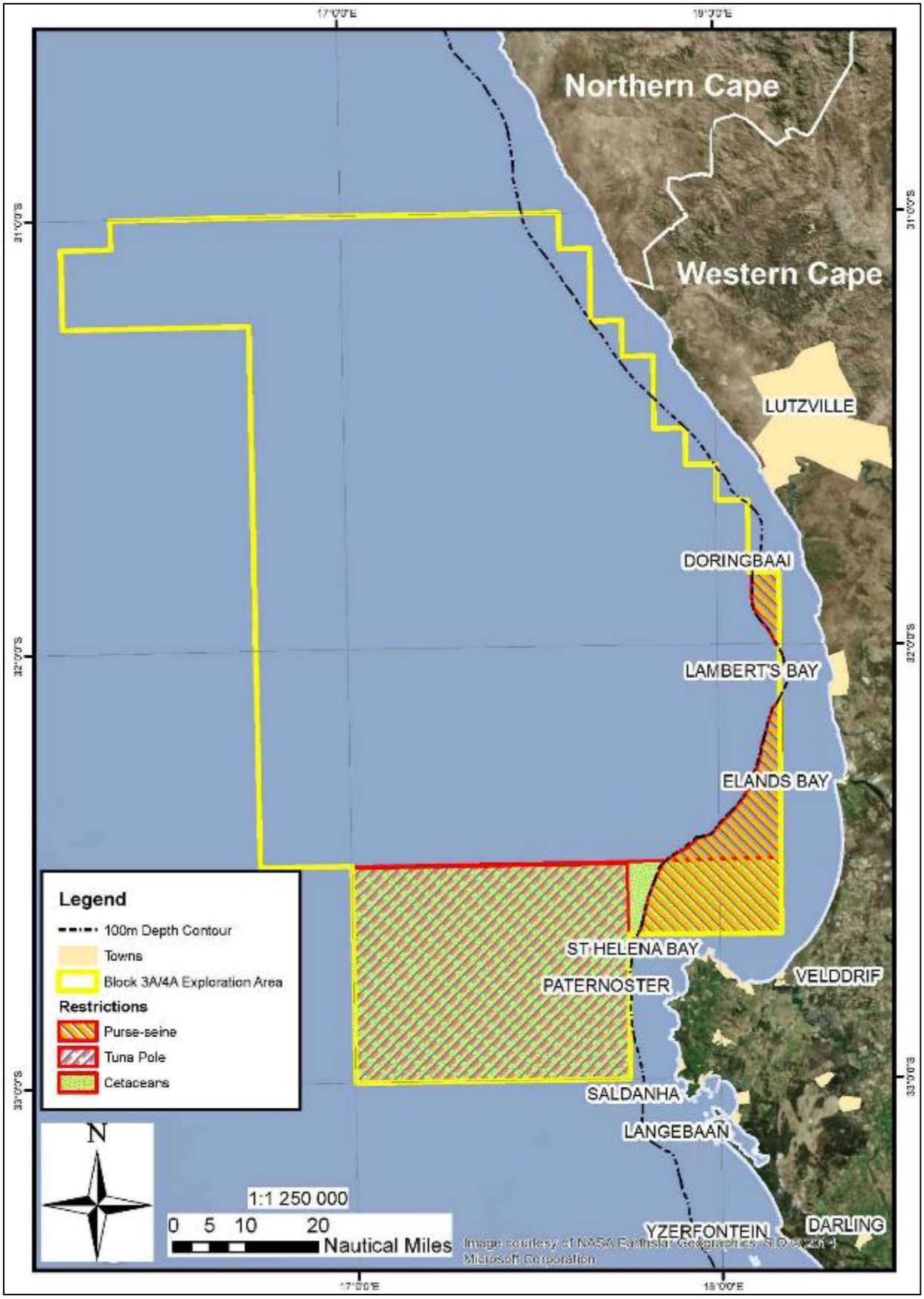


Figure: Summary of geographical restrictions in Block 3A/4A (to be read in conjunction with the table above).

COMPLIANCE WITH EMP AND MARPOL STANDARDS

The Operator is required to comply with all mitigation measures stipulated within the EMP, as well as comply with all relevant MARPOL Standards to ensure that potential impacts associated with all components of the exploration activities are reduced as far as possible and kept within manageable limits.

SURVEY PROCEDURES

SEISMIC SURVEYS

The following mitigation measures must be implemented:

- All survey vessels must be fitted with Passive Acoustic Monitoring (PAM) technology. As a minimum, PAM technology must be used during the pre-watch period and when surveying at night or during adverse weather conditions and thick fog. The hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise and be fitted with two hydrophones to allow directional detection of cetaceans;
- Independent on-board MMOs and PAM operators must be appointed for the duration of the seismic survey. The MMOs and PAM operators must have experience in seabird, turtle and marine mammal identification and observation techniques;
- Implement a "soft-start" procedure of a minimum of 20 minutes duration when initiating seismic surveying. This build-up of power should occur in uniform stages to provide a constant increase in output. When surveying in inshore areas (<50 m depth), a "soft-start" procedure of 30 minutes' duration is recommended;
- All breaks in airgun firing of longer than 20 minutes must be followed by the 30 minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks shorter than 20 minutes should be followed by a visual assessment for marine mammals within the 500 m mitigation zone (not a 30 minute pre-shoot watch) and a "soft-start" of similar duration. Where possible, "soft-starts" should be planned so that they commence within daylight hours;
- In the unlikely event that unusual fish behaviour or mortalities (e.g., mass floating fish) are observed and linked directly to airgun operations, firing should be suspended, and the incident investigated in line with the environmental incident protocol.
- Prior to the commencement of "soft starts" an area of 500-m radius around the survey vessel (exclusion zone) should be scanned (visually and using PAM technology) for the presence of diving seabirds, turtles, seals and cetaceans. There should be a dedicated pre-shoot watch of at least 60 minutes (to account for deep-diving species). "Soft starts" should be delayed until such time as this area is clear of diving seabirds, turtles and seals and in the case of cetaceans should not begin until 30 minutes after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen;
- Marine mammal (e.g. seabird, turtle, cetaceans, etc.) incidence and behaviour should be recorded by an on-board MMO. Any obvious mortality or injuries to marine mammals as a direct result of the survey should result in temporary termination of operations;
- Seismic shooting should be terminated when obvious negative changes to cetacean behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching the firing airgun;
- Any attraction of predatory seabirds (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an on-board MMO;

- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards';
- ~~Seismic~~ Surveys should be planned to avoid cetacean migration periods or winter breeding concentrations (1st June to end 30th November) and ensure that migration paths are not blocked. However, as several of the large whale species are also abundant on the West Coast between September and February (inclusive), the best time of year to conduct seismic operations is late summer and early winter (end February – mid June), across the entire block. However, any surveys planned between December and end February should only be scheduled to operate in the northern section of the block, i.e. avoiding the southern portion of the block off Cape Columbine.
- During night-time line changes low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line;
- The use of the lowest practicable airgun volume should be defined and enforced and airgun use should be prohibited outside of the licence area;
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Tripp seamount. On lines beyond that the low power guns can be stopped during turns, but the normal start-up procedure should nonetheless be maintained;
- All data recorded by MMOs should, as a minimum, form part of a survey close–out report. Furthermore, daily reports should be forwarded to the necessary authorities (e.g. DFFE, fishing bodies, NGO's, etc.,) to advise them of interactions and compliance with the mitigation measures; and
- Marine mammal incidence data and seismic source output data arising from surveys shall be included as an appendix to the Close-out report to be submitted to PASA after completion of the survey and shall be made available on request to relevant government bodies and NGO's, if required (e.g. DAFF, Marine Mammal Institute, etc.).

HIGH RESOLUTION BATHYMETRY SURVEY

The following mitigation measures must be implemented:

- On-board MMOs should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses;
- Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment;
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area;
- Ensure that PAM is incorporated into all surveys; and
- Ensure an MMO is on-board the vessel to ensure compliance with mitigation measures during surveying.

SEABED SAMPLING AND HEATFLOW MEASUREMENTS THE FOLLOWING MITIGATION MEASURES MUST BE IMPLEMENTED:

- The final positioning of the sample sites must avoid existing seafloor infrastructure (including seafloor telecommunication cables) and any cultural heritage material identified during the multi-beam bathymetry survey;
- If any cultural heritage material is found during sampling activities SAHRA should be notified immediately. If any cultural heritage material older than sixty years is to be disturbed a permit would be required from SAHRA; and

- No anchoring is permitted within 1 nautical mile of seafloor telecommunication cables.

AIRBORNE GRAVITY AND MAGNETIC SURVEY

The following mitigation measures must be implemented:

- Pre-plan flight paths (for mobilisation and demobilisation to and from the Exploration Area) to ensure that no flying occurs over coastal reserves, bird colonies, marine reserves or Important Bird Areas;
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided, particularly during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November);
- During mobilisation to and from the Exploration Area, aircraft should maintain a minimum altitude of at least 300 m above sea level;
- An exemption permit shall be applied for from the Department of Forestry, Fisheries and the Environment (DFFE) for the entire survey area for aircraft to be able to approach to within 300 m of whales;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

GENERAL

The following mitigation measures must be implemented:

- Ensure that the survey vessels are certified for seaworthiness via an internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas);
- Ensure that collision prevention equipment is on-board the vessels, such as, radar, multi-frequency radio, foghorns, etc. Additional precautions include:
- The chase boat;
- The existence of an internationally agreed safety zone around the survey vessel;
- Cautionary notices to mariners; and
- Access to current weather service information.
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night;
- Report any emergency situation to SAMSA;
- Communication between all parties active in or planning future offshore activities within Block 3A/4A should be undertaken so that pre-planning can be done to prevent disruption to activities. The Operator would need to ensure that they notify all stakeholders timeously of their survey times;
- Should any disagreement arise, PASA and / or the Department of Mineral and Petroleum Resources should be contacted;
- Ensure that a waste management plan is available for the vessel (required for any ship with a crew of more than 15 people).

- Discharge comminuted galley waste no closer than 3 nm from the coast. All food waste not comminuted to be discharged no closer than 12 nm from the coast. Vessels must be en-route; and
- Ensure that all waste disposal contractors are compliant with the relevant local bylaws and authority requirements in terms of municipal waste disposal.

IMPACT ON OTHER USERS OF THE SEA

FISHERIES

- Inform the sector of the safety protocols to adhere to and details of the survey area prior to commencement.
- Regular updates of the survey design must be communicated to vessels operating in the vicinity of Block 3A/4A;
- Fishing industry bodies and other key affected parties should be informed of the proposed survey activities and requirements with regards to the safe operational limits around the survey vessels prior to the commencement of the project. The following industrial bodies and affected parties include:
    - Department of Forestry, Fisheries and the Environment;
    - South African Tuna Association;
    - South African Tuna Long-Line Association;
    - Fresh Tuna Exporters Association;
    - South African Deep-Sea Trawling Industry Association;
    - South African Commercial Linefish Association;
    - West Coast and Peninsula Commercial Skiboat Association;
    - Shark Longline Association;
    - South African West Coast Rock Lobster Association;
    - Transnet National Ports Authority (ports of Cape Town and Saldanha Bay); and
    - South African Maritime Safety Association.
- Daily Navigational Warnings should be issued for the duration of the survey operations through the South African Naval Hydrographic Office.
- A Fisheries Liaison Officer (FLO) should be present on board the survey vessels to facilitate communications with vessels in the vicinity of the survey vessel – any fishing vessel targets at a radar range of 24 nautical miles from the survey vessel should be called via radio and informed of the navigational safety requirements.
- Affected parties should be notified through fishing industry bodies when survey activities are complete and the vessel is off location.
- Areas of high Tuna Pole fishing activity is due West of St Helena Bay between 32° 30´ S and 33° S and 16° 45 E and 17° 45´ E, which coincides with the southern portion of Block 3A/4A and this area should be monitored for the presence of tuna pole vessels during the survey via the Vessel Monitoring System unit at DFFE and via radar on board the survey vessel.

- It is recommended that any exploration activities proposed to take place in this southern portion are timed to avoid peak Tuna Pole fishing activity (i.e. between November and February and May), as far as possible.
- The surveys should commence in the northern-most extent of the block and then work southwards into the Small Pelagic Purse-Sein fishing grounds (highest fishing activity undertaken southwards of 31° 40´S and inshore of the 100 m depth contour).
- It is also recommended, depending on survey times, to commence with the North / South lines closer inshore and then move further offshore, thereby avoiding the main Small Pelagic Purse- Sein fishing activities from April to July.
- An "adaptive" management approach is recommended in order to minimise impacts by deciding on the best mitigation measures once specific survey dates are known and depending on the specific fishing activity being undertaken at the time.

FISHERIES RESEARCH

- Timing of the proposed surveys should avoid periods when research surveys are being conducted (i.e. mid-May to mid-June and mid-October to mid-December).
- Notify the managers of the research programmes regarding planned survey periods prior to commencements.

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List of Abbreviations

Abbreviation	Item
BID	Background Information Document
DFFE	Department of Forestry, Fisheries and the Environment
DMPR	Department of Mineral and Petroleum Resources
DNV	Det Norske Veritas
EEZ	Exclusive Economic Zone
EMP	Environmental Management Programme
FLO	Fisheries Liaison Officer
HAB	Harmful Algal Blooms
HydroSAN	South African Navy Hydrographic Office (also referred to as SANHO)
I&AP	Interested & Affected Party
IAGC	International Association for Geophysics Contractors
ICMA	Integrated Coastal Management Act (24 of 2008)
J&G	Jeffares & Green
JNCC	Joint National Coordinating Committee
JOC	Joint Operations Centre
MARPOL	International Convention for the Prevention of Pollution from Ships 73/78
MedEvac	Medical Evacuation
MMO	Marine Mammal Observer
MPAs	Marine Protected Areas
MPCCLA	Marine Pollution (Control and Civil Liability) Act (6 of 1981)
MPRDA	Minerals and Petroleum Resources Development Act 28 of 2002
MPRDAA	Minerals and Petroleum Resources Development Amendment Act 49 of 2008
MSDS	Material Safety Data Sheet
NBSA	National Biodiversity Spatial Assessment
NEMA	National Environment Management Act 107 of 1998 (as amended)

Abbreviation	Item
OHSA	Occupational Health and Safety Act 85 of 1993 (as amended)
PAM	Passive Acoustic Monitoring
PASA	Petroleum Agency of South Africa
PetroSA	Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PPE	Personal Protective Equipment
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SHEQ	Safety, Health, Environment and Quality
TAC	Total Allowable Catch
UNFCC	United Nations Framework Convention on Climate Change
UNCLOS	United Nations Law of the Sea Convention
VTS	Vehicle Traffic Services

1 SECTION 1: INTRODUCTION

1.1 PROJECT BACKGROUND

The Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd (PetroSA), with partner Sasol Petroleum International applied to the Petroleum Agency South Africa (PASAs) for an Exploration Right to undertake exploration and geophysical surveys in Block 3A/4A off the West Coast of South Africa (see Figure 1). Acting as South Africa's national oil company, PetroSA undertakes exploration and production of oil and natural gas, sells petrochemical products to South Africa´s major oil companies and exports petrochemical products to the international markets.

Jeffares and Green (Pty) Ltd (J&G) was appointed by PetroSA to compile an Environmental Management Programme (EMP) in terms of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended, for submission to and approval by PASA.

PetroSA submitted an Application for an Exploration Right to PASA, which was subsequently accepted on 5 June 2014. PetroSA was then required to submit an EMP to PASA by 3 October 2014, which was subsequently approved in 2015. It should be noted that the generic term 'Operator' is used throughout the EMP, should PetroSA decide not to undertake the exploration activities. This would enable an easy transfer of the Exploration Right to another entity, which would include this EMP and all the conditions without the need to update or amend this document.

This EMP has been compiled based on previous similar offshore studies and EMP's undertaken for PetroSA, which were provided to J&G for use in the compilation of this EMP. Information was also sourced from PASA's generic EMP.

The Initial Period of the Exploration Right and associated activities according to the approved work programme started on 5 February 2021 and lapsed on 4 February 2024. PetroSA submitted an application for renewal of this right on 1 February 2024. PetroSA is required to implement the exploration activities (as approved in the work programme) in accordance with the requirements of the approved Environmental Management Programme (EMPr) (Jeffares and Green, 2014). A Regulation 34 National Environmental Management Act (Act 107 of 1998-NEMA), Environmental Impact Assessment Regulations (GNR982)(EIA Regulations) compliance audit was conducted in April 2025. The findings of the audit included recommendations to amend the EMPr.

Environmental Impact Management Services (Pty) Ltd, was appointed by PetroSA to amend the Environmental Management Programme (EMPr) (i.e. Jeffares and Green, 2014), for submission to and approval by PASA. This EMPr reflects these amendments. All amendments are reflected in blue text for ease of reference.

1.2 BLOCK 3A/4A EXPLORATION AREA DETAILS

1.2.1 NAME OF EXPLORATION AREA

Block 3A/4A.

1.2.2 CONTACT PERSON

Item	Details
Manager:	Sumesh Naidoo
Postal Address:	Private Bag X5, Parow, 7499 151 Frans Conradie Drive, Parow
Phone:	021 929 3000
Facsimile:	021 929 0423
Cell:	071 551 2441
E-mail:	sumesh.naidoo@petrosa.co.za

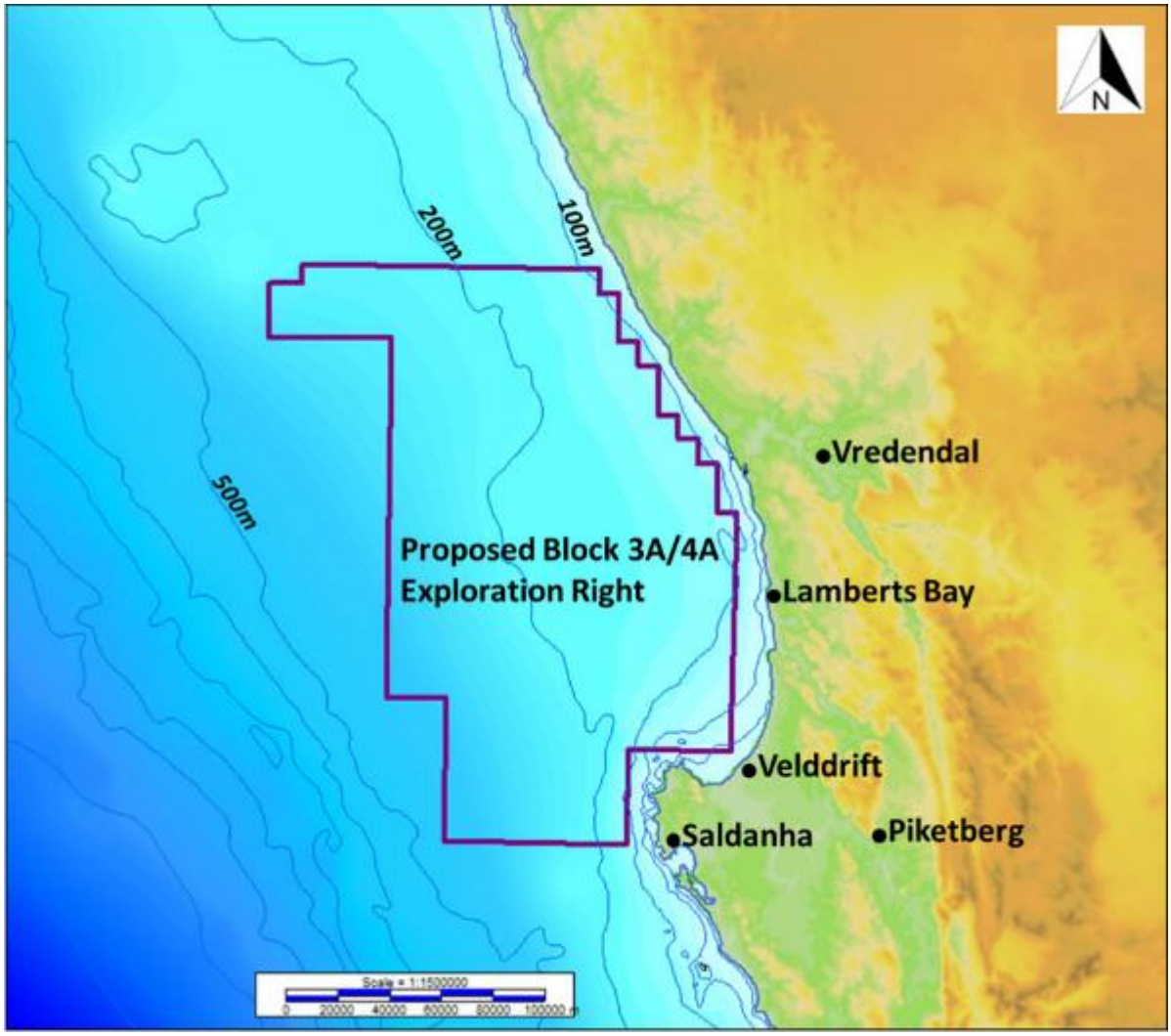

Figure 1: Position of Block 3A/4A off the West Coast of South Africa

1.3 AREA AND LOCATION

This EMP covers proposed exploration and geophysical surveys in Petroleum Licence Block 3A/4A, located off the West Coast of South Africa (see Figure 1).

Block 3A/4A is a 25 332 km² license block located off the West Coast of South Africa in water depths ranging from 20 m to about 480 m. The co-ordinates of Block 3A/4A are indicated in Table 1.

Table 1: Co-ordinates of Block 3A/4A exploration area off the West Coast of South Africa

POINTS	LATITUDE (SOUTH)	LONGITUDE (EAST)
A	31° 00' 1.258" S	16° 22' 56.924" E
B	31° 00' 1.218" S	16° 45' 56.975" E
C	31° 00' 0.000" S	17° 35' 00.000" E
D	31° 05' 0.000" S	17° 35'0 0.000" E
E	31° 05' 0.000" S	17° 40' 00.000" E
F	31° 15' 0.000" S	17° 40'0 0.000" E
G	31° 15' 0.000" S	17° 45' 00.000" E
H	31° 20' 0.000" S	17° 45' 00.000" E
J	31° 20' 0.000" S	17° 50' 00.000" E

POINTS	LATITUDE (SOUTH)	LONGITUDE (EAST)
K	31° 30' 0.000" S	17° 50' 00.000" E
L	31° 30' 0.000" S	17° 55'0 0.000" E
M	31° 35' 0.000" S	17° 55' 00.000" E
N	31° 35' 0.000" S	18° 00' 00.000" E
P	31° 40' 0.000" S	18° 00' 00.000" E
Q	31° 40' 0.000" S	18° 05' 00.000" E
R	31° 50' 0.000" S	18° 05' 00.000" E
S	31° 50' 0.000" S	18° 10' 00.000" E
T	32° 40' 0.000" S	18° 10' 00.000" E
U	32° 40' 0.000" S	17° 45' 00.000" E
V	33° 00' 0.000" S	17° 45' 00.000" E
W	33° 00' 0.866" S	17° 39' 57.288" E
X	33° 00' 0.922" S	16° 59' 57.193" E
Y	32° 30' 0.996" S	16° 59' 57.138" E
Z	32° 30' 1.020" S	16° 44' 57.104" E
A1	31° 15' 1.169" S	16° 44' 57.009" E
B1	31° 15' 1.211" S	16° 14' 56.938" E
C1	31° 04' 1.254" S	16° 14' 56.915" E
D1	31° 04' 1.244" S	16° 22' 56.935" E

1.4 APPLICABLE LEGISLATION

This section provides an overview of environmental legislation, policies and plans, which have relevance to this application for an Exploration Right and the amendment of the EMPr. Please note that this section provides an indication of key pieces of legislation and is not necessarily exhaustive. The full list of legislation should be verified against the Operators legal register, which should be regularly updated.

1.4.1 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (NO. 28 OF 2002), AS AMENDED

This EMP was approved in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) in 2015. The EMP was submitted before the One Environmental System that require exploration activities to be approved in terms of the National Environmental Management Act, 1998 as amended (NEMA) and for which an Environmental Authorisation (EA) would be issued. Therefore, the EMPr has a Record of Decision (RoD) that approves it in terms of the MPRDA. However, since the One Environmental System is applicable now, the EMPr needs to comply with Appendix 4 of the EIA Regulations, 2014.

The EMPr is now updated to align it with Appendix 4 of the EIA Regulations, 2014. This updated EMP will be submitted to the Petroleum Agency South Africa (PASA) for consideration and the Minister of Mineral and Petroleum Resources (DMPR) (or delegated authority).

1.4.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NO. 107 OF 1998), AS AMENDED

The National Environmental Management Act (No. 107 of 1998) (NEMA) is the overarching framework act for environmental management in South Africa. At the time of applying for authorisation for the activities and the approval of the Environmental Management Programme (EMPr) in 2014, the Environmental Impact Assessment (EIA) Regulations (2010), as amended, provides a list of activities in GN R544, R545 and R546, that if triggered require Environmental Authorisation before commencement, was relevant. This project did not trigger any Listed Activities in terms of the NEMA EIA Regulations 2010, and as such did not require Environmental Authorisation in terms of NEMA at the time.

Regulation 54(a)(2) of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended and currently in effect) (GNR982- EIA Regulations), requires all rights and permits issued in terms of the Mineral and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA) and associated Environmental Management Plans and / or Programmes to be subjected to the audit requirements stipulated in Part 3 of Chapter 5 of the Regulations. Part 3, Chapter 5 of the EIA Regulations in turn require that compliance with the conditions of the environmental authorisation, and the EMPr are audited and an environmental audit report submitted to the relevant competent authority.

Environmental Impact Management Services (Pty) Ltd (EIMS) was appointed by PetroSA to undertake an Environmental Audit of the Record of Decision (RoD) approving the Environmental Management Programme (EMPr) in terms of the Mineral and Petroleum Resources Development Act (Act No 28 of 2002) (MPRDA) (PASA Ref:12/3/1/283/2/2/1), as well as of the EMPr, for the Block 3A/4A Exploration Right (PASA Ref:12/3/283), off the West Coast of South Africa.

The scope of the audit was to assess compliance with the requirements of the EMPr and associated RoD for Block 3A/4A exploration activities for the Initial Exploration Period (2021 – 2024) held by PetroSA, and also to confirm the continued adequacy of the EMPr for the First Renewal Period exploration activities (application submitted 1 February 2024, not yet approved). The approved EMPr is the EMPr submitted by Jeffares and Green in 2014, which was approved in January 2015.

The requirements of Regulations 34 of the EIA Regulations, 2014 (as amended and currently in effect) with regards to findings of the adequacy of the EMPr and access to the audit report states:

4) "Where the findings of the environmental audit report contemplated in sub-regulation (1) indicate-

a) insufficient mitigation of environmental impacts associated with the undertaking of the activity; or

b) insufficient levels of compliance with the environmental authorisation or EMPr and, where applicable the closure plan;

the holder must, when submitting the environmental audit report to the competent authority in terms of sub-regulation (1), submit recommendations to amend the EMPr or closure plan in order to rectify the shortcomings identified in the environmental audit report.

5) When submitting recommendations in terms of sub-regulation (4), such recommendations must have been subjected to a public participation process, which process has been agreed to by the competent authority and was appropriate to bring the proposed amendment of the EMPr and, where applicable the closure plan, to the attention of potential and registered interested and affected parties, including organs of state which have jurisdiction in respect of any aspect of the relevant activity and the competent authority, for approval by the competent authority.

6) Within 7 days of the date of submission of an environmental audit report to the competent authority, the holder of an environmental authorisation must notify all potential and registered interested and affected parties of the submission of that report, and make such report immediately available-

a) to anyone on request; and

b) on a publicly accessible website, where the holder has such a website."

This update of the 2014 Jeffares and Green EMPr include the recommendations of the Audit Report dated 2025. In addition, factually incorrect information due to changes in legislation have also been addressed in this updated EMPr.

An EMPr must comply with Section 24N of NEMA and contain all the information listed in Appendix 4 of the EIA Regulations, 2014.

1.4.3 OTHER RELEVANT LEGISLATION TO BE CONSIDERED

Additional national and international legislation and conventions that must be complied with, amongst others, include the following:

- Applicable South African Legislation:
    - Carriage of Goods by Sea Act, 1986 (No. 1 of 1986) (as amended by the Shipping General Amendment Act 23 of 1997 and the International Arbitration Act 15 of 2017);
    - Dumping at Sea Control Act, 1980 (No. 73 of 1980);
    - Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983);
    - Integrated Coastal Management Act, 2008 (No. 24 of 2008);
    - Marine Living Resources Act, 1998 (No. 18 of 1998);
    - Marine Traffic Act, 1981 (No. 2 of 1981);
    - Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981);
    - Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986);
    - Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
    - Maritime Safety Authority Act, 1998 (No. 5 of 1998);
    - Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
    - Maritime Zones Act 1994 (No. 15 of 1994);
    - Merchant Shipping Act, 1951 (No. 57 of 1951);
    - Mine Health and Safety Act, 1996 (No. 29 of 1996);
    - National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004);
    - National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004);
    - National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008);
    - National Environmental Management: Protected Areas Act (No. 57 of 2003);
    - National Environmental Management: Waste Act, 2008 (No. 59 of 2008);
    - National Heritage Resources Act, 1999 (No. 25 of 1999)
    - National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999);
    - National Ports Act, 2005 (No. 12 of 2005);
    - Nuclear Energy Act, 1999 (No. 46 of 1999);
    - National Water Act, 1998 (No. 36 of 1998);
    - Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations;
    - Sea-Shore Act, 1935 (No. 21 of 1935);
    - Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
    - Ship Registration Act, 1998 (No. 58 of 1998);
    - UPRDA??
    - Wreck and Salvage Act, 1995 (No. 94 of 1995); and

- White Paper on National Environmental Management of the Ocean (No. 426 of 2014).

- International Marine Pollution Conventions:
  - International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
  - Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08);
  - International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention);
  - United Nations Convention on Law of the Sea, 1982 (LOSC); and
  - Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol).

1.5 DESCRIPTION OF EXPLORATION PROGRAMME

PetroSA originally applied for an Exploration Right for the following activities in Block 3A/4A in an initial three year exploration period:

- Airborne Gravity and Magnetic Survey;
- 2D Seismic Acquisition;
- High Resolution Bathymetry Survey;
- Seabed Sampling and Heatflow Measurements; and
- 3D Seismic Acquisition.

It should be noted that the Operator may not undertake all of the above-mentioned exploration activities, as this will be dependent on the findings of the initial surveys which will determine whether further surveys are required.

The following information is a generic description of the proposed activities to be undertaken across Block 3A/4A.

1.5.1 AIRBORNE GRAVITY AND MAGNETIC SURVEY

This type of survey would take measurements of the gravity and magnetic fields of the earth from a low flying aircraft, to better understand the regional subsurface geology. This includes, but is not limited to interpretation of basement structures, amount of sediment fill, faulting and volcanic intrusions. To obtain the highest quality data and resolution, the aircraft that will be taking the measurements will fly in a pre- determined grid over the survey area, which is proposed to include most of the block area, at a height of between 50 m and 200 m, with relatively close line spacing of generally no more than 10 km parallel spaced lines.

Airborne gravity surveys map the density variations within the earth while airborne magnetic surveys map the variation in the magnetic field which is generally present due to the changes in the magnetic content of the underlying strata. Gravity surveys can be used to determine the amount of sediment fill in a basin while the magnetic surveys assist in identifying igneous or volcanic bodies.

Although acquisition of such data is passive and the measurement equipment does not emit any inducing forces, low altitude overflights may have both acoustic and visual impacts on large marine mammals in the area. At this stage it is not yet known which airport/s would be used as the logistics base for fixed-wing operations as part of the proposed airborne geophysical acquisition. However, if the Saldanha Bay, Langebaan Weg or Vredendal airfields are suitable, flight paths will need to be planned to avoid seal colonies.

1.5.1.1 DURATION

It is anticipated that it would take in the order of two to three weeks to complete, which excludes estimated downtime due to bad weather, etc.

1.5.2 SEISMIC SURVEYS

1.5.2.1 OVERVIEW

Seismic surveys are used to determine the sub-sea geological formations as part of marine oil and gas exploration. Seismic vessels travel along transects of a prescribed pre-selected grid. During these surveys, a high level, low frequency sound is directed towards the seabed from seismic sound sources, which are towed by a vessel (see Figure 2). These seismic sound signals are reflected by the geological layers, bounce back to the sea surface and are captured by hydrophones towed by the same vessel. These reflected signals are then used to interpret the subsea geological formations. When surveying, the vessel would travel between 4 and 6 knots.

A seismic vessel travels along transects of a prescribed grid that is carefully chosen to cross any known or suspected geological structure in the area. The sound source is fired at approximately 12 to 30 second intervals. The sound waves are reflected by boundaries between sediments of different densities and returned signals are computer processed after being recorded by the hydrophone streamers. A surface tailbuoy with radar reflectors would be connected to the end of each streamer to provide a visible location point for reference. The airgun sound source is situated up to 200 m behind the vessel at a depth of 5 to 10 m below the surface.

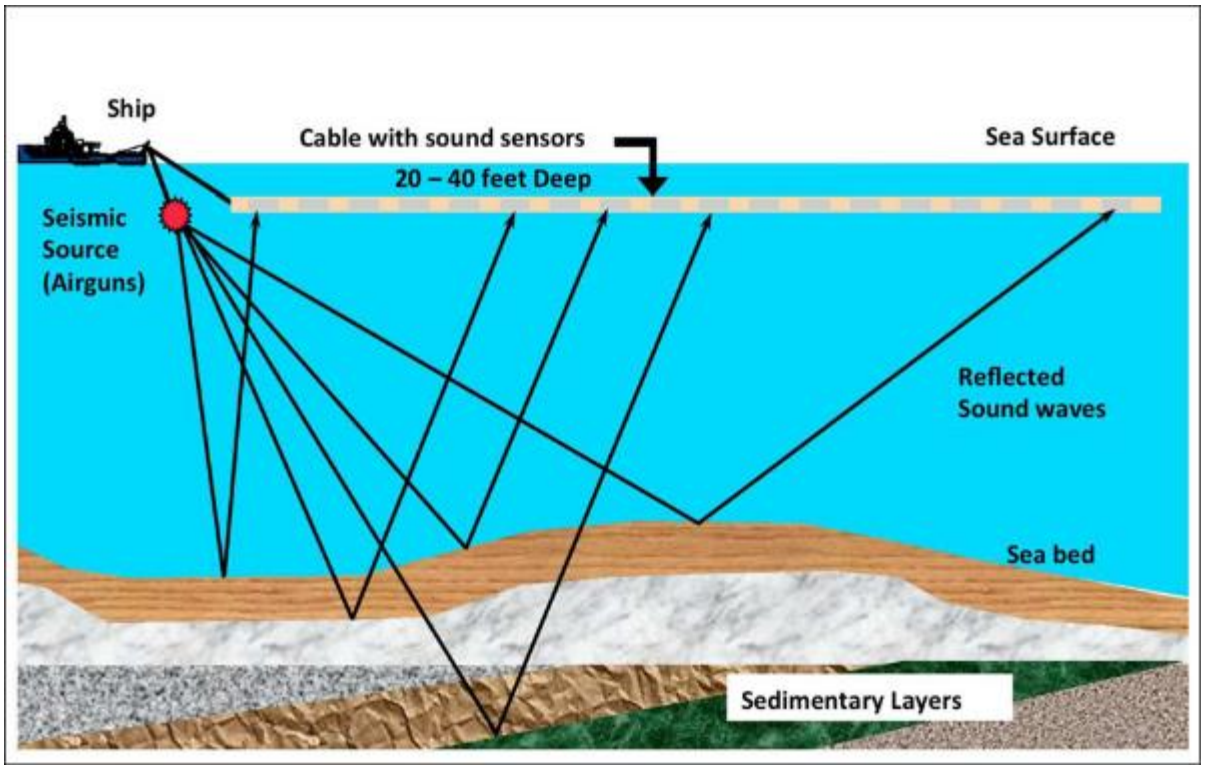

Figure 2: Graphic representation of the operation of a seismic survey (energytomorrow.org)

1.5.2.2 2D AND 3D SEISMIC ACQUISITION

The Operator proposes to acquire a widely spaced 2D seismic survey over Block 3A/4A which would then assist in determining the exact location for the 3D seismic acquisition as part of their exploration programme[3].

A 2D survey provides a vertical slice through the earth's crust along the survey track-line. The vertical scales on displays of such profiles are generally in two-way sonic time, which can be converted to depth displays by using sound velocity data. 2D surveys are typically applied to obtain regional data from widely spaced survey grids (tens of kilometres) and infill surveys on closer grids (down to 1 km spacing) are applied to provide more detail over specific areas of interest such as potentially drillable petroleum prospects. A 2D survey typically involves a towed airgun array and a single streamer. For a 2D survey the entire seismic array from the tow- ship to the end of the streamer may be up to 10 000 m in length.

A 3D survey is typically applied to promising petroleum prospects to assist in fault line interpretation, distribution of sand bodies, estimates of oil and gas in place and the location of boreholes. A 3D survey operation requires multiple traverses of the survey area over the region of interest. Typically the surface sail line tracks of the vessel are separated by half the streamer array width (i.e. for 10 streamers separated by 100 m, the sail line tracks would be every 450 m). A typical 3D seismic survey configuration is illustrated in Figure 3 and comprises the following components:

- a towed airgun array and up to 12 lines of geophones spaced 5 to 10 m apart between 3 m and 20 m below the water surface. The array can be up to 10 000 m long and 1 000 m wide;
- a series of strings (commonly termed 'streamers') of hydrophones towed behind the survey vessel (see Section 1.5.1.4); and
- a control and recording system co-ordinating the firing of shots, the recording of returned signals and accurate position fixing.

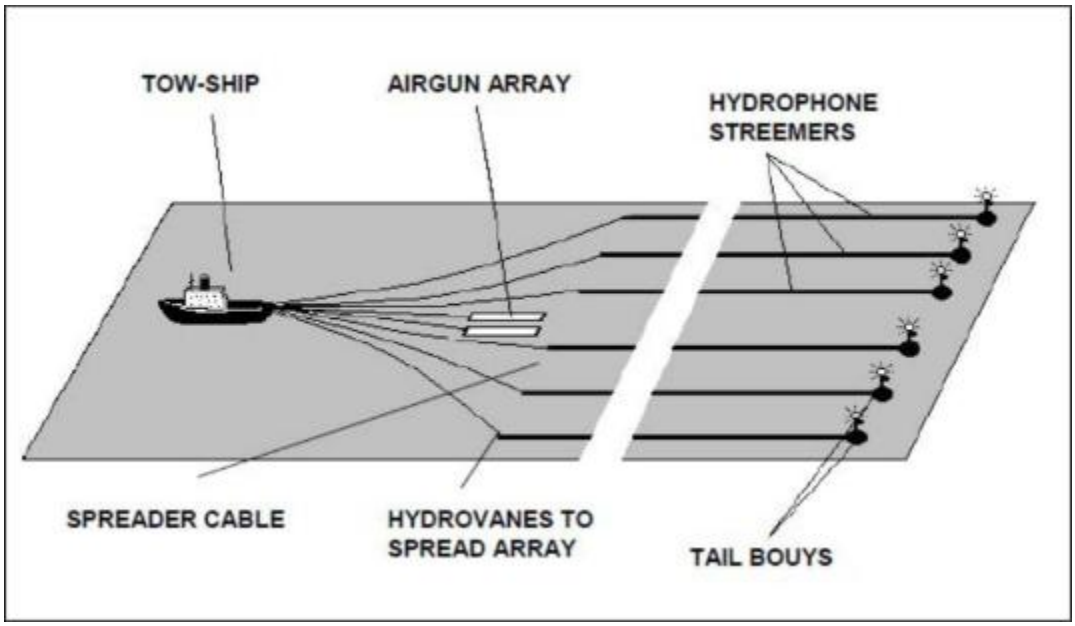

Figure 3: A typical 3D seismic survey configuration (CCA Environmental, 2011).

[3] Although the 3D seismic survey would be undertaken last, it is discussed in this section as information for 2D and 3D surveys are similar in nature.

1.5.2.3 SOUND SOURCES

Sound sources (commonly referred to as 'airguns') are underwater pneumatic devices from which high pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The acoustic signal propagates through the water and the subsurface and reflections are transmitted back to the surface. The sound source must be submerged in the water, typically at a depth of 5 to 10 m.

The frequency of the signal depends on the energy of the compressed air prior to discharge. Airguns are used on an individual basis (usually for shallow water surveys) or in arrays. Arrays of airguns are made up of towed parallel strings of airguns (usually comprised of between 12 and 70 airguns in total). A single airgun could typically produce sound levels of the order of 220-230 dB re 1 mPa @ 1m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of 100-1000 Hz, while the optimum wavelength for deep seismic work is in the 10-80 Hz range.

One of the required characteristics of a seismic shot is that it is of short duration (the main pulse is usually between 5 and 30 milliseconds). The main pulse is followed by a negative pressure reflection from the sea

surface of several lower magnitude bubble pulses. Although the peak levels during the shot may be high the overall energy is limited by the duration of the shot.

1.5.2.4 RECORDING EQUIPMENT

Signals reflected from geological discontinuities below the seafloor are recorded by hydrophones mounted inside streamer cables. Hydrophones are typically made from piezoelectric material encased in a rubber plastic hose. This hose containing the hydrophones is called a streamer. The reflected acoustic signals are recorded and transmitted to the seismic vessel for electronic processing. Analysis of the returned signals allow for interpretation of subsea geological formations.

The length of streamers can be up to 10 000 m in length. A 2D survey involves only one length of streamer towed behind the vessel, while 3D surveys typically involve an array of up to 10 streamers, spaced 50 m to 100 m apart.

1.5.2.5 EXCLUSION ZONE

As data acquisition requires that the position of the survey vessel and the array be accurately known, seismic surveys require accurate navigation of the sound source over pre-determined survey transects. As a result, the array and the hydrophone streamers need to be towed in a set configuration behind the seismic vessel, means that the survey operation has little manoeuvrability while operating, and cannot deviate from the planned seismic lines. Ship tracks in a 3D survey are typically some 450 m apart because of the wide turning circle (one to two times the streamer length) of the vessel and its tow.

The Merchant Shipping Act, 1951 (Act No. 57 of 1951) defines a seismic survey vessel engaged in surveying as a "vessel restricted in its ability to manoeuvre". It further requires that any other vessels, such as fishing vessels, as far as possible, keep out of the way of a vessel that is restricted in its ability to manoeuvre. Furthermore, the Marine Traffic Act, 1981 (Act No. 2 of 1981), states that a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an "offshore installation". Such an offshore installation is protected by a 500 m safety zone. Any unauthorised vessel entering the safety zone is committing an offence in terms of this act. The seismic contractor / operator of the vessel would also request other vessels to stay beyond a safe operational limit that is greater than the statutory 500 m safety zone (see Figure 4).

An exclusion zone of at least a 500 m will need to be enforced around the seismic vessel at all times and a chase boat (small manoeuvrable vessel) would be used to warn vessels that are in danger of breaching the exclusion zone. A sweeper vessel is generally used to sail ahead of the seismic vessel removing fishing gear and other obstacles from the path of the vessel, or liaising with fishing operators to do so.

For semi-industrial, industrial and recreational fishers and other related activities, the seismic survey journey plan and exclusion areas will be communicated to these stakeholders well in advance to ensure that the

appropriate planning can be done in accordance with a communication plan. Notices to Mariners will be communicated through the proper channels, and harbour/ port masters at Saldanha Bay will be informed of exclusion zones.

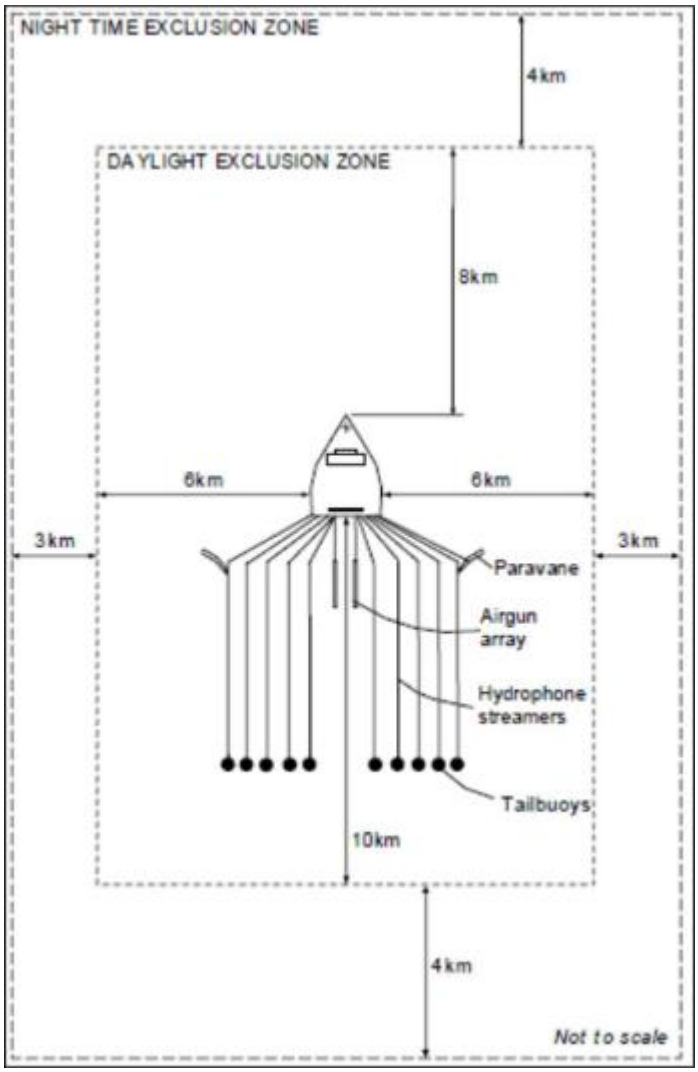

Figure 4: Typical configuration for a 3D seismic survey showing exclusion zones / limitations applicable to any other vessels in the area during the time of survey (CCA Environmental, 2012).

1.5.2.6 DURATION AND SURVEY DETAILS

It is estimated that if a 2D seismic survey were to be undertaken in the remaining licence periods, i would take approximately one month to complete, which excludes estimated downtime due to bad weather, etc. Due to the presence of sensitive cetacean migration periods or winter breeding concentrations (1st of June to 30th of November) and the abundance of several of the large whale species on the West Coast between September and end February, largely in the southern section of the block, the best time of year to conduct seismic operations is late summer and early winter (end February - mid June). The Operator, would, as far as possible, avoid surveying during the sensitive periods (i.e. between June and end February) in the southern portion of the block. Section 2.3.2 provides further details in this regard.

As previously indicated, the 2D survey details have yet to be finalised and the information presented in this report thus only provides possible survey details at this stage. Figure 5 provides a possible configuration for the 2D survey.

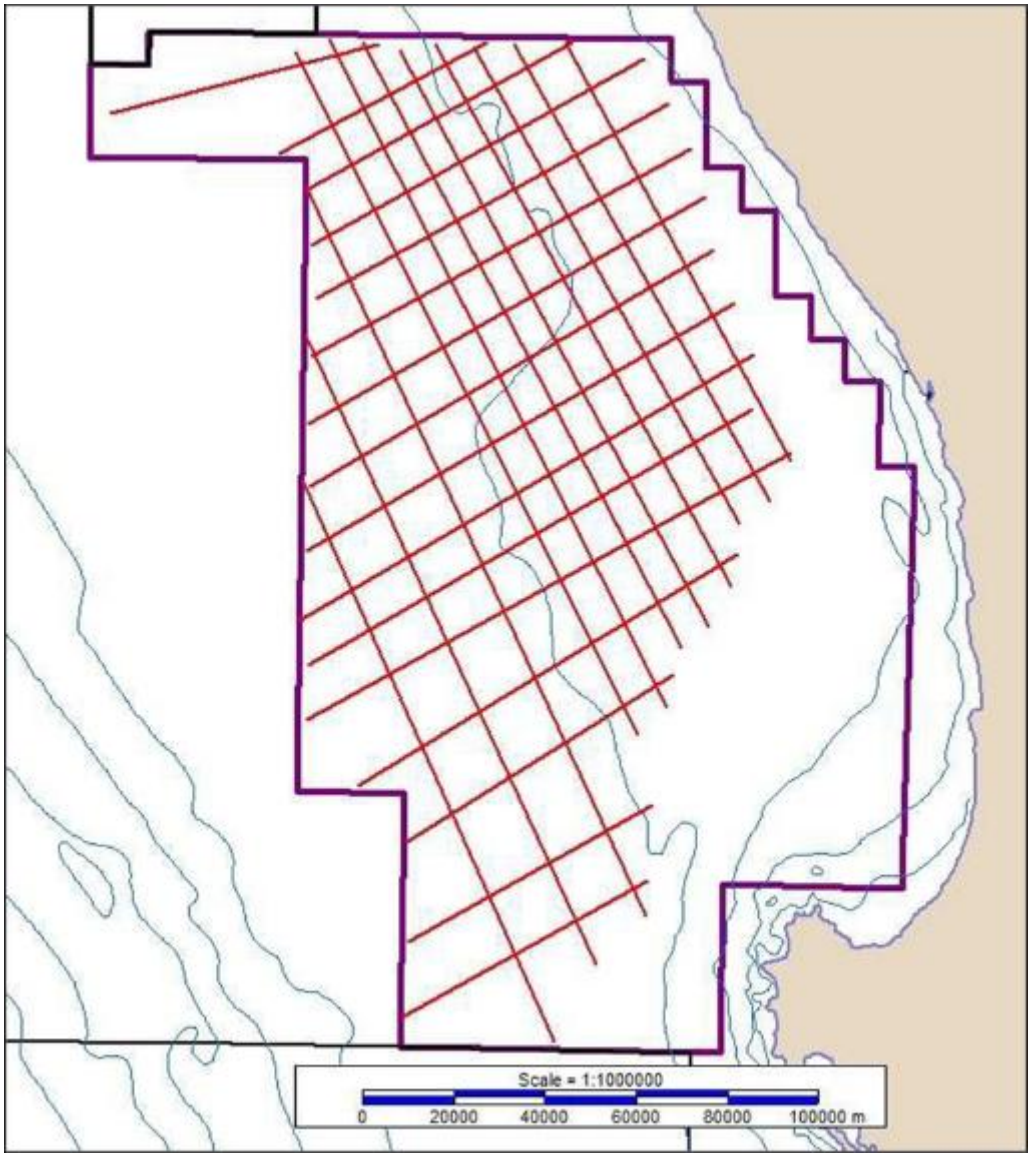

Figure 5: Indicative 2D Seismic Survey Grid within License Block 3A/4A

At this stage specific details for a 2D seismic survey will only be available once a vessel has been contracted by the Operator. The final configuration of the survey will be compiled into an Environmental Notification that will be submitted to PASA for information purposes and which will include details of the following:

- Survey lines, period and duration;
- Vessel specifications;
- Certification compliance; and
- Relevant insurance.

Once the 2D survey has been undertaken the data will be analysed. As is norm in the industry, after data analysis, target areas will be identified for further 3D seismic surveying. The specific details of these potential surveys will be compiled into further Environmental Notifications for submission to PASA.

1.5.3 HIGH RESOLUTION BATHYMETRY SURVEY

1.5.3.1 METHODOLOGY

A high resolution multi-beam bathymetry survey is proposed for Block 3A/4A during the First Renewal Period anticipated to be at the end of 2026 / early 2027. The survey would be undertaken using deep water multi-beam echo sounder (MBES) equipment and a sub-bottom profiler mounted on a survey vessel to obtain swath bathymetry and a sub-bottom profiler to image the seabed and the near surface geology (see Figure 6). The multi-beam system provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth. Although this type of survey typically does not require the vessel to tow any cables (hull mounted), it is "restricted in its ability to manoeuvre" due to the operational nature of this work.

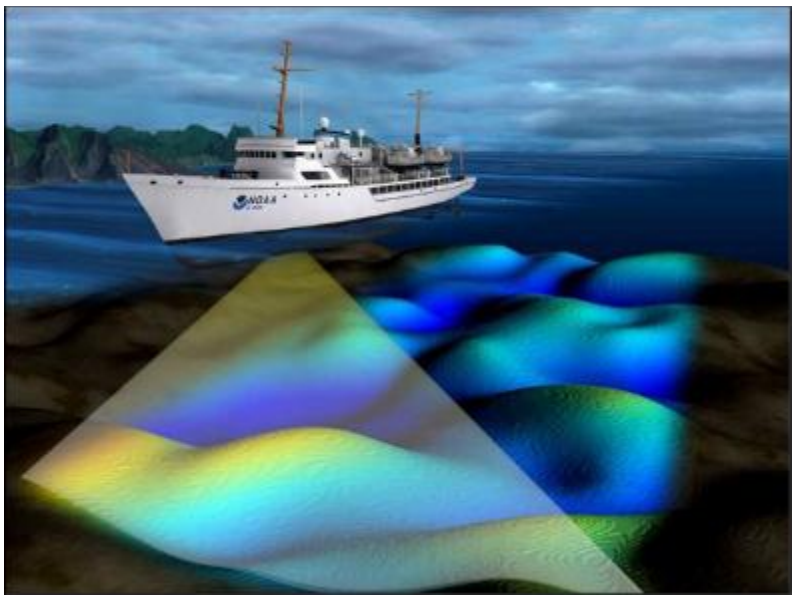

Figure 6: Image of a high resolution bathymetric survey (noaacoastsurvey.wordpress.com)

Results from this survey would be used to determine the structure and geology of the seafloor and produce a digital terrain model of the seafloor in Block 3A/4A.

The MBES emits a fan of acoustic beams from a transducer (see Figure 6) at frequencies ranging from 10 kHz to 200 kHz which generally produces sound levels in the order of 207 db re 1µPa at 1m. This is approximately 1000 times less than that produced for a seismic survey. The sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 3 kHz to 40 kHz and typically produces sound levels in the order of 206 db re 1µPa at 1m.

The bathymetry survey generally does not require the survey vessel to tow any equipment or cables, however, the acquisition of high quality multi-beam bathymetry data requires that the position of the survey vessel be accurately known. These surveys consequently require accurate navigation of the sound source over predetermined survey transects and the vessel is therefore restricted in its ability to manoeuvre based on the width of the measuring swathes (see Section 1.5.8 regarding exclusion zone requirements).

1.5.3.2 DURATION OF SURVEY

The high resolution multi-beam bathymetry survey would take an estimated two to three weeks to complete, which excludes estimated downtime due to bad weather, etc.

1.5.4 SEABED SAMPLING

1.5.4.1 INTRODUCTION

The seafloor sampling programme would consist of collecting up to 200 core samples of seafloor sediments across Block 3A/4A for laboratory geochemical analysis in order to determine if any naturally occurring hydrocarbons are present.

1.5.4.2 METHODOLOGY

Piston coring is one of the more common methods used to collect seafloor sediment samples. The piston coring rig is comprised of a trigger assembly, the coring weight assembly, core barrels, tip assembly and piston. The programme would likely utilise a core barrel capable of retrieving sediment samples that are up to 6 m in length and 6.7 cm in diameter. A seabed sampling probe is illustrated in Figure 7 with the sequence of operation illustrated in Figure 8.

Figure 7: A seabed sampling probe (workboats.co).

A piston coring device with ultra-short baseline (USBL) navigation would be used to collect the seafloor samples. The USBL navigation system is used to accurately track the position of the core through the water column and position the core over the desired target for sampling (see Figure 8 for the piston core operation sequence). The piston corer is lowered over the side of the survey vessel, winched downward through the water column, and allowed to fall from about 3m above the seafloor to allow good penetration.

(A). As the trigger weight hits the bottom (B), it releases the weight on the trigger arm and the corer is released to "free-fall" the 3m distance to the bottom (B & C), forcing the core barrel to travel down over the piston into the sediment (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 pullout of the winch commences. This suction triggers the separation of the top and bottom sections of the piston (E). No equipment would be left behind on the seafloor.

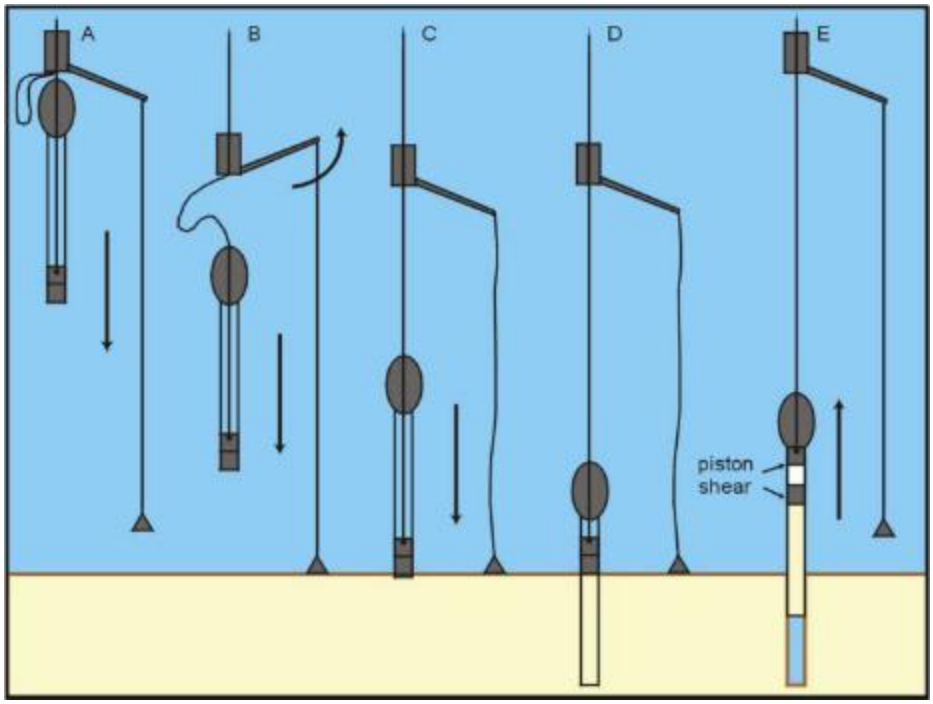

Figure 8: Schematic of the piston core operation at the seafloor (Source: TDI-Brooks from CCA, 2013).

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. The remaining sediment would be returned to the seafloor. Water depth, date, time and latitude and longitude would be recorded for each sample.

1.5.4.3 EXTENT AND DURATION OF SAMPLING

Each individual core would have a disturbance volume of 0.02m³, resulting in a total disturbance volume of approximately 4.23m³ for the entire seabed sampling operation. The core sampling procedure would consist of approximately 200 samples. The exact number and location of core samples would only be identified following the analysis of the existing data and the high resolution bathymetry survey.

It is anticipated that the seafloor sampling programme would take in the order of four to eight weeks to complete, which excludes estimated downtime due to bad weather, etc.

1.5.5 SEABED HEATFLOW MEASUREMENTS

1.5.5.1 INTRODUCTION

The heatflow measurements would be conducted during the Seabed Sampling process, using heatflow probes, which would measure both the temperature and thermal conductivity of sediments in situ up to 3m below the seafloor (see example of a heatflow measuring device in Figure 9). The primary goal of this programme is to measure the thermal conductivity of the seafloor sediments at numerous locations throughout the survey area to provide a representative dataset of sedimentary heat dispersion through near surface sediments. Acquisition of this data would be used to (1) determine the thermal regime(s) present in the area of interest and (2) create thermal models in order to understand the maturity of source sediments at depth and the resulting potential of any hydrocarbon systems present in the region.

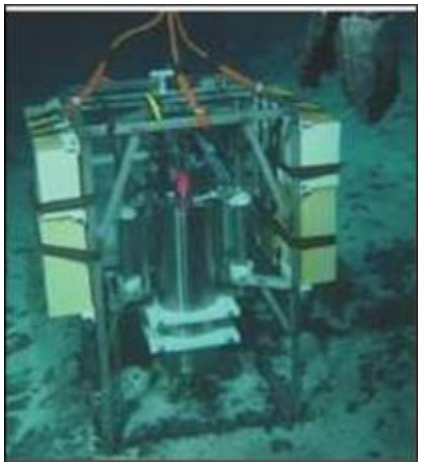

Figure 9: A heatflow measuring device (nature.com).

1.5.5.2 METHODOLOGY

The heatflow probe typically consists of a 6 cm diameter solid alloy steel bar, which extends from the wire termination at the top through the 500 kg lead-fill weight stand, down to the tip of the heatflow probe. The out-rigged thermistor string is attached parallel to the steel bar.

The measurement device would be lowered from a vessel to near the seabed. The probe is navigated to specific target sites using the USBL navigation described in Section 1.5.3.2. It is then allowed to drop under its own weight, being driven into the sediments by gravity. A heat pulse is applied through the probe which allows the thermal conductivity of the sediments to be measured. The probe is allowed to equilibrate and then recovered to the surface after about 20 minutes. No samples or other materials would be recovered with the heat flow probe.

1.5.5.3 EXTENT AND DURATION

The exact number and location of heatflow measurements would only be identified following the analysis of the existing data . It is anticipated that it would take in the order of two to three weeks to complete, which includes estimated downtime due to bad weather, etc., and if undertaken together with the piston coring / seabed sampling programme.

Figure 10: Heatflow probe being lowered over the side of a survey vessel (www.geo.uni-bremen.de) (Left) and schematic of heatflow probe in seabed (Right) (http://www.tdi- bi.com/field_services/hf_info/description.htm) (from Pulfrich, 2014).

1.5.6 SUPPORT SERVICES

Vessel supplies, including food, water, fuel and lubricants will likely be loaded at the port of Saldanha Bay.

Bunkering, including refuelling, of the various survey vessels may either take place while out at sea or will be undertaken at the Port of Saldanha Bay. Bunkering at sea would only take place once permission from the South African Maritime Safety Authority (SAMSA) is obtained.

1.5.7 EXCLUSION ZONE FOR EXPLORATION ACTIVITIES, EXCLUDING AIRBORNE SURVEYS

Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18) states that survey vessels engaged in surveying operations are defined as "vessel restricted in its ability to manoeuvre[4]" which requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing shall, as far as possible, keep out of the way of the survey operations.

Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a vessel used for the purpose of exploiting the seabed (i.e. vessels used for the high resolution bathymetery survey, seabed sampling and heatflow measurements) or a seismic vessel and its array of airguns and hydrophones (i.e. 2D and 3D survey vessels) 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 500 m safety zone would be communicated to key stakeholders well in advance of the various proposed activities being undertaken as part of the exploration programme. Notices to Mariners will also be communicated through the proper channels.

1.5.8 INITIAL PERIOD EXPLORATION ACTIVITIES

The approved exploration work programme and EMPr for the Initial Period included the following exploration activities as described in the sections above:

- Aerial gravity and magnetic surveys;
- Seismic surveys;
- High resolution bathymetry surveys;
- Seabed sampling; and
- Heatflow measurements.

These activities are described in Sections 1.5.1 to 1.5.8. As at June 2025, none of the above activities have been conducted in the Initial Exploration Period.

A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from Airborne Gravity and Magnetic Survey to utilising 2D seismic data purchased from the Contractor. This was completed.

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[4]The term "vessel restricted in her ability to manoeuvre" means a vessel which from the nature of her work is restricted in her ability to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel. The term "vessels restricted in their ability to manoeuvre" shall include but not be limited to:

(i) a vessel engaged in laying, servicing, or picking up a navigation mark, submarine cable or pipeline;
(ii) a vessel engaged in dredging, surveying or underwater operations;
(iii) a vessel engaged in replenishment or transferring persons, provisions or cargo while underway;
(iv) a vessel engaged in the launching or recovery of aircraft;
(v) a vessel engaged in mine clearance operations; and
(vi) a vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.

1.5.9 FIRST RENEWAL PERIOD EXPLORATION ACTIVITIES

A renewal application was submitted on 1 February 2024. The EWP submitted in support of the renewal application include the intention to conduct the following activities:

- Multibeam Bathymetry Survey;
- Seafloor Geochemical Survey and Sampling; and
- 3D Seismic Acquisition (contingent).

The frontier nature of the Orange Basin and the sparse and limited success of exploration wells in the shallow water areas results in a high degree of uncertainty of the hydrocarbon potential., specifically the presence, age, spatial distribution, and type of potential source rocks. The exploration wells drilled in the previous campaigns in Block 3A/4A did not intersect a well-developed source rock. However, based on 2D seismic data evaluations, gas/fluid escape features, mud volcanoes or intrusions that seem to propagate from deeper sediments to the seafloor and presenting as pockmarks on the seabed have been identified.

Should these features be related to the release of hydrocarbons, their presence can be interpreted as indicative of an active petroleum system or DHI (direct hydrocarbon indicator). Should this be the case, the top seal of the prospects might be jeopardized. Therefore, the genesis of these features needs to be better understood. Currently, there is a lack of sufficient and good pre-requisite quality data required for a detailed evaluation.

It is for this reason that the seafloor geochemical survey and sampling is proposed. The acquired surface data (Backscatter and Bathymetry) and near-surface data (Chirp sub-bottom profiles, if acquired) will be used in combination with the currently available 2D seismic data to identify, prioritize, and target locations for seafloor sampling. Selected sites of active hydrocarbon seeps will be sampled with precisely navigated piston cores and will be analysed (onboard or at the geochemical laboratory) for the presence of thermogenic gas.

The previous attempts to sample the seafloor in the block have not yielded conclusive results due to technology deficiencies at the time. Upon completion of the proposed surveys, the results will be interpreted and integrated with other geophysical and geological datasets. The successful sampling of active hydrocarbon seepages will give a geochemical character and probably the age of the source, thereby de-risking of quality of the source rock.

The following highlights the work programme, in relation to Block 3A/4A.

1.5.9.1 SEAFLOOR GEOCHEMICAL SURVEY AND SAMPLING

A Seafloor Geochemical Exploration (SGE) survey is a petroleum prospecting tool based on the premise that upward migrated petroleum from deep source rocks and reservoirs can be detected in near-surface sediments and is used to rapidly evaluate the critical elements of a given petroleum system potential, with a negligible environmental impact. In Block 3A/4A, using the vintage and newly reprocessed 2D seismic data, swarms of potential fluid/gas vertical migration have been identified (Figure 11). The current wells in Block 3A/4A did not intersect a well-developed source rock, a key petroleum component in de-risking the identified leads. With the discoveries in the deepwater Orange Basin in Namibia, the presence of source rocks in the Orange Basin was derisked, but the migration pathways towards the shelf area is still uncertain. The proposed operation includes sampling the seafloor and detecting seabed thermogenic hydrocarbon seepages through a geochemical survey.

The identification of surface and sub-surface features in the block is limited by the quality and location of the currently available surveys, however, a holistic approach to cover the prospective areas of the block can be achieved by acquisition of high-resolution seafloor survey (Multibeam bathymetry) supplemented by backscatter data in the absence lateral extensive 3D survey data coverage.

The presence of near-surface migrated thermogenic hydrocarbons provides strong evidence that an active petroleum system is present, as well as critical information on source, maturity, and migration pathways. Upon completion, the results will be interpreted and integrated with other geophysical and geological datasets.

1.5.9.2 MULTIBEAM BATHYMETRY SURVEY (MBES)

The seafloor geochemical sampling campaign is preceded by the selection of the potential seepage sites from the integration of high-resolution multibeam, backscatter data and seismic data. Although seafloor samples were acquired in the block previously, the methodology applied during this sampling program did not integrate multibeam and backscatter to analyse the best places for seafloor sampling of potential seeps therefore the proposed acquisition of the Multibeam survey is key to surface sampling.

The estimated amount of USD 3,000,000 will be invested in the Seafloor Geochemical Exploration Survey (Multibeam Bathymetry and Backscatter), Piston Coring and associated laboratory analyses and consultancy thereof. High-graded sampling locations will be determined by the results of the analysis of the seafloor features identified through MBES data and integrated with 2D and the small 2001 vintage 3D seismic data. The overall results integration is expected to high grade the area of future 3D survey placement.

1.5.9.3 CONTINGENT WORK PROGRAMME: 3D SEISMIC ACQUISITION

Prospectivity in Block 3A/4A has previously focused on the grabens trending sub-parallel to the coastline. Results from Gazania-1 well (Block 2B) indicated the need for robust geological and geophysical interrogation and integration of good quality seismic data to sufficiently de-risk plays and leads in Block 3A/4A. Data quality in Block 3A/4A is plagued by multiples and processing artefacts (linear and random noise). Most of the 2D seismic lines were acquired using short cable lengths, negatively affecting the quality of the data.

Most of the syn-rift graben leads and the Aptian pinch-out plays are at depths where the data does not allow for proper imaging. Processing artefacts including sea-bottom multiples, diffraction patterns, dipping noise, fault continuity issues, ringing effects, random noise, dead traces, mis-ties between different seismic vintages, low-dominant frequencies, narrow bandwidths, and velocity anomalies and pull-downs contaminate the seismic data leading to interferences with imaging of structural dips and geology. It is also challenging to interpret decreases and increases in acoustic impedance due to various vintages having variable phases and polarities. These processing artefacts add high uncertainty during interpretation and often prevent generation of robust interpretations especially in the eastern part of the block.

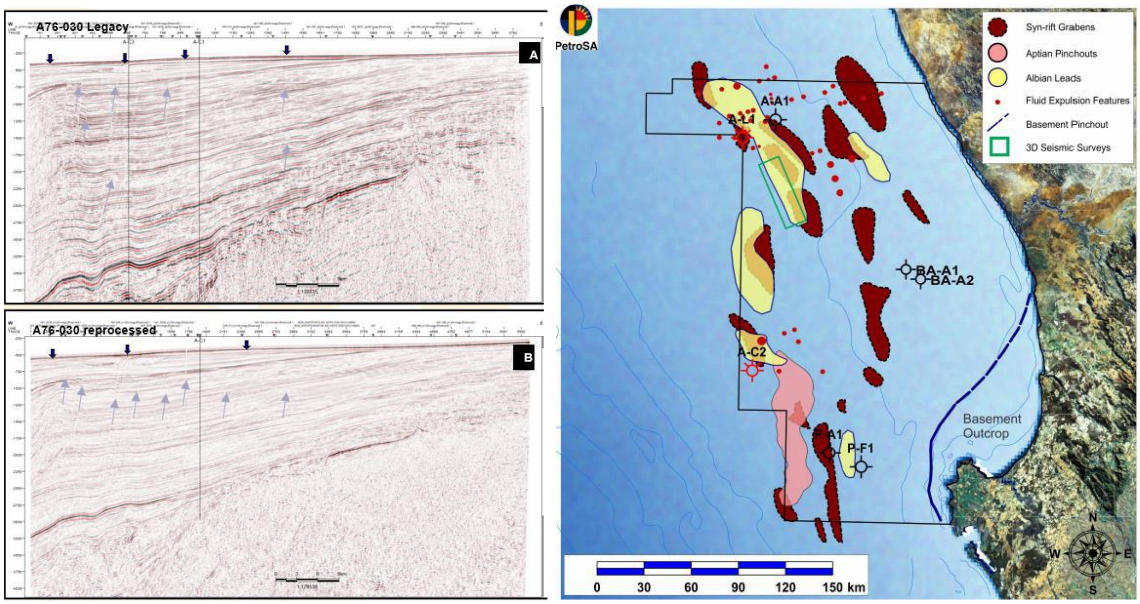


Figure 11: (a) A76 -030 Legacy 2D seismic line and (b) same reprocessed line showing possible gas/fluid migration features

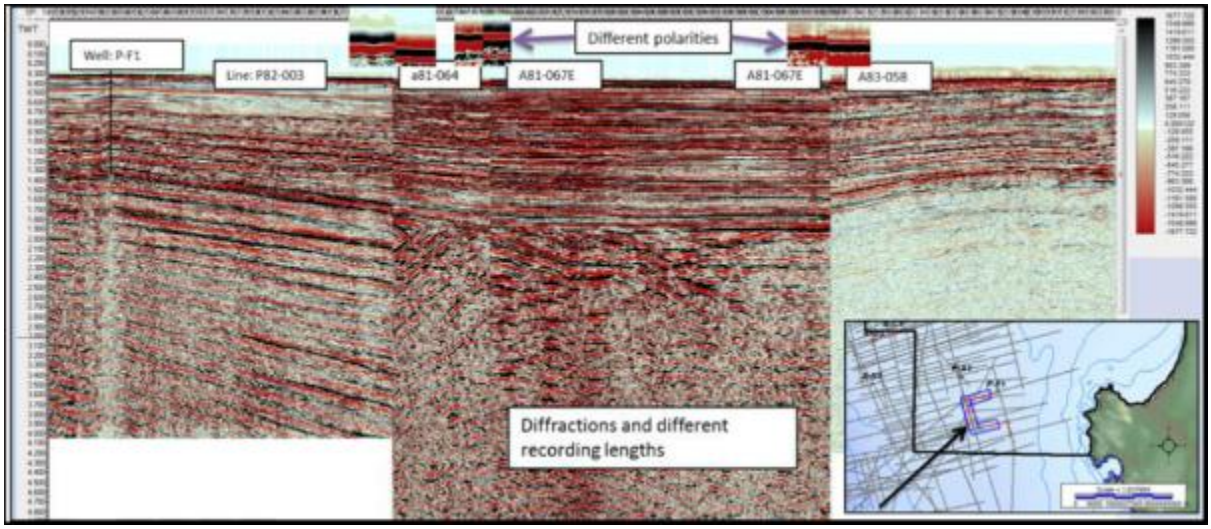


Figure 12: Block 3A/4A seismic quality indicating contamination by processing artefacts

For the Initial Period of this Exploration Right, PetroSA licensed 4118.9-line km of 2D data from a prospecting company who reprocessed vintage data. The work programme commitment for the licensing of approximately 4000-line km of 2D data was thus fulfilled during the first exploration right phase.

TGS (the company who reprocessed the vintage 2D data) has demonstrated the capability to use modern processing and PSTM imaging workflows to produce a consistent set of 2D lines across the basin. The reprocessed lines exhibit improved de-multiple, enhanced fault definition, improved imaging of subtle sedimentary features and a broader bandwidth with significant recovery of lower frequencies. Examples of the results of this reprocessing are shown below.

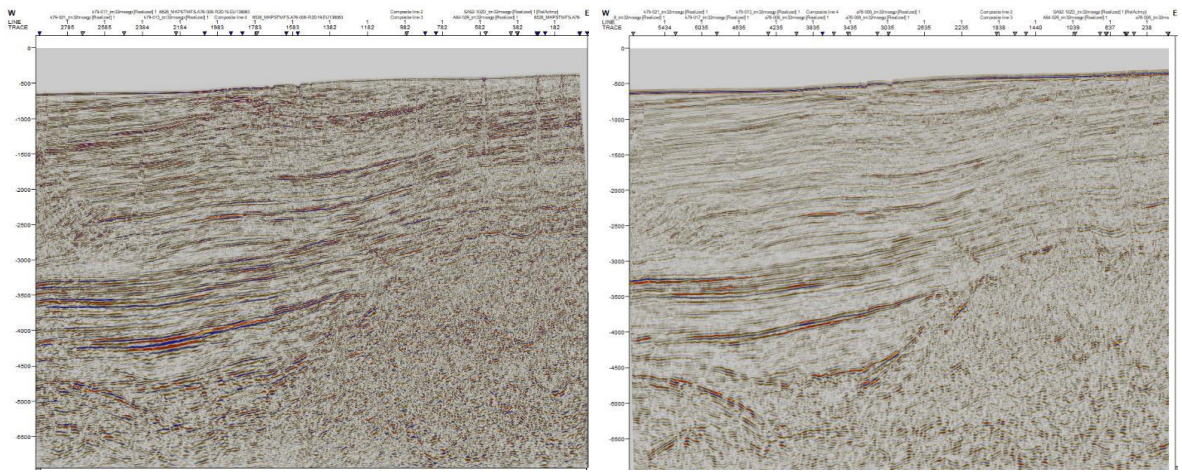


Figure 13: Sample line A76-008 of original vs reprocessed seismic data by TGS where the grabens and overlaying sediment are better defined.

Although the acquired reprocessed dataset has managed to resolve some of the data issues previously highlighted, the concern in the acquisition of the data is the wide space in between the reprocessed lines. The original data was acquired with short cable length between 2400 - 3000m and deteriorates after 2,5 seconds. The emerging seismic acquisition and processing technologies provide high resolution of seismic data and provide high signal to noise ratio, which will dramatically improve the subsurface imaging. Acquiring new, technologically advanced, 3D seismic data can reduce uncertainties and provide for the means to develop drillable prospects through complex geological and geophysical workflows. The mulltibeam survey and geochemical sampling will indicate where to best place this new 3D seismic survey.

1.5.10 SUMMARY OF EXPLORATION PROGRAMME

Table 2 provides a summary of the exploration activities proposed by the Operator during the renewal period and estimated dates and timeframes.

Table 2: Proposed Exploration Programme and dates

ORDER OF ACTIVITIES	EXPLORATION ACTIVITY	DATE	EXPECTED TIMEFRAMES
1	Multibeam Bathymetry Survey;	December to March Year 1	± 2 – 3 weeks
2	Seafloor Geochemical Survey and Sampling; and	December to March Year 2	± 1 month
3	3D Seismic Acquisition (contingent).	TBC	TBC

1.6 PROCEDURES FOR ENVIRONMENTAL RELATED EMERGENCIES AND REMEDIATION

The Operator would manage any offshore emergencies in terms of the environmental management procedures set out in Section 3.11 – Incidents and Emergencies.

1.7 PLANNED MONITORING AND ENVIRONMENTAL MANAGEMENT

The Operator would undertake appropriate management of the environment during the proposed exploration activities, in accordance with the management requirements as set out in Section 3. In order to ensure compliance during the implementation of the project, on-going monitoring, auditing and reporting would take place against the targets and objectives specified in this EMP. All audit reports would produce a set of recommended corrective actions, which would be used as a tool to document all corrective actions taken and how they were performed.

In addition to the above, the Operator would also undertake annual performance assessments in order to comply with the MPRDA and its relevant Regulations. The performance assessments would monitor the Operator's compliance in terms of the EMP and would be submitted to PASA for their review.

PetroSA also has a Health, Safety and Environmental Policy Statement (Appendix 1) which sets out PetroSA's commitment to ensure successful implementation of all conditions stipulated within the EMP for the project.

In addition to the above, the Operator would also undertake annual independent external audit of the EMPr in order to comply with NEMA and its relevant Regulations. The audits would monitor the Operator's compliance in terms of the EMPr and the Record of Decision (RoD) that approved the EMPr, and would be submitted to PASA for their review. In addition, the audit will also assess the ability of the measures contained in the EMPr, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the exploration activities planned and or executed.

1.8 FINANCIAL PROVISION

In terms of the MPRDA, Section 51(b), the Operator is required to make financial provision for the project in order to show that they can meet the conditions included as part of this EMP. The financial provision that will be provided by the Operator will cover EMP requirements, such as, monitoring, reporting or specialist studies.

Environmental management actions required as a result of an incident or accident would be covered by the PetroSA's insurance, as described below:

- Third Party liability, which includes personal injury, property damage, seepage and pollution as a result of any offshore exploration operations, is covered up to USD150 000 000 (one hundred and fifty million US Dollars) per occurrence;

In addition, as a condition of contract PetroSA requires a Contractor to carry insurance that is appropriate for the work being performed which may include the following:

- Workmen's compensation insurance as required in terms of the provisions of the Compensation for Occupational Injuries and Diseases Act, 1993 (No. 130 of 1993) or similar applicable Acts;
- Employer's liability insurance with a limit of liability at all times of not less than USD 1 000 000 (one million US Dollars) for each occurrence or such larger amounts for which Contractor already have cover;
- Non-ownership aviation liability with a limit of liability at all times of not less than USD 50 000 000 (fifty million US Dollars) for each occurrence or such larger amounts for which Contractor already has cover;
- Comprehensive general public liability insurance including pollution with a limit of liability of not less than USD 1 000 000 (one million US Dollars) per occurrence;

- Motor vehicle liability insurance including passenger liability indemnity;
- Physical Damage Insurance for loss or damage to Contractor's equipment and machinery. Such coverage shall be on All Risks Insurance basis or its equivalent for full value of Contractor Group material and equipment. However, the Contractor shall have the right to self-insure these items;
- Hull and Machinery Insurance in the form of Full Form Hull and Machinery Insurance, including collision liability, with limits of liability at least equal to the full value of the vessel; and
- Standard Protection and Indemnity Insurance, at least equal to the value of each vessel owned or chartered (including Tower's Liability, where applicable).

Proof of Financial Provision will be provided to PASA in the following manner:

- Environmental Notification, as well as copies of the insurance cover carried by the Contractors and the Operator, will be provided to PASA at least 14 days prior to the commencement of any exploration activity;
- A copy of the insurance certificate for the year will be provided to PASA on the renewal date of each year; and
- The annual Performance Assessment reports and the annual revision of the closure provision will be submitted to PASA.

1.9 UNDERTAKING BY THE APPLICANT

Appendix 2 includes the undertaking by PetroSA which states that they will comply with the provisions of the MPRDA and the NEMA and associated Regulations.

2 SECTION 2: GENERAL CONTEXT

2.1 EMPR STUDY PROCESS

2.1.1 TERMS OF REFERENCE

The Terms of Reference for the proposed project was to obtain an Exploration Right for Block 3A/4A in terms of the MPRDA to allow the Operator to carry out exploration and geophysical surveys to determine the presence of oil and gas reserves off the West Coast of South Africa. The EMPr was approved in 2014 and this is an update to give effect to the recommendations in the 2025 audit report. The audit report made recommendations to update the EMPr to better mitigate the impacts of the proposed exploration activities.

2.1.2 ASSUMPTIONS AND LIMITATIONS

- This EMPr process was undertaken in terms of the MPRDA, 2002 and the NEMA, 1998 and associated Regulations.
- The EMPr used information from similar offshore EMPr documents, as provided by PetroSA to detail the project description of the various project components, as well as information from the specialist studies specific to this project. It is assumed that the information provided by PetroSA and specialists is correct, accurate and unbiased at the time of use. This updated EMPr is based on the 2014 EMPr, however, the project description has been updated with the new work program as submitted to DMPR for the renewal period, which differs from activities/project description for the initial exploration period.
- There will be no significant changes to the project description or surrounding offshore environment between completion of the report and implementation of the proposed project that could substantially influence findings and recommendations with respect to mitigation and management, etc.
- This study assumes that all recommended mitigatory measures would be implemented as proposed by the Operator.
- The project description is largely generic as specific details were not yet available, such as specific 2D and 3D survey lines, etc. However, this generic information has not limited the specialist studies or the compilation of this EMP. The assessment covered the entire area of Block 3A/4A.
- The 2014 EMPr offers generic, sometimes outdated impact management actions and fails to address specific activity and site impacts adequately. This updated EMPr addresses this issue by updating impact management outcomes and impacts where necessary. However, further impact assessment is needed when specific location details and technical specifications for exploration activities are available, likely necessitating further amendments and supplements before exploration activities can commence.

2.1.3 PROCESS UNDERTAKEN

2.1.3.1 INITIAL PUBLIC PARTICIPATION PROCESS

The following public participation was undertaken to date (refer to Appendix 3):

- An Interested and Affected Party (I&AP) database was opened and remained open for the duration of the project. The database included key organisations, such as fishing operators, government agencies, offshore industry bodies, etc.
- Compilation of a Background Information Document (BID), which included an overview of the legislative requirements, summary of the project description and details regarding an opportunity for I&APs to comment on the project.
- The BID was released for a 21-day public review and comment period from 8 July 2014 to 29 July 2014.

- A notification letter and a copy of the BID was sent to all I&APs on the project database at the start of the commenting period.
- Two advertisements were placed in the following papers, informing interested parties of the project and commenting period:
    - Cape Times – 8 July 2014
    - Weslander – 10 July 2014
- A total of four comments were received on the BID and advertisements.
- A Comments and Responses Report was compiled to respond to and address the comments raised.

2.1.3.2 PUBLIC PARTICIPATION FOR EMPR UPDATE

The following public participation will be undertaken (refer to Appendix 3):

- The Interested and Affected Party (I&AP) database was updated and opened and will remain open for the duration of the project. The database includes key organisations, such as fishing operators, government agencies, offshore industry bodies, etc.
- The updated EMPr will be released for a 30-day public review and comment period from 31 July 2025 to 01 September 2025.
- A notification letter and a copy of the EMPr will be sent to all I&APs on the project database at the start of the commenting period.
- Site notices will be placed at locations along the exploration right area.
- Three advertisements will be placed in the following papers, informing interested parties of the project and commenting period:
    - Weslander.
    - Plattelander.
    - Ons Kontrei,
- All comments received will be included in the final EMPr to be submitted to PASA.
- A Comments and Responses Report will be compiled to respond to and address the comments raised.

2.1.3.3 SPECIALIST INPUT

Table 3 provides details of the two specialist studies that were undertaken between July and August 2014 in order to assess all the potential impacts and to guide the completion of this EMP (refer to Appendices 4 and 5 for the specialist reports)

Table 3: Specialist Studies completed for the project

SPECIALIST STUDY	SPECIALIST CONSULTANT	QUALIFICATIONS
Marine Fauna	Dr Andrea Pulfrich –Pisces Environmental Services (Pty) Ltd	PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany
Impact on Fishing Industry	Mr. Dave Japp – CapFish cc	MSc (Ichthyology and Fisheries Science), Rhodes University
	Ms. Sarah Wilkinson – CapFish cc	BSc (Hons) (Botany), University of Cape Town

In order to complete the specialist studies, the respective specialists' gathered relevant information, including information from similar studies, in order to inform the assessment of identified environmental impacts that may occur as a result of the proposed project in Block 3A/4A. Each specialist study provided an assessment for identified impacts, according to a pre-defined rating system (see Appendix 6). In order to reduce negative impacts or enhance positive impacts a number of recommendations and mitigation measures are provided in each specialist report.

2.1.3.4 EMP REPORT COMPILATION

This EMP was originally compiled in terms of Section 39 and Regulation 51 of the MPRDA. Information within the EMP was been gathered from other projects of a similar nature undertaken off the West Coast of South Africa, as the information presented as part of the project description and certain potential impacts are largely generic in nature. The EMP also includes a summary of key information and the impact assessments from both specialist studies. The specialist studies informed the overall assessment of the project and provided input into mitigation measures and recommendations that should be implemented in order to reduce any negative impacts that may occur during the project.

The EMPr is now updated to bring it in line with the requirements of the NEMA and EIA Regulations, 2014.

2.1.3.5 OPPORTUNITY TO COMMENT AND PUBLIC MEETING – ORIGINAL EMP

The EMP was released for a 30-day public comment and review period from 22 August until 22 September 2014. A copy of the EMP was made available at the following locations for review:

- Saldanha Bay Public Library (30 Berg Street, Saldanha Bay); and
- J&G website (www.jgi.co.za/public-participation).

A Public Meeting was held on 9 September 2014 at the Saldanha Bay Protea Hotel (51B Main Road) from 5 pm to 7 pm. The meeting included a presentation on the proposed project and provided an opportunity for I&APs to ask any questions that they may have had about the proposed project. All comments on the EMP was ~~be~~ submitted to J&G (see details below) by no later than 22 September 2014.

Company	Jeffares & Green (Pty) Ltd Ms
Attention:	Anèl Dannhauser
Tel:	(021) 532 0940
Fax:	(021) 532 0950
Address:	PO Box 38561, Pinelands, 7430
Email:	dannhausera@jgi.co.za

2.1.3.6 OPPORTUNITY TO COMMENT– UPDATED EMPR

The updated EMPr will be released for a 30-day public comment and review period from 31 July 2025 until 01 September 2025. A copy of the updated EMPr will be made available at the following locations for review:

- Hard copy of the updated EMPr are available at the following locations for review:
    - A.J Bekeur Library (Robson Street, Port Nolloth, Richtersveld)
    - Kamiesburg Local Municipality (Wag Way Street, Hondeklip Bay)
    - Lamberts Bay Public Library (Church Street, Lamberts Bay)
    - Elands Bay Public Library (Main Road, Elands Bay)
    - St Helena Bay Library (2 Albertros Street, St Helena Bay)
    - Vredenburg Public Library (2 Academy Street (close to West Coast College), Vredenburg)

- An electronic copy can be downloaded from the EIMS Website: https://www.eims.co.za/public-participation

All comments on the EMP must be submitted to EIMS (see details below) by no later than 01 September 2025.

Company	EIMS (Pty) Ltd
Attention:	Miss Monica Niehof
Tel:	(011) 789 7170
Fax:	(086) 571 - 9047
Email:	Block3a4a@eims.co.za

2.2 DESCRIPTION OF AFFECTED ENVIRONMENT – MARINE ENVIRONMENT (OFFSHORE)

Information relating to the affected environment has been extracted from the Marine Fauna Specialist Report (to view the full report, see Appendix 4). The information from the baseline marine environment section of the specialist report was in turn based on information gleaned from Lane & Carter (1999), CCA & CMS (2001) and Penney et al. (2007) and more recent scientific studies undertaken in the general area. The description of benthic macrofaunal communities was provided by Natasha Karenyi of the South African National Biodiversity Institute and the section on marine mammals was provided by Dr Simon Elwen of the Namibian Dolphin Project and Mammal Research Institute (University of Pretoria) for a similar seismic exploration project on the West Coast. Information relating to the fisheries sector has been extracted from the Fishing Specialist Study (to view full report, see Appendix 5).

2.2.1 GEOPHYSICAL CHARACTERISTICS

2.2.1.1 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 (180 km) off the Orange River (Figure 14). 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 nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle and outer shelf normally lacks relief and slopes gently seawards reaching the shelf break at a depth of ~300 m.

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. Child's Bank 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 at its shallowest point. The bank area has been estimated to cover some 1 450 km2 (Sink et al. 2012).

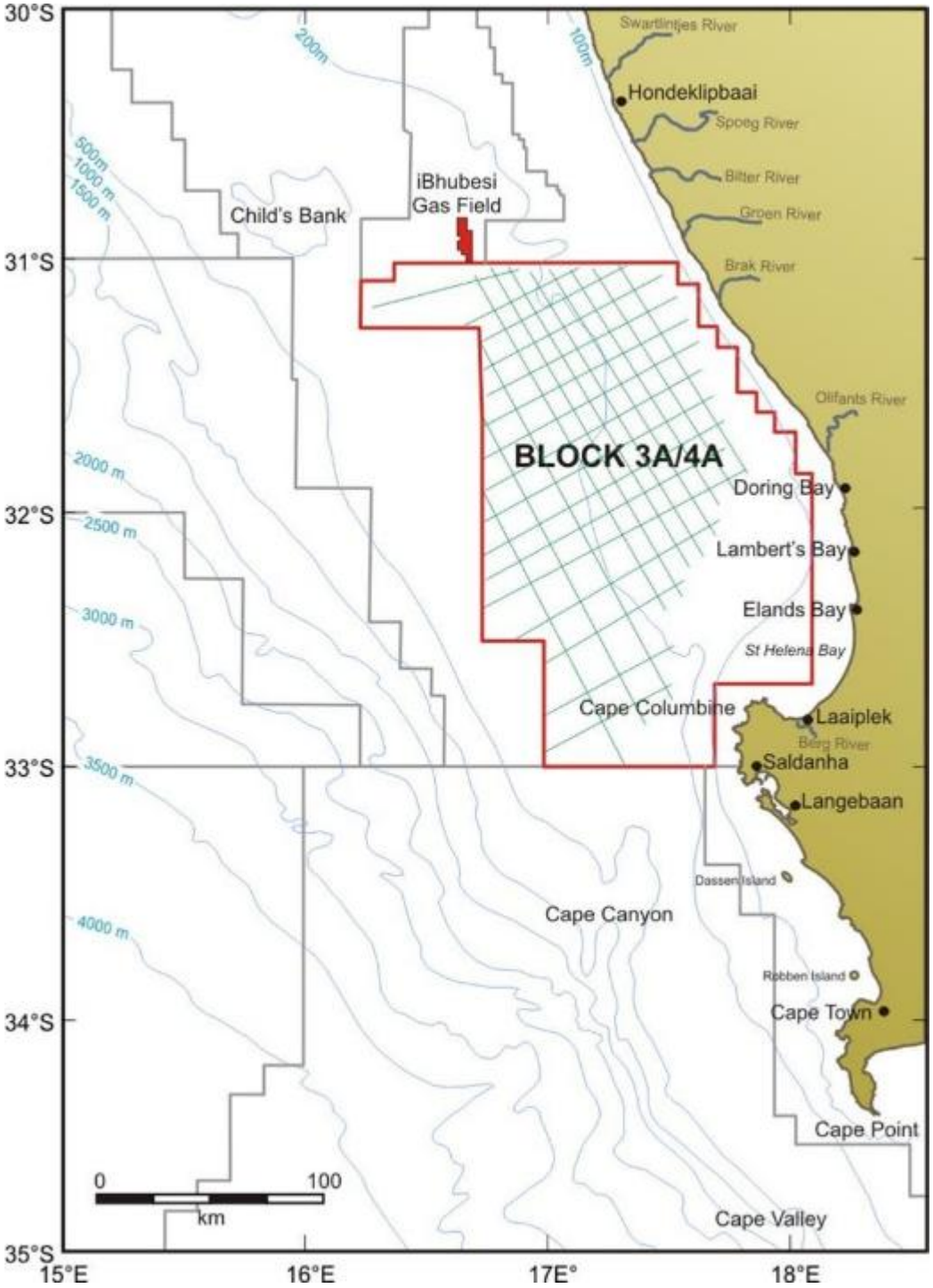


Figure 14: Bathymetry of the South African West Coast showing the 3A/4A Exploration Area (red polygon) in relation to other petroleum licence blocks and features and places mentioned in the text. The proposed 2D survey lines are shown in green, however, the exact configuration is yet to be finalised and may cover the entire block (Pulfrich, 2014).

2.2.1.2 COASTAL AND INNER-SHELF GEOLOGY AND SEABED GEOMORPHOLOGY

The distribution of seabed surface sediment types off the South African north-western coast is illustrated in Figure 15. 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 inner shelf between the Orange River and St Helena Bay (Birch et al. 1976). Further offshore, sediment is dominated by muds and sandy muds. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

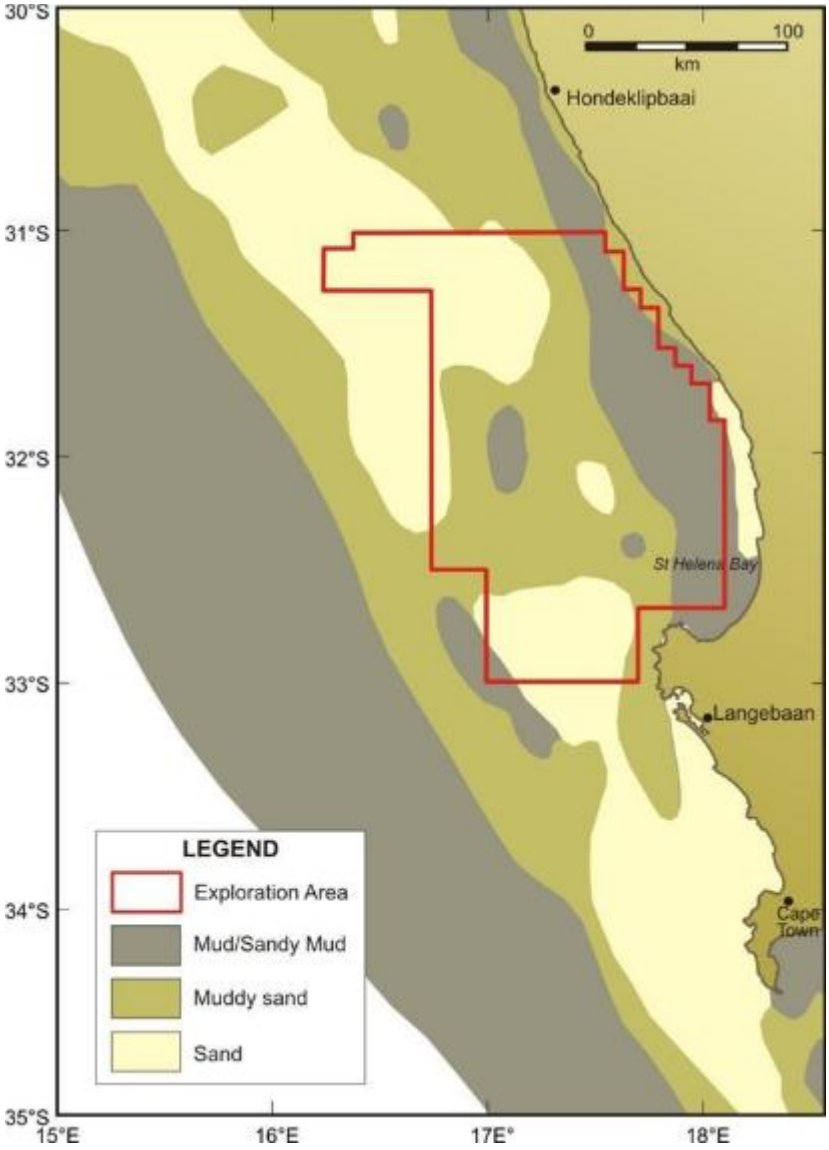


Figure 15: Sediment distribution on the continental shelf off the South African West Coast in relation to the Block 3A/4A Exploration Area (adapted from Rogers 1977) (Pulfrich, 2014).

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.

2.2.2 BIOPHYSICAL CHARACTERISTICS

2.2.2.1 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, and gales (winds exceeding 18 m/s or 35 kts) are frequent (CSIR 2006). Virtually all winds in summer come from the south to south-southeast, averaging 20 - 30 kts and reaching speeds in excess of 100 km/h (60 kts). The combination of these southerly/south-easterly winds drives the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer.

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. This ‘reversal’ from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shoreward and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 4% 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.

2.2.2.2 LARGE-SCALE CIRCULATION AND COASTAL CURRENTS

The southern African West Coast is strongly influenced by the Benguela Current. 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. On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current, resulting in considerable variation in current speed and direction over the domain. 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) (Figure 16). 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; Boyd & Oberholster 1994; Shannon & Nelson 1996).

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 (average sea surface temperature 10 - 14°C). 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 Cape Point (34°S), Cape Columbine (33°S) and Namaqua (30°S) upwelling cells (Taunton-Clark 1985). Of these,

the Cape Columbine upwelling cell falls within the proposed Exploration Area. Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March.

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. The surface water of the Agulhas Current is generally >21 °C, and its influence west of Cape Agulhas results in average sea surface temperatures in the southern Benguela of 16 - 20 °C (Shannon 1985). During the process of ring formation, intrusions of cold sub-Antarctic 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)

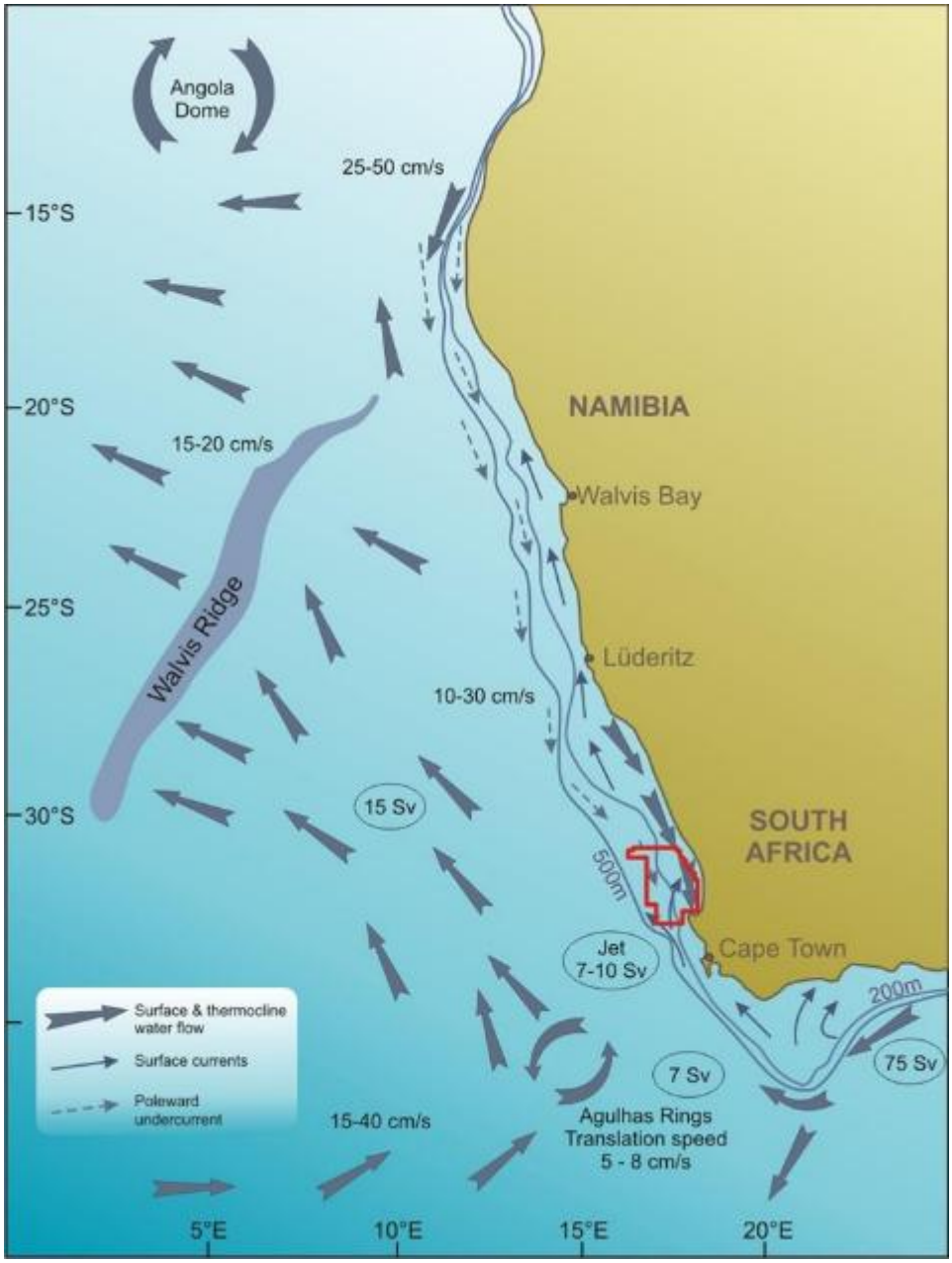


Figure 16: Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (re-drawn from Shannon & Nelson 1996) (Pulfrich, 2014).

2.2.2.3 WAVES AND TIDES

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action, rating between 13-17 on the 20 point exposure scale (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds characteristic of the region. The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

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, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

2.2.2.4 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 (approximately 80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey et al. 1985; Chapman & Shannon 1985).

2.2.2.5 UPWELLING AND PLANKTON PRODUCTION

During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (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.

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. Biological decay of

plankton blooms can in turn lead to “black tide” events, as the available dissolved oxygen is stripped from the water during the decomposition process. Subsequent anoxic decomposition by sulphur reducing bacteria can result in the formation and release of hydrogen sulphide (Pitcher & Calder 2000).

2.2.2.6 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/km2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone (Shannon et al. 2003). It is estimated that 36% of the phytoplankton and 5% of the zooplankton is 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.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (see Shannon & Pillar 1985; Pitcher 1998). 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.

2.2.2.7 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).

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. During storm events, concentrations near the seabed may even reach up to 10,000 mg/ℓ (Miller & Sternberg 1988). In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured 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 re-suspending and transporting considerable quantities of sediment equatorward. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington et al. 1990; Rogers & Bremner 1991).

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).

Mean sediment deposition is naturally higher near the seafloor due to constant re-suspension of coarse and fine PIM by tides and wind-induced waves. Aggregation or flocculation of small particles into larger aggregates occurs as a result of cohesive properties of some fine sediments in saline waters. The combination of re-suspension of seabed sediments by heavy swells, and the faster settling rates of larger inorganic particles, typically causes higher sediment concentrations near the seabed. Significant re-suspension of sediments can also occur up into the water column under stronger wave conditions associated with high tides and storms. Re-suspension can result in dramatic increases in PIM concentrations within a few hours (Sheng et al. 1994). Wind speed and direction have also been found to influence the amount of material re- suspended (Ward 1985).

2.2.3 BIOLOGICAL ENVIRONMENT

Biogeographically, the study area falls within the cold temperate Namaqua Bioregion (Emanuel et al. 1992; Lombard et al. 2004) (Figure 17).

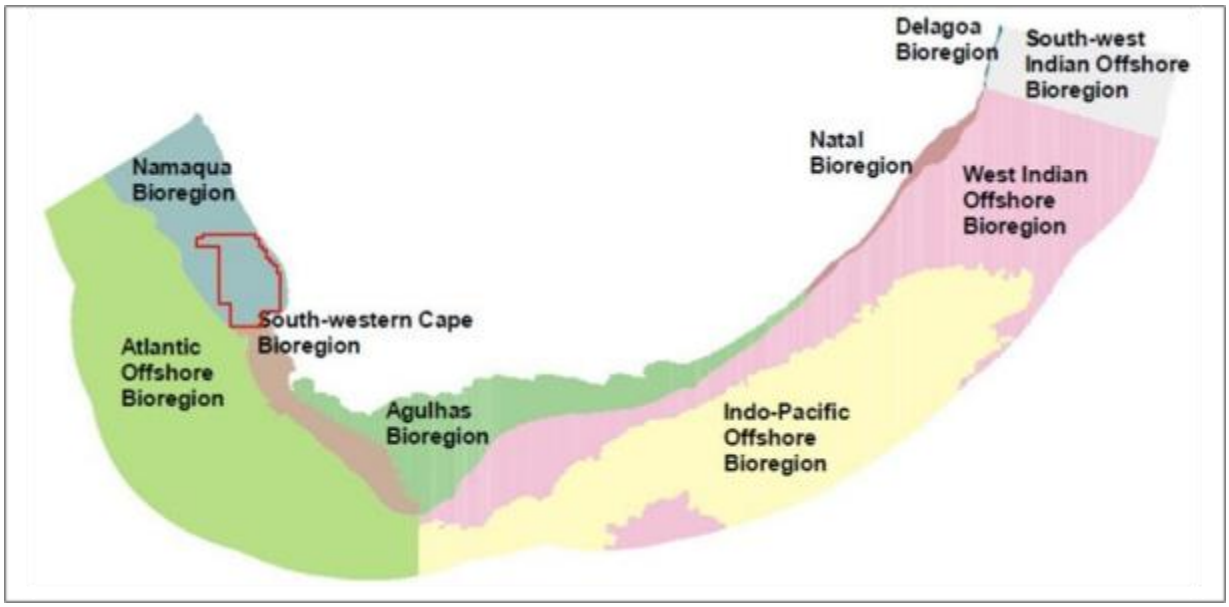


Figure 17: The South African inshore and offshore bioregions in relation to the Exploration Area (red polygon) (adapted from Lombard et al. 2004) (Pulfrich, 2014).

The coastal, wind-induced upwelling characterising the Western Cape coastline, is the principal 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. The West Coast is, however, characterized by low marine species richness and low endemicity (Awad et al. 2002).

2.2.3.1 NEARSHORE AND OFFSHORE UNCONSOLIDATED HABITATS BIOTA

The benthic biota of soft bottom substrates constitutes invertebrates that live on, or burrow within, the sediments, and are generally divided into megafauna (>10 cm), 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 impacts (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Environmental Evaluation Unit 1996; Parkins & Field 1997; 1998; Pulfrich & Penney 1999; Goosen et al. 2000; Savage et al. 2001; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b; Steffani 2009, 2010; Atkinson et al. 2011; Steffani 2012). The description below is drawn from recent surveys by Karenyi (unpublished data), De Beers Marine Ltd surveys in 2008 and 2010 (unpublished data), and Atkinson et al. (2011).

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth, Karenyi unpublished data) off the Namaqualand coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile predators (e.g. the gastropod Bullia laevissima and polychaete Nereis sp.), sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by the mud prawns Callianassa sp. and Calocaris barnardi. A second mid-shelf sandy community occurring in sandy sediments, is characterised by various polychaetes including deposit- feeding Spiophanes soederstromi and Paraprionospio pinnata.

Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast (Figure 18). 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).

Figure 18: Benthic macrofaunal genera commonly found in nearshore sediments include: (top: left to right) Ampelisca, Prionospio, Nassarius; (middle: left to right) Callianassa, Orbinia, Tellina; (bottom: left to right) Nephtys, hermit crab, Bathyporeia (Pulfrich, 2014).

Given the state of our current knowledge of South African macro-infauna it is not possible to determine the threat status or endemicity of macro-infauna species on the west coast, although such research is currently underway (pers. comm. Ms N. Karenyi, SANBI and NMMU). However, the marine component of the 2011 National Biodiversity Assessment (Sink et al. 2012), rated portions of the outer continental shelf on the West Coast as 'vulnerable', 'endangered' and 'critically endangered' (Figure 19). Particularly the area to the southeast of Child's Bank between the 200 m and 500 m depth contour has been rated as 'vulnerable', and nearshore areas on the inner shelf south of Cape Columbine have been rated as 'endangered'. There is, however, only minimal overlap of these on the north-western and southern boundaries of the Block 3A/4A Exploration Area, respectively.

Generally, species richness increases from the inner shelf across the mid shelf and is influenced by sediment type (Karenyi unpublished data). 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 further offshore.

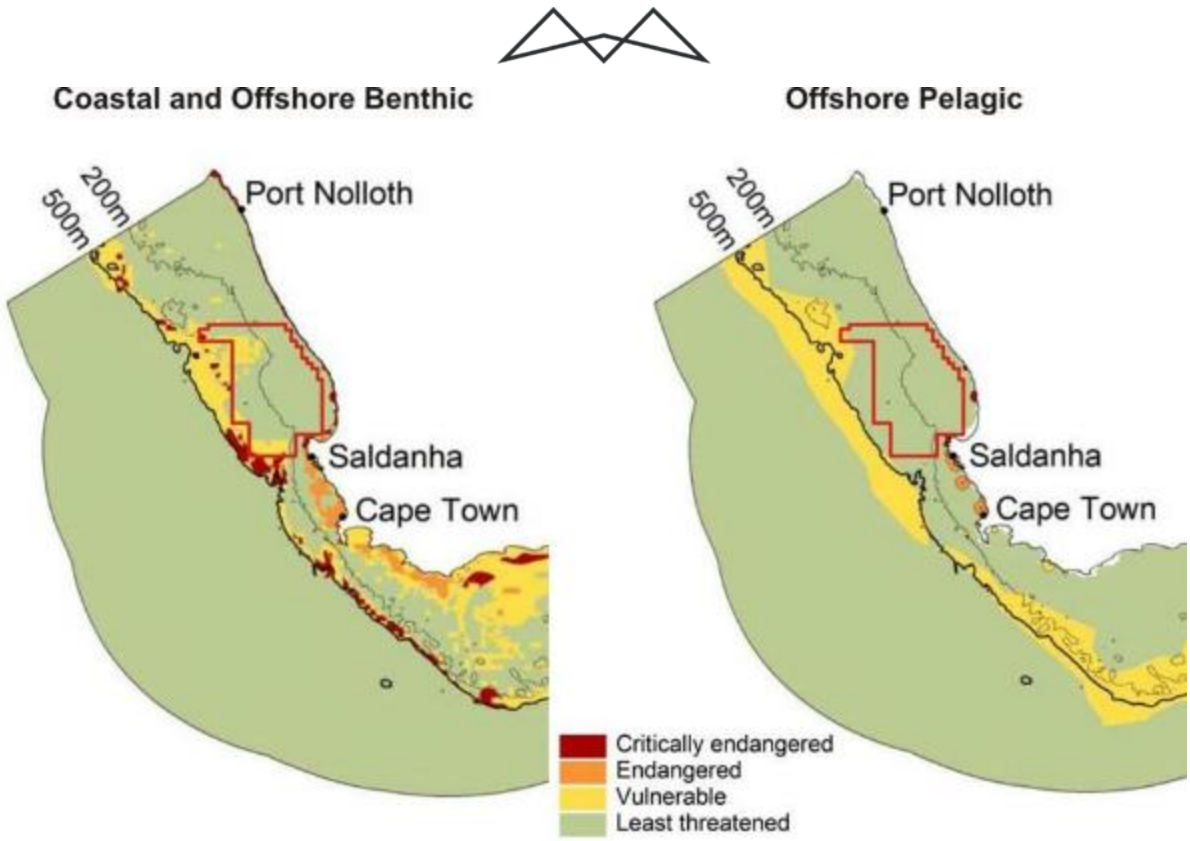


Figure 19: Ecosystem threat status for coastal and offshore benthic habitat types (left), and offshore pelagic habitat types on the South African West Coast in relation to the Exploration Area (red polygon) (adapted from Sink et al. 2012) (Pulfrich, 2014).

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), 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 deepwater 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.

2.2.3.2 OFFSHORE BIODIVERSITY PRIORITIES

Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments, a systematic biodiversity plan has been developed for the West Coast with the objective of identifying coastal and offshore priority focus areas for MPA expansion (Sink et al. 2011; Majiedt et al. 2013). 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. Those within the general project area and potentially affected by the proposed exploration activities are illustrated in Figure 20.

The biodiversity data were used to identify nine focus areas for protection on the West Coast between Cape Agulhas and the South African – Namibian border. Those within the broad project area shown in Figure 21. The Exploration Area overlaps with the southern portion of the Child's Bank, offshore portions of the Rietpoort and north-western portion of the West Coast Consolidated focus areas. Of these, the West Coast Consolidation spans two ecoregions and includes coastal, inshore and offshore habitat types, including the Cape Canyon and five existing MPAs within the West Coast National Park. This is the only focus area where targets for the Namaqua Boulder Shore (Critically Endangered) and Southern Benguela Canyon (Critically Endangered) can be met. Additional threatened habitat types that require protection within this area include Namaqua inner shelf reef (Critically Endangered) (Majiedt et al. 2013). Of principal importance in the general project area is the proposed Namaqua MPA, which stretches between the Groen and Spoeg Rivers and adjacent to the Namaqua National Park. This area meets habitat targets for 14 habitat types including Critically Endangered habitat types such as Namaqua Inshore Reef, Namaqua Inshore Hard Grounds and Namaqua Sandy Inshore. This area lies immediately to the north of the northern boundary of Block 3A/4A.

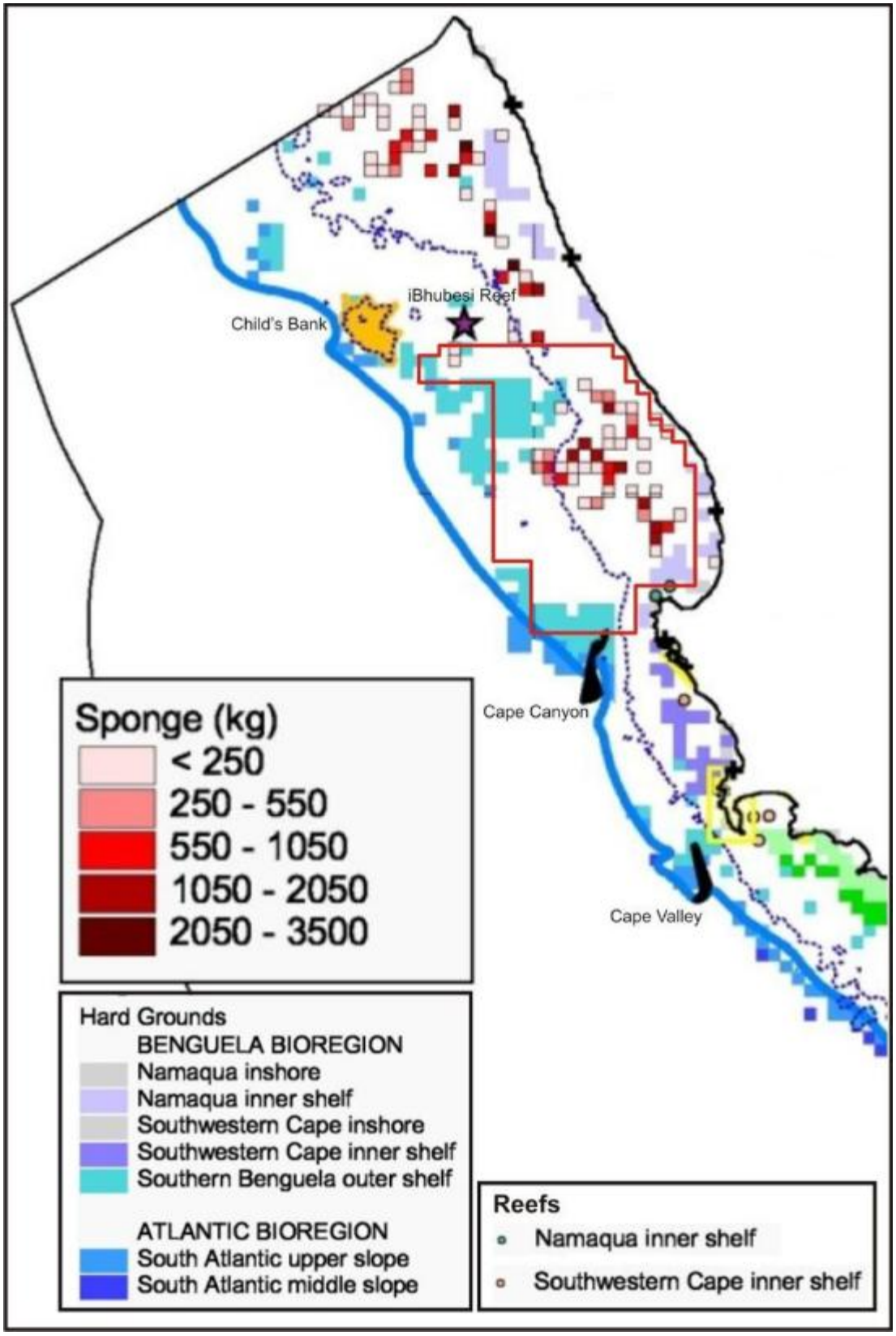


Figure 20: Potential Vulnerable Marine Ecosystems (VMEs) on the West Coast in relation to the Exploration Area (red polygon) (adapted from Sink et al. 2011) (Pulfrich, 2014).

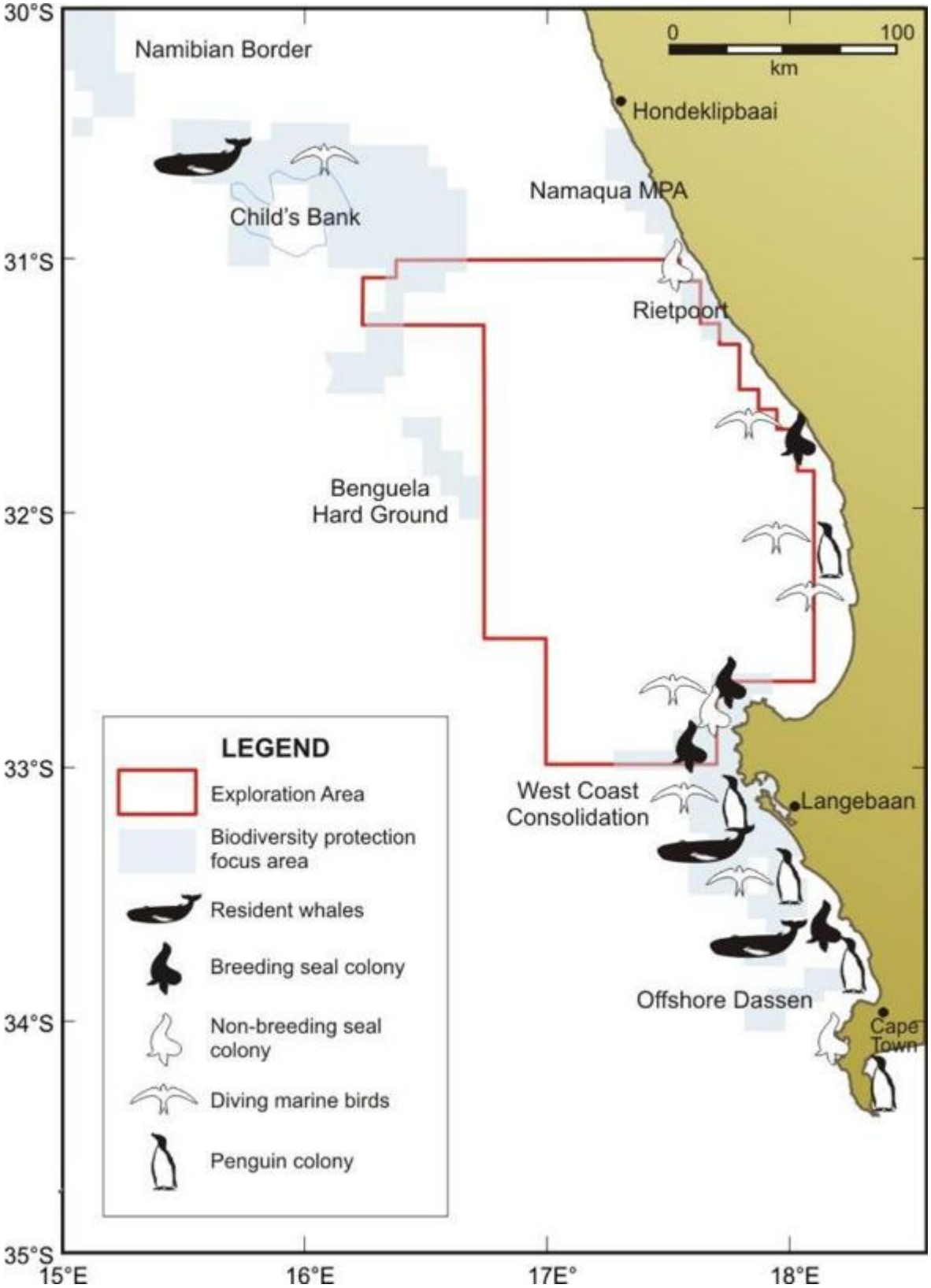


Figure 21: Areas identified by Majiedt et al. (2013) as priority areas for the protection of benthic and pelagic habitats are shaded blue (Pulfrich, 2014).

2.2.3.3 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. 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. Deep water corals are known from the iBhubezi Reef to the east of the Gas Field. Furthermore, evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off southern Namibia and to the south-east of Child's Bank (De Beers Marine, unpublished data) (Figure 22) suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges do occur on the continental shelf.

Figure 22: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine) (Pulfrich, 2014).

A geological feature of note is the carbonate mound (bioherm), Child's Bank (Dingle et al. 1987) located north-west of the Licence Block. Composed of sediments and the calcareous deposits from an accumulation of carbonate skeletons of sessile organisms (e.g. cold-water coral, foraminifera or marl), such features typically have topographic relief, forming isolated seabed knolls in otherwise low-profile homogenous seabed habitats (Kopaska-Merkel & Haywick 2001; Kenyon et al. 2003; Wheeler et al. 2005; Colman et al. 2005). 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.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

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 many species (SPRFMA 2007).

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts (Rogers 1994). Deep- and cold-water corals (including stony corals, black corals and soft corals) (Figure 23, left) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994; Kenyon et al. 2003). Some of the smaller cnidarian's species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework (Figure 23, right) thereby creating spatially fragmented areas of high biological diversity. Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers et al. 2008). Levels of endemism on seamounts are also relatively high compared to the deep sea. As a result of conservative life histories (i.e. very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

Figure 23: Seamounts are characterised by a diversity of deep-water corals that add structural complexity to seabed habitats and offer refugia for a variety of invertebrates and fish (Photos: www.dfo-mpo.gc.ca/science/Publications/article/2007/21-05-2007-eng.htm, Ifremer & AWI 2003) (Pulfrich, 2014).

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. South Africa's seamounts and their associated benthic communities have not been extensively sampled by either geologists or biologists (Sink & Samaai 2009).

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).

2.2.3.4 FISH

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 with increasing depth (Roel 1987; Smale et al. 1993; Macpherson & Gordoa 1992; Bianchi et al. 2001; Atkinson 2009), with the most substantial change in species composition occurring in the shelf break region between 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 cartilaginous fishes on the West Coast is discussed by Compagno et al. (1991). The species that may occur on the continental shelf in the general project area, and their approximate depth range, are listed in Table 4.

Table 4: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Compagno et al. 1991) (Pulfrich, 2014).

COMMON NAME	SCIENTIFIC NAME	DEPTH RANGE (M)
Frilled shark	*Chlamydoselachus anguineus*	**200-1,000**
Six gill cowshark	*Hexanchus griseus*	**150-600**
Bramble shark	*Echinorhinus brucus*	**55-285**
Arrowhead dogfish	*Deania profundorum*	**200-500**
Longsnout dogfish	*Deania quadrispinosum*	**200-650**
Spotted spiny dogfish	*Squalus acanthias*	**100-400**
Shortnose spiny dogfish	*Squalus megalops*	**75-460**
Shortspine spiny dogfish	*Squalus mitsukurii*	**150-600**
Sixgill sawshark	*Pliotrema warren*	**60-500**
Tigar catshark	*Halaelurus natalensis*	**50-100**
Izak catshark	*Holohalaelurus regani*	**100-500**
Yellowspotted catshark	*Scyliorhinus capensis*	**150-500**
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	**<10-300**
Houndshark	*Mustelus mustelus*	**<100**
Whitespotted houndshark	*Mustelus palumbes*	**>350**
Little guitarfish	*Rhinobatos annulatus*	**>100**
Atlantic electric ray	*Torpedo nobiliana*	**120-450**

COMMON NAME	SCIENTIFIC NAME	DEPTH RANGE (M)
Roughnose legskate	*Crurirajaparcomaculata*	**150-620**
Thorny skate	***Raja radiata***	**50-600**

Pelagic Communities

In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the 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. Noteworthy is that the marine component of the 2011 National Biodiversity Assessment (Sink et al. 2012), rated the majority of the offshore pelagic habitat types as 'least threatened' (see Figure 19, right), with only a narrow band along the shelf break of the West Coast being rated as 'vulnerable', primarily due to its importance as a migration pathway for various resource species (e.g. whales, tuna, billfish, turtles).

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 (Figure 24).

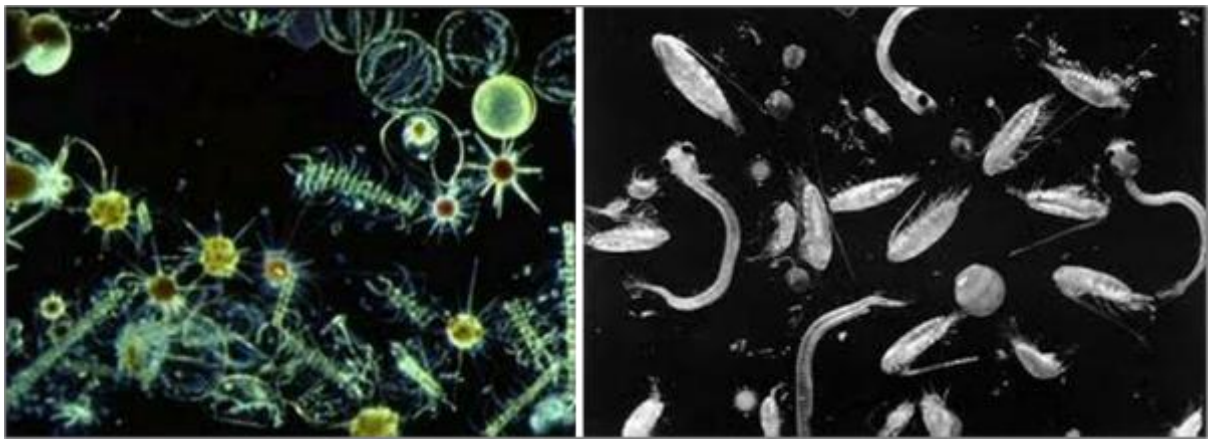


Figure 24: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells (Pulfrich, 2014).

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m2/day for the midshelf region and decreasing to 1 g C/m2/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.

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are Centropages brachiatus, Calanoides carinatus, Metridia lucens, Nannocalanus minor, Clausocalanus arcuicornis, Paracalanus parvus, P. crassirostris and

Ctenocalanus vanus. All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, except for M. lucens which undertakes considerable vertical migration.

The macrozooplankton (≥1,600 µm) are dominated by euphausiids of which 18 species occur in the area. The dominant species occurring in the nearshore are Euphausia lucens and Nyctiphanes capensis, although neither species appears to survive well in waters seaward of oceanic fronts over the continental shelf (Pillar et al. 1991).

Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1-1.0 g C/m2, with production increasing north of Cape Columbine (Pillar 1986). Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplanktors (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 Tripp seamount in response to topographically steered upwelling around such seabed features.

Zooplankton biomass 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.

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) (see Figure 26), and their eggs and larvae form an important contribution to the ichthyoplankton in the region. Ichthyoplankton abundance within the Exploration Area is thus expected to be high.

Pelagic Fish

Fish species commonly found in kelp beds off the West Coast include hottentot Pachymetopon blochii (Figure 25, left), twotone fingerfin Chirodactylus brachydactylus (Figure 25, right), red fingers Cheilodactylus fasciatus, galjoen Dichistius capensis, rock suckers Chorisochismus dentex, maned blennies Scartella emarginata and the catshark Haploblepharus pictus (Sauer et al. 1997; Brouwer et al. 1997; Branch et al. 2010).

Figure 25: Common fish found in kelp beds include the Hottentot fish (left, photo: commons. wikimedia.org) and the twotone fingerfin (right, photo: www.parrphotographic.com) (Pulfrich, 2014).

Small pelagic species occurring beyond the surfzone and generally within the 200 m contour 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 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). 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.

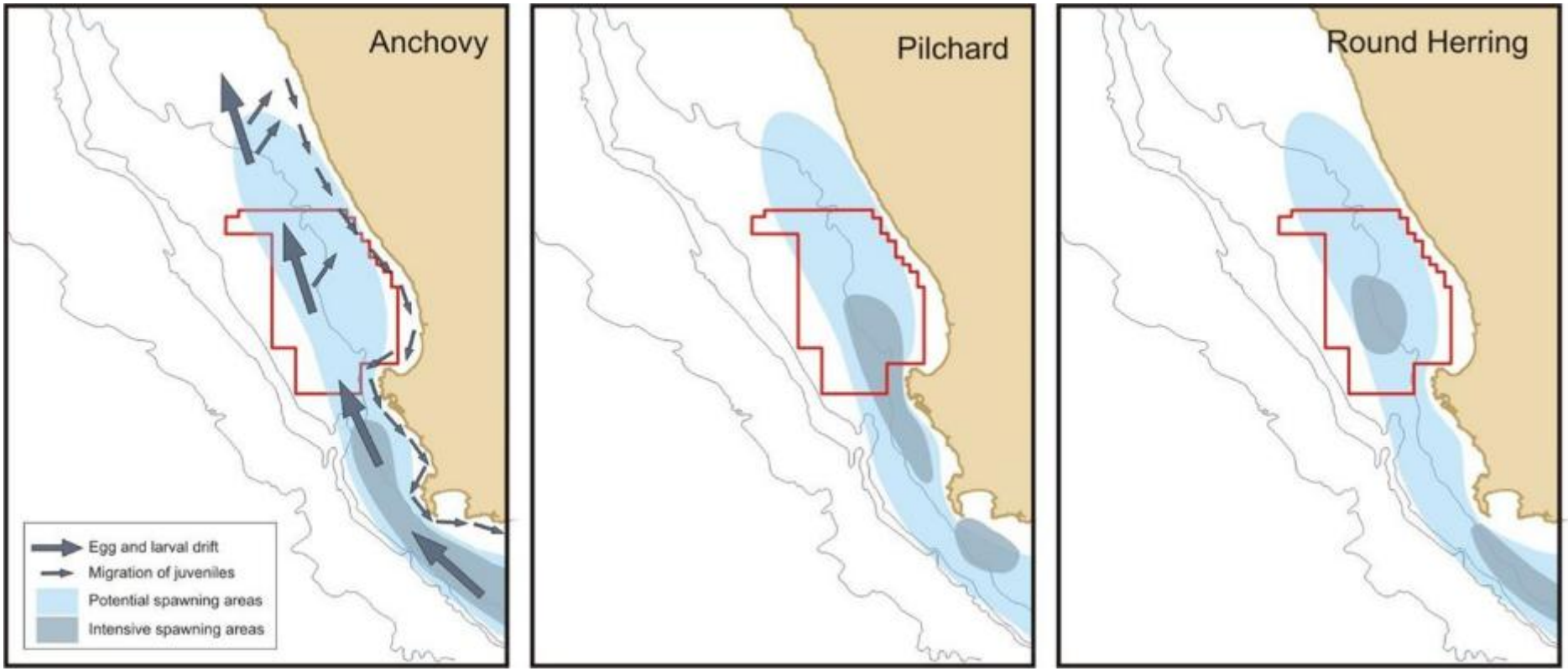


Figure 26: Major spawning areas in the southern Benguela region in relation to the Exploration Area (red polygon) (adapted from Cruikshank 1990) (Pulfrich, 2014).

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. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). 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).

Large pelagic species include tunas, billfish and pelagic sharks, which 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 (Figure 27, right), yellowfin T. albacares, bigeye T. obesus, and skipjack Katsuwonus pelamis tunas, as well as the Atlantic blue marlin Makaira nigricans (Figure 27, left), the white marlin Tetrapturus albidus and the broadbill swordfish Xiphias gladius (Payne & Crawford 1989). The distributions of these species are dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. These species have a highly seasonal abundance in the Benguela and show seasonal associations with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts (Penney et al. 1992). Seasonal association with Child's Bank to the north of the Exploration Area occurs between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/ NAM/body.htm; see CapFish 2014 – Fisheries Specialist Study).

Several 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 may also be encountered in coastal and offshore areas. This species is a significant apex predator along the southern African coast, particularly in the vicinity of the seal colonies.

Figure 27: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters (photos: www.samathatours.com; www.osfimages.com) (Pulfrich, 2014).

Although not necessarily threatened with extinction, great whites are listed in Appendix II (species in which trade must be controlled to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and is described as "vulnerable" in the International Union for Conservation of Nature (IUCN) Red listing. In response to global declines in abundance, white sharks were legislatively protected in South Africa in 1991.

Many of the large migratory pelagic species are considered threatened by the IUCN, primarily due to overfishing (Table 5). 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, where the fins are removed and the remainder of the body discarded.

Table 5: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the West Coast (Pulfrich, 2014).

COMMON NAME	SPECIES	IUCN CONSERVATION STATUS
Tunas		
Southern Bluefin Tuna	*Thunnus maccoyii*	Critically Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened
Yellowfin Tuna	*Thunnus albacares*	Near Threatened
Frigate Tuna	*Auxis thazard*	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern
Billfish		
Blue Marlin	*Makaira nigricans*	Vulnerable
Sailfish	*Istiophorus platypterus*	Least concern
Swordfish	*Xiphias gladius*	Least concern
Black Marlin	*Istiompax indica*	Data deficient
Pelagic Sharks		
Pelagic Thresher Shark	*Alopias pelagicus*	Vulnerable
Common Thresher Shark	*Alopias vulpinus*	Vulnerable
Great White Shark	*Carcharodon carcharias*	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable
Longfin Mako	*Isurus paucus*	Vulnerable
Blue Shark	*Prionace glauca*	Near Threatened
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Vulnerable

2.2.3.5 CEPHALOPODS

Fourteen species of cephalopods have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish (Lipinski 1992; Augustyn et al. 1995). Most of the cephalopod resource is distributed on the mid-shelf 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). They form an important food item for demersal fish.

Pelagic invertebrates that may be encountered in the Exploration Area are the colossal squid Mesonychoteuthis hamiltoni and the giant squid Architeuthis sp. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-Antarctic Southern Ocean (Figure 28, left) while the giant squid is usually found near continental and island slopes all around the world's oceans (Figure 28, right). Both species

could thus potentially occur in the Exploration 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.

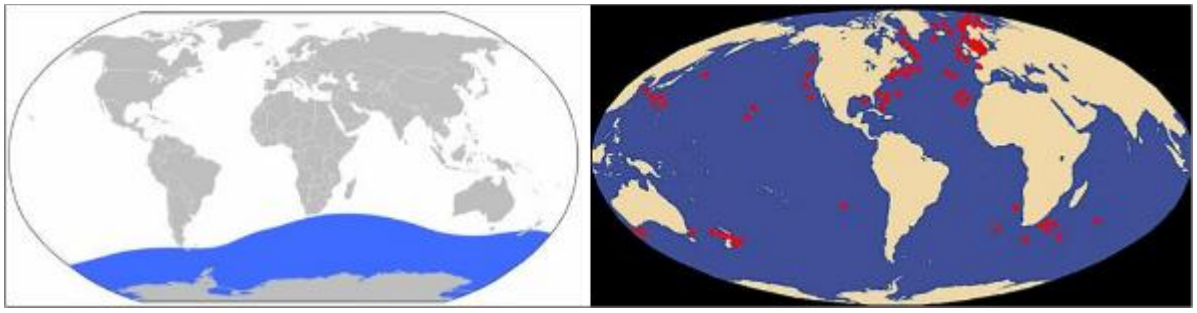


Figure 28: Distribution of the colossal squid (left) and the giant squid (right) (www.wikipedia.org) (Pulfrich, 2014).

2.2.3.6 TURTLES

Three species of turtle occur along the West Coast, namely the Leatherback (Dermochelys coriacea) (Figure 29, left), and occasionally the Loggerhead (Caretta caretta) (Figure 29, right) and the Green (Chelonia mydas) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast.

Figure 29: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com) (Pulfrich, 2014).

The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa. The Benguela ecosystem, especially the northern Benguela where jellyfish 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 southeast Indian Ocean (South Africa) (Lambardi et al. 2008, Elwen & Leeney 2011; SASTN 2011). 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) (Figure 30).

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). Loggerhead and green turtles 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.

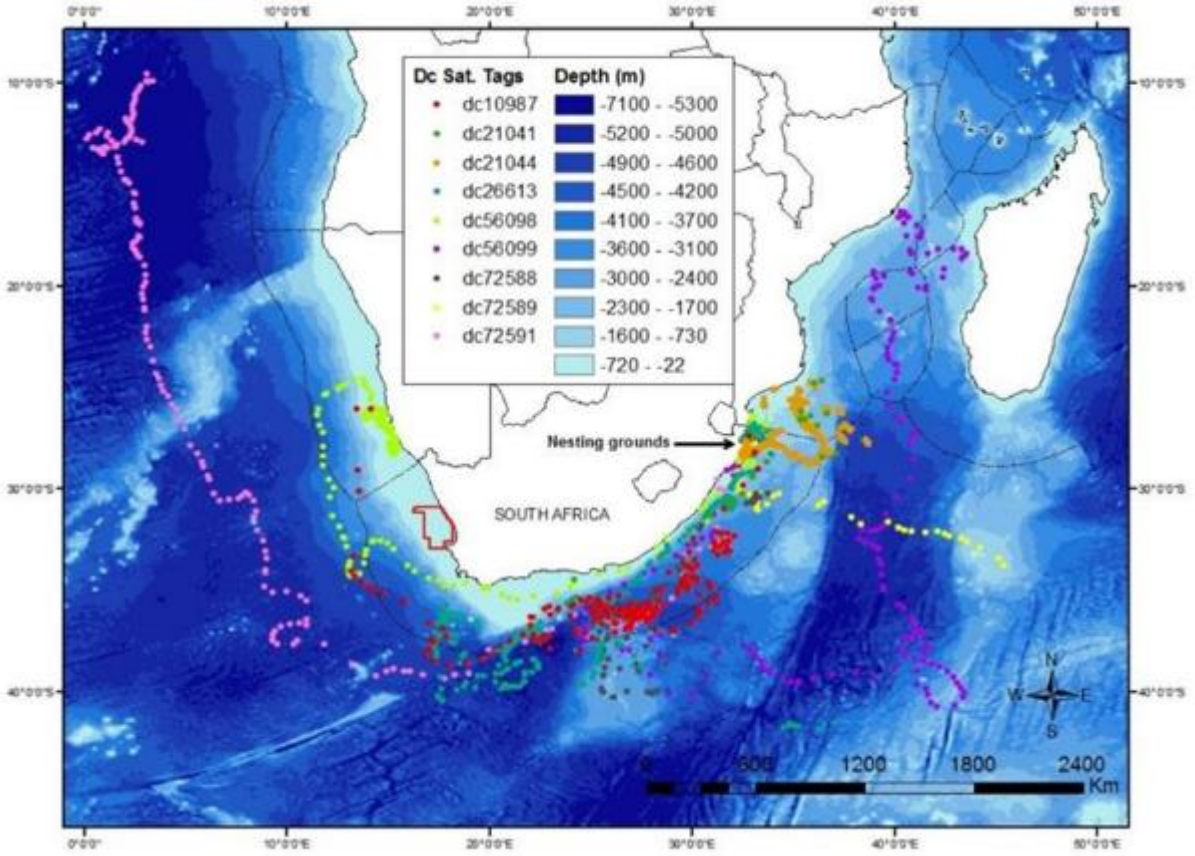


Figure 30: The post-nesting distribution of nine satellite tagged leatherback females (1996 – 2006; Oceans and Coast, unpublished data) in relation to the Exploration Area (red polygon) (Pulfrich, 2014).

2.2.3.7 SEABIRDS

Large numbers of coastal and pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the Southern Ocean. The 18 species classified as being common in the southern Benguela are listed in Table 6. 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 species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

Table 6: Pelagic seabirds common in the southern Benguela region (Crawford et al. 1991) (Pulfrich, 2014).

COMMON NAME	SPECIES NAME	GLOBAL IUCN
Shy albatross	*Thalassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Near Threatened
Yellow nosed albatross	*Thalassarche chlororhynchos*	Endangered
Giant petrel sp.	*Macronectes halli/giganteus*	Least concern
Pintado petrel	*Daption capense*	Least concern
Greatwinged petrel	*Pterodroma macroptera*	Least concern

COMMON NAME	SPECIES NAME	GLOBAL IUCN
Soft plumaged petrel	*Pterodroma mollis*	Least concern
Prion spp	*Pachyptila spp.*	Least concern
White chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Cory's shearwater	*Calonectris Diomedea*	Least concern
Great shearwater	*Puffinus gravis*	Least concern
Sooty shearwater	*Puffinus griseus*	Near Threatened
European Storm petrel	*Hydrobates pelagicus*	Least concern
Leach's storm petrel	*Oceanodroma leucorhoa*	Least concern
Wilson's storm petrel	*Oceanites oceanicus*	Least concern
Blackbellied storm petrel	*Fregetta tropica*	Least concern
Skua spp.	*Catharacta/Stercorarius spp.*	Least concern
Sabine's gull	*Larus sabini*	Least concern

14 species of seabirds breed in southern Africa; Cape Gannet (Figure 31, left), African Penguin (Figure 31, right), four species of Cormorant, White Pelican, three Gull and four Tern species (Table 7). The breeding areas are distributed around the coast with islands being especially important. Breeding islands within the project area are Bird Island at Lambert's Bay, the Saldanha Bay islands, Dassen Island off Yzerfontein and Robben Island in Table Bay. 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, however, are known to forage up to 140 km offshore (Dundee 2006; Ludynia 2007), and African Penguins have also been recorded as far as 60 km offshore.

Figure 31: Cape Gannets Morus capensis (left) (Photo: NACOMA) and African Penguins Spheniscus demersus (right) (Photo: Klaus Jost) breed primarily on the offshore Islands (Pulfrich, 2014).

Table 7: Breeding resident seabirds present along the West Coast (CCA & CMS 2001) (Pulfrich, 2014).

COMMON NAME	SPECIES NAME	GLOBAL IUCN STATUS
African Penguin	*Spheniscus demersus*	Endangered
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Endangered
Bank Cormorant	*Phalacrocorax neglectus*	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Least Concern
Cape Gannet	*Morus capensis*	Vulnerable
Kelp Gull	*Larus dominicanus*	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern

COMMON NAME	SPECIES NAME	GLOBAL IUCN STATUS
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Least Concern
Swift Tern	*Sterna bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Sterna balaenarum*	Near Threatened

2.2.3.8 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-four species of whales and dolphins are known (based on historic sightings or stranding records) or likely (based on habitat projections of known species parameters) to occur in these waters (Table 8). Apart from the resident species such as the endemic Heaviside's dolphin and dusky dolphin, the Benguela also hosts species that migrate between Antarctic feeding grounds and warmer breeding ground waters, as well as species with a global distribution. The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records prior to 1970. Current information on the distribution, population sizes and trends of most cetacean species occurring on the west coast of southern Africa is lacking. Information on smaller cetaceans in deeper waters and deep diving species (e.g. beaked whales) is particularly poor, and the precautionary principle must be used when considering possible encounters with cetaceans in this area.

Table 8: Cetacean species known or likely to occur and their likely encounter frequency within the Exploration Area based on the best available knowledge of density and seasonality. Note that for beaked whales, knowledge of numbers, density and encounter rates is particularly poor and (together with the Kogiids and pygmy right whale) they are difficult to detect visually and are thus likely to be underestimated in any visual survey, due to generally small group sizes and cryptic behaviour (Pulfrich, 2014).

COMMON NAME	SPECIES	SHELF	OFFSHORE	LIKELY ENCOUNTER FREQUENCY	IUCN CONSERVATION STATUS
Delphinids					
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Daily	Data Deficient
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Daily	Data Deficient
Common bottlenose dolphin	*Tursiops truncatus*	Yes	Yes	Monthly	Least Concern
Common (short beaked) dolphin	*Delphinus delphis*	Yes	Yes	Monthly	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	Yes	Yes	Occasional	Data Deficient
Striped dolphin	*Stenella coeruleoalba*	Yes	Rare	Very rare	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	Edge	Yes	Very rare	Least Concern
Long-finned pilot whale	*Globicephala melas*	Edge	Yes	Daily	Data Deficient
Short-finned pilot whale	*Globicephala macrorhynchus*	Edge	Yes	Vagrant	Data Deficient
Rough-toothed dolphin	*Steno bredanensis*	Edge	Yes	Very rare	Least Concern
Killer whale	*Orcinus orca*	Occasional	Yes	Occasional	Data Deficient
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Occasional	Data Deficient
Pygmy killer whale	*Feresa attenuata*	Edge	Yes	Rare	Data Deficient
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	Occasional	Least Concern
Sperm whales					
Pygmy sperm whale	*Kogia breviceps*	Edge	Yes	Occasional	Data Deficient
Dwarf sperm whale	*Kogia sima*	Edge	?	Very rare	Data Deficient
Sperm whale	*Physeter macrocephalus*	Edge	Yes	Occasional	Vulnerable
Beaked whales					
Cuvier's	*Ziphius cavirostris*	No	Yes	Occasional	Least Concern
Arnoux's	*Beradius arnouxii*	No	Yes	Occasional	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	No	Yes	Occasional	Not assessed

COMMON NAME	SPECIES	SHELF	OFFSHORE	LIKELY ENCOUNTER FREQUENCY	IUCN CONSERVATION STATUS
Layard's	*Mesoplodon layardii*	No	Yes	Occasional	Data Deficient
True's	*M. mirus*	No	Yes		Data Deficient
Gray's	*M. grayi*	No	Yes	Occasional	Data Deficient
Blainville's	*M. densirostris*	No	Yes		Data Deficient
Baleen whales					
Antarctic Minke	*Balaenoptera bonaerensis*	Yes	Yes	Monthly	Data Deficient
Dwarf minke	*B. acutorostrata*	Yes	Yes	Occasional	Least Concern
Fin whale	*B. physalus*	Yes	Yes	Occasional	Endangered
Blue whale	*B. musculus*	No	Yes	Very Rare	Endangered
Sei whale	*B. borealis*	Yes	Yes	Occasional	Endangered
Bryde's (offshore)	*B. brydei*	Yes	Yes	Occasional	Not assessed
Bryde's (inshore)	*B brydei (subspp)*	Yes	Yes	Occasional	Data Deficient
Pygmy right	*Caperea marginata*	Yes	?	Occasional	Least Concern
Humpback	*Megaptera novaeangliae*	Yes	Yes	Daily	Least Concern
Southern right	*Eubalaena australis*	Yes	No	Daily	Least Concern

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, as well as those more commonly associated with colder waters of the west coast (e.g. dusky dolphins and long finned pilot whales) and those of the warmer east coast (e.g. striped and Risso's dolphins) (Findlay et al. 1992). The location of the survey lies north of this transition zone and can be truly on the 'west coast'. However, the warmer waters that occur offshore of the Benguela ecosystem (more than ~100km offshore and on the western edge of the Exploration Area) provide an entirely different habitat, that despite the relatively high latitude may host some species associated with the more tropical and temperate parts of the Atlantic such as rough toothed dolphins, Pan-tropical spotted dolphins and short finned pilot whales. Owing to the uncertainty of species occurrence offshore, species that may occur 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. The continental slope (200 - 2 000 m) tends to support the highest diversity of cetaceans, as species from both shelf and pelagic environments may be found. Cetacean density (i.e. number of animals encountered) on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across thousands of kilometres.

Cetaceans comprise 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 behaviour and acoustic behaviour, these two groups are considered separately.

Table 8 lists the cetaceans likely to be found within the impact zone , based on data sourced from: Findlay et al. (1992), Best (2007), Weir (2011), Dr J-P. Roux, (MFMR pers. comm.) and unpublished records held by the Namibian Dolphin Project. Of the 34 species listed, three are endangered and one is considered vulnerable (IUCN Red Data list Categories). Altogether 18 species are listed as “data deficient” underlining how little is known about their distributions and population trends. Most 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.

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 (<200 m). All 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, 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. Because of the complexities of the migration patterns, each species is discussed separately below, and a best estimate of expected seasonality within the Licence Block is provided in Table 9.

The most abundant baleen whales in the Benguela are Southern Right whales and Humpback whales (Figure 32). In the last decade, both species have been increasingly observed to remain on the west coast of South Africa well after the 'traditional' South African whale season (June - November) into spring and early summer (October

- February) where they have been observed feeding in upwelling zones, especially off Saldanha and St Helena Bays (Barendse et al. 2011; Mate et al. 2011). Increasing numbers of summer records of both species, suggest that animals may also be feeding near the Lüderitz upwelling cell in southern Namibia (NDP unpubl. dat

Figure 32: The Humpback whale Megaptera novaeangliae (left) and the Southern Right whale Eubalaena australis (right) are the most abundant large cetaceans occurring along the southern African West Coast (Photos: www.divephotoguide.com; www.aad.gov.au) (Pulfrich, 2014).

Table 9: Seasonality of baleen whales in the impact zone based on data from multiple sources, predominantly commercial catches (Best 2007 and other sources) and data from stranding events (NDP unpubl data). Values of high (H), Medium (M) and Low (L) of the particular species within each month are relative within each row (species) and not comparable between species (Pulfrich, 2014).

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bryde's Inshore	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's Offshore	H	H	H	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	H	H	L	H	H	H	L	L
Fin	M	M	M	H	H	H	M	H	H	H	M	M
Blue	L	L	L	L	L	H	H	H	L	M	L	L
Minke	M	M	M	H	H	H	M	H	H	H	M	M
Humpback	M	M	L	L	L	H	H	M	M	L	M	H
Southern Right	H	M	L	L	L	H	H	H	M	M	H	H
Pygmy right	H	H	H	M	L	L	L	L	L	L	M	M

Humpback Whale (Megaptera novaeangliae)

Most humpback whales passing through the Benguela are migrating to breeding grounds off tropical West Africa, between Angola and the Gulf of Guinea (Rosenbaum et al. 2009; Barendse et al. 2010). A recent synthesis of available humpback whale data from Namibia (Elwen et al. 2013) shows that in coastal waters, the northward migration stream is larger than the southward peak supporting earlier observations from whale catches (Best and Allison 2010). This supports previous suggestions that animals migrating north strike the coast at varying places mostly north of St Helena Bay (South Africa) resulting in increasing whale density on shelf waters as one moves north towards Angola, but no clear migration 'corridor'. On the southward migration, there is evidence that many humpback whales follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including most mother-calf pairs), possibly lingering in the feeding grounds off Cape Columbine in summer (Elwen et al. 2013, Rosenbaum et al. 2014). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse et al. 2010; Best and Allison 2010; Elwen et al. 2013). Recent abundance estimates put the number of animals in the west African breeding population to be more than 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased since this time at about 5% per annum (IWC 2012). Humpback whales are thus likely to be the most frequently encountered baleen whale in the Licence Block, ranging from the coast out beyond the shelf, with year-round presence but numbers peaking in June – July (northern migration) and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.

Southern Right Whale (Eubalaena australis)

The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is a single population within this range (Roux et al. 2011). The most recent abundance estimate for this population is available for 2008 which estimated the population at ~4 600 individuals including all age and sex classes, which is thought to be at least 23% of the original population size (Brandaõ et al. 2011). Since the population is continuing to grow at ~7% per year (Brandaõ et al. 2011), the population size in 2013 would number more than 6 000 individuals. When the population numbers crashed, due to whaling, 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) and Mozambique (Banks et al. 2011). Southern right whales are seen regularly in the nearshore waters of the West Coast (<3km from shore), extending north into southern Namibia (Roux et al. 2001, 2011). Right whales have been recorded in West Coast waters in all months of the year (J-P Roux pers comm) but with numbers peaking in winter (June - September).

In the last decade, deviations from the predictable and seasonal migration patterns of these two species have been reported from the Cape Columbine – Yzerfontein area (Best 2007; Barendse et al. 2010). High abundances of both Southern Right and Humpback whales in this area during spring and summer (September-February), indicates that the upwelling zones off Saldanha and St Helena Bay may serve as an

important summer feeding area (Barendse et al. 2011, Mate et al. 2011). It was previously thought that whales feed only rarely while migrating (Best et al. 1995), but these localised summer concentrations suggest that these whales may in fact have more flexible foraging habits.

Bryde's Whale (Balaenopter edeni)

Two genetically and morphologically distinct populations of Bryde's whales live off the coast of southern Africa (Best 2001; Penry 2010) (Figure 33, left). The 'offshore population' lives beyond the shelf (>200m 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 broader potential impact zone in January - March. The 'inshore population' of Bryde's whales is unique amongst baleen whales in the region by being non-migratory. Bryde's whales live on the continental shelf and Agulhas Bank ranging from approximately Durban in the east to at least St Helena Bay off the west coast. They may move further north into the Benguela current areas off the west of coast of South Africa and Namibia, especially in the winter months (Best 2007).

Figure 33: The Bryde's whale Balaenoptera brydeileft) and the Minke whale Balaenoptera bonaerensis (right) (Photos: www.dailymail.co.uk; www.marinebio.org) (Pulfrich, 2014). Sei Whale (*Balaenoptera borealis*)

Almost all information on this species from the southern African sub-region originates from whaling data from shore based whaling stations in the Saldanha Bay area, which operated from 1958-1963. Sei whales spend time at high latitudes (40-50°S) during summer months and migrate north through South African waters where they were historically hunted in high numbers, to unknown breeding grounds further north (Best 2007). Since whaling catches were confirmed off Congo and Angola, it is likely that they migrate through the impact zone. Due to their migration pattern, densities in the broader potential impact zone are likely to show a bimodal peak with numbers predicted to be highest in May - June and again in August - October. During hunting, all whales were caught in waters deeper than 200 m with most caught deeper than 1,000 m (Best and Lockyer 2002). Importantly, there may be considerable variation in the number of sei whales within an area between years, which may be influenced by food availability in feeding areas. However, a recent sighting of a sei whale mother-calf pair in March 2012 (NDP unpubl. data) and a live stranding in July 2013, in Walvis Bay, supports their contemporary and probably year-round occurrence in the Benguela waters.

Fin Whale (Balaenoptera physalus)

Fin whales were historically caught off the west coast of South Africa and Namibia. A bimodal peak in the catch data from South African shore-based stations suggests animals were migrating further north to breed (during May-June) before returning to Antarctic feeding grounds (during August-October). However, the location of the breeding ground (if any) and how far north it remains a mystery (Best 2007). Some juvenile animals may feed year-round in deeper waters off the shelf (Best 2007). Four strandings have been reported from Namibia in the last decade during January, April (2) and October (NDP unpubl. data) and a live animal was seen at Dassen Island, South Africa in November 2011 (MRI unpubl. data). Recent data from the area around Lüderitz in Namibia (April-May 2014) provides evidence of their contemporary occurrence in Namibian Waters. Combined, the stranding data and increasing number of sightings in recent years suggests the population abundance of fin whales may be recovering post whaling, and that the species is likely to be seen with greater regularity in coming years. To date, most sightings or strandings have occurred in late summer (April-May), supporting evidence from whaling data that this is a peak time of occurrence off the southern African West Coast.

Blue Whale (Balaenoptera musculus)

Antarctic blue whales were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during June to July in Walvis Bay, Namibia and at Namibe, Angola suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Only three confirmed sightings of blue whales have occurred off the entire west coast of Africa since 1973 (Branch et al. 2007), although search effort (and thus information), especially in pelagic waters is very low. A recent sighting (May 2014) off southern Namibia was confirmed from photographs to be a blue whale. This suggests that the population using the area may have become locally extinct because of whaling and there is a low chance of encountering the species in the survey or impact area.

Minke Whale (Balaenoptera bonaerensis / acutorostrata)

Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale (Balaenoptera bonaerensis) (see Figure 33) and the dwarf minke whale (B. acutorostrata subsp); both species occur in the Benguela (Best 2007, NDP unpubl data). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round.

The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minke whales have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean in summer months. Around southern Africa, dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions. Both species are generally solitary, and densities are likely to be low in the impact area.

Pygmy Right Whale (Caperea marginata)

The smallest of the baleen whales, the pygmy right whale occurs in the Benguela and has a history of stranding within or near Walvis Bay, Namibia (Leeney et al. 2013), and Lüderitz (January 2014). The species is, however, more commonly associated with cool temperate waters between 30°S and 55°S. There are no data on the abundance or conservation status of this species. As it was not subjected to commercial whaling, the population is expected to be near to original numbers. Sightings of this species at sea are rare (Best 2007) due in part to their small size and inconspicuous blows and as such the density in the impact area is likely to be low.

Odontocetes (toothed) whales

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

Sperm Whale (Physeter macrocephalus)

All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 (Best 2007). Sperm whales are the largest of the toothed whales (Figure 34, left) 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 000m depth, although they occasionally come onto the shelf in water 500 - 200m deep (Best 2007). They are relatively abundant globally (Whitehead 2002), although no estimates are available for South African waters.

Figure 34: Sperm whales Physeter macrocephalus (left) and killer whales Orcinus orca (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org) (Pulfrich, 2014).

Seasonality of historic catches off west South Africa suggests that medium and large sized males are more abundant in winter months while female groups are more abundant in autumn (March - April), although animals occur year-round (Best 2007). Sperm whales were one of the most frequently seen cetacean species during a

series of observations made from offshore seismic survey vessels operating in tropical West Africa between Angola and the Gulf of Guinea, with a sighting rate of 0.3 groups per 8 hours (Weir 2011). Sightings in northern Angola were all made in water deeper than 780 m and showed a seasonal pattern with most animals seen during April - June (Weir 2011). Sperm whales are deep divers and have long dive durations more than 30 minutes, making them difficult to detect visually. However, due to their powerful echolocation clicks they can be detected easily using Passive Acoustic Monitoring (PAM). Sperm whales in the impact zone are likely to be encountered only in deeper waters (>500 m), predominantly in the winter months (April – October).

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) and are thus unlikely to be encountered in the Licence Block.

Pygmy and Dwarf Sperm Whales (Kogia spp)

The genus Kogia currently contains two recognised species, the pygmy (K. breviceps) and dwarf (K. sima) sperm whales. 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. The majority of what is known about Kogiid whales in the southern African subregion results from studies of stranded specimens (e.g. Ross 1979; Findlay et al. 1992; Plön 2004; Elwen et al. 2013). Kogia species are most frequently found in pelagic and shelf edge waters, are thus likely to occur in the western portion of the Exploration Area at low levels; seasonality is unknown.

Dwarf sperm whales are associated with the warmer waters south and west of St Helena Bay and their abundance in the Exploration Area is thus likely to be very low and only in the warmer offshore waters west of the Benguela current. Pygmy sperm whales are recorded from both the Benguela and Agulhas ecosystem (Best 2007) and are likely to occur in the Licence Block in waters deeper than approximately 1 000 m.

Killer Whale (Orcinus orca)

Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007) (Figure 34, right). Killer whales occur year-round in low densities off western South Africa (Best et al. 2010), Namibia (Elwen and Leeney 2011) and in the Eastern Tropical Atlantic (Weir et al. 2010). Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the Licence Block at low levels.

False Killer Whale (Pseudorca crassidens)

Although 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). The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m but with a few close to shore as well (Findlay et al. 1992). False killer whales usually occur in groups ranging in size from 1 100 animals (mean 20.2) (Best 2007) and are thus likely to be easily seen in most weather conditions. However, the strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, all between St Helena Bay and Cape Agulhas), which may aggrandize the consequences of any injury or harassment by seismic airguns or associated activities (as has recently been shown for the closely related melon headed whale by Southall et al. 2013). There is no information on population numbers and no evidence of seasonality in the region (Best 2007).

Long-finned Pilot Whales (Globicephala melas)

Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it (Mate et al. 2005; Findlay et al. 1992; Weir 2011). They are regularly seen associated with the shelf edge by marine mammal observers (MMOs) and fisheries observers. The distinction between long-finned and short finned (G. macrorhynchus) pilot whales is difficult to make at sea. As the latter are regarded as more tropical species (Best 2007), it is likely that most pilot whales encountered in

the impact site will be long-finned. Pilot whales are likely to be among the most encountered odontocetes in vicinity of the seismic survey and impact area.

Common Bottlenose Dolphins (Tursiops truncatus)

Two species of bottlenose dolphins occur around southern Africa the smaller Indo-Pacific bottlenose dolphins, which occurs exclusively to the east of Cape Point in water usually <30 m deep (and thus outside the impact area) and the larger common bottlenose form of bottlenose dolphin. The latter species occurs in two forms. The inshore form occurs as a small and apparently isolated population that occupies the very coastal (usually <15 m deep) waters of the central Namibian coast. It is considered a conservation concern but is unlikely to be encountered in the impact area. Little is known about the offshore form of the species, and nothing about their population size or conservation status. They sometimes occur in association with other species such as pilot whales (NDP unpubl data) or false killer whales (Best 2007) and are likely to be present year-round in waters deeper than 200 m.

Common Dolphin (Delphinus spp)

The common dolphin is known to occur offshore in Namibian waters (Findlay et al. 1992). The extent to which they occur in the impact zone is unknown, but likely to be low. Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region (Findlay et al. 1992) and 92 (± SD 115) for Angola (Weir 2011) and 37 (± SD 31) in Namibia (NDP unpubl data). They are more frequently seen in the warmer waters offshore and to the north of the country, seasonality is not known.

Southern Right Whale Dolphins (Lissodelphis peronii)

The cold waters of the Benguela provide a northwards extension of the normally subantarctic habitat of this species (Best 2007). Most records in the region originate in a relatively restricted region between 26°S and 28°S off Lüderitz (Rose and Payne 1991) in water 100 2 000 m deep (Best, 2007), where they are seen several times per year (Findlay et al. 1992; JP Roux pers comm.), including a recent live stranding of two individuals in Lüderitz Bay in December 2013. They are often seen in mixed species groups with other dolphins such as dusky dolphins. It is possible that the Namibian sightings represent a regionally unique and resident population (Findlay et al. 1992). Encounters in the impacts zone are unlikely.

Dusky Dolphins (Lagenorhynchus obscurus) (Figure 35, right)

In water <500 m deep, dusky dolphins are likely to be the most frequently encountered small cetacean. The species is very boat friendly and will often approach boats to bowride. This species is resident year-round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep, but may occur as far offshore as 2 000 m depth (Findlay et al. 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lamberts Bay, but further north they are usually found further from shore in slightly deeper waters (Elwen et al. 2010a; NDP unpubl data). Abundances estimates are being calculated but currently suggest a relatively large population of several thousand at least. Group sizes up to 800 have been reported in southern African waters (Findlay et al. 1992). Dusky dolphins are resident year-round in the Benguela, although a hiatus in sightings (or low-density area) is reported between ~27°S and 30°S, associated with the Lüderitz upwelling cell (Findlay et al. 1992).

Figure 35: The endemic Heaviside's Dolphin Cephalorhynchus heavisidii (left) (Photo: De Beers Marine Namibia), and Dusky dolphin Lagenorhynchus obscurus (right) (Photo: scottelowitzphotography.com) (Pulfrich, 2014).

Heaviside's Dolphins (Cephalorhynchus heavisidii) (Figure 31Figure 35, left)

This species is relatively abundant in the Benguela ecosystem within the region of 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen et al. 2009). Individuals show high site fidelity to small home ranges, 50-80 km along shore (Elwen et al. 2006) and may thus be more vulnerable to threats within their home range. This species occupies waters from the coast to at least 200 m

depth, (Elwen et al. 2006; Best 2007) and can thus be expected to be encountered throughout the Exploration Area. They may show a diurnal onshore-offshore movement pattern (Elwen et al. 2010b), but this varies throughout the species range. Their small group sizes and inconspicuous behaviour when offshore make monitoring their presence very difficult. However, their echolocation clicks can be detected using PAM technology at ranges up to ~500 m and the characteristic high frequency, narrow band nature of the clicks (Morisaka et al. 2011) makes them easily distinguished form other species in the area. Heaviside's dolphins are resident year-round.

Other Delphinids

Several other species of dolphins that might occur in the deeper waters of impact area at low levels include the pygmy killer whale, Risso's dolphin, rough toothed dolphin, pan tropical 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 impact zone, but it is likely that encounters would be rare.

Beaked Whales (various species)

Beaked whales were never targeted commercially, and their pelagic distribution makes them largely inaccessible to most researchers making them the most poorly studied group of cetaceans. With recorded dives of well over an hour and more than 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals (Tyack et al. 2011), but they also appear to be particularly vulnerable to certain types of anthropogenic noise. Several species of beaked whale (mainly Cuvier's but also Blainville's and Gervais' beaked whales) have been recorded to strand or die at sea, often en-masse, in response to man- made sounds, particularly mid frequency naval sonar and potentially multi-beam echo-sounders (Cox et al. 2006, MacLeod and D'Amico, 2006). Although the exact reason for this vulnerability is not yet fully understood, the existing evidence indicates that these animals are susceptible to man-made noise and precautions should be taken to avoid causing any harm. All the beaked whales that may be encountered in the offshore portions of the impact zone are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod and D'Amico 2006; Best 2007). The long, deep dives of beaked whales make them both difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives.

In summary, the humpback and southern right whale are likely to be encountered in the Exploration Area year-round, with numbers in the Cape Columbine area highest between September and February, and not during winter as is common on the South Coast breeding grounds. Whaling data indicates that several other large whale

species are also most abundant on the West Coast during winter: fin whales peak in May-July and October-November; Sei whale numbers peak in May-June and again in August-October and offshore Bryde's whale numbers are likely to be highest in January-February. Whale numbers on the shelf and in offshore waters are thus likely to be highest between October and February (inclusive).

Of the migratory cetaceans, the Blue, Sei and Fin whales are listed as 'Endangered' in the IUCN Red Data book. 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.

2.2.3.9 SEALS

The Cape fur seal (Arctocephalus pusillus pusillus) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 36).

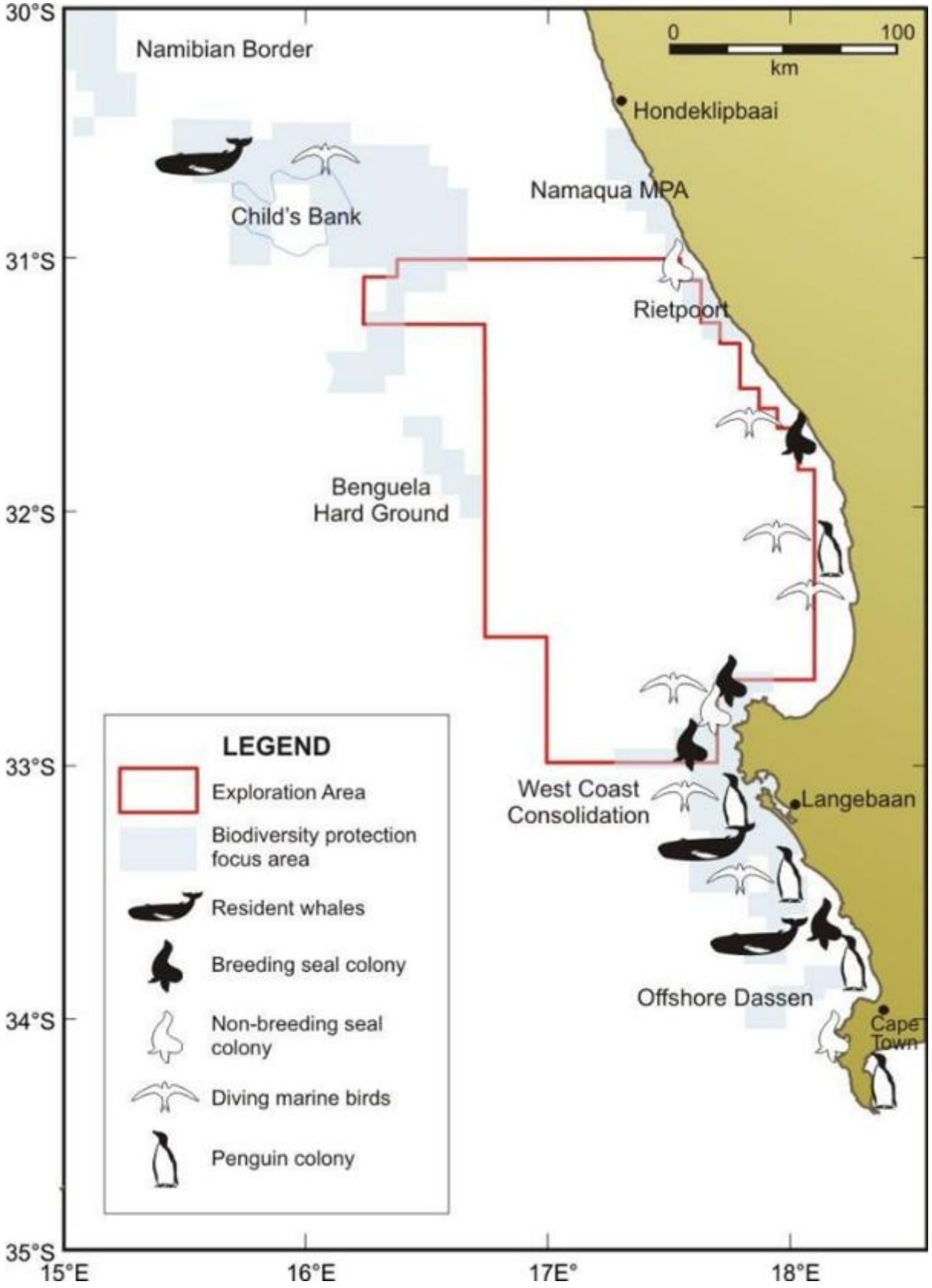


Figure 36: Locations of seabird and seal colonies and resident whale populations in relation to Block3A/4A (Pulfrich, 2014).

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).

2.2.4 HUMAN UTILISATION

2.2.4.1 FISHERIES AND OTHER HARVESTING

The Department of Forestry, Fisheries and the Environment (DFFE) regulates and monitors South Africa's commercial fisheries, where currently approximately 14 different commercial sectors operate within South African waters. Recreational fishing is also active along the coastline, comprising shore angling and small, open boats, generally less than 10 m in length.

The primary fisheries in South African terms of highest economic value and greatest landed tonnage are as follows:

- Demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (Merluccius paradoxus and M. capensis); and
- Pelagic-directed purse-seine fishery targeting pilchard (Sardinops sagax), anchovy (Engraulis encrasicolus) and red-eye round herring (Etrumeus whitheadii).

Secondary species in these fisheries includes a large assemblage of demersal fish of which monkfish (Lophius vomerinus), kingklip (Genypterus capensis) and snoek (Thyrsites atun) are the most commercially important.

The following fisheries are active off the West Coast of South Africa:

- Small pelagic purse-seine;
- Demersal trawl;
- Demersal long-line;
- Pelagic long-line;
- Tuna pole;
- Traditional line fish; and
- West Coast rock lobster sectors.

The principle commercial fish species undergo a critical migration pattern in the Benguela ecosystem. This migration is central to the sustainability of the small pelagic and hake fisheries. The process is as follows (see Figure 37):

- Adults spawn on the central Agulhas Bank in spring (September to November);
- Spawn drifts northwards in the Benguela current across the shelf;
- As eggs drift northwards, hatching takes place followed by larval development;
- Settlement of larvae occurs in the inshore areas, in particular the bays that are used as nurseries. This takes place from October through to Autumn (March onwards);

  Juveniles shoal and begin a southward migration. This is the main period where the anchovy and sardine are targeted by the small pelagic purse seine fishery. The demersal species, such as hake migrate offshore into deeper water.

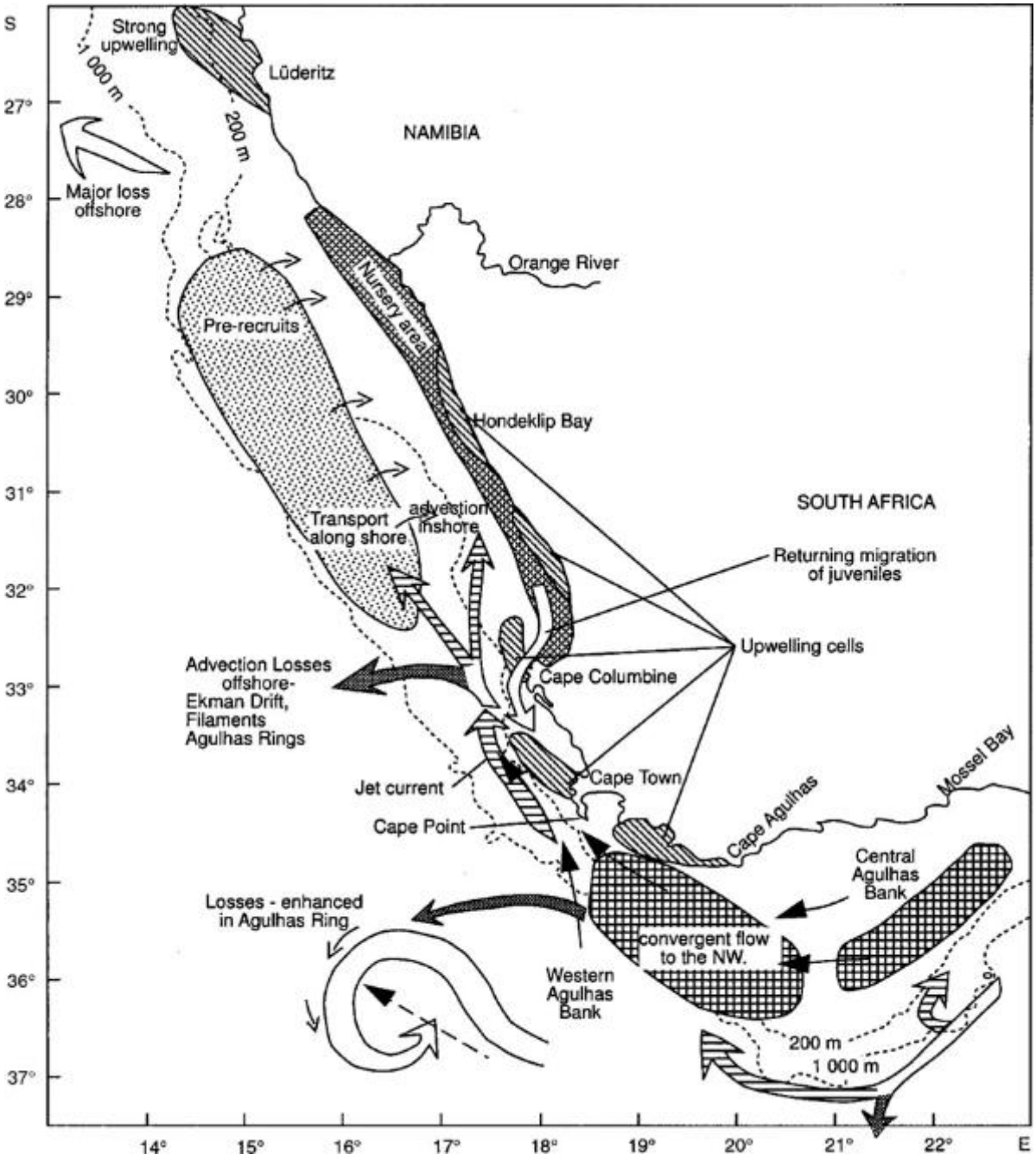


Figure 37: West Coast nursery ground and western/central Agulhas Bank spawning ground [After Hutchings et al., 2002 - light stippled area on the West Coast marks the main recruiting area for the fishery. Dark stippled area on the Agulhas Bank marks the main spawning grounds] (CapFish, 2014).

Demersal Trawl

The hake-directed trawl fishery is the most valuable sector of the South African fishing industry and is split into two sub-sectors: the offshore ("deep-sea") sector which is active off both the South and West Coasts, and the much smaller inshore trawl sector which is active off the South Coast.

A fleet of 45 trawlers operate within the offshore sector targeting the Cape hakes (Merluccius capensis and M. paradoxus;) (see Figure 38, Left). Main by-catch species include monkfish (Lophius vomerinus;) (see Figure 38 Right), kingklip (Genypterus capensis;) (see Figure 39, Left) and snoek (Thyrsites atun;) (see Figure 39, Right).

Figure 38: Cape hake, Merluccius capensiss (Left) and Anglerfish (monk), Lophius vomerinus (Right) (CapFish, 2014).

Figure 39: Kingklip, Genypterus capensis (Left) and Snoek, Thyrsites atun (Right) (source: www.illustrationsource.com) (CapFish, 2014).

The current annual Total Allowable Catch (TAC) of hake across all sectors is 156 075 tons (2013), of which the majority is landed by the demersal trawl sector. In 2012, of a total hake TAC of 144 671 tons, 118 688 tons (82%) was landed by the demersal trawl sector. Of this amount, 115 465 tons was landed by the offshore demersal trawl sector and 3 223 tons by the inshore trawl sector.

The last five years (2008 to 2012) have seen a decline in catch and effort with a reported 44 092 trawls per year with and associated catch of 113 607 tons of hake and 125 599 tons of all species landed per year.

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. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 80 m in length. The gear configurations are similar for both freezer and wet fish vessels. Trawl gear is deployed astern of the vessel and the main elements of the gear include the following (see Figure 40).

- Steel trawl warps up to 32 mm in diameter - in pairs up to 3 km long when towed;
- A pair of trawl doors (500 kg to 3 tons each);
- Net footropes which may have heavy steel bobbins attached (up to 24" diameter; maximum 200 kg) as well as large rubber rollers (“rock-hoppers”); and
- Net mesh (diamond or square shape) is normally wide at the net opening whereas the bottom end of the net (or cod-end) has a mesh size minimum limit of 110 mm (stretched).
- Trawl warps (steel wire rope);
- Trawl;
- Codend;
- Headrope;
- Doors (<3000kg); and
- Spread (>100m)

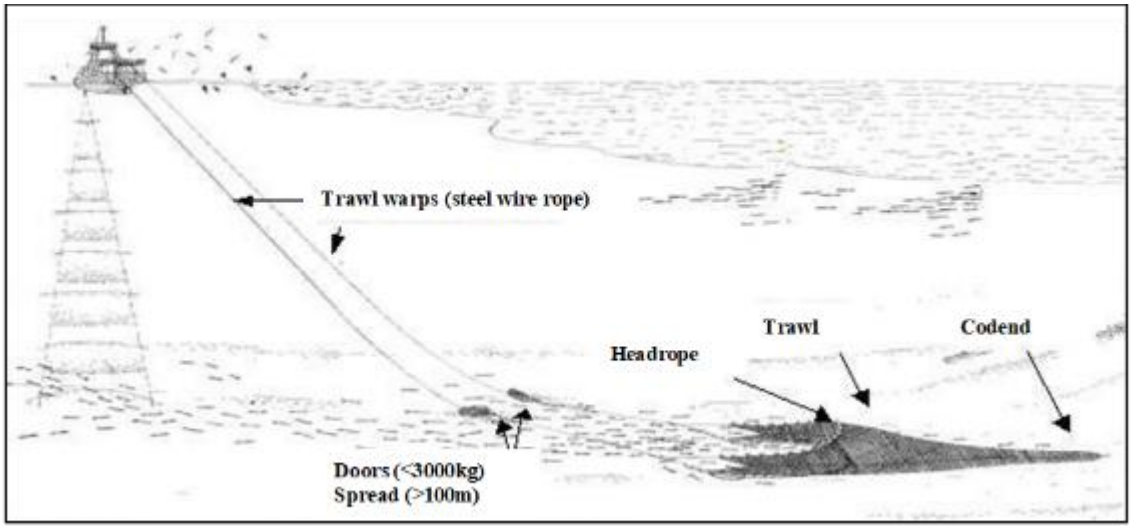


Figure 40: Typical gear configuration used by demersal trawlers (offshore) targeting hake (CapFish, 2014).

Generally, trawlers tow their gear at 3.5 knots for two to four hours per drag. When towing gear, the distance of the trawl net from the vessel is usually between two and three times the depth of the water. The horizontal net opening may be up to 50 m in width and 10 m in height and the swept area on the seabed between the doors may be up to 150 m.

Several monk-directed trawlers are also known to operate on the West Coast. These vessels use slightly heavier trawl gear, trawl at slower speeds and for longer periods than hake-directed trawlers. Monk gear includes the use of “tickler” chains positioned ahead of the footrope to chase the monk off the substrate and into the net. These trawlers tow for up to eight hours at a time at a speed of between 2 and 3 knots and generally fish during the night.

Trawls are usually conducted along specific trawling lanes on “trawl friendly” substrate (flat, soft ground). On the West Coast, these grounds extend in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours. 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 (i.e. Cape Columbine and Cape Canyon), where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. Trawlers are prohibited from operating within five nautical miles of the coastline.

Figure 41 shows the spatial distribution of trawl fishing effort (2000 – 2012) along the West Coast in relation to Block 3A/4A. Data reported by the fishery over this 13-year period indicate that fishing grounds overlap 6099 km2 of the south-western portion of the Licence Block, seawards of the 200 m isobath. Catch and effort records within this area amounted to 604 tons and 2063 hours per annum, respectively. This is equivalent to 1.2% of the overall effort and 1.0% of total catch recorded by the sector.

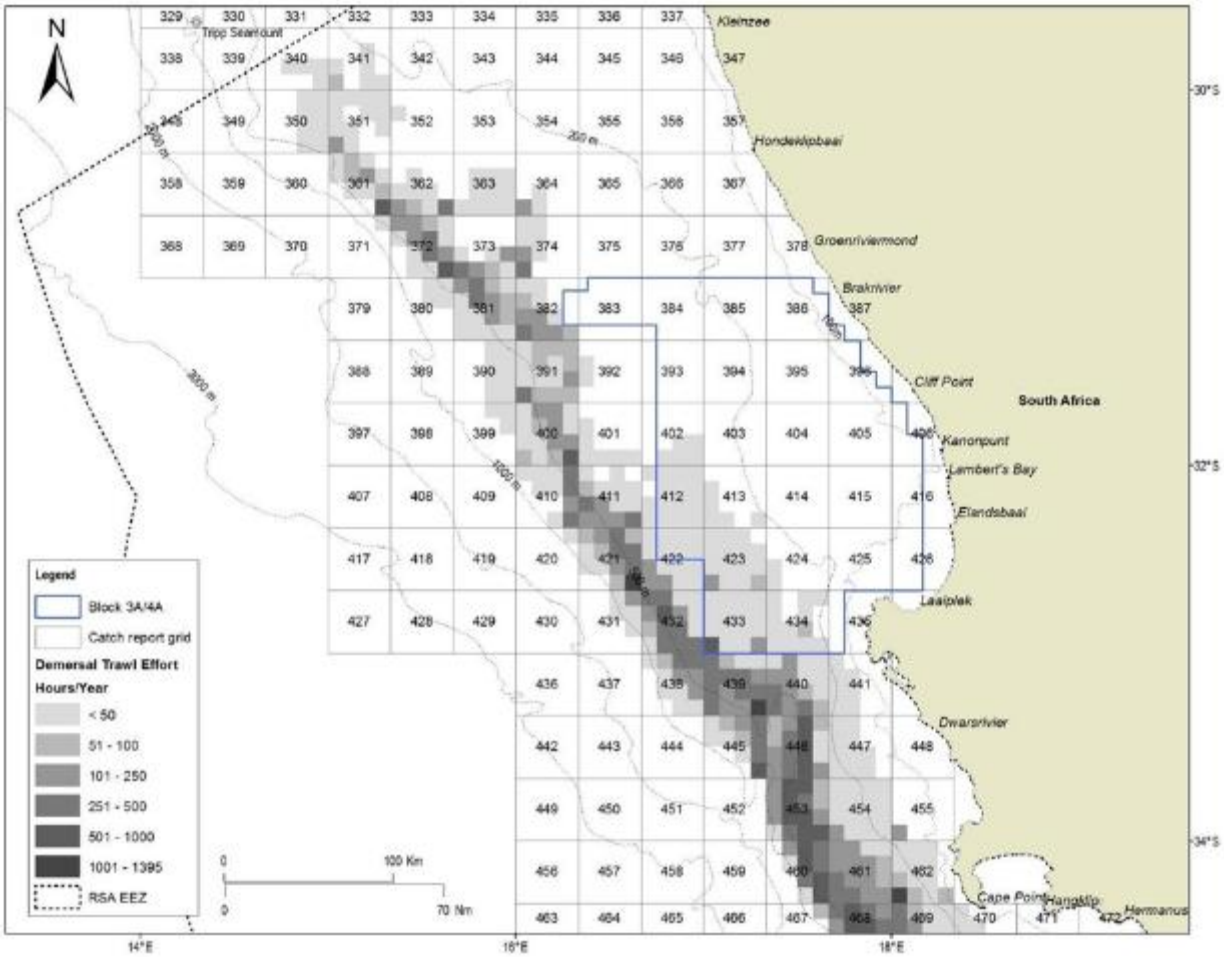


Figure 41: Spatial distribution of fishing effort expended by the demersal trawl sector targeting hake over the period 2000 to 2012 off the West Coast of South Africa in relation to Block 3A/4A (CapFish, 2014).

Demersal Long-Line

The demersal long-line fishing technique is used to target bottom-dwelling species of fish. Two fishing sectors utilize this method of capture, namely the hake long-line fishery targeting the Cape hakes (M. capensis and M. paradoxus) and the shark long-line sector targeting only demersal species of shark.

A demersal long-line vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor (see Figure 42). Steel anchors, of 40 kg to 60 kg, are placed at the ends of each line to anchor it and are marked with an array of floats. If a double line system is used, top and bottom lines are connected by means of dropper lines. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom line breaks at any point along the length of the line. 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) by means of a snood. Gear is usually set at night at a speed of between 5 and 9 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. Long-line vessels vary in length from 18 m to 50 m and remain at sea for four to seven days at a time. Currently 64 hake-directed and six shark-directed vessels are operational within the fishery, most of which are based at Cape Town and Hout Bay harbours.

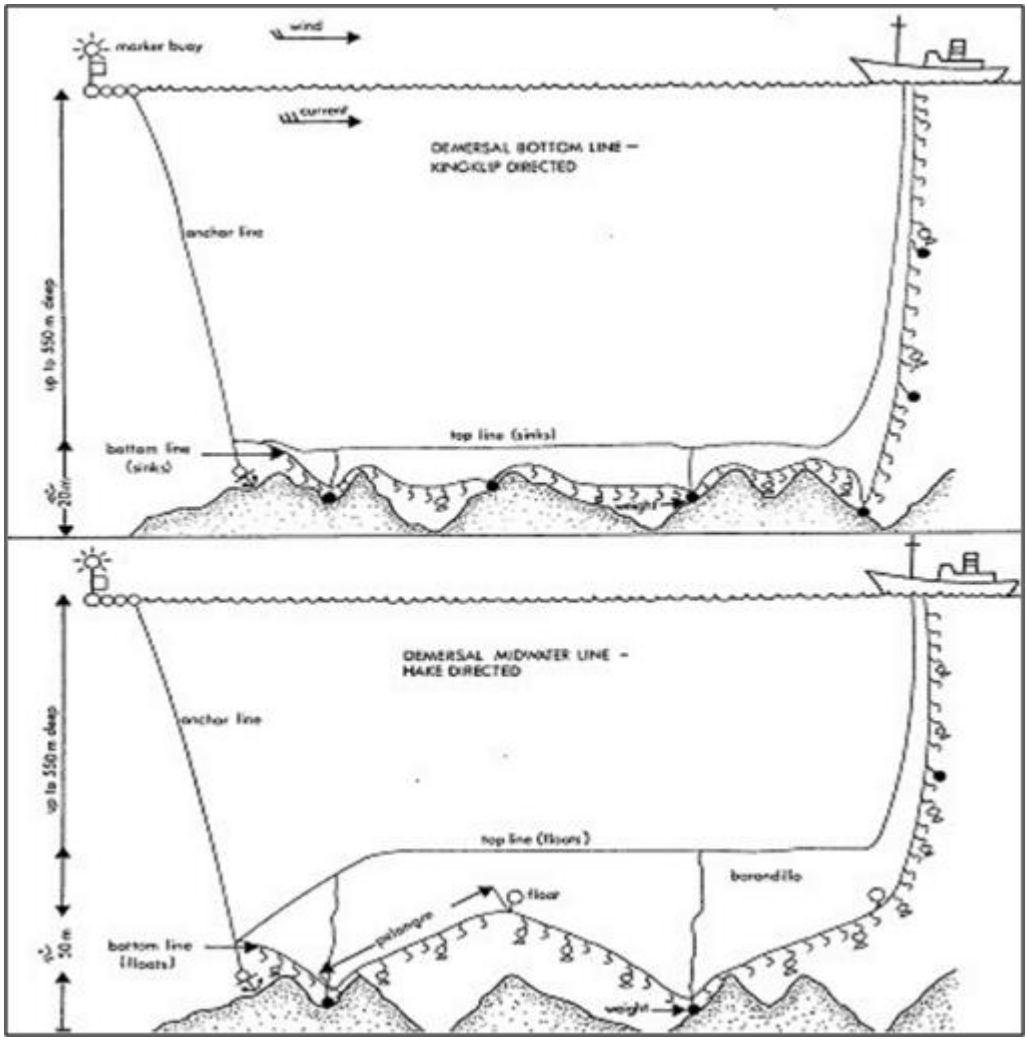


Figure 42: Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters (CapFish, 2014).

(A) Hake-directed fishery

Like the demersal trawl fishery, the target species of long-line fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. The catch landed is predominantly prime quality hake for export to Europe and is packed unfrozen on ice therefore the value is approximately 50% higher than that of trawled hake. Operations are ad hoc and intermittent, subject to market demand.

Of the total hake TAC of 144 671 tons set for 2012, the catch taken by the long-line fleet amounted to 8 399 tons (~6%, and 9 257 tons including all other non-hake species landed). Over the period 2000 to 2012, the fishery set an average of 30.7 million hooks and landed 8 791 tons of hake per year. This is slightly higher than the reported catch and effort over the last five years (2008 to 2012), during which time the fishery set an average of 28.9 million hooks and landed 8 368 tons of hake per year.

Demersal long-line vessels fish in similar areas to those targeted by the hake-directed trawling fleet. Lines are usually set parallel to bathymetric contours, extending along the shelf edge to the 1 000m isobath in places. Figure 43 shows the spatial distribution of hake-directed long-line catch recorded off the West Coast for the years 2000 to 2012. Hake-directed long-line grounds cover approximately 13 130km2 of Block 3A/4A, primarily seawards of the 200m isobath. Over the period 2000 to 2012, an annual average of 155.7 tons of landed catch and 598 360 set hooks were recorded within the area, equivalent to 1.6% of the overall catch and 1.8% of the total effort reported by the fishery.

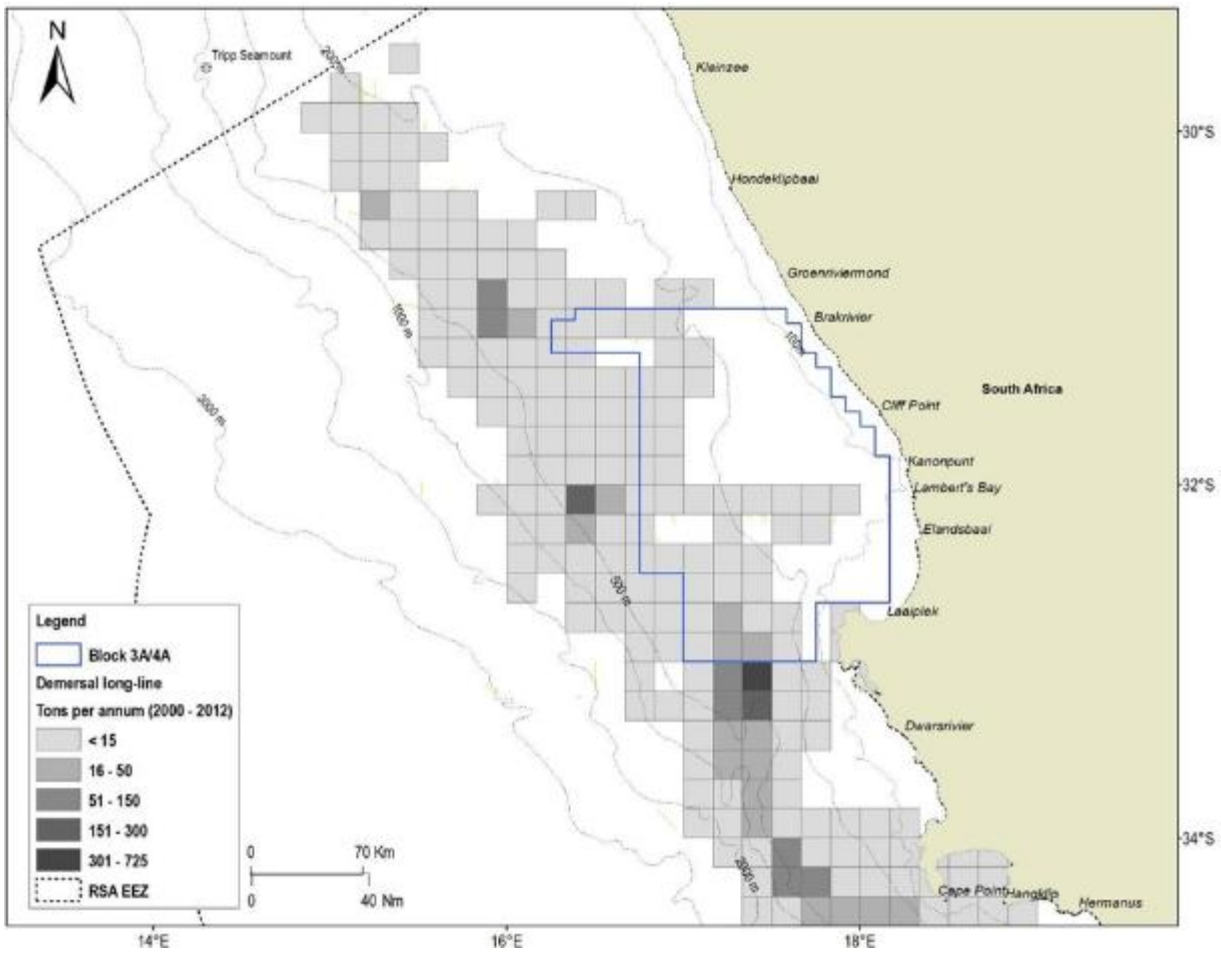


Figure 43: Spatial distribution of catch landed by the hake-directed demersal long-line fishery in relation to Block 3A/4A (2000 – 2012) (CapFish).

(B) Shark-directed fishery

Capture of demersal shark species occurs primarily in the demersal shark long-line fishery whilst catches of pelagic shark species occurs primarily in the large pelagic sector that targets tuna and swordfish.

Spatial records show that fishing effort does not coincide with Block 3A/4A, with the closest reported fishing activity located approximately 25 km south of the Licence Block (see). The likelihood of the fishery being impacted is improbable and there is therefore no impact expected on the fishery. The degree of confidence in the assessment is high.

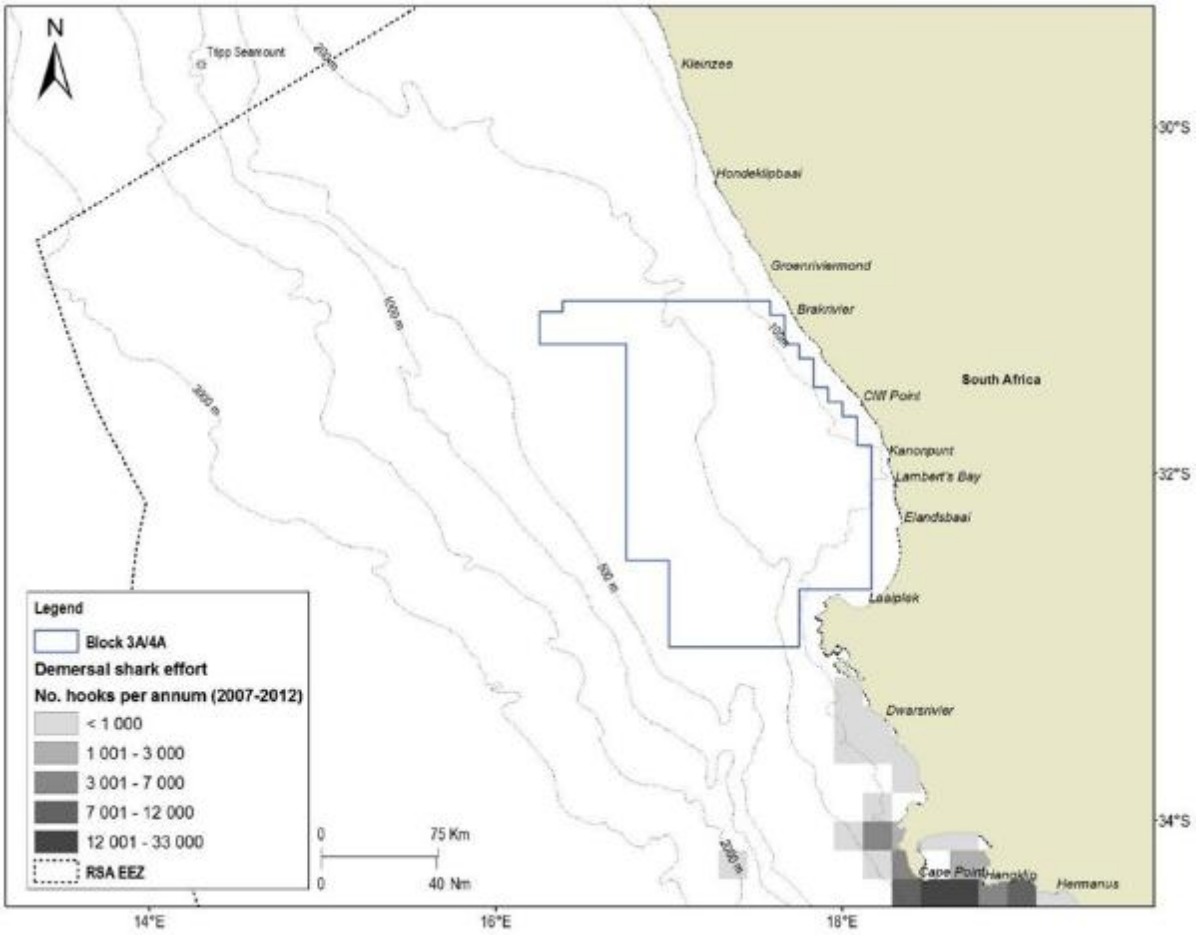


Figure 44: Spatial distribution of effort expended by the demersal long-line fishery targeting shark species displayed on a 10' x 10' grid (2007 – 2012) in relation to Block 3A/4A (CapFish, 2014).

Large Pelagic Long-Line

The large pelagic long-line fishery operates extensively within the South African Exclusive Economic Zone (EEZ) targeting primarily tuna and swordfish. The main target species is yellowfin tuna with a high bycatch of blue shark (see Figure 45). Tuna, tuna-like species and billfishes are migratory stocks and are therefore managed as a "shared resource" amongst various countries. The rights holders now include a small fleet of local long-liners although the fishery is still undertaken primarily with Japanese vessels fishing in joint venture with South African companies. There are currently 30 commercial large pelagic fishing rights issued for South African waters and 31 vessels active in the fishery.

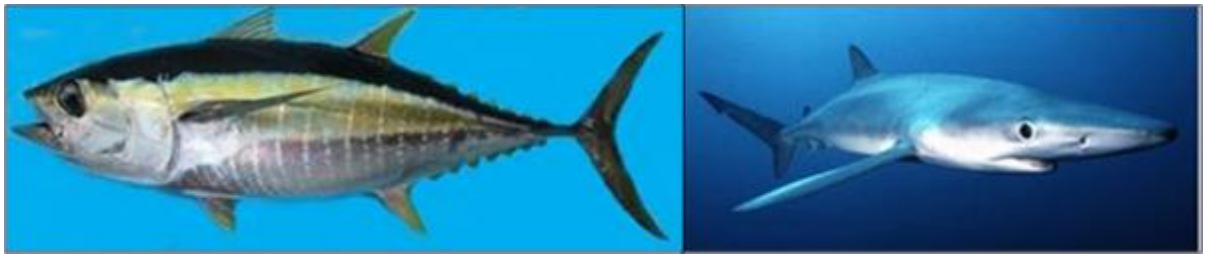


Figure 45: Yellowfin tuna Thunnus albacares is the principle target species in the pelagic longline fishery (Left) and Blue shark Prionace glauca is one of the most commonly caught shark species in South African waters but is discarded due to its high urea content (Right) (CapFish, 2014).

Historically, the fishery operates extensively from the continental shelf break into deeper waters, year-round. Vessels range from 30m to 54m in length. Gear consists of monofilament mainlines of between 25km and 100km in length which are suspended from surface buoys and marked at each end (Figure 46 and Figure 47 Left).

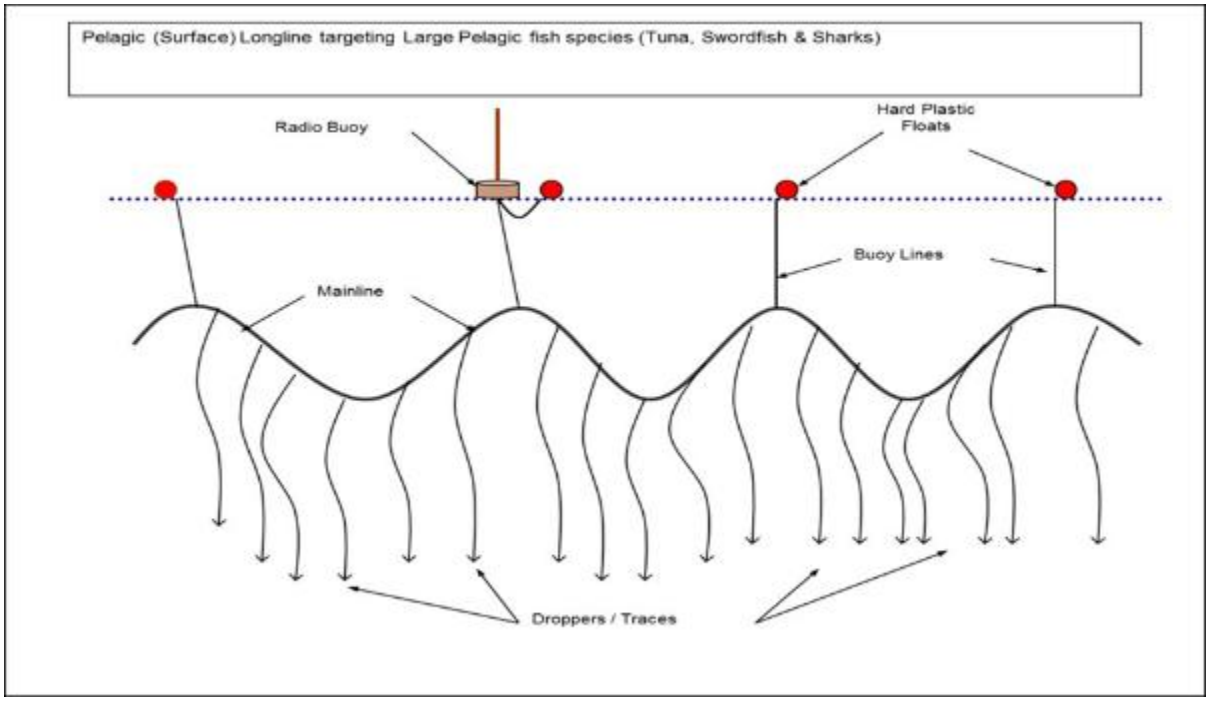


Figure 46: Typical pelagic long-line gear configuration targeting tuna, swordfish and shark species. Note: gear floats close to the surface of the sea and would present a potential obstruction to surface navigation (CapFish, 2014).

The main fishing line is normally suspended 20m below the water surface via droppers connecting it to surface buoys at regular intervals. Baited hooks are attached to the mainline via 20m long trace lines, thereby targeting fish at a depth of 40m below the surface. Up to 3 500 hooks may be set per line. Lines are usually set at night, with hauling commencing the next morning. 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 the line position for later retrieval. A line may be left drifting for a considerable length of time before retrieval by means of a powered hauler at a speed of approximately one knot. During hauling, vessel manoeuvrability is severely restricted, and, in the event of an emergency, the line may be dropped and hauled in at a later stage. A photograph of a typical high seas long-line vessel is shown in Figure 47 (Right).

Figure 47: Photograph of a mainline (braided monofilament) with a dropper line and trace typically used by the pelagic long-line fishery (white line) (Left) and a typical high seas longliner active in South African water (Right) (CapFish, 2014).

Pelagic long-line vessels can be expected within the area of interest and especially concentrated where the continental slope is steepest. During the period 2000 to 2012, the national catch and effort recorded within the

large pelagic fishery amounted to an average of 3 018 tons and 3.49 million hooks set per year. The last five years (2008 to 2012) have seen an increase in effort, whilst landings have remained relatively constant within the fishery (3 047 tons and 4.84 million hooks set per year).

Figure 48 shows the spatial distribution of catch reported by the large pelagic long-line sector with most of the effort expended offshore of the shelf break (waters deeper than 500m). Whereas this does not coincide with Block 3A/4A, there are incidental fishing records within the Block amounting to 1.3 tons of catch and 1100 hooks set per year. This is equivalent to <0.1% of the total catch and effort recorded within the fishery.

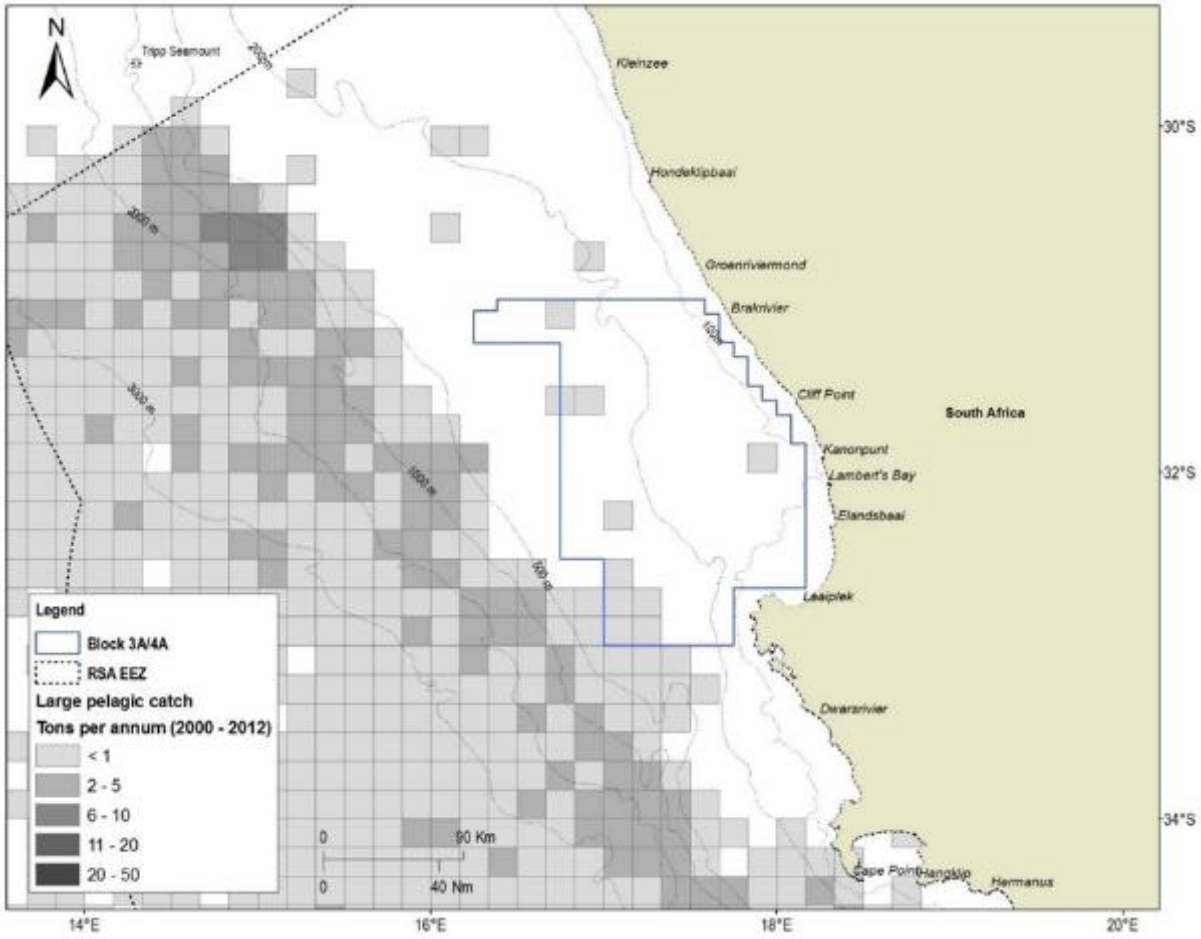


Figure 48: Spatial distribution of catch reported by the domestic and foreign pelagic long-line sector (all species) from 2000 to 2012 in relation to Block 3A/4A (CapFish, 2014).

Tuna Pole Fishing

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock (T. alalunga) and a very small amount of skipjack tuna (Katsuwonus pelamis) (Figure 49), yellowfin tuna and bigeye tuna. The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March. The South African fleet consists of approximately 128 pole-and-line vessels which are based at the ports of Cape Town, Hout Bay and Saldanha Bay.

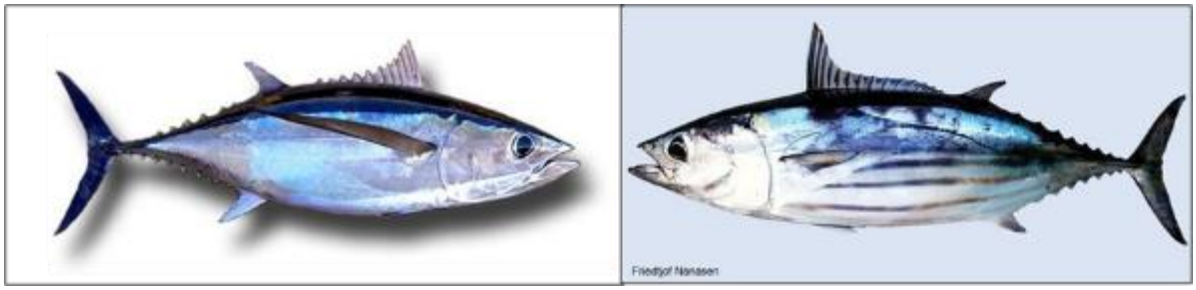


Figure 49: Longfin tuna, Thunnus alalunga (Left) and Skipjack tuna, Katsuwonus pelamis (Right) (CapFish, 2014).

Vessels operating within the fishery are typically small (< 25 m in length). Catch is stored on ice, in chilled sea water or frozen and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on the distance of the fishing grounds from port. Vessels drift whilst attracting and catching pelagic tuna species. Whilst at sea, most of the 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 also flung out to entice the tuna to the surface (chumming). Tuna swimming near the surface is caught with hand-held fishing poles. The ends of these poles are fitted with a short length of fishing line leading to a hook. Hooked fish are pulled from the water, and many tons can be landed in a short period of time. To land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 50).

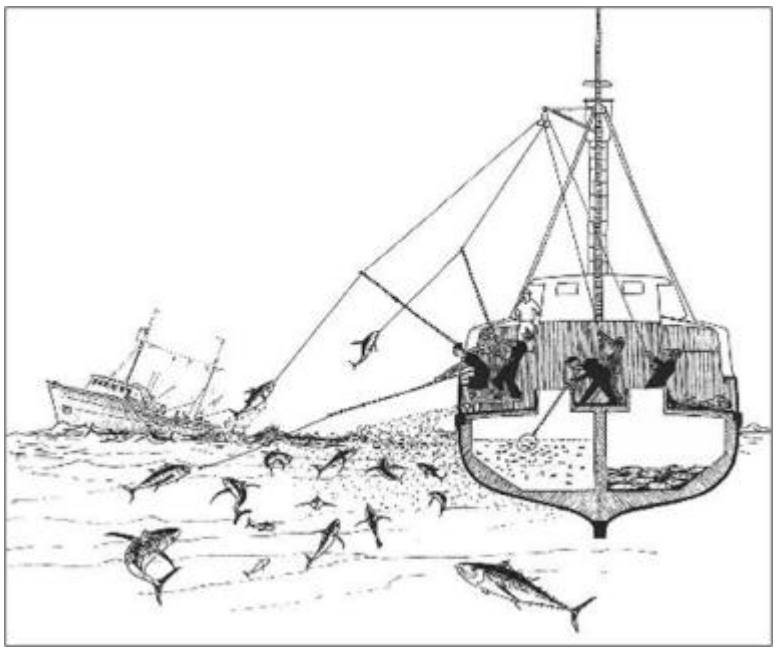


Figure 50: Schematic diagram of pole and line operation (www.fao.org/fishery) (CapFish, 2014).

Fishing activity occurs along the entire West Coast beyond the 200m isobath. Activity would be expected to occur along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. The nature of the fishery and communication between vessels often results in many these vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and as they do not anchor or have any fixed gear in the water, these vessels remain highly manoeuvrable and could take avoiding action at any time.

However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located several vessels will move into the area and target a single shoal which may remain in the area for days at a time. As such the fishery is dependent on window periods of

favourable conditions relating to catch availability. Although fishing activity is highly variable during the fishing season, peak catches are usually experienced between February and March, with relatively lower levels of activity between December and January.

The 2014 TAC for the South African tuna pole fishery (albacore) is set at 4 400 tons. The total catch landed, and effort expended by the tuna pole sector over the period 2003 to 2012 was 4 110 tons and 5 723 fishing events per year. Over the period 2008 to 2012, effort within the fishery was slightly lower, whilst reported landings remained constant (4 221 tons and 4 707 fishing events per annum).

Figure 51 shows the spatial distribution of catch reported by the tuna pole fishery on the West Coast of South Africa. The southern extent of Block 3A/4A coincides with favoured fishing areas utilized by the sector, particularly an area located 80km due west of Saldanha Bay. Over the period 2003 to 2012, an average of 408 tons per year were caught within Block 3A/4A, which is equivalent to 11.1% of the total landings recorded for the fishery.

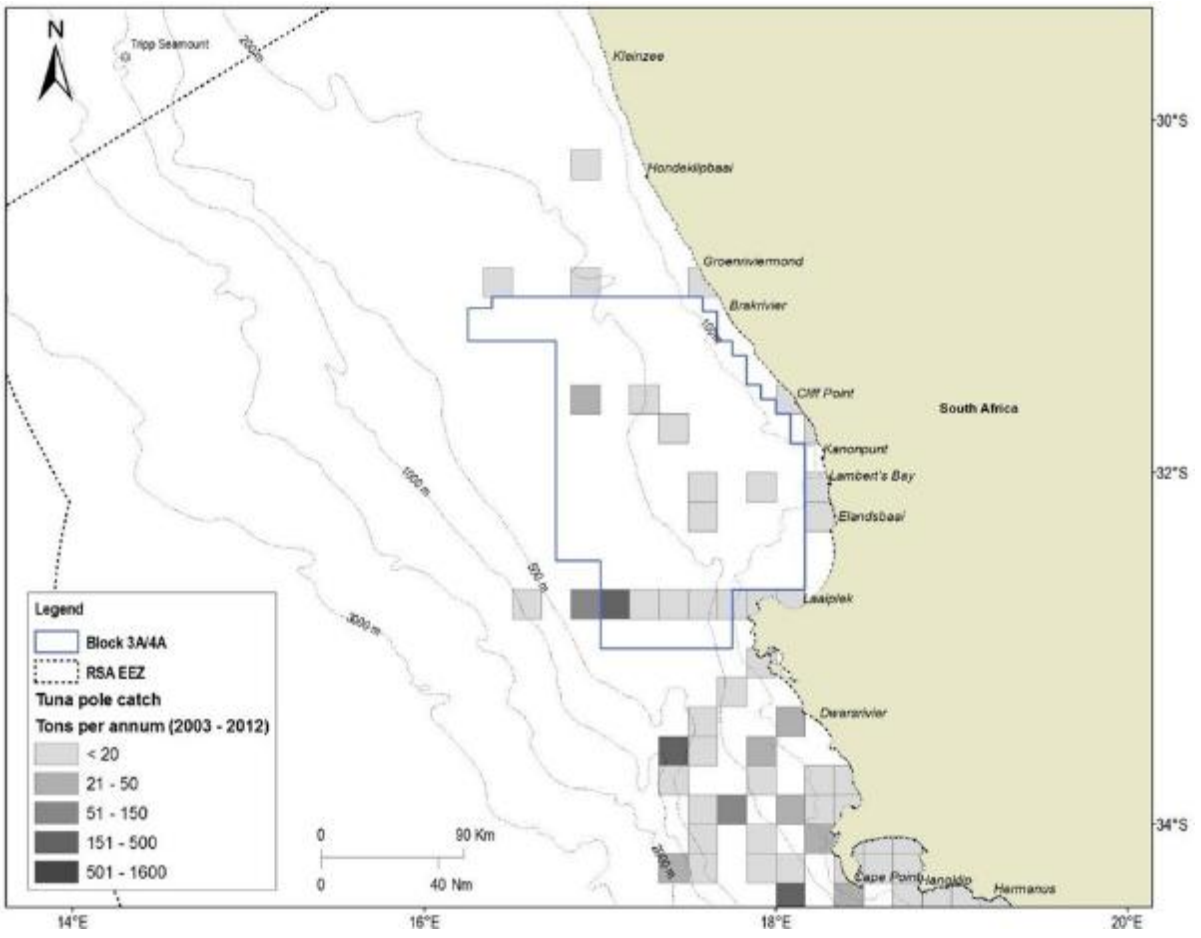


Figure 51: Spatial distribution of tuna pole catch from 2003 to 2012 in relation to Block 3A/4A (CapFish), 2014).

Traditional Line-fish

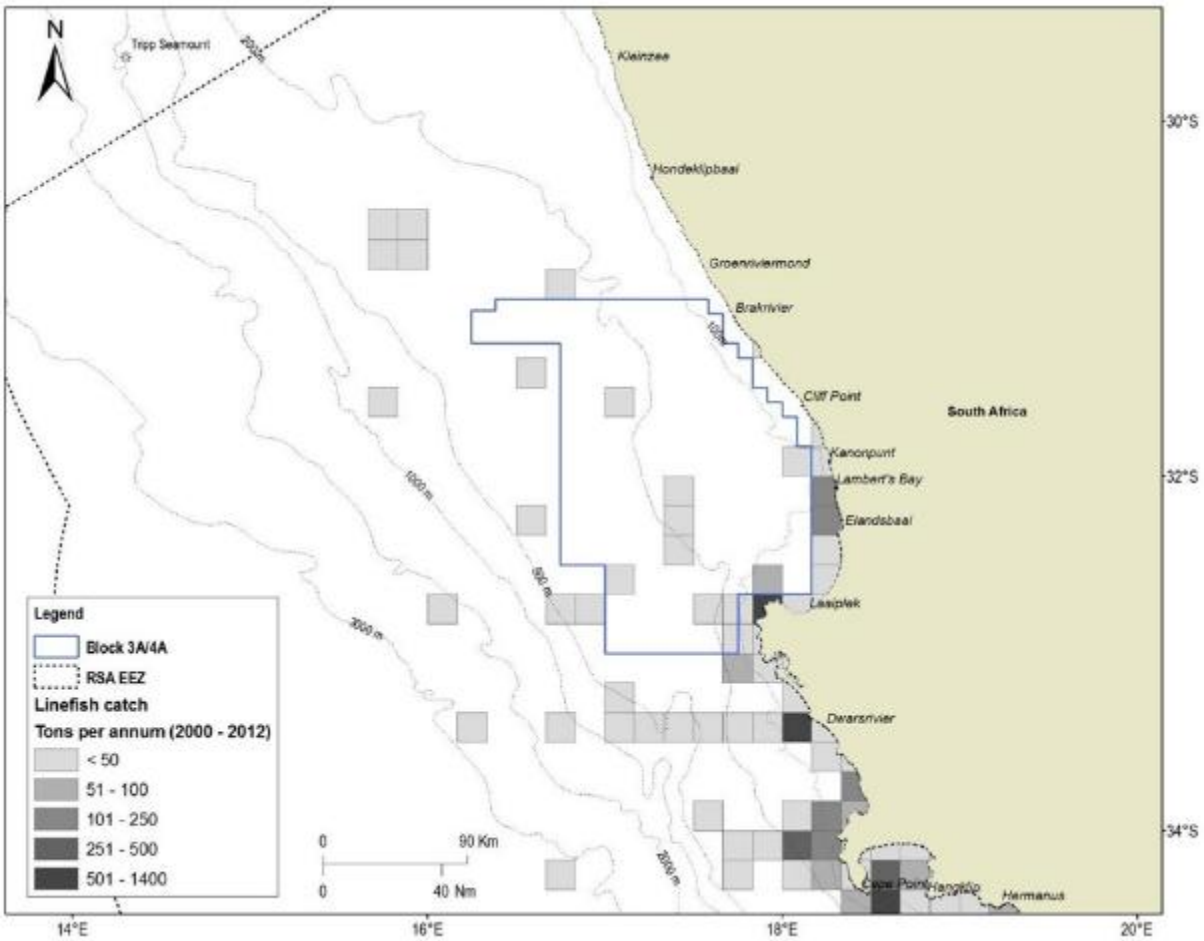
The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. The bulk of the fishery catch is made up of about 35 different species of reef fish as well as pelagic and demersal species which are mostly marketed locally as "fresh fish". The fishery is widespread across 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. The majority of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf up to a maximum depth of 200m between the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing

vessels generally range up to a maximum of 40 nautical miles offshore, although fishing at the outer limit and beyond this range would be sporadic (C. Wilke, pers. comm[5]).

Line fishing techniques consist of hook and line deployments (up to 10 hooks per line) and differ from the pelagic long-line fishing technique in that the use of set long-lines is not permitted. The fishery includes commercial, subsistence and recreational sectors[6]. Up to 3 000 boats are involved in the fishery on the national level, 450 of which are involved in the commercial fishery and range in size from 3m beach-launched dinghy's to 20m harbour-based vessels that may remain at sea for up to 30 days (Mann, 2000).

Over the period 2000 to 2012, the fishery reported an annual catch of 13 082 tons (see Figure 52). Recent landings have been somewhat lower since the reduction of commercial effort. Annual catches for the sector were reported as 8 551 tons over the period 2008 to 2012 compared to 15 913 tons over the period 2000 to 2007.

Records of fishing activity off the West Coast of South Africa are predominantly coastal, with few fishing events located within Block 3A/4A. Over the period 2000 to 2012, an average of 72.3 tons of catch were taken within the Block each year, which is equivalent to 0.6% of the total catch recorded by the fishery.



[5] Mr C. Wilke (christopherW@daff.gov.za) has been the chief technician at DFFE for 35 years and is the principal person for linefish data collection and collation.

[6] Note: These fisheries are not artisanal in nature.

Figure 52: Spatial distribution of catch landed by the traditional linefish sector (2000 – 2012) in relation to the proposed exploration activities in Block 3A/4A (CapFish, 2014).

Small Pelagic Purse-Seine

The small pelagic fishery is the largest South African fishery by volume and the second most important in terms of value. Small pelagic species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade, with average landings of 468 000 tons (all species) per annum over the period 2000 to 2012 compared to 391 000 tons per annum recorded between 2008 and 2012. The two main targeted species are sardine and anchovy (Figure 53), with associated by-catch of round herring (red-eye) and juvenile horse mackerel. Fishing grounds occur primarily along the West and South Coasts of the Western Cape and Eastern Cape coast up to a maximum distance of 100km offshore, but usually closer inshore. Most of the fleet of 101 vessels operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast.

Figure 53: Sardine, Sardinops sagax, also called pilchard is a shoaling species and is the most valuable species in the purse-seine fishery (Left) and anchovy, Engraulis encrasicolus (Right) (CapFish, 2014).

The fleet consists of wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48m. The targeted 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 60m to 90m (see Figure 54). Netting walls surround aggregated fish, preventing them from diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped on-board into the hold of the vessel. 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.

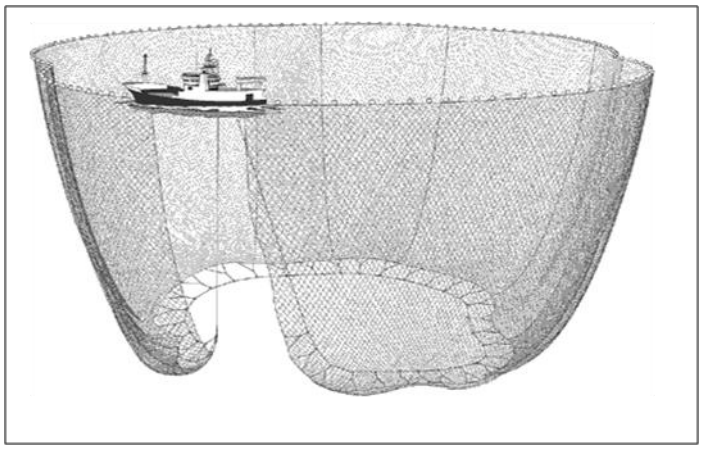


Figure 54: Schematic showing typical configuration and deployment of a small pelagic purse-seine net for anchovy and pilchard in South African waters (CapFish, 2014).

The small pelagic sector operates throughout the year with a short break from mid-December to mid-January. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and distribution of the targeted species. The sardine-directed fleet concentrates effort in a broad area extending from Lambert's Bay, southwards past Saldanha Bay and Cape Town towards Cape Point and then eastwards

along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert's Bay to Kleinbaai (19.5°E) 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 55 shows the average annual effort expended by the small pelagic purse-seine fishery from 2000 to 2012, indicating the range of fishing grounds on the West Coast, predominantly from the 31°S line of latitude southwards and within 100 km of the shoreline. Over the period 2000 to 2012, an average of 73 856 tons of catch were taken within Block 3A/4A each year, which is equivalent to 15.8% of the total catch recorded by the fishery. The associated effort expended by the fishery in Block 3A/4A was 3 732 hours per year, equivalent to 16.8% of the overall effort recorded by the fishery.

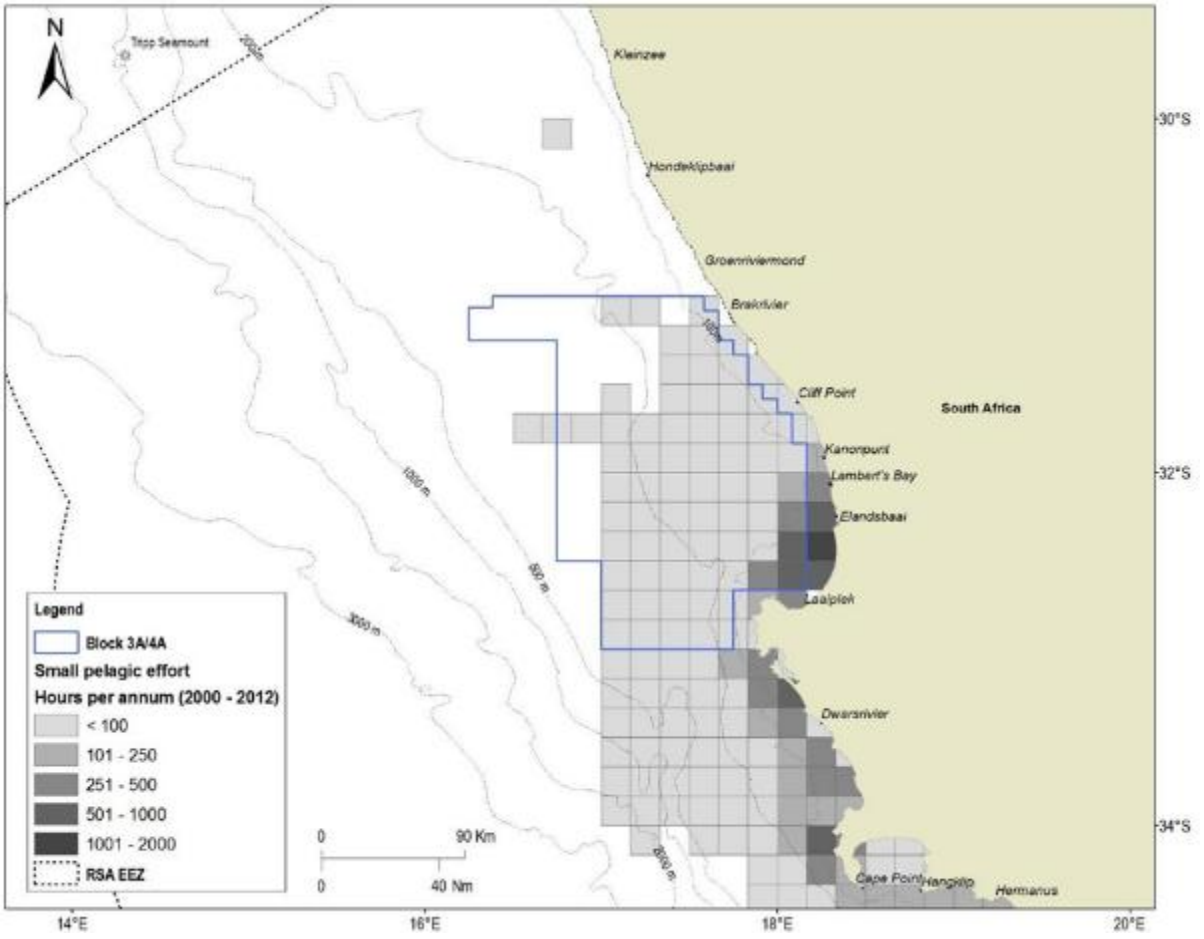


Figure 55: Spatial distribution of catch reported by the small pelagic purse-seine fishery (2000 – 2012) in relation to Block 3A/4A (CapFish, 2014).

West Coast Rock Lobster

The West Coast rock lobster (J. lalandii) (Figure 56) is a slow-growing, long-lived species which occurs inside the 200m depth contour along the entire West Coast to East London on the East Coast. The fishery is divided into the offshore fishery and the near-shore fishery, both directed inshore of the 100 m isobath. Effort is seasonal with boats operating from the shore and coastal harbours. Catch is landed whole and is managed using a TAC, 80% and 20% of which is allocated to the offshore and inshore fisheries respectively. A total national landing of approximately 1 879 tons (whole weight) was recorded for 2012.

Figure 56: West Coast Rock Lobster Jasus lalandii (traditionally caught on the South African West Coast) (CapFish, 2014).

Fishing grounds are divided for management purposes into Zones (and further subdivided into Areas) stretching from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape. The offshore sector operates in a water depth range of 30 m to 100 m whilst the inshore fishery is restricted by the type of gear used to waters shallower than 3 m in depth. The offshore sector makes use of traps consisting of rectangular metal frames covered by netting, which are deployed from trap boats (otherwise known as “deck boats”) whilst the inshore fishery makes use of hoop-nets deployed from small dinghies. The West Coast rock lobster offshore fishing fleet consists of vessels that range in length from 6 m to 14 m. Traps are set at dusk and retrieved during the early morning using a powerful winch for hauling. Vessels using traps will leave up to 30 traps per vessel in the fishing grounds overnight during the week, Monday to Friday. As a requirement of permit conditions for this sector, all traps must be removed over the weekend.

The spatial distribution of catch taken by the inshore and offshore fisheries over the period 1969 to 2012 is illustrated in Figure 57. Fishing occurs inshore of the 100m isobath along the eastern extent of Block 3A/4A, with one fishing ground located within Management Zone 4 falling within the boundaries of the Block.

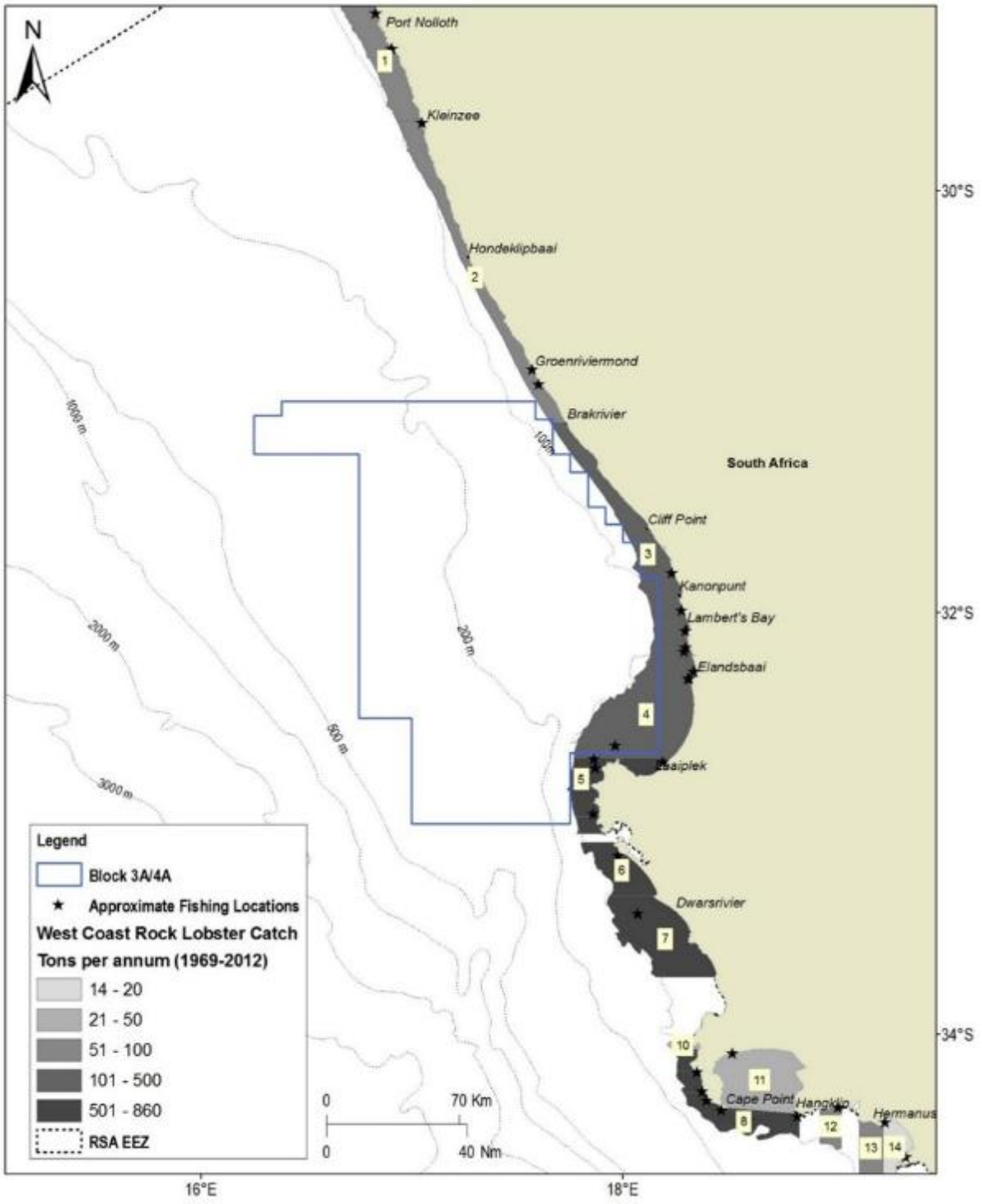


Figure 57: Spatial distribution of total catch (1969 – 2012) reported by the West Coast Rock Lobster fishery (includes inshore and offshore sectors) in relation to Block 3A/4A. Management areas labelled (1 – 14) and approximate fishing locations within management zones are shown (CapFish, 2014).

Fisheries Research

A survey of demersal fish resources is carried out twice a year by DFFE to set the annual TACs for demersal fisheries. Stratified, 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. A similar gear configuration to that of commercial demersal trawlers is used, however nets are towed for a shorter duration of generally 30 minutes per tow. Research was first started in 1985 where the West Coast

offshore region is surveyed from Cape Agulhas (20° E) to the Namibian maritime border. The survey duration is approximately one month and takes place in January off the West Coast and May off the South Coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. Approximately 120 trawls are conducted during each survey and the location of these trawls is pre-determined usually a week before the cruise is scheduled to take place.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence 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 travels pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200m isobath. The survey is designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DFFE survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the East.

2.2.4.2 SHIPPING TRANSPORT

The major shipping lanes off the coast of South Africa are situated on the outer edge of the continental shelf, between 12 and 24 nautical miles offshore (see Figure 58). Inshore shipping is largely confined to fishing vessels.

Figure 58: Global Shipping Density map (August 2013), which provides a good indication of the main worldwide shipping routes, insert focused around southern Africa (Source: Hydrographer SA Navy).

There are no Chartered Traffic Separation Schemes off Saldanha Bay or in Block 3A/4A. However, the Vehicle Traffic Service (VTS) specifies the traffic lanes that ships must follow upon approaching and entering/leaving the harbour (see Figure 59). Information on the Saldanha Bay VTS is available from the Hydrographer SA Navy.

Figure 59: Vehicle Traffic Services off the coast of Saldanha Bay (purple lines) with the approximate position of the southern edge of Block 3A/4A in red (Source: Hydrographer SA Navy).

2.2.4.3 OIL AND GAS EXPLORATION AND MINING

According to the PASA website[7], in 1967 a new Mining Rights Act was passed and offshore concessions were granted to a number of international companies, which led to the first offshore well being drilled in 1969 and the discovery by Superior of gas and condensate in the Ga-A1 well situated in the Pletmos Basin (off the south coast of South Africa). The PASA further indicates that in the entire offshore area there are now over 300 exploration wells including appraisal and production wells and in addition 233 000 km of 2D seismic data and 10 200 km2 of 3D seismic data have been acquired since exploration began offshore.

Exploration for oil and gas is currently undertaken off the entire coast of South Africa (i.e. East, South and West Coasts). PASA has allocated several petroleum exploration blocks off the coast of South Africa. Figure 60 shows

[7] http://www.petroleumagencysa.com/index.php/petroleum-geology-resources/exploration-history

the location of the various offshore blocks off the South African coast and indicates their status, i.e. whether they have Exploration or Production Rights, Technical Co-operation Permits, etc. Six wells are located within Block 3A/4A (Pers. comm., Ms P Ngesi of PASA, 8 August 2014), however, all these wells were plugged and abandoned after drilling.

The following exploration projects off the West Coast of South Africa are in various planning and approval stages (Pers. comm., Ms P Ngesi of PASA, 8 August 2014):

- Cairn South Africa (Pty) Ltd – proposing to expand the approved drilling programme for a further five wells outside the approved drilling area in Block 1. An Environmental Impact Assessment and EMP process is currently underway for approval by the Department of Environmental Affairs (DEA) and PASA, respectively.
- OK Energy Limited – proposing to explore for oil and gas in the Ultra-deep license area, Orange Basin. Application not yet granted.
- Sunbird Energy (Pty) Ltd – proposing to develop the Ibhubesi Gas Field, which includes a new 400km offshore pipeline that would cut across Block 3A/4A. No timeframes for this project are available as yet and an environmental process for the additional components is currently being undertaken, which requires approval from DFFE and PASA.
- Shell South Africa Upstream B.V. – proposing to drill one or two exploration wells in the northern part of the Orange Basin Deep Water License Area. No timeframes / approval for this project as yet.
- Anadarko South Africa (Pty) Ltd – has obtained an exploration right for further surveys (seafloor heatflow measurements and possible multi-beam bathymetry survey) in Block 5/6 and 7 to be undertaken within the next two years.
- Spectrum – speculative 2D survey in northern Orange Basin. Highly possible between December and May 2014/2015.
- Thombo – exploration well drilling in Block 2B. No formal commitment has been lodged or approved.
- New Age – proposing to explore for oil and gas in block west of Block 5 & 6. No exploration right granted yet.

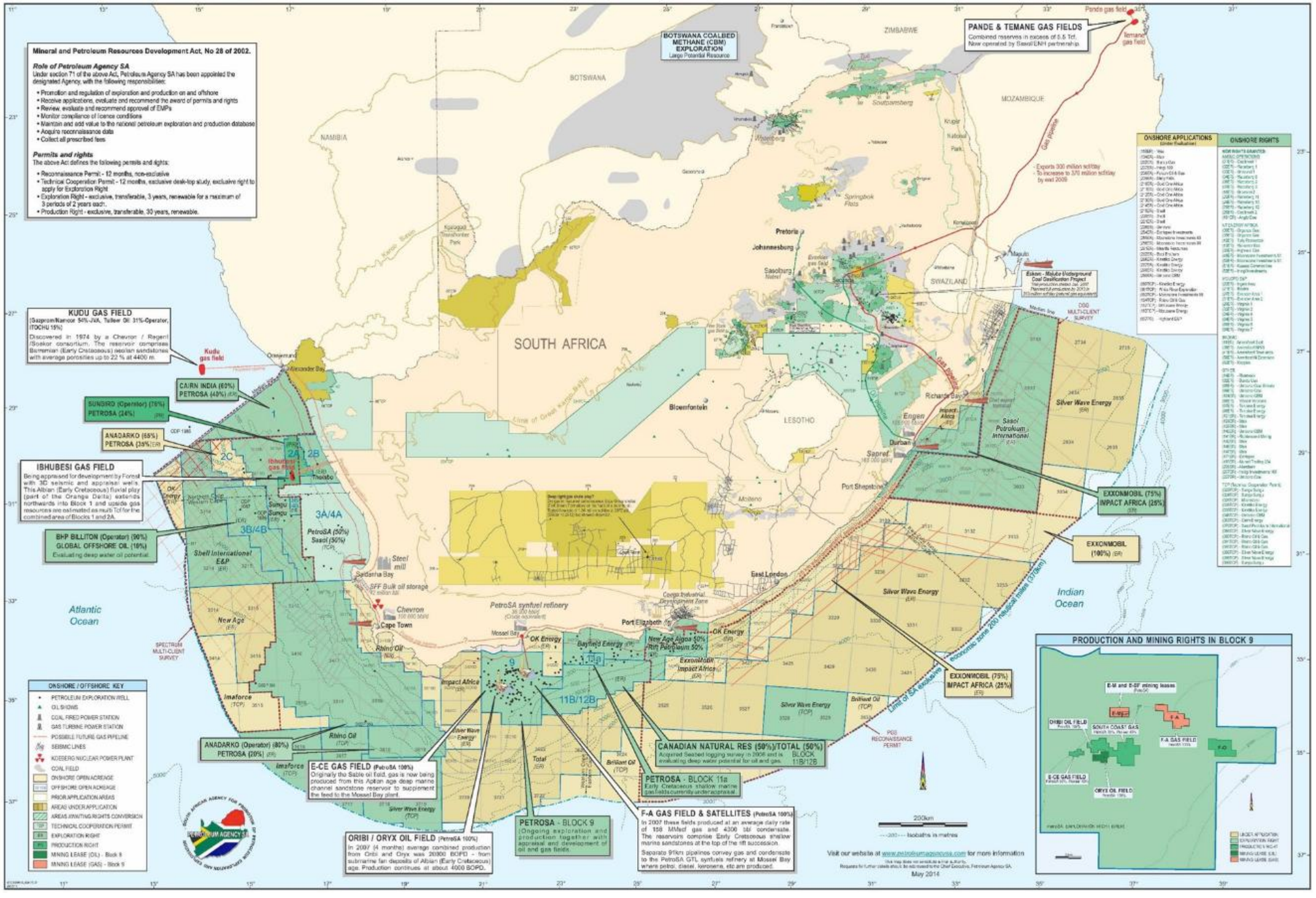


Figure 60: Map showing the various petroleum license blocks and the various rights held by each block off the South African coast (after PASA, 2014).

2.2.4.4 DIAMOND PROSPECTING AND MINING

Marine diamond mining areas are divided into concession areas off the west coast of South Africa, which extend from the Orange River mouth to just south of Saldanha Bay. The concession areas are divided into four groups, namely group 'a', 'b', 'c', and 'd' and cover the following areas (see Figure 61):

- 'a' concession areas are located along the coastline and begin at 31.49 m seaward of the low water mark and extends 1 km seawards of the high-water mark.
- 'b' concession areas start 1 km offshore of the high-water mark and end 5 km offshore of the high-water mark.'c' concession areas start 5 km from the high-water mark and extend to a water depth of 200 m below sea level.
- 'd' concession areas are in water depths between 200 m and 500 m.

The concession areas located in Block 3A/4A include the concession areas 'c' and 'd' for the most part (see Figure 61).

To the south of Hondeklipbaai, on the Namaqualand coast, marine diamond mining is restricted to the nearshore in a-concessions and includes diver-assisted operations from small, converted fishing vessels. As a result of the global recession and reduced diamond princes, the last few years has seen a substantial decline in small-scale diamond mining operations along the Namaqualand coast. Vessels mainly operate out of Alexander Bay and Port Nolloth. No deep-water mining is currently underway in the South African offshore concession areas. However, De Beers Consolidated Mines (De Beers) secured a Prospecting Right for platinum group metals, gold and sapphires in the DMBC license area in October 2009 and between December 2008 and March 2011, De Beers secured Prospecting Rights for heavy minerals, platinum group metals, gold and sapphire for sea areas 1c, inshore portions of 2c, 3c, 4c and 5c, as well as 6c, 7c, 8c, 9c, 10c, 12c, 14c, 15c, 16c, 17c, 18c and 20c. De Beers are currently developing plans for future prospecting in some of these areas, however, the only potential concession area that overlaps with Block 3A/4A is concession area 10c (pers. comm., Lesley Roos, De Beers, 8 August 2014).

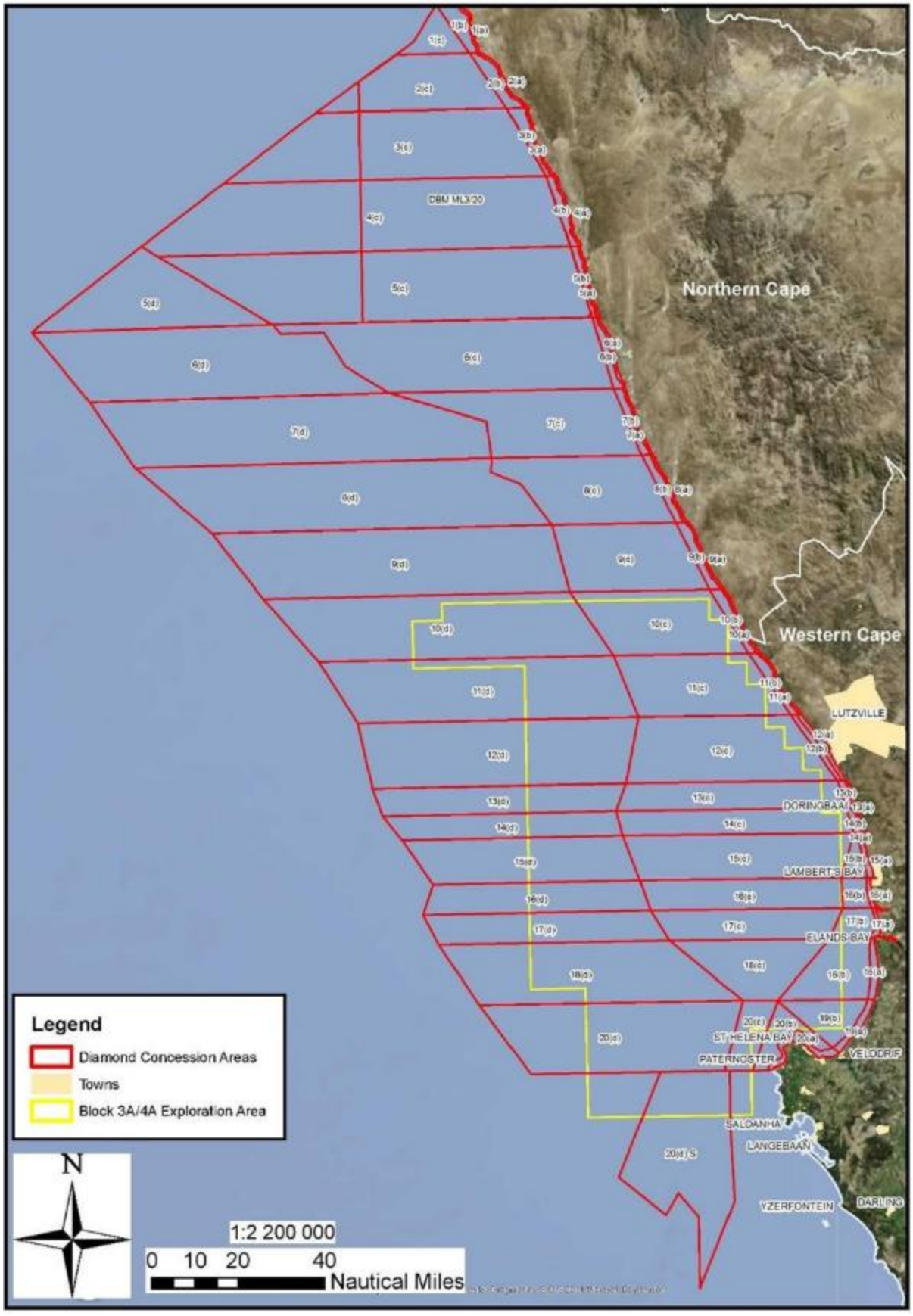


Figure 61: Map showing the marine diamond mining concession areas in relation to Block3A/4A.

2.2.4.5 PROSPECTING AND MINING OF OTHER MINERALS

Glauconite pellets and peletal phosphorous occur on the seafloor over large areas of the continental shelf on the West Coast (CCA, 2011) and are a source of agricultural phosphate and potassium. The southern edge of Block 3A/4A intersects with the top section of Agrim1 and SOM1 prospecting areas (see co-ordinates in Table 10 and Figure 62). The status of prospecting in these areas is unknown (pers. comm., Mr Koen, Department of Mineral Resources, 25 July 2014).

Table 10: Co-ordinates of glauconite and phosphorite prospecting blocks off the West Coast (from CCA, 2011)

BLOCK TITLE	LATITUDE (S)	LONGITUDE (E)
Agrimin1	32°49'40.11''	17°19'57.12''
	32°49'39.93''	16°44'23.13''
	33°17'40.92''	17°01'11.70''
	33°13'59.88''	17°07'59.99''
SOM1	32°49'39.00''	16°50'9.66''
	33°10'24.74''	16°53'29.30''
	33°40'00.00''	17°50'00.00''
	33°23'30.00''	17°50'00.00''
	33°19'00.00''	17°24'00.00''
	33°29'00.00''	17°41'00.00''
	33°16'00.00''	17°41'00.00''
	32°49'00.00''	17°20'08.0''

2.2.4.6 ARCHAEOLOGICAL SITES

There are approximately 3 000 shipwrecks off the coast of South Africa, SAHRA cannot say for certain exactly how many wrecks there are within Block 3A/4A. Most of the sites assessed along the West Coast are close to shore (Pers. Comm. Sophie Winton, 11August 2014, SAHRA). Shipwrecks older than 60 years have National Monument status.

2.2.4.7 AMMUNITION AND EXPLOSIVE DUMPING GROUNDS

SAN Chart 55 provides information on currents, water depth, undersea dangers, such as ammunition and explosive dumpsites, other offshore features such as submarine cables, etc. No known features that may hamper the proposed exploration activities are located within Block 3A/4A (see Figure 63).

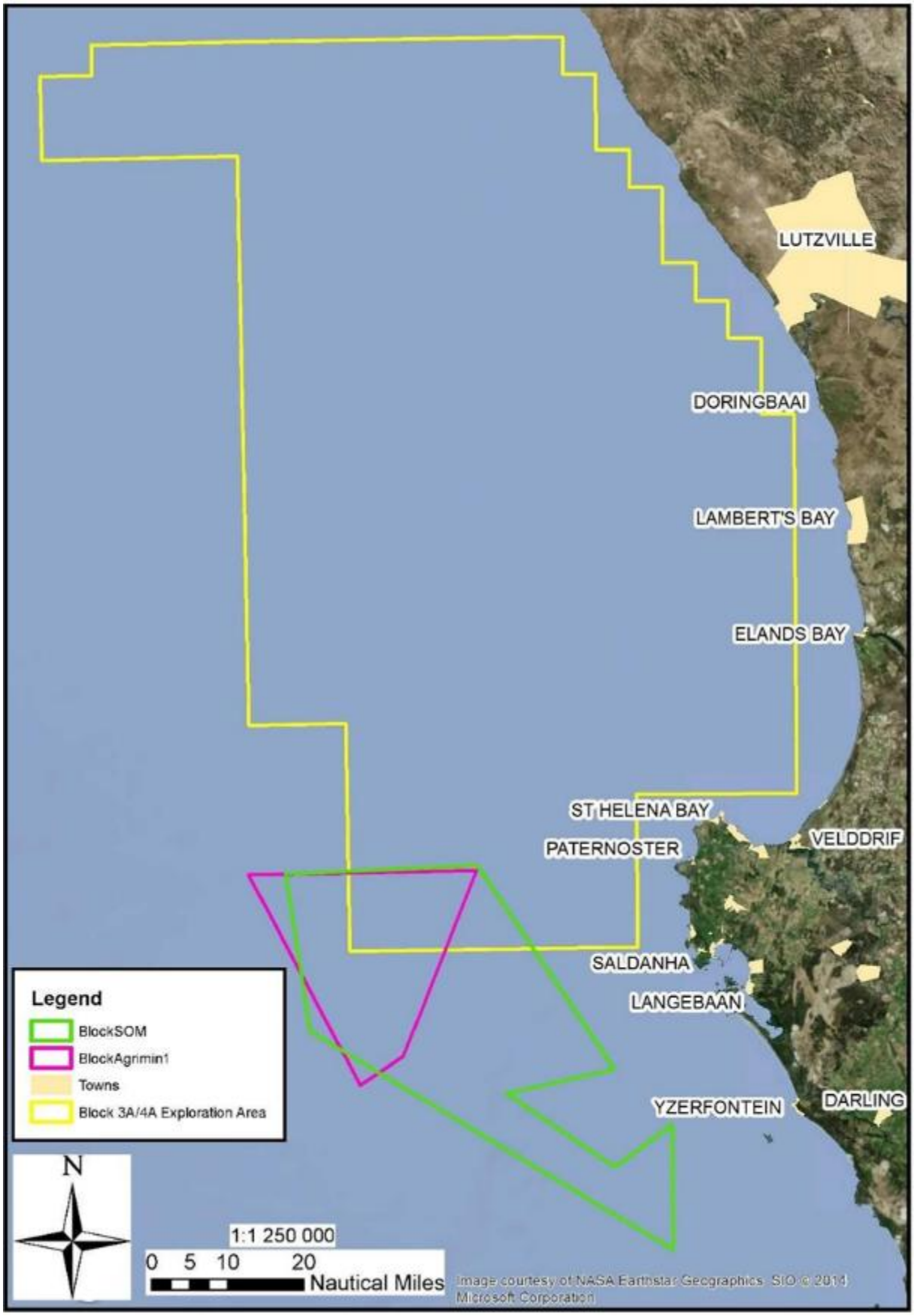


Figure 62: Glauconite and phosphorite prospecting blocks off the West Coast located within Block 3A/4A.

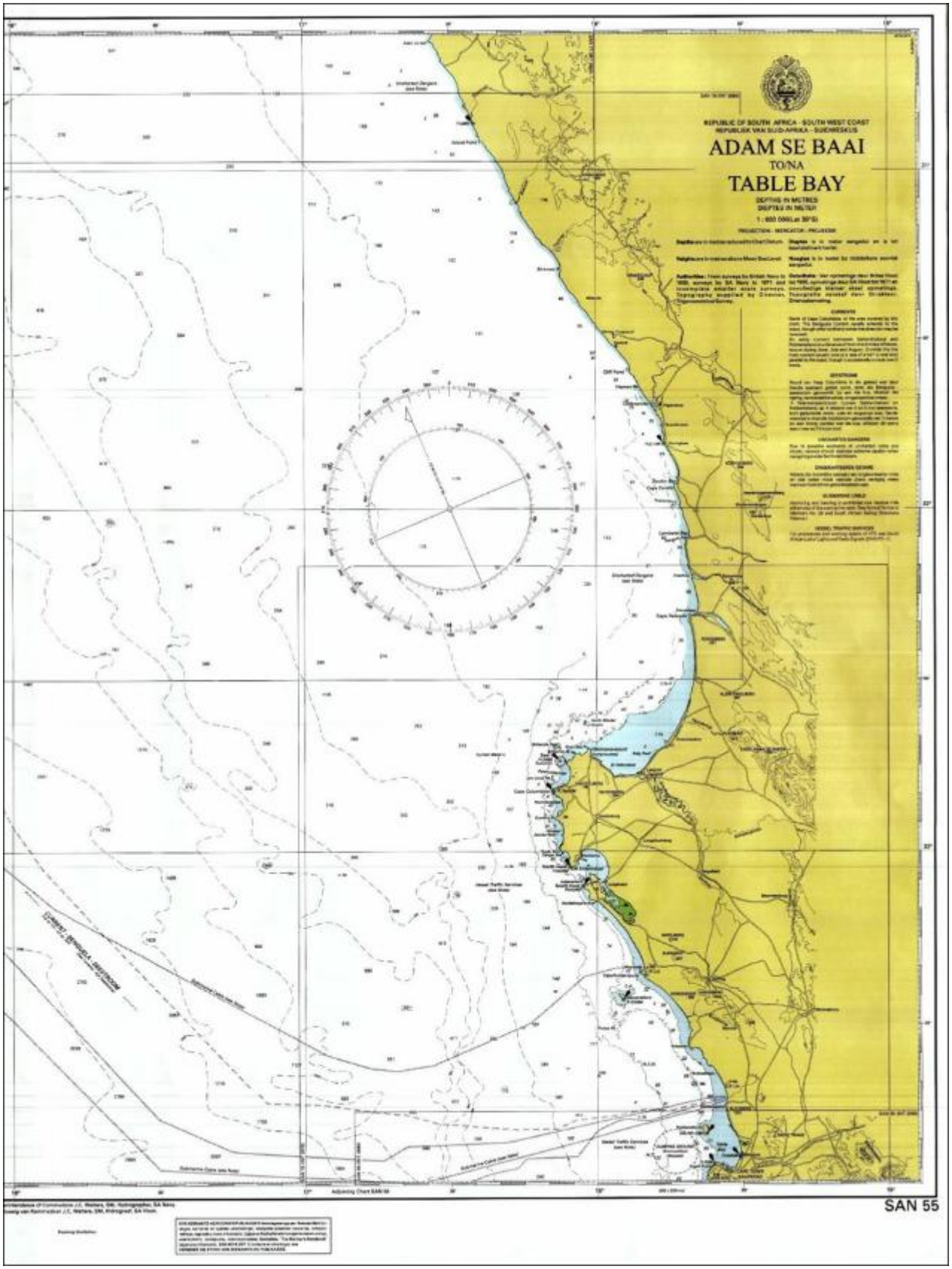


Figure 63: Section of SANS Chart 55, illustrating ammunition and dumping grounds off the West Coast of South Africa, highlighting those located within Block 3A/4A.

2.2.5 ANTHROPOGENIC ACTIVITIES

Due to the location of Block 3A/4A, positioned approximately 4 km off the coast at its closest point, any offshore recreational uses would be negligible.

2.2.6 PROTECTED AREAS

2.2.6.1 MARINE PROTECTED AREAS OFF THE WEST AND SOUTH-WEST COASTS OF SOUTH AFRICA

The Rocher Pan Marine Protected Area (MPA) exists along the coastline of the Western Cape, but it does not fall within Block 3A/4A. Rocher Pan MPA was declared in 1988[8] and stretches 500 m offshore of the high-water mark of the adjacent Rocher Pan Nature Reserve (25 km north of Veldrif). The MPA primarily protects a stretch of beach important as a breeding area to numerous waders.

The West Coast National Park, which was established in 1985 incorporates the Langebaan Lagoon and Sixteen Mile Beach MPAs, as well the following islands (see Figure 64):

- 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 zone;
- Limited recreational zone; and
- Multi-purpose recreational areas zone.

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.

[8] http://www.capenature.co.za/reserves/rocherpan-nature-reserve/

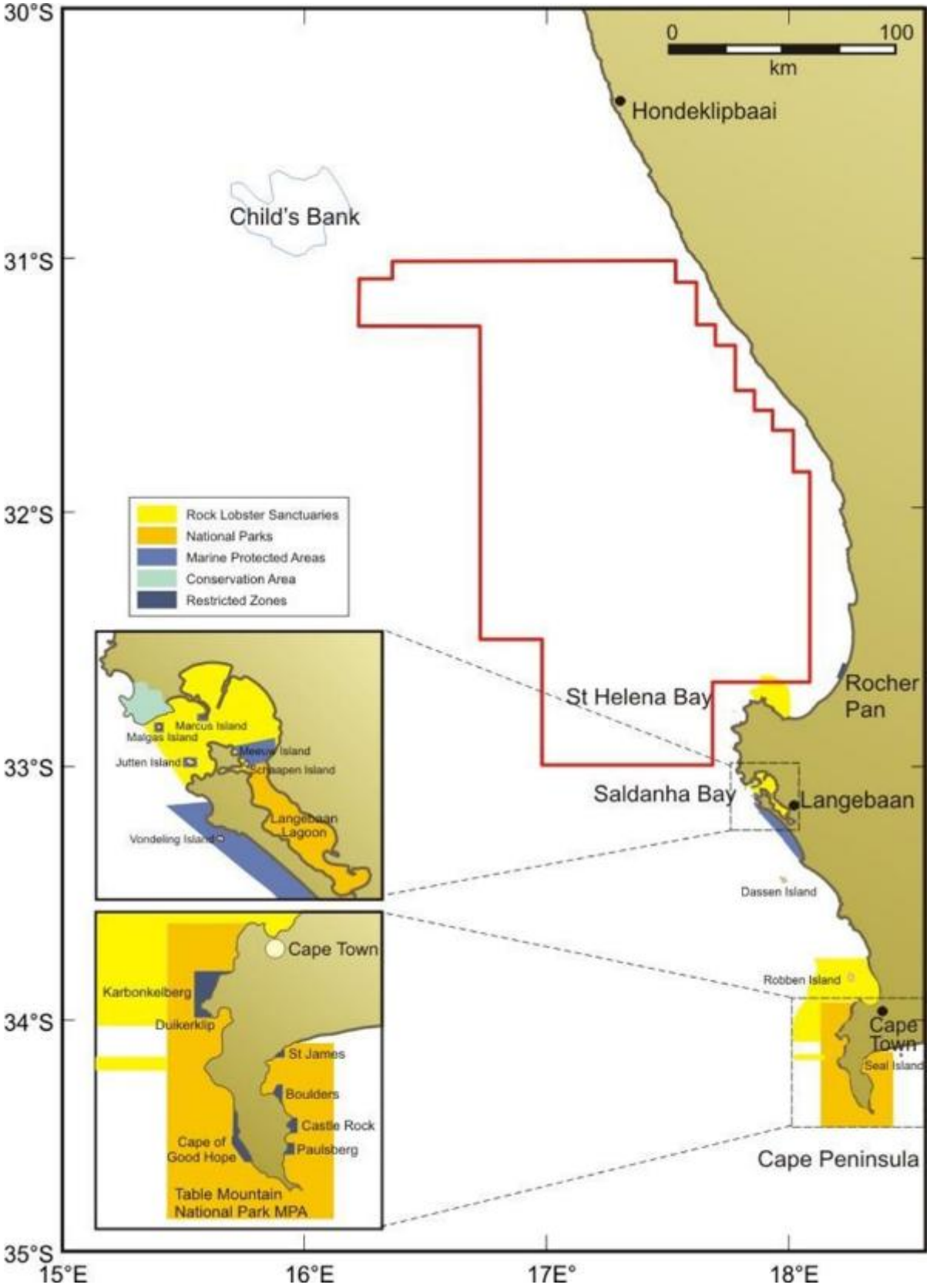


Figure 64: Conservation areas and Marine Protected Areas on the West Coast, in relation to the Exploration Area (red polygon) (Pulfrich, 2014).

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 (see

Figure 64). The proposed exploration activities would not impact on the Table Mountain MPA as it lies more than 110 km southeast of the Licence Block.

In February 2004, the then Department of Environmental Affairs and Tourism issued a notice of intention to declare the Namaqualand MPA under Section 43 of the Marine Living Resources Act (No. 18 of 1998), with the objectives of[9]:

- Protecting marine habitats and ecosystems that are representative of South Africa's cool-temperate west coast;
- Serve as a reference area against which the effects of demersal trawling can be assessed; and
- Promote ecotourism along the coastline that has been elsewhere heavily impacted by diamond mining.

However, the initial area of 9 700 km^2 has been considerably reduced to consider various stakeholders' interests. Figure 65 provides a proposed area for the MPA, however, this has yet to be finalised and may change. Block 3A/4A is located to the south of this proposed MPA.

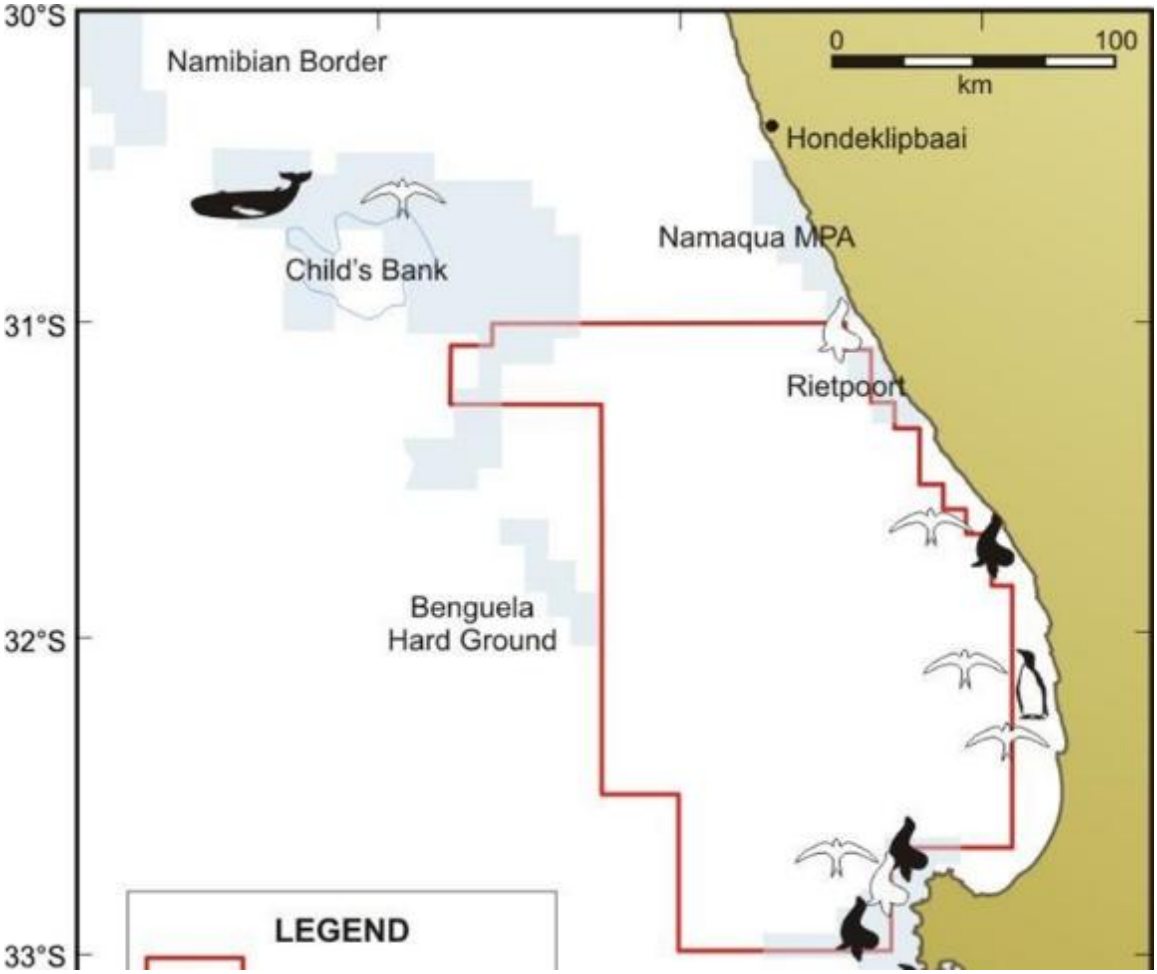


Figure 65: Proposed Namaqualand MPA off the Northern Cape Coast, north of Block 3A/4A (Pulfrich, 2014)

[9] Government Gazette, 17 February 2004, Government Notice No. 205

2.2.6.2 RAMSAR SITE

Langebaan Lagoon is the only Ramsar site along the west coast, but is not located in Block 3A/4A, which is situated further offshore.

2.2.6.3 MARINE CONSERVATION AREAS AND SANCTUARY'S

Marine conservation areas in the Saldanha Bay / Cape Columbine region include:

- Paternoster Rocks – Egg and Seal Island reserves for seabirds and seals;
- Jacob's Reef – Island reserve for seabirds and seals;
- An area within the military base, SAS Saldanha; and
- Vondeling Island.

A Rock Lobster Sanctuary is in St Helena Bay and no rock lobster may be caught in Saldanha Bay eastwards of a line between North Head and South Head.

2.2.6.4 SUMMARY OF FEATURES SPECIFIC TO BLOCK 3A/4A

Features specific to the Block 3A/4A Exploration Area are summarised below:

- The Exploration Area is approximately 25,332 km² in extent;
- Water depths range between 20 m and 480 m;
- The Exploration Area lies on the continental shelf with the nearest points located approximately 4km offshore of the stretch of coastline between Brand se Baai and Jakkalshok and off Skurfbaai;
- Seabed sediments along the inshore portion of the Exploration Area are dominated by the mudbelt, with muddy sands and sands occurring further offshore;
- The sediments are likely to host a range of benthic macrofaunal species including polychaete worms, crustaceans and echinoderms;
- The southern portion of the Exploration Area within the Cape Columbine upwelling cell, and waters are likely to be seasonally cold, nutrient rich and hosting high abundances of phytoplankton, zooplankton and ichthyoplankton;
- A wide variety of inshore reef fish, small pelagic and demersal fish species are likely to be encountered in the inshore portions of the Exploration Area, with the large migratory pelagic species (e.g. tunas, billfish and pelagic sharks), occurring further offshore;
- Migrating leatherback turtles are also likely to occur, as are a variety of pelagic seabirds;
- Marine mammals likely to be encountered include migrating and resident humpback and southern right whales and small odontocetes known to frequent continental shelf waters;
- The Exploration Area lies offshore of MPAs but overlaps with numerous proposed priority areas for the protection of benthic and pelagic habitats in the northern and southern ends of the block.

2.3 DETAILED IMPACT ASSESSMENT

The purpose of this section is to describe and assess the potential environmental impacts (both positive and negative) of the proposed exploration and geophysical surveys in Block 3A/4A off the West Coast of South Africa. The specialist impact assessments (included in Appendices 4 and 5) have been integrated into the report in the sub-section that follow.

Potential impacts associated with the various components of the proposed project have been assessed in the following three categories, namely:

- Impact of Normal Vessel and Aircraft Operations;
- Impact on Marine Fauna; and
- Impact on Other Users of the Sea

The following specialist studies were undertaken to assess the potential impact of the proposed project on the marine and socio-economic environments.

- Impact on Marine Fauna; and
- Impact on Fishing Industry.

All potential impacts have been assessed according to the same set of criteria to ensure that a comprehensive and standardised assessment of potential impacts is undertaken to determine the overall impact significance (refer to Appendix 6). It should be noted that all impacts are negative, unless otherwise stated. Mitigation measures have been identified and recommended for all identified impacts to reduce the overall negative impact significance to an acceptable level, while enhancing the positive impacts, where and if possible. Mitigation measures aim to ensure that:

- Environmental benefits of a proposed activity are enhanced;
- Negative impacts are avoided, minimised or remedied; and
- Residual negative impacts are within acceptable levels.

Unless otherwise indicated, all potential impacts identified in the following sections would be for the duration of the exploration only, because of the high-energy marine environment and / or the transient nature of survey activities. It is expected that each component would be short term in nature and estimated timeframes are provided[10]:

- Airborne Gravity and Magnetic Survey – approximately 2 to 3 weeks.
- 2D Seismic Survey – approximately 1 month;
- High Resolution Bathymetry Survey and Seabed Sampling – approximately 1 month;
- Heatflow Measurements – approximately 2 to 3 weeks; and
- 3D Seismic Survey – approximately 2 months.

It must be highlighted that the Operator may not undertake all the above-mentioned exploration activities, as this will be dependent on the findings of the initial surveys.

2.3.1 IMPACT OF NORMAL VESSEL AND AIRCRAFT OPERATIONS

2.3.1.1 EMISSIONS TO THE ATMOSPHERE

Impact Statement

Maritime vessels and aircraft used for offshore oil and gas surveys have gaseous emissions from the fuels used on these ships (exhaust gases) as well as from burning of waste material. These emissions mainly include Carbon Monoxide (CO), Carbon Dioxide (CO2), Nitrogen Oxides (NOX), Sulphur Dioxide (SO2) and particulate matter such as soot. Many of these pollutants are transformed to secondary species which mix with the ambient air (such as nitrates and sulphates forming from reactions of Sulphur and Nitrogen emissions with the surrounding

[10] All timeframes provided are indicative and based on average past timeframes undertaken by PetroSA. Mechanical and weather delays area always a high possibility, which could affect the timeframes provided.

atmosphere). Such secondary species may have further effects upon the environment such as acidification that may be harmful to ecosystems and that may lead to harmful health effects. An increase in atmospheric Ozone (O3) due to emissions from ships is also experienced and is more pronounced in the summer months.

Atmospheric emissions from maritime vessels and aircraft contribute to the decrease in ambient air quality. The abovementioned pollutants also form part of Green House Gases (GHGs) which absorb and re-emit infrared radiation leading to an increase in climate change.

Discussion and Assessment of Impact

Emissions from the maritime vessels, aircraft and associated infrastructure (such as airgun compressors) to be used for the surveys are anticipated to have an impact of low intensity and would be like other diesel-powered vessels of a similar size. The surveys will be undertaken in relatively short time periods, thereby lessening the overall impact of the emissions on the atmosphere. All incineration of waste on-board maritime vessels must comply with the relevant MARPOL 73/78[11] standards. It is anticipated that all waste incinerated on-board any of the vessels and thus the ensuing emissions would be minimal.

Emissions to the atmosphere are anticipated to be of low intensity, of short duration and of local extent. The potential impact was assessed to be of VERY LOW significance, with and without mitigation.

Mitigation Measures

The following mitigation measure is recommended:

- Ensure that vessels, aircraft and associated infrastructure used for the relevant surveys have an up- to-date maintenance plan to ensure all equipment functions optimally to prevent build-up of soot, unburnt diesel and other particulate matter that may increase atmospheric emissions.

Table 11: Potential impact of the exploration activities on normal vessel and helicopter operations.

IMPACTS OF EMISSIONS TO THE ATMOSPHERE		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

2.3.1.2 DISCHARGES / DISPOSAL TO THE SEA

Discharges and disposal to the sea from maritime vessels used during the surveys would include deck drainage, machinery space drainage, sewage, galley waste and solid wastes. These are described below.

2.3.1.2.1 Deck Drainage

[11] MARPOL 73/78 is an International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto. All vessels operating within the South African Exclusive Economic Zone are required to conform to legal requirements for waste management and pollution control, including the Marine Pollution Act (No 2 of 1986 - which incorporate MARPOL 73/78 standards) and the Dumping at Sea Control Act, 1965 (No 73 0f 1965). These Acts make provision for the discharge of sewage, plastics, oil, galley wastes, hazardous liquids and packaged hazardous material.

Impact Statement

Discharges from the deck area to the marine environment would mainly involve potentially small volumes of solvents, cleaning materials and oil, which could impact on water quality.

Discussion and Assessment of Impact

All discharges have to comply with the relevant MARPOL standards. Due to the small quantities to be discharged, the potential impacts on water quality would be minimal. Due to the extensive volume of the ocean, it would act as a dilutor and lessen the impact. All vessels would also have to comply with MARPOL standards. As such, the potential impact of deck drainage on water quality would be of low intensity, at a local level and of short-term duration and was assessed to be of VERY LOW significance with and without mitigation (see Table 12).

Mitigation Measures

- Use low toxicity biodegradable lubricants, detergents, solvent and other cleaning fluids.
- All substances to be drained should first be collected in an oil-water catchment system.
- All substances to be disposed of in the marine environment should comply with the relevant MARPOL standards.
- Include the importance of contamination prevention / minimisation and spill management in the environmental awareness training to be provided to all vessel staff.

Table 12: Potential impact of discharges / disposal to sea.

IMPACTS OF DECK DRAINAGE		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	Medium – High	Medium - High

2.3.1.2.2 Machinery Space Drainage

Impact Statement

Discharges from the machinery space would include mainly bilge waste (oily water from the bilges) and sludge (waste residue from the filtration of fuel oil), minor quantities of grease, other lubricants and fuel may also be present, which may impact water quality.

Discussion and Assessment of Impact

In terms of MARPOL 73/78, 'all discharges of oil are prohibited unless certain criteria are satisfied'. These criteria must always be complied with and includes that the ship must be en-route (i.e. moving), oily mixtures must have been processed through the oil filtering equipment, oil content of the mixture must not exceed 15 parts per million (ppm) and that the oily mixtures must not be mixed with cargo residues.

Compliance with the MARPOL standards would ensure that the discharges are of limited volumes and that the content of the discharges would not significantly impact on the surrounding water quality and marine environment. As such, the potential impact of machinery space drainage on water quality would be of low intensity, at a local level and of short-term duration and was assessed to be of VERY LOW significance with and without mitigation (see Table 13).

Mitigation Measures

No mitigation other than compliance with MARPOL standards is required.

Table 13: Potential impact of machinery space drainage.

IMPACTS OF DECK DRAINAGE		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	Medium – High	Medium - High

2.3.1.2.3 Sewage

Impact Statement

Sewage discharges into the sea would increase the organic and bacteriological load to the marine environment. This can cause a health hazard, especially in coastal areas, leading to oxygen depletion and it can also create obvious visual pollution.

Discussion and Assessment of Impact

As with discharges from the machinery space, MARPOL 73/78 standard (Annexure IV of MARPOL) requires that certain criteria must be met before any discharges to the sea is allowed. This includes a limitation on the distance from the nearest land from which any discharges may be made[12]. Oceans are considered capable of assimilating and dealing with raw sewage through natural bacterial action[13] and wind and wave action also helps to disperse the sewage. Any discharges within the minimum distance from the land is not allowed and sewage must then be disposed of at the nearest port for treatment in a sewage treatment plant. Certain areas are also zoned as 'no discharge zones'.

It is anticipated that due to the relatively short duration of the surveys and the comparably small staff complement of the crews, that the volumes of sewage to be discharged would be minimal. Sewage would also be treated to the required MARPOL standard prior to discharge into the marine environment. The potential impact of sewage on the marine environment would have a low intensity at the local level and would be of short-term duration. The impact was assessed to be of VERY LOW TO LOW significance, without mitigation and VERY LOW significance with mitigation (see Table 14).

Mitigation Measures

- All discharges must comply with the relevant MARPOL standards.

[12] Annex IV (Regulation 8 1(a)): Subject to the provision of Regulation 9 of this Annex, the discharge of sewage into the sea is prohibited, except when: the ship is discharging comminuted and disinfected sewage using a system approved by the Administration in accordance with regulation 3(1)(a) at a distance of more than 4 nautical miles from the nearest land, or sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land, provided that in any case, the sewage that has been stored in holding tanks shall not be discharged instantaneously but at a moderate rate when the ship is en route and proceeding at not less than 4 knots; the rate of discharge shall be approved by the Administration based upon standards developed by the Organization;

[13] http://www.imo.org/OurWork/Environment/PollutionPrevention/Sewage/Pages/Default.aspx

- All discharges may take place no closer to the coast than the minimum distance specified by MARPOL 73/78 Annex IV.

Table 14: Potential impact of sewage on the marine environment.

IMPACT OF SEWAGE ON THE MARINE ENVIRONMENT		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low – Medium	Very Low
Significance	**Very Low – Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

2.3.1.2.4 Galley Waste

Impact Statement

Discharges from the galley areas of the vessels would be restricted to food wastes, identified cargo residues, animal carcasses and identified cleaning agents and additives in wash water according to the revised MARPOL Annex V[14]. Such waste could add an additional organic and bacterial load on the environment.

It is a further requirement of MARPOL that these wastes should not be harmful to the environment.

Discussion and Assessment of Impact

It is anticipated that the galley wastes from the survey vessels would be minimal due to the comparably small crew compliment and the relatively short duration of the surveys. Solid wastes to be discharged (mainly food) must be comminuted to particle sizes less than 25 mm. No disposal may take place within 3 nm (±5.5 km) from the coast.

The potential impact of galley waste on the marine environment would be of low intensity at the local level and of short-term duration and was assessed to be of VERY LOW significance with and without mitigation (see Table 15).

Mitigation Measures

- Always Comply with the revised MARPOL Annex V standards.
- Ensure that a waste management plan is available for the vessel (required for any ship with a crew of more than 15 people).

Discharge comminuted galley waste no closer than 3 nm from the coast. All food waste not comminuted to be discharged no closer than 12 nm from the coast. Vessels must be en-route.

[14] http://officerofthewatch.com/2012/11/07/ships-garbage-management-under-revised-marpol-annex-v/

Table 15: Potential impact of galley waste on the marine environment.

IMPACT OF GALLEY WASTE ON THE MARINE ENVIRONMENT		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High

2.3.1.2.5 Solid Waste

Impact Statement

All waste disposal must comply with the revised MARPOL Annex V (January 2013). Any disposal of non-biodegradable domestic wastes and other solid wastes (e.g. plastic bags, bottles, containers, operational waste, etc.) will have a detrimental effect on the marine environment and could lead to mortalities of marine animals, through entanglement, suffocation, etc., and would also result in visual pollution.

Discussion and Assessment of Impact

All solid wastes would be incinerated on the vessel or taken to the shore for disposal at a land-based facility. Solid waste disposal would thus not result in an impact to the marine environment. However, spillage of any of the prohibited substances may lead to an impact on the marine environment. This could involve impacts on water quality, suffocation or other health impacts to marine fauna through interaction with plastics or other solid wastes, etc. Implementation of an effective waste management plan would reduce the potential for litter. Specialist waste disposal contractors would be required to dispose of hazardous waste. The likelihood of solid waste being released into the marine environment is negligible.

Table 16 provides a summary of the prohibitions relating to waste disposal[15].

The potential impact of the disposal of solid waste on the marine environment would be of zero to very low intensity at the local level and of short-term duration and was assessed to be INSIGNIFICANT (see Table 16).

Table 16: Simplified overview of the discharge provisions of the revised MARPOL Annex V

Type of garbage	**Ships outside special areas**	**Ships within special areas**	Offshore platforms and all ships within 500 m of such platforms
Food waste comminuted or ground	Discharge permitted **≥3 nm from the nearest land and *en route***	Discharge permitted **≥12 nm from the nearest land and *en route***	Discharge permitted ≥12 nm from the nearest land
Food waste not comminuted or ground	Discharge permitted **≥12 nm from the nearest land and *en route***	Discharge prohibited	Discharge prohibited
Cargo residues[1] not contained		Discharge prohibited	Discharge prohibited

[15] http://www.imo.org/OurWork/Environment/PollutionPrevention/Garbage/Documents/2014%20revision/Annex%20V%20discharge%20requirements%2007-2013.pdf

Type of garbage	Ships outside special areas	Ships within special areas	Offshore platforms and all ships within 500 m of such platforms
in wash water	Discharge permitted **≥12 nm from the nearest land and *en route***		
Cargo residues[1] contained in wash water		Discharge only permitted in specific circumstances2 **and ≥12 nm from the nearest land and *en route***	Discharge prohibited
Cleaning agents and additives[1] contained in cargo hold wash water	Discharge permitted	Discharge only permitted in specific circumstances[2] **and ≥12 nm from the nearest land and *en route***	Discharge prohibited
Cleaning agents and additives[1] contained in deck and external surfaces wash water		Discharge permitted	Discharge prohibited
Carcasses of animals carried on board as cargo, and which died during the voyage	Discharge permitted **as far from the nearest land as possible and *en route***	Discharge prohibited	Discharge prohibited
All other garbage including plastics, domestic waste, cooking oil, incinerator ashes, operational waste and fishing gear.	Discharge prohibited	Discharge prohibited	Discharge prohibited
Mixed garbage	**When garbage is mixed with or contaminated by other substances prohibited from discharge or having different discharge requirements, the more stringent requirements shall apply**		

Notes:

1- These substances must not be harmful to the marine environment.

2- According to regulation 6.1.2 of MARPOL Annex V, the discharge shall only be allowed if: (a) both the port of departure and the next port of destination are within the special area and the ship will not transit outside the special area between these ports (regulation 6.1.2.2); and (b) if no adequate reception facilities are available at those ports (regulation 6.1.2.3).

Mitigation Measures

- Always Comply with the revised MARPOL Annex V standards.
- Ensure that a waste management plan is available for the vessel (required for any ship with a crew of more than 15 people). This should include information on waste minimisation, collection, storage, processing, disposal, equipment used on-board for waste handling and the designation of the person in charge of the waste management plan.
- Ensure that all stored waste is secured to prevent litter.
- Ensure that all waste disposal contractors are compliant with the relevant local bylaws and authority requirements in terms of municipal waste disposal.

Table 17: Potential impact of the disposal of solid waste on the marine environment.

IMPACT OF SOLID WASTE DISPOSAL ON THE MARINE ENVIRONMENT		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Zero – Very Low	Zero
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

2.3.1.3 NOISE FROM VESSEL OPERATIONS IMPACT STATEMENT

Noise from survey and supporting vessels could result in localised disturbances to marine fauna.

Discussion and Assessment of Impact

Note that this impact is not related to noise from survey operations (such as acoustic noise from seismic surveys).

Survey vessel noise disturbances are anticipated to be like that of other shipping vessels in the surrounding area (such as fishing and cargo transport vessels). Noise disturbances may result in temporary behavioural changes in nearby marine faunal species, such as swimming away or diving deeper. Such disturbances are anticipated to be short term, and behavioural changes would be reversed once the vessel leaves the area.

The potential impact of vessel noise on marine fauna would be of very low to low intensity at the local level and of short-term duration and was assessed to be of VERY LOW significance with and without mitigation (see Table 18).

Mitigation Measures

It is not deemed necessary to mitigate noise impacts from survey and supporting vessels.

Table 18: Potential impact of noise from vessel operations on the marine fauna.

IMPACTS OF VESSEL NOISE ON MARINE FAUNA		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Very Low	Very Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

2.3.2 IMPACT ON MARINE FAUNA

2.3.2.1 IMPACT OF SEISMIC NOISE

2.3.2.1.1 Potential Impacts to Plankton Species (including Ichthyoplankton)

Impact Statement

Potential impacts of seismic pulses on plankton would include physiological injury or mortality in the immediate vicinity of the airgun sound source, as the movement of phytoplankton and zooplankton is largely limited by currents and they are not able to actively avoid the seismic vessel.

Discussion and Assessment of Impact

Plankton distribution is naturally temporally and spatially variable and due to intense upwelling areas off the West Coast, which are characterised by diminished phytoplankton biomass and nutrient poor oceanic waters beyond the influence of upwelling, phytoplankton and zooplankton abundances in the Exploration Area are thus expected to be comparatively low. A deficiency of phytoplankton results in poor feeding conditions for micro-, meso- and macrozooplankton and for ichthyoplankton.

Phytoplankton are not known to be affected by seismic surveys and are unlikely to show any significant effects of exposure to air-gun impulses outside of a 1 m distance (Kosheleva, 1992; McCauley, 1994). The abundance and spatial distribution of zooplankton is highly variable and dependent on factors such as fecundity, seasonality in production, tolerances to temperature, length of time spent in the water column, hydrodynamic processes and natural mortality. Zooplankton densities are generally low and patchily distributed. The amount of exposure to the influence of seismic airgun arrays is thus dependent on a wide range of variables. Invertebrate members of the plankton that have a gas-filled flotation aid, may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for other plankton. However, for a large seismic array, a physiological effect out to 10 m from the array is considered a generous value with known effects demonstrated to 5 m only (Kostyuchenko, 1971).

McCauley (1994) concludes that when compared with total population sizes or natural mortality rates of planktonic organisms, the relative influence of seismic sound sources on these populations can be considered insignificant.

As plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would thus be of negligible to low intensity across the Exploration Area and for the duration of the surveys (short-term). The overall potential impact of seismic noise on plankton and ichthyoplankton is therefore deemed to be VERY LOW both with and without mitigation (see Table 19).

Mitigation Measures

No direct mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.

Table 19: Potential impact of seismic noise on plankton and ichthyoplankton.

IMPACTS OF SEISMIC NOISE ON PLANKTON AND ICHTHYOPLANKTON		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

2.3.2.1.2 Potential Impacts Marine Invertebrates

Impact Statement

Some marine invertebrates have mechanoreceptors or statocyst organs that are sensitive to hydroacoustic disturbances, although most do not possess hearing organs that perceive sound pressure. Potential impacts of seismic pulses on invertebrates could include physiological injury and behavioural avoidance of seismic survey areas. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely.

Discussion and Assessment of Impact

- Physiological injury and mortality on invertebrate fauna

There is little published information on the effects of seismic surveys on invertebrate fauna. It has been postulated, however, that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range, such as less than 5 m away. This implies that only surveys conducted in very shallow water will have any detrimental effects on these fauna. As the seismic and multibeam surveys would be conducted more than 20 m depth and beyond 10 km from the coast, the received noise at the seabed would be within the far-field range, and outside of distances at which physiological injury of benthic invertebrates would be expected. The potential impact of seismic noise on physiological injury or mortality of benthic invertebrates is consequently deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of VERY LOW significance, with and without mitigation (see Table 20).

- Physiological injury and mortality on pelagic cephalopods

Although a causative link to seismic surveys has not been established with certainty, giant squid strandings coincident with seismic surveys have been reported (Guerra et al., 2004). Furthermore, controlled-exposure experiments during which cephalopods were subjected to low-frequency sounds resulted in permanent and substantial alterations of the sensory hair cells of the statocysts of four squid species (André et al., 2011). The potential impact of seismic noise on physiological injury or mortality of pelagic cephalopods could thus potentially be of high intensity across the survey area and for the survey duration. However, as the probability of an encounter is considered low, the impact is deemed to be of VERY LOW significance both without and with mitigation (see Table 21).

- Behavioural avoidance

There is also little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses. Limited avoidance of airgun sounds may occur in mobile neritic and pelagic invertebrates and is deemed to be of low intensity. Of the marine invertebrates only, cephalopods are receptive to the far-field sounds of seismic airgun arrays. Although consistent avoidance has not been reported, behavioural changes have been observed at 2 – 5 km from an approaching large seismic source (McCauley et al., 2000). The received noise at the seabed would be within the far-field range, and thus outside of distances at which avoidance of benthic invertebrates would be expected, but potentially within the response range of neritic cephalopods. The potential impact of seismic noise on invertebrate behaviour is consequently deemed to be of low to negligible intensity across the survey area and for the survey duration and is of VERY LOW significance both with and without mitigation (see Table 22).

Mitigation Measures

No mitigation measures for potential impacts on marine invertebrates and their larvae are feasible or deemed necessary and no mitigation for potential impact of seismic noise on invertebrate behaviour is deemed necessary.

Table 20: Potential impact of seismic noise to benthic invertebrates resulting in physiological injury.

IMPACTS OF SEISMIC NOISE TO BENTHIC INVERTEBRATES RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (for duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative

Table 21: Potential impact of seismic noise to pelagic and neritic invertebrates resulting in physiological injury.

IMPACTS OF SEISMIC NOISE TO PELAGIC AND NERITIC INVERTEBRATES RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (for duration of survey)	Short-term
Intensity	High	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Table 22: Potential impact of seismic noise to marine invertebrates resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE TO MARINE INVERTEBRATES RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (for duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

2.3.2.1.3 Potential Impacts to Fish

Impact Statement

Potential impacts of seismic pulses to fish species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication and indirect impacts due to effects on predators or prey.

Discussion and Assessment of Impact

- Physiological injury and mortality

The greatest risk of physiological injury from seismic sound sources, when surveying in shallow coastal regions, is for species that establish home ranges on shallow-water reefs or congregate in inshore waters to spawn or feed, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Large demersal or reef-fish species with swim-bladders are also more susceptible than those without this organ. Such species may suffer physiological injury or severe hearing damage, and adverse effect may intensify and last for a considerable time after the termination of the sound source. As the proposed exploration area will extend from 20 – 480 m depths, species frequenting the shallower nearshore waters may be negatively affected, although this is only likely at very close range. For demersal and neritic species occurring in deeper water, the received noise at the seabed would be within the far-field range and thus outside of distances at which physiological injury or avoidance would be expected. The potential physiological impact on demersal and nearshore reef species would be of low to medium intensity and is therefore considered to be of LOW significance without mitigation and VERY LOW significance with mitigation (see Table 23).

Given the high mobility of most fish, it is assumed that they would avoid seismic noise at levels below those where physiological injury or mortality would result. In many of the large pelagic species the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore

lower. Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. The potential physiological impact on migratory pelagic species, would be of medium to high intensity, but the duration of the impact on the population would be limited to the short-term. The impact on pelagic species is therefore considered to be of LOW significance, without mitigation and VERY LOW significance with mitigation (see Table 24).

- Behavioural avoidance

Behavioural responses, such as avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds, have been documented at received levels of about 160 dB re 1 Pa. Short term behavioural changes may be of limited concerns for fish populations, but if it alters the ability of fisherman to catch the fish during this period then there is the potential for short-term indirect impacts. There are currently concerns from commercial fisherman that seismic survey activities in southern Namibia are linked to reductions in tuna catches (David Russel, pers. comm.). As the science and data are not conclusive, the respective Ministries have agreed that additional research is needed on the subject before policy decisions on seismics and fisheries can be made (G. Schneider, Geological Survey of Namibia, pers. comm.). Seasonal association of large migratory pelagic fish with Child's Bank to the north of the Exploration Area occurs between October and June, with commercial catches often peaking in March and April. Exploration activities in Block 3A/4A may overlap slightly with the migration path of the species concerned, but direct impacts are unlikely.

The potential impact on fish behaviour could therefore be of high intensity (in the near field of the seismic source array), over the short to medium term with duration of the effect being equal to the duration of exposure, although these vary between species and individuals and are dependent on the properties of the received sound. Any observed effects will be limited to the Exploration Area and are unlikely to persist for more than a few days after termination of the seismic source. Consequently, it is of MEDIUM significance without mitigation and LOW significance with mitigation (see Table 25).

- Masking of environmental sounds and communication

Communication and the use of environmental sounds by fish in the offshore environment off the South African West Coast are unknown. Some nearshore reef species, however, are likely to produce isolated sounds or to call in choruses. Impacts arising from masking of sounds are expected to be of low intensity due to the duty cycle of seismic surveys in relation to the more continuous biological noise. Such impacts would occur across the survey area and for the duration of the survey and are consequently considered of VERY LOW significance both with and without mitigation (see Table 26).

- Reproductive success / spawning

Fish populations can be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. If fish on their migration paths or spawning grounds are exposed to powerful external forces, they may be disturbed, deviate from traditional migration paths or even cease spawning altogether thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Considering the wide range over which the potentially affected species occur, the relatively short duration of the proposed exploration activities and that the migration routes do not constitute narrow restricted paths, the impact is considered to be of LOW significance without mitigation and VERY LOW significance with mitigation measures (see Table 27).

Indirect effects of mortality to ichthyoplankton (assessed in Section 2.3.2.1.1) on recruitment to adult fish populations is also considered to be VERY LOW both with and without mitigation.

- Indirect impacts due to effects on predators or prey

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species, such as sharks to small pelagic fish species stunned by seismic

noise. In such cases where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators and the significance of this impact is considered to be VERY LOW with and without mitigation (see Table 28). Little information is available on the feeding success of large migratory species in association with seismic survey noise. Considering the extensive range over which large pelagic fish species feed in relation to the survey area the impact is likely to also be of VERY LOW significance with and without mitigation (see Table 28).

Mitigation Measures

The following mitigation measures are recommended:

- Implement a "soft-start" procedure of a minimum of 20 minutes' duration when initiating seismic surveying (JNCC, 2010), to allow fish to move out of the survey area and thus avoid potential physiological injury as a result of seismic noise. When surveying in inshore areas (<50 m depth), a "soft-start" procedure of 30 minutes duration is recommended.
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.
- Airgun firing should be terminated if mass mortalities of fish as a direct result of shooting are observed (such as fish floating on the ocean's surface or feeding frenzies by oceanic predators).

Table 23: Potential impact of seismic noise on demersal fish resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON DEMERSAL FISH RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

Table 24: Potential impact of seismic noise on pelagic fish resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON PELAGIC FISH RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Medium to High	Low to Medium
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 25: Potential impact of seismic noise on fish resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE ON FISH RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short- to Medium-term (species specific)	Short- to Medium-term
Intensity	High	Medium
Significance	**Medium**	**Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 26: Potential impact of seismic noise on fish resulting in masking of sounds.

IMPACTS OF SEISMIC NOISE ON FISH RESULTING IN MASKING OF SOUNDS		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Table 27: Potential impact of seismic noise on reproductive success and spawning.

IMPACTS OF SEISMIC NOISE ON REPRODUCTIVE SUCCESS AND SPAWNING		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	High	Low to Medium
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 28: Potential impact of seismic noise on fish resulting in indirect impacts on food sources.

IMPACTS OF SEISMIC NOISE ON FISH RESULTING IN INDIRECT IMPACTS ON FOOD SOURCES		
	Without Mitigation	**With Mitigation**
Extent	Local (limited to survey area)	Local
Duration	Short-term (duration of survey)	Short-term
Intensity	Low	Low
Significance	**Very Low – Low (sardine run)**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

2.3.2.1.4 Potential Impacts to Seabirds

Impact Statement

Only species that feed by plunge-diving or that rest on the sea surface may be affected by the underwater noise of seismic surveys. Potential impacts of seismic pulses to diving birds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The seabird species are all highly mobile and would be expected to flee from approaching seismic noise sources at distances well beyond those that could cause physiological injury, but initiation of a sound source at full power in the immediate vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds. The potential for physiological injury or behavioural avoidance in non-diving seabird species is considered insignificant and has not been discussed further.

Discussion and Assessment of Impact

- Physiological injury

The continuous nature of the intermittent seismic survey pulses suggest that diving birds would hear the sound sources underwater at distances where levels would not induce mortality or injury and consequently be able to flee an approaching sound source. The potential for physiological impact of seismic noise on diving birds could be of high intensity but would be limited to the survey area and survey duration (short term). Of the plunge diving species that occur along the Western Cape coastline, only the Cape Gannet regularly feeds as far offshore as 100 km, the rest foraging in nearshore areas up to 40 km from the coast. The nearest nesting grounds are at Bird Island in Lambert's Bay and Malgas and Marcus Island at Saldanha. There is therefore a high probability of encountering gannets in the survey area, particularly during spring and summer when pelagic shoaling species frequent the area during their spawning migrations. African Penguins are known to forage as far as 60 km offshore and juveniles have been reported to travel up the coast regularly. The nearest African Penguin nesting sites are at the Saldanha Bay Islands, Dassen and Robben Islands. The survey operation is thus likely to encounter penguins, particularly when operating in the southern inshore portion of the Exploration Area. The potential physiological impact on diving species could thus be of LOW significance without mitigation and VERY LOW significance with mitigation (see Table 29).

- Behavioural avoidance

Behavioural avoidance by diving seabirds would be limited to the vicinity of the operating airgun within the survey area over the duration of the survey period, particularly if this overlaps with the 'sardine run'. The impact is likely to be of medium to high intensity. The potential impact on the behaviour of diving seabirds is of LOW significance without mitigation and VERY LOW significance with mitigation (see Table 30).

- Indirect impacts due to effects on prey

As with other vertebrates, the assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would

depend on the diet make-up of the bird species concerned and the effect of seismic surveys on the diet species. No information is available on the feeding success of seabirds in association with seismic survey noise. Most plunge-diving birds, however, forage on small shoaling fish prey species relatively close to the shore, their feeding ranges may overlap with seismic operations, namely airgun firing, which may encroach to within 10 km from the shore in some areas. The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed, however, suggest that indirect impacts would be of VERY LOW significance with and without mitigation (see Table 31).

- Other Potential Impacts

Other potential adverse interactions between seabirds and seismic surveys are:

  - Stranding of birds on the survey vessel due to being attracted to the vessel lights at night; and
  - Oiling through accidental loss of buoyancy liquid or hydraulic fluid from the towed gear.

However, while there is some potential for effects on individual seabirds through strandings or oiling, no significant effects on seabird populations are predicted, as the number of animals potentially affected will be small. The impacts are thus assessed as being INSIGNIFICANT (see Table 32).

Mitigation Measures

Recommendations for mitigation include:

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration (JNCC, 2010). When surveying in inshore areas (<50 m depth), a "soft-start" procedure of 30 minutes' duration is recommended.
- An area of radius of 500 m be scanned by an on-board MMO for the presence of diving seabirds prior to the commencement of "soft starts" and that soft starts be delayed until such time as this area is clear of diving seabirds.
- Seabird incidence and behaviour should be recorded by an on-board MMO. Any obvious mortality or injuries to seabirds as a direct result of the survey should result in temporary termination of operations.
- Any attraction of predatory seabirds (by mass disorientation or stunning of fish because of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an on-board MMO.
- If obvious mortality or injuries to diving seabirds is observed, the survey should be terminated temporarily until such time the MMO confirms that the risk to diving seabirds has been significantly reduced.

Table 29: Potential impact of seismic noise on diving seabirds resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON DIVING SEABIRDS RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 30: Potential impact of seismic noise on diving seabirds resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE ON DIVING SEABIRDS RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium to High	Low
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 31: Potential impact of seismic noise on seabirds resulting in indirect impacts on food sources.

IMPACTS OF SEISMIC NOISE ON SEABIRDS RESULTING IN INDIRECT IMPACTS ON FOOD SOURCES		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Table 32: Potential impact of seismic surveys to seabirds through stranding or oiling.

IMPACTS OF SEISMIC SURVEYS TO SEABIRDS THROUGH STRANDING OR OILING		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

2.3.2.1.5 Potential Impacts to Turtles

Impact Statement

Three species of turtles occur along the West Coast, however, it is only the Leatherback turtle which is likely to be encountered in the deeper waters of Block 3A/4A. However, abundances are likely to be low, comprising occasional migrants. The most likely impacts to turtles from seismic survey operations include physiological injury (including disorientation) or mortality from seismic noise or collision with or entanglement in towed seismic apparatus, behavioural avoidance of seismic survey areas and indirect effects because of seismic sounds on prey species.

Discussion and Assessment of Impact

- Physiological injury (including disorientation) or mortality

Although no information could be sourced on physiological injury to turtle hearing because of seismic sounds, the overlap of their hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise. Recent evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle would be expected to result in physiological injury. The potential impact could therefore be of high intensity but remain within the short-term. However, as the abundance of adult turtles in the survey area is low, the likelihood of encountering turtles during the proposed exploration activities is thus expected to be very low. The potential physiological impact on turtles is thus considered to be of LOW – MEDIUM significance without mitigation and VERY LOW significance with mitigation (see Table 33).

Although collisions between turtles and vessels are not limited to seismic ships, the large amount of equipment towed astern of survey vessels does increase the potential for collision, or entrapment within seismic equipment and towed surface floats. However, most of the seismic array is located at 5-10m below the sea surface, with surface equipment limited to floats designed to keep the airgun array at the desired depth and floats and tail buoys, which keep the hydrophone streamers at the desired depths. The potential for collision or entanglement is also highly dependent on the abundance and behaviour of turtles in the Exploration Area at the time of the survey. As the breeding areas for Leatherback turtles occur over 3 000 km north-west of the survey area (in Republic of Congo and Gabon), turtles encountered during the survey are likely to be migrating vagrants and impacts through collision or entanglement would be of low intensity and short-term. The impacts on turtles through collision or entanglement of seismic equipment is thus considered to be of VERY LOW significance with and without mitigation (see Table 34).

- Behavioural avoidance

Behavioural changes by turtles in response to seismic sounds range from apparent lack of movement away from active airgun arrays through to startle response and avoidance by fleeing an operating sound source. Reproductive success of turtles may also be affected by seismic noise or collision and entanglement. The impact of seismic sounds on turtle behaviour is of high intensity but would persist only for the duration of the survey, and be restricted to the survey area. Given the general extent of turtle migrations relative to the seismic survey target grid, the impact of seismic noise on turtle migrations is deemed to be of LOW significance without mitigation and VERY LOW significance with mitigation (see Table 35), while the potential impact on reproductive success of turtles through seismic noise or collision and entanglement was assessed to be of LOW – MEDIUM significance without mitigation and VERY LOW – LOW significance with mitigation (see Table 36). The potential impact of turtles being attracted to vessel lights was deemed to be insignificant and was thus not further assessed.

- Masking of environmental sounds and communication

Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites (which on the African West coast are >3 000 km north-west of the Exploration Area in the Republic of Congo and Gabon). Although it is speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. There is no information available in the literature on the effect of seismic noise in masking environmental cues and communication in turtles, but their low abundance in the survey area would suggest that the potential significance of this impact (should it occur) would be INSIGNIFICANT (see Table 37).

- Indirect effects because of seismic sounds on prey species

Leatherback turtles feed on jellyfish, which are pelagic and therefore have a naturally temporally and spatially variable distribution. Adverse modification of such pelagic food sources would thus be insignificant and the effects of seismic surveys on the feeding behaviour of turtles is thus expected to be of VERY LOW significance, with and without mitigation (see Table 38).

Mitigation Measures

The following mitigation measures are recommended:

- All initiation of airgun firing be carried out as “soft-starts” of at least 20 minutes duration (JNCC, 2010).
- An area of radius of 500 m be scanned by an on-board MMO for the presence of turtles prior to the commencement of “soft starts” and that these be delayed until such time as this area is clear of turtles.
- Daylight observations of the survey region should be carried out by an on-board MMO and incidence of turtles and their responses to seismic shooting should be recorded.
- Seismic shooting should be terminated when obvious changes to turtle behaviour is observed from the survey vessel, or animals are observed diving within the immediate vicinity (within 500 m) of operating airguns.
- Any obvious mortality or injuries to turtles as a direct result of the survey should result in temporary termination of operations.
- Ensure that ‘turtle-friendly’ tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector ‘turtle guards’.

Table 33: Potential impact of seismic noise on turtles resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON TURTLES RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	**Low – Medium**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 34: Potential impact of seismic surveys on turtles resulting in mortality through collision and entanglement.

IMPACTS OF SEISMIC SURVEYS ON TURTLES RESULTING IN MORTALITY THROUGH COLLISION AND ENTANGLEMENT		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Table 35: Potential impact of seismic noise on turtles resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE ON TURTLES RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	High	Low
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Highly Probable	Probable
Confidence	High	High

Table 36: Potential impact on reproductive success of turtles through seismic noise or collision and entanglement.

IMPACTS ON REPRODUCTIVE SUCCESS OF TURTLES THROUGH SEISMIC NOISE OR COLLISION AND ENTANGLEMENT		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Medium-term	Short-term
Intensity	High	Low
Significance	**Low – Medium**	**Very Low - Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

Table 37: Potential impact of seismic noise on turtles resulting in masking of sounds.

IMPACTS OF SEISMIC NOISE ON TURTLES RESULTING IN MASKING OF SOUNDS		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Table 38: Potential impact of seismic noise on turtles resulting in indirect impacts on food sources.

IMPACTS OF SEISMIC NOISE ON TURTLES RESULTING IN INDIRECT IMPACTS ON FOOD SOURCES		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

2.3.2.1.6 Potential Impacts to Cetaceans (Whales and Dolphins)

Impact Statement

A wide diversity of cetaceans (whales and dolphins) occurs off the South African West Coast. Most migratory cetaceans in southern African waters are baleen whales (mysticetes), while toothed whales (odontocetes) may be resident or migratory. Potential impacts of seismic pulses on whales and dolphins could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication and indirect impacts due to effects on prey.

Discussion and Assessment of Impact

When assessing the potential effects of seismic surveys on marine mammals there is a lack of data (uncertainty) concerning the auditory capabilities and thresholds of impacts on the different species encountered and the individual variability in hearing thresholds and behavioural responses, which are likely to influence the degree of impact (Luke et al., 2009; Gedamke et al., 2011). This uncertainty and variability can have a significant bearing on how risk to marine mammals is assessed. Deficiencies in the current data prohibit a full understanding of the encounter frequencies with cetaceans or corresponding impacts of seismic surveys on marine mammals, and high-resolution baseline data from the proposed Exploration Area and impact zone are necessary to fully understand the effect that seismic exploration may have on South Africa's cetacean community.

- Physiological injury

Typical sound source levels for the proposed seismic survey are 243-249 dB re 1 µPa @1 m, which exceed the sources levels required for hearing damage (PTS and TTS). Marked differences occur in the hearing capabilities of baleen whales (mysticete cetaceans) and toothed whales and dolphins (odontocete cetaceans). The vocalisation and estimated hearing range of baleen whales (centred at below 1 kHz) overlap the highest peaks of the power spectrum of airgun sounds and consequently these animals may be more affected by disturbance from seismic surveys (Nowacek et al., 2007). In contrast, the hearing of toothed whales and dolphins is centred at frequencies of between 10 and 100 kHz. These species may react to seismic shots at long ranges, but hearing damage from seismic shots is only likely to occur at close range.

Available information suggests that the animal would need to be near operating airguns to suffer physiological injury and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. However, avoidance may be complicated by the multipath nature of sound in the ocean. Mitigation measures involving a "soft-start" procedure would help to alert cetaceans to the increasing sound level and promote movement away from the sound source. Deep-diving cetacean species may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focussed seismic surveys, where the downward focussed impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

The impact of physiological injury to both mysticete and odontocete cetaceans because of high-amplitude seismic sounds is deemed to be of high intensity but would be limited to the immediate vicinity of operating airguns within the impact zone. It is proposed that the 2D and 3D surveys would be scheduled for between December and May, thereby avoiding the peak humpback and southern right whale migration periods. However, resident whales (particularly in the vicinity of Cape Columbine) and those making exploratory trips from summer feeding grounds are still likely to be encountered until late February. The impact is therefore considered to be of MEDIUM significance without mitigation and LOW significance with mitigation (see Tables 2.37 and 2.41).

- Behavioural disturbance

Avoidance of seismic survey activity by cetaceans, particularly mysticete species, begins at distances where levels of approximately 150 to 180 dB are received. More subtle alterations in behaviour may occur at received levels of 110 dB. Although behavioural avoidance of seismic noise in the proposed survey area by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of most baleen whale species.

Of greater concern than general avoidance of migrating whales is avoidance of critical breeding habitat or area where mating, calving or nursing occurs. Southern right whales mostly remain in the coastal area south of Lambert's Bay but are also seen regularly along the northern Namaqualand coast and in southern Namibia and are increasingly expanding their range as the population. The proposed Exploration Area thus overlaps with nearshore West coast regions typically utilised by southern right whales as a mating, calving, or nursery grounds. There is also potential overlap with migration routes of both humpback and southern right whales, as well as other baleen whale species. Although encounter rates peak in migration periods, humpback and right whales are found in West Coast waters year-round. Other baleen whale species are also found year-round or have seasonal occurrences which are not well known, but existing data shows year-round presence of mysticetes. The southern portion of the Exploration Area overlaps with the West Coast feeding ground around Cape Columbine, where local abundances of temporary resident humpbacks and southern rights whales occur during summer months.

The potential impact of behavioural avoidance of seismic survey areas by mysticete cetaceans is of high intensity, across the survey area and for the duration of the survey. If the surveys are planned for December to May (i.e. outside of the main winter migration periods) interactions with migrating whales should be low, however, interaction with the summer feeding aggregations is highly likely until late February. The impact of seismic surveying is thus considered to be of MEDIUM significance before mitigation and LOW significance with mitigation (see).

Information available on behavioural responses of toothed whales and dolphins to seismic surveys is more limited than that for baleen whales. No seasonal patterns of abundance are known for odontocetes occupying the proposed Exploration Area, but several species are year-round residents. Furthermore, several toothed whale species have a more pelagic distribution thus occurring further offshore, with species diversity and encounter rates likely to be highest on the shelf slope. A precautionary approach to avoiding impacts is thus recommended and consequently the impact of seismic survey noise on the behaviour of toothed whales is of medium intensity over the survey area and for the duration. The overall significance will therefore vary between species and consequently ranges between LOW and VERY LOW before mitigation and VERY LOW with mitigation (see Table 44).

- Masking of environmental sounds and communication

Baleen whales appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while toothed whales vocalise at frequencies higher than these. As the by-product noise in the mid-frequency range can travel far (at least 8 km) and extend up to 22kHz (Goold & Fish, 1998), masking of communication sounds produced by whistling dolphins and blackfish is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in December – January when accompanied by calves, so is likely to be seasonally high in the Exploration Area. Additionally, the effect of masking may be reduced by the intermittent nature of seismic pulses (Gordon et al., 2003). If the surveys are planned for December to May, the intensity of impact on baleen whales is likely to be low over the

survey area and duration, but high in the case of toothed whales. Whereas for mysticetes the significance is rated as LOW without and VERY LOW with mitigation (see Table 41), for odontocetes it is rated as MEDIUM without mitigation and LOW with mitigation (see Table 45).

- Indirect impacts due to effects on prey

As with other vertebrates, the assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment. However, it is likely that both fish and cephalopod prey of toothed whales and dolphins may be affected over limited areas, although the impacts are difficult to determine. The broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would be of VERY LOW significance with and without mitigation (see Table 46). Baleen whales seldom feed while on breeding migrations and rely on blubber reserves, so the significance of indirect effects on their food source is VERY LOW (see Table 42).

- Other potential impacts

Given the slow speed (about 4 - 6 knots) of the vessel while towing the seismic array, ship strikes are also unlikely. Entanglement in gear is, however, possible.

Mitigation Measures

The following mitigation measures are recommended:

- Seismic surveys should be planned to avoid cetacean migration periods or winter breeding concentrations (June to end November) and ensure that migration paths are not blocked. However, as several of the large whale species are also abundant on the West Coast between September and February (inclusive), the best time of year to conduct seismic operations is late summer and early winter (end February – mid June), across the entire block. However, any surveys planned between December and end February should only be scheduled to operate in the northern section of the block, i.e. avoiding the southern portion of the block off Cape Columbine.

- All survey vessels must be fitted with Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations. As a minimum, PAM technology must be used during the pre-watch period and when surveying at night or during adverse weather conditions and thick fog. The hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise and be fitted with two hydrophones to allow directional detection of cetaceans.

- As no seasonal patterns of abundance are known for odontocetes occupying the proposed study area, a precautionary approach to avoiding impacts throughout the year is recommended.

- Independent on-board MMOs and PAM operators must be appointed for the duration of the seismic survey. The MMOs and PAM operators must have experience in seabird, turtle and marine mammal identification and observation techniques.

- The implementation of “soft-start” procedures of a minimum of 20-minutes’ duration on initiation of seismic surveying would mitigate any extent of physiological injury in most mobile vertebrate species because of seismic noise and is consequently considered a mandatory management measure for the implementation of the proposed seismic survey. This requires that the sound source be ramped from low to full power, thus allowing a flight response to outside the zone of injury or avoidance. This build-up of power should occur in uniform stages to provide a constant increase in output. The rationale for the 20 minute “soft-start” period is based on the flight speeds of cetacean species. Where possible, “soft-starts” should be planned so that they commence within daylight hours.

- Prior to the commencement of “soft starts” an area of 500-m radius around the survey vessel (exclusion zone) should be scanned (visually and using PAM technology) for the presence of diving seabirds, turtles, seals and cetaceans. There should be a dedicated pre-shoot watch of at least 60 minutes (to account for deep-diving species). “Soft starts” should be delayed until such time as this area is clear of

cetaceans and should not begin until 30 minutes after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen.

- All breaks in airgun firing of longer than 20 minutes must be followed by a 30-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Note that the 20-minute (or longer) break can coincide with the 30 minutes pre-shoot survey. However, the 30-minute pre-shoot watch may not coincide with the 20 minute "soft-start". Breaks shorter than 20 minutes should be followed by a visual assessment for marine mammals within the 500 m mitigation zone (not a 30-minute pre-shoot watch) and a "soft-start" of similar duration.
- Seismic shooting should be terminated when obvious negative changes to cetacean behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching the firing airgun.
- During night-time line changes low level warning airgun discharges should be fired at regular intervals to keep animals away from the survey operation while the vessel is repositioned for the next survey line.
- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area.
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Tripp seamount. On lines beyond that the low power guns can be stopped during turns, but the normal start-up procedure should nonetheless be maintained.
- All data recorded by MMOs should as a minimum form part of a survey close–out report. Furthermore, daily reports should be forwarded to the necessary authorities (e.g. DFFE, fishing bodies, NGO's, etc., (see Section 3.4)) to advise them of interactions and compliance with the mitigation measures.
- Marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, Department of Agriculture, Fisheries and Forestry, and the Petroleum Agency of South Africa for analyses of survey impacts in local waters.

Table 39 to Table 42 indicate the potential impact of seismic noise to mysticete cetaceans.

Table 39: Potential impact of seismic noise on baleen whales resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON BALEEN WHALES RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low to Medium
Significance	**Medium**	**Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Table 40: Potential impact of seismic noise on baleen whales resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE ON BALEEN WHALES RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	**Medium**	**Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Table 41: Potential Impact of seismic surveys on baleen whales resulting in masking of sounds and communication.

IMPACTS OF SEISMIC SURVEYS ON BALEEN WHALES RESULTING IN MASKING OF SOUNDS AND COMMUNICATION		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	**Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Table 42: Potential impact of seismic surveys on baleen whales resulting from indirect effects on their prey.

IMPACTS OF SEISMIC SURVEYS ON BALEEN WHALES RESULTING FROM INDIRECT EFFECTS ON THEIR PREY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Table 43 to Table 46 indicate the potential impact of seismic noise to odontocete cetaceans.

Table 43: Potential impact of seismic noise on toothed whales and dolphins resulting in physiological injury.

IMPACTS OF SEISMIC NOISE ON TOOTHED WHALES AND DOLPHINS RESULTING IN PHYSIOLOGICAL INJURY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low to Medium
Significance	**Medium**	**Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Table 44: Potential impact of seismic noise on toothed whales and dolphins resulting in behavioural avoidance.

IMPACTS OF SEISMIC NOISE ON TOOTHED WHALES AND DOLPHINS RESULTING IN BEHAVIOURAL AVOIDANCE		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium	Low to Medium
Significance	**Very Low – Low (species specific)**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Table 45: Potential impact of seismic surveys on toothed whales and dolphins resulting in masking of sounds and communication.

IMPACTS OF SEISMIC SURVEYS ON TOOTHED WHALES AND DOLPHINS RESULTING IN MASKING OF SOUNDS AND COMMUNICATION		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	**Medium**	**Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Table 46: Potential impact of seismic surveys on toothed whales and dolphins resulting from indirect effects on their prey.

IMPACTS OF SEISMIC SURVEYS ON TOOTHED WHALES AND DOLPHINS RESULTING FROM INDIRECT EFFECTS ON THEIR PREY		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

2.3.2.2 IMPACT OF AERIAL SURVEYS AND HELICOPTER OPERATIONS IMPACT STATEMENT

Although reported behavioural reactions by seabirds, seals and whales to aircraft are highly variable and often anecdotal, it is safe to assume that any observed effects because of the proposed aerial exploration and helicopter operations will be in response to both acoustic and visual cues. Effects could include significant disturbance on breeding success or mortalities of juveniles.

Discussion and Assessment of Impact

There are several offshore islands and emergent reefs along the coast of the proposed Exploration Area, which provide important roosting and few breeding opportunities for seabirds. In addition, the estuaries of the Berg and Olifants River mouth and Verlorenvlei serve as important roosting and foraging sites for coastal and seabirds. Numerous Important Bird Areas (IBAs) (West Coast National Park and Saldanha Bay Islands, Bird Island, Olifants River Estuary, Verlorenvlei, Lower Berg River wetlands, Dassen Island) also occur along the coastline in the general project area. Indiscriminate or direct flying over seabird colonies and these coastal IBAs could thus have a significant disturbance impact on breeding success or mortalities of juveniles. The potential impact of behavioural changes and disturbance in birds in response to aircrafts, is of medium intensity, across the survey area and for the duration of the survey. The impact of aerial surveying on coastal birds is of LOW – MEDIUM significance before mitigation and VERY LOW significance with mitigation (see Table 47).

Likewise, seals will experience severe disturbance from low-flying aircraft usually reacting by showing a startle response and moving rapidly into the water. Although, any observed response is usually short-lived, disturbance of breeding seals can lead to pup mortalities through abandonment or injury by fleeing, frightened adults. There are several Cape fur seal colonies along the coastline inshore of the Exploration Area, such as Elephant Rocks (north of the Olifants River mouth) and Paternoster Rocks and Jacobs Reef at Cape Columbine. Non-breeding colonies occur at Strandfontein Point (south of Hondeklipbaai), on Bird Island at Lamberts Bay and at Paternoster Point at Cape Columbine. If the Saldanha Bay, Langebaan Weg, or Vredendal airfields are used as the logistics base for fixed-wing operations as part of the proposed airborne geophysical acquisition, flight paths will need to be planned to avoid these colonies.

Low altitude flights (especially parallel to the coast) can also have a significant disturbance impact on cetaceans during their breeding and mating season. The level of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions.

The National Environmental Management: Protected Areas Act (2003) stipulate that the minimum over-flight height over nature reserves, national parks and world heritage sites is 762 m (2,500 ft). The Marine Living Resources Act (1998) prohibits aircraft to approach within 300 m of a whale. Indiscriminate low altitude flights over whales, seals, seabird colonies and turtles could thus have an impact on behaviour and breeding success. Although such impacts would be local, they may have wider ramifications over the range of the affected species

and are deemed to range from medium to high intensity. The significance of the potential impact is considered to range from LOW – MEDIUM significance without mitigation, and VERY LOW significance with mitigation (see Table 47).

Mitigation Measures

The following mitigation measures are recommended:

- Pre-plan flight paths (for mobilisation and demobilisation to and from the Exploration Area) to ensure that no flying occurs over coastal reserves, bird colonies or IBAs.
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided, particularly during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November). As no seasonal patterns of abundance are known for odontocetes occupying the Exploration Area, a precautionary approach to avoiding impacts throughout the year is recommended.
- During mobilisation to and from the Exploration Area, aircraft should maintain a minimum altitude of at least 300 m above sea level.
- Aircraft may not approach to within 300 m of whales in terms of the Marine Living Resources Act, 1998. As this may be both impractical and impossible, an exemption permit must be applied for through the Department of Environmental Affairs.
- The contractor should comply fully with aviation and authority guidelines and rules.
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

Table 47: Potential impact of aerial surveys on seabirds, seals and cetaceans.

IMPACTS OF AERIAL SURVEYS ON SEABIRDS, SEALS AND CETACEANS		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to	Local
Duration	Short-term	Short-term
Intensity	Medium to High	Low
Significance	**Low – Medium**	**Very Low**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

2.3.2.3 IMPACTS OF HIGH-RESOLUTION BATHYMETRY SURVEY IMPACT STATEMENT

Marine sonar operations, such as High-Resolution Bathymetry Surveys, could cause acoustic or physical disturbance to marine mammals,

Discussion and Assessment of Impact

Although baleen whales, toothed whales and pinnepeds would be expected to hear sonar signals from most types of oceanographic sonars at frequencies within their functional hearing range, the animals would only be affected if they were within the sonar beam. As the anticipated radius of influence of a multi-beam sonar or the sub-bottom profiler is significantly less than that for an airgun array and the statistical probability of crossing a cetacean or pinniped with the narrow multi-beam fan several times, or even once, is very small, the effects of high frequency sonars on these fauna can be considered to be of VERY LOW significance with and without mitigation (see Table 48). However, despite the low significance of impacts, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals. These have been revised to be more applicable to the southern African situation under 'Mitigation Measures' below.

Mitigation Measures

- On-board MMOs should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.
- Ensure that PAM is incorporated into all surveys;
- A MMO would be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

Table 48: Potential impact of multi-beam and sub-bottom profiling sonar on cetaceans.

IMPACTS OF MULTI-BEAM AND SUB-BOTTOM PROFILING SONAR ON CETACEANS		
	Without Mitigation	**Without Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

2.3.2.4 IMPACTS OF DROP-CORE SAMPLING AND HEAT FLOW MEASUREMENTS IMPACT STATEMENT

The proposed core sampling activities are expected to result in the disturbance and loss of benthic macrofauna through removal of sediments and potential crushing of benthic epifauna in the trigger weight footprint. In the case of the heat flow probe, penetration of the probe into the seabed may lead to disturbance of benthic macrofauna in the 6-cm diameter footprint of the probe.

Discussion and Assessment of Impact

Assuming a core diameter of 67 mm, each drop-core sample will remove a surface area of ~0.003 m2. Core barrels are typically 6 m in length thus resulting in the removal of 0.02 m3 of sediment per sample at maximum penetration. It is proposed to take in the order of 200 cores, thereby impacting a total cumulative area of 0.6 m^2 and removing a maximum of 4 m3 of sediment.

As benthic fauna typically inhabits the top 20 - 30 cm of sediment, removal of the sediment samples will result in the elimination of the benthic infaunal and epifaunal biota in the sample footprints. Considering the available area of similar habitat in the Natal Valley, this reduction in benthic biodiversity can be considered negligible.

Depending on the texture of the sediments at the target sites, slumping of adjacent unconsolidated sediments into the excavation can be expected over the very short-term. Although this may result in localised disturbance of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonization of impacted areas and the subsequent recovery of disturbed areas of seabed (Maurer et al., 1979, 1981a, 1981b, 1982, 1986; Ellis, 2000; Schratzberger et al., 2000; but see Harvey et al., 1998; Blanchard & Feder, 2003).

Natural rehabilitation of the seabed following sampling or dredging operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf (Penney & Pulfrich 2004; Steffani 2007b, 2009a, 2009b, 2010a, 2010c). Recovery rates of impacted communities are variable and dependent on the sampling/dredging/mining approach, sediment influx

rates and the influence of natural disturbances on succession communities. Although recovery in the Bathyal habitats is likely to be very slow, this is offset by the insignificant seabed area disturbed by the proposed core sampling.

The structure of the recovering communities is also highly spatially and temporally variable confirming the high natural variability in benthic communities in the region. The community developing after an impact depends on the following:

- The nature of the impacted substrate;
- Differential re-settlement of larvae in different areas; and
- Environmental factors such as bedload transport, near-bottom dissolved oxygen concentrations etc.

Indications of significant recruitments and natural mortalities in recovering succession communities has provided evidence of natural disturbances (Pulfrich & Penney 1999). Savage et al. (2001) noted similarities in apparent levels of disturbance between mined and unmined areas off the southern African west coast, and areas of the Oslofjord in the NE Atlantic Ocean, which is known to be subject to periodic low oxygen events. They concluded that the lack of clear separation of impacts from reference samples suggests that short-term physical disturbance resulting from mining or dredging is no more stressful than the regular naturally occurring anoxic events typical of the West Coast continental shelf area. The high-intensity negative impact of sediment removal is unavoidable, but as it will be extremely localised (i.e. confined to the core footprints) the impact can confidently be rated as being INSIGNIFICANT (see Table 49).

Some disturbance or loss of adjacent benthic biota can also be expected because of the placement on the seabed of the trigger weight and the penetration into the sediments of the heat flow probe. Epifauna and infauna beneath the footprint of the weight/probe may be smothered or crushed resulting in a reduction in benthic biodiversity. Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive. The impacts will be of low intensity, highly localised and short- term as recolonization will occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to be INSIGNIFICANT (see Table 49).

Mitigation Measures

No mitigation measures are possible or considered necessary for the direct loss of macrobenthos due to core sampling or indirect loss due to crushing by the trigger weight.

Table 49: Potential impact of drop-core survey on benthic macrofauna through removal or crushing.

IMPACTS OF DROP-CORE SURVEY ON BENTHIC MACROFAUNA THROUGH REMOVAL OR CRUSHING		
	Without Mitigation	**With Mitigation**
Extent	Local: limited to core area or trigger weight Footprint	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

2.3.3 IMPACT ON OTHER USERS OF THE SEA

2.3.3.1 POTENTIAL IMPACT ON FISHING INDUSTRY

2.3.3.1.1 Potential Impact on Fishing Sectors

Impact Statement

During the proposed 2D and 3D seismic surveys, high resolution bathymetry survey as well as seabed sampling and heat flow measurements, the vessels and equipment are deemed to be an offshore installation, which requires a 500m safety / exclusion zone around the vessel and survey equipment at all times. As such, all other vessels are prohibited from being within 500m of the survey vessel, which could disrupt fishing routes and exclude fishing activities from happening in certain areas. This could impact on the number of fish caught, especially if the surveys are undertaken during main fishing seasons (for certain fishing sectors). The high-resolution bathymetry survey vessel would also be restricted in its manoeuvrability and as such, vessels engaged in fishing shall, as far as possible, keep out of the way of survey activities. The following fishing sectors are assessed below:

- Demersal Trawl,
- Demersal Long-Line (hake-directed)[16];
- Large Pelagic Long-Line;
- Tuna Pole;
- Traditional Line-Fish;
- Small Pelagic Purse-Seine; and
- West Coast Rock Lobster.

It should be noted that for each of the assessments below, although the extent of the proposed 2D survey would be regional in scale, the safety zone surrounding a 2D survey vessel and towed gear array would be mobile and would affect only the vicinity around the survey vessel rather than the entire extent of the proposed survey / area of Block 3A/4A. A 3D survey would typically focus on a smaller, localised area to that of a 2D survey. The impact for both 2D and 3D surveys is therefore considered to be of local extent.

Generic mitigation for each sector is provided at the end of this section, however, where specific additional mitigation is required, this has been included with the relevant fishing sector.

Discussion and Assessment of Impact

- Demersal Trawl

Data reported by the fishery between 2000 and 2012 indicate that fishing grounds overlap 6099 km2 of the south-western portion of Block 3A/4A, between the 200m and 750m isobaths. Catch and effort records within this area amount to 604 tons and 2063 hours per annum. This is equivalent to 1.2% of the overall effort and 1.0% of total catch recorded by the sector. The fishery operates year-round, with relatively higher levels of effort during the autumn/winter months. Over twice as many trawls were reported during the six- month period from March to August (465 trawls per year) in comparison to the equivalent period from September to February (207 trawls per year)[17].

Fish movements and related behavioural patterns associated with feeding preferences could be affected if the fish show avoidance behaviour to the noise; however, this impact should be short-term and only in the immediate vicinity of the survey vessel.

[16] According to CapFish, 2014, although demersal long-line is split into hake-directed and shark directed, only the hake directed fishery has been assessed. Spatial records for shark-directed fishing show that fishing effort does not coincide with Block3A/4A and therefore there is no impact expected on the fishery.

[17] During the months of spring and summer, a proportion of effort is directed southwards towards the fishing grounds of Brown's Bank.

The potential impact of the proposed 2D, 3D and high-resolution bathymetry surveys, seafloor sampling and heatflow measurement programme on the demersal trawl fishery was assessed to be of low intensity at the

local extent and with a short-term duration. The overall impact was assessed to be of VERY LOW significance with and without mitigation (see Table 50).

Table 50: Potential impact on demersal trawl fisheries

IMPACT ON DEMERSAL TRAWL			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	Low	Low	Low
Significance	**Very Low**	**Very Low**	**Very Low**
Status	Negative	Negative	Negative
Probability	Probable	Probable	Probable
Confidence	High	High	High

- Demersal Long-Line (hake-directed)

Description and Assessment of Impacts

Hake-directed long-line grounds cover approximately 13 130km2 of Block 3A/4A, primarily seawards of the 200m isobath. Within Block 3A/4A the total percentage of the overall catch landed was 1.6% and the total effort reported by the fishery was 1.8% between 2000 and 2012. Operations are ad hoc and intermittent, subject to market demand.

Once the gear has been set-up it is left for up to eight hours before being retrieved, which can take a further six to ten hours to complete. As such, the vessel would not be able to move quickly out of a particular area.

Fish movement and related behavioural patterns associated with feeding preferences could be affected if the fish show avoidance behaviour to the noise, however, this would be in the immediate vicinity of the survey vessel. Most of the fishing is undertaken between June and August, with relatively higher levels of effort recorded between June and December, which falls outside of the proposed survey times. The potential impact of the proposed 2D, 3D and high-resolution bathymetry surveys, seafloor sampling and heatflow measurements programme on the demersal hake-directed long-line fishery was assessed to be of low intensity at the local extent and with a short-term duration. The overall impact was assessed to be of VERY LOW significance with and without mitigation (see Table 51).

Table 51: Potential impact on demersal long-line fisheries (hake-directed)

IMPACT ON DEMERSAL LONG-LINE (HAKE-DIRECTED)			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	**Local**	**Local**	**Local**
Duration	**Short-term**	**Short-term**	**Short-term**
Intensity	**Low**	**Low**	**Low**
Significance	**Very Low**	**Very Low**	**Very Low**
Status	**Negative**	**Negative**	**Negative**
Probability	**Probable**	**Probable**	**Probable**
Confidence	**High**	**High**	**High**

- Large Pelagic Long-Line

Description and Assessment of Impact

Pelagic long-line vessels are concentrated where the continental slope is steepest, and the majority of effort is located offshore of the shelf break in waters deeper than 500 m (i.e. outside of Block 3A/4A). However, there are incidental fishing records within the Block, equivalent to <0.1% of the total catch and effort recorded within the fishery. The proposed exploration activities are not likely to impact on the spawning or migratory behaviour of target species (i.e. tuna and other large pelagic species), although some behavioural changes can be expected. Fish movements and related behavioural patterns associated with feeding preferences could be affected if the fish show avoidance behaviour to the noise, however, this impact should be short-term and only in the immediate vicinity of the survey vessel.

The impact of the proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme on the large pelagic long-line fishery is assessed to be of very low intensity, of local extent and of short-term duration. The potential impact was assessed to be INSIGNIFICANT (see Table 52).

Table 52: Potential impact on larger pelagic long-line fisheries.

IMPACT ON LARGE PELAGIC LONG-LINE			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	Very low	Very low	Very low
Significance	**Insignificant**	**Insignificant**	**Insignificant**
Status	Negative	Negative	Negative
Probability	Improbable	Improbable	Improbable
Confidence	High	High	High

- Tune Pole Fishery

Description and Assessment of Impact

Fishing trips last on average between four and five days, with most of the time spent searching for fish with actual fishing taking place over a relatively short period. Fishing activity occurs along the entire West Coast beyond the 200 m isobath. Fishing is expected to occur along the shelf break with preferred fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. During fishing activities, the vessels do not have any fixed gear in the water and thus the vessels remain highly manoeuvrable and could take avoiding action at any time. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods. The fishery operates year-round, with relatively higher levels of effort recorded during the months of November to February and another peak in May.

The impact of the proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme on the tuna pole fishery is assessed to be of high intensity, at the local extent and of short-term duration. The potential impact was assessed to be of LOW significance with and without mitigation.

Mitigation Measures

The following additional mitigation measure is recommended:

- Areas of high Tuna Pole fishing activity is due West of St Helena Bay between 32° 30´ S and 33° S and 16° 45 E and 17° 45´ E, which coincides with the southern portion of Block 3A/4A and this area should be monitored for the presence of tuna pole vessels during the survey via the Vessel Monitoring System unit at DFFE and via radar on board the survey vessel.
- It is recommended that any exploration activities proposed to take place in this southern portion are timed to avoid peak Tuna Pole fishing activity (i.e. between November and February and May), as far as possible.

Table 53: Potential impact on the tuna pole fishery.

IMPACT ON TUNA POLE FISHERY			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	High	High	High
Significance	**Low**	**Low**	**Low**
Status	Negative	Negative	Negative
Probability	Probable	Probable	Probable
Confidence	High	High	High

- Traditional Line-Fishery

Description and Assessment of Impacts

The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf up to a maximum depth of 200m from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Records of fishing activity off the West Coast of South Africa are predominantly coastal, with few fishing events located within Block 3A/4A. Between 2000 and 2012 0.6% of the total catch recorded by the fishery was taken within Block 3A/4A.

The impact of the proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme on the traditional long-line fishery is assessed to be of low intensity, at the local extent and of short-term duration. The potential impact was assessed to INSIGNIFICANT (see Table 54).

Table 54: Potential impact on traditional line fishery

IMPACT ON TRADITIONAL LINE-FISHERY			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	Very low	Very low	Very low
Significance	**Insignificant**	**Insignificant**	**Insignificant**
Status	Negative	Negative	Negative
Probability	Improbable	Improbable	Improbable
Confidence	High	High	High

- Small Pelagic Purse-Seine

Description and Assessment of Impacts

The small pelagic fishery is the largest South African fishery by volume and the second most important in terms of value. Fishing grounds occur up to a maximum distance of 100 km offshore, but usually closer inshore. Activity within Block 3A/4A is highest southwards of 31° 40´S and inshore of the 100 m depth contour, however there is also activity in deeper waters to approximately the 250 m depth contour. Vessels usually fish overnight and return to offload their catch the following day. During fishing, once the net is deployed the vessel is unable to manoeuvre until the net has been fully recovered on-board, which may take up to 1.5 hours. The small pelagic sector operates throughout the year except for a short break between mid- December to mid-January. Fishing activities are undertaken predominantly from the 31°S line of latitude southwards and within 100 km of the shoreline. During 2000 and 2012, the yearly average catch taken within Block 3A/4A equates to 15.8% of the total catch recorded by the fishery. The main fishing activities are undertaken between April and July. The impact of the proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme on the small pelagic purse-seine fishery is assessed to be of high intensity, at the local extent and of short-term duration. The potential impact was assessed to be of LOW significance with and without mitigation (see

Table 55).

Mitigation Measures

The following additional mitigation measure is recommended:

- The surveys should commence in the northern-most extent of the block and then work southwards into the fishing grounds (highest fishing activity undertaken southwards of 31° 40´S and inshore of the 100 m depth contour).
- It is also recommended, depending on survey times, to commence with the North / South lines closer inshore and then move further offshore, thereby avoiding the main fishing activities from April to July.

Table 55: Potential impact on small pelagic purse-seine fishery

IMPACT ON SMALL PELAGIC PURSE-SEINE			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	High	High	High
Significance	**Low**	**Low**	**Low**
Status	Negative	Negative	Negative
Probability	Probable	Probable	Probable
Confidence	High	High	High

- West Coast Rock Lobster

Description and Assessment of Impacts

The West Coast rock lobster occurs inside the 200 m depth contour along the entire West Coast to East London on the East Coast. The fishery is divided into the offshore (between 30m and 100m water depths) and onshore sectors, both of which operate inshore of the 100m isobaths. Fishing grounds are divided into four management zones, of which Management Zone 4 is in the southeastern corner of Block 3A/4A. Management Zones 3 to 14 operate between 15 November and 30 June.

Rock Lobster movements and related behavioural patterns associated with feeding preferences could be affected if the lobsters show avoidance behaviour to the noise; however, this impact should be short-term and only in the immediate vicinity of the survey vessel.

The impact of the proposed 2D and 3D seismic surveys, high resolution bathymetry survey, and seafloor sampling and heatflow measurement programme on the West Coast rock lobster fishery is assessed to be of medium intensity, at the local extent and of short-term duration. The potential impact was assessed to be of VERY LOW significance (see Table 56). However, should the survey remain outside of the West Coast rock lobster fishing area (i.e. Management Zone 4), then there would be NO IMPACT to this fishery.

Table 56: Potential impact on the West Coast rock lobster fishery.

IMPACT ON WEST COAST ROCK LOBSTER			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	Medium	Medium	Medium
Significance	**Very Low**	**Very Low**	**Very Low**
Status	Negative	Negative	Negative

Probability	Improbable	Improbable	Improbable
Confidence	High	High	High

General Mitigation Measures for Fisheries

The following mitigation measures are recommended to minimise all fishing related impacts:

- Inform the sector of the safety protocols to adhere to and details of the survey area prior to commencement.
- Regular updates of the survey design must be communicated to vessels operating in the vicinity of Block 3A/4A.
- Fishing industry bodies and other key affected parties should be informed of the proposed survey activities and requirements with regards to the safe operational limits around the survey vessels prior to the commencement of the project. The following industrial bodies and affected parties include:
    - Department of Forestry, Fisheries and the Environment (DFFE);
    - South African Tuna Association (SATA);
    - South African Tuna Long-Line Association (SATLA);
    - Fresh Tuna Exporters Association (FTEA);
    - South African Deep-Sea Trawling Industry Association (SADSTIA);
    - South African Commercial Linefish Association;
    - West Coast and Peninsula Commercial Skiboat Association;
    - Shark Longline Association;
    - South African West Coast Rock Lobster Association;
    - Transnet National Ports Authority (ports of Cape Town and Saldanha Bay); and
    - oSouth African Maritime Safety Association (SAMSA).
- Daily Navigational Warnings should be issued for the duration of the survey operations through the South African Naval Hydrographic Office.
- A Fisheries Liaison Officer (FLO) should be present on board the survey vessels to facilitate communications with vessels in the vicinity of the survey vessel – any fishing vessel targets at a radar range of 24 nautical miles from the survey vessel should be called via radio and informed of the navigational safety requirements.
- Affected parties should be notified through fishing industry bodies when survey activities are complete and the vessel is off location.
- An “adaptive” management approach is recommended to minimise impacts by deciding on the best mitigation measures once specific survey dates are known and depending on the specific fishing activity being undertaken at the time.

2.3.3.1.2 Potential Impacts on Fisheries Research

Impact Statement

DFFE undertakes offshore research bi-annually to determine TAC allowed for the following fishing season. The proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme could affect planned research survey areas due to the 500 m safety / exclusion zone around these vessels at all times.

Discussion and Assessment of Impact

Two types of research surveys (undertaken twice a year) are undertaken by DFFE to set the annual TACs for demersal fisheries, namely:

- Survey to determine demersal fish resources; and
- Acoustic survey to assess the biomass of small pelagic species.
    - Demersal fish resources survey

The West Coast offshore region is surveyed from Cape Agulhas (20° E) to the Namibian maritime border. No set trawl positions are used as paths are randomly selected to cover specific depth strata that range from the coast to the 1000m isobaths. (20° E) to the Namibian maritime border. Stratified, 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. Approximately 120 trawls are conducted during each survey and the location of these trawls is pre-determined usually a week before the cruise is scheduled to take place. The survey duration is approximately one month and takes place in January for the West Coast survey.

    - Small pelagic species

An acoustic survey is used to determine the biomass of small pelagic species. The survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200m isobath. Surveys are undertaken between mid-May and mid-June, and the second survey is undertaken between mid-October and 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.

The potential impact of the 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme on the demersal and acoustic research surveys would be of high intensity, of local extent and of short duration. The potential impact was assessed to be of LOW significance with and without mitigation and would result in NO IMPACT if the proposed surveys are undertaken outside of the research survey timeframes (see

Table 57).

Mitigation Measures

The following mitigation measures are recommended in order to reduce the intensity of the impact:

- Timing of the proposed surveys should avoid periods when research surveys are being conducted (i.e. mid-May to mid-June and mid-October to mid-December).
- Notify the managers of the research programmes regarding planned survey periods prior to commencements[18].

[18] The relevant contacts at DFFE currently responsible for the planning of the demersal and acoustic cruises are Deon Durholtz (DeonD@daff.gov.za) and Janet Coetzee (JanetC@nda.agric.za) respectively.

Table 57: Potential impact on Fisheries Research Surveys.

IMPACT ON FISHERIES RESEARCH: ACOUSTIC AND DEMERSAL SURVEYS			
	Temporary exclusion zone around the 2D and/or 3D seismic survey vessel	**Temporary exclusion zone around the high resolution bathymetry survey vessel**	**Temporary exclusion zone around the vessels for seafloor sampling & heatflow programme**
Extent	Local	Local	Local
Duration	Short-term	Short-term	Short-term
Intensity	High	High	High
Significance	**Low**	**Low**	**Low**
Status	Negative	Negative	Negative
Probability	Probable	Probable	Probable
Confidence	High	High	High

2.3.3.2 POTENTIAL IMPACT ON MARINE TRANSPORT ROUTES IMPACT STATEMENT

The proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme could affect shipping and sailing due to the 500 m safety / exclusion zone around these vessels at all times and the fact that the vessels would be travelling predetermined paths with restricted manoeuvrability. As such, all other vessels would need to ensure that they do not come within 500m of the respective survey vessels.

14 The relevant contacts at DFFE currently responsible for the planning of the demersal and acoustic cruises are Deon Durholtz (DeonD@daff.gov.za) and Janet Coetzee (JanetC@nda.agric.za) respectively.

Discussion and Assessment of Impact

Shipping traffic inshore of the continental shelf is located between 12 and 24 nautical miles offshore, while most of the shipping traffic is located on the outer edge of the continental shelf. During the proposed exploration activities, there is likely to be some interaction with marine traffic that could result in delays and/or disruptions to shipping / sailing activities. However, notices to mariners would be issued regularly and all other key information would be communicated to mariners via daily notifications.

The potential impact on shipping in Block 3A/4A would be of high intensity, of local extent and of short-term duration. The potential impact was assessed to be of LOW significance, with and without mitigation (see Table 58).

Mitigation Measures

The following mitigation measures are recommended, in addition to those provided for the fishing industry, namely:

- Ensure that the survey vessels are certified for seaworthiness via an internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas);
- Ensure that collision prevention equipment is on-board the vessels, such as, radar, multi-frequency radio, foghorns, etc. Additional precautions include:
    - The chase boat;
    - The existence of an internationally agreed safety zone around the survey vessel;
    - Cautionary notices to mariners; and
    - Access to current weather service information.

- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergency situation to SAMSA.

Table 58: Potential impacts on marine transport routes.

IMPACTS ON MARINE TRANSPORT ROUTES		
	Without Mitigation	**With Mitigation**
Extent	Local	Local
Duration	Short-term (for duration of survey)	Short-term
Intensity	Low	Low
Significance	**Low**	**Low**
Status	Negative	Negative
Probability	Low	Low
Confidence	Medium	Medium

2.3.3.3 POTENTIAL IMPACT ON MARINE PROSPECTING, MINING, EXPLORATION AND PRODUCTION ACTIVITIES

Impact Statement

The proposed 2D and 3D seismic surveys, high resolution bathymetry survey and seafloor sampling and heatflow measurement programme and associated 500 m exclusion / safety zone could disrupt marine prospecting, mining and other exploration and production activities in and around Block 3A/4A.

Discussion and Assessment of Impact

At present, there is no known active mining, prospecting or other activities taking place within Block 3A/4A and as such there is no resultant impact. However, there is a likelihood in the future that such activities may take place within Block 3A/4A at the same time as certain components of the proposed project. For example, Sunbird Energy is proposing to construct a 400 km pipeline from the Ibhubesi Gas Field to the coast, which would cut across Block 3A/4A, however, approval for this project has yet to be obtained. Although the survey vessels would only survey within Block 3A/4A, the vessels may need to exit the block to turn around, which could result in a localised impact on any other activities in neighbouring petroleum and mining license blocks. De Beers is also developing mining plans for various Concession areas and area 10(c) is located within Block 3A/4A and as such future engagement between the Operator and De Beers should take place to ensure activities do not overlap.

As such, the impact on other prospecting, exploration or production activities would be of very low intensity, of short duration and highly localised and was assessed to be of VERY LOW significance with and without mitigation (see Table 59).

Mitigation Measures

To ensure that there is no conflict between this project and other Marine Prospecting, Mining, Exploration and Production Activities, the following should be adhered to:

- Communication between all parties active in or planning future offshore activities within Block 3A/4A should be undertaken so that pre-planning can be done to prevent disruption to activities. Specific parties include De Beers. The Operator would need to ensure that they notify all stakeholders timeously of their survey times.
- Should any disagreement arise, PASA and / or the Department of Mineral and Petroleum Resources should be contacted.

Table 59: Potential impact on Marine Prospecting, Mining, Exploration and Production Activities in and around Block 3A/4A.

IMPACTS ON MARINE PROSPECTING, MINING, EXPLORATION AND PRODUCTION ACTIVITIES		
	Without Mitigation	**With Mitigation**
Extent	Local	Local
Duration	Short-term (for duration of survey)	Short-term
Intensity	Very Low	Very Low
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Probability	Low	Low
Confidence	Medium	Medium

2.4 SUMMARY AND RECOMMENDATIONS

2.4.1 CONCLUSIONS

PetroSA applied for an Exploration Right to undertake 2D and 3D seismic surveys, high resolution bathymetry survey, seabed sampling and heatflow measurement programme and an airborne gravity and magnetic survey in Block 3A/4A off the West Coast of South Africa.

The approved exploration work programme and EMPr for the initial period included the following exploration activities:

- Aerial gravity and magnetic surveys;
- Seismic surveys;
- High resolution bathymetry surveys;
- Seabed sampling; and
- Heatflow measurements.

These activities are described in Sections 1.5.1 to 1.5.8. None of the above activities have been conducted in the initial exploration period.

A renewal application was submitted on 1 February 2024 to conduct the following activities:

- Multibeam Bathymetry Survey;
- Seafloor Geochemical Survey and Sampling; and
- 3D Seismic Acquisition (contingent).

The potential impacts were assessed according to the following classifications:

- Impact of normal vessel operations;
- Impact on Marine Fauna; and
- Impact on other users of the sea.

2.4.1.1 IMPACT OF NORMAL VESSEL OPERATIONS

The potential impacts associated with vessel operations would be similar to any other vessel of a similar tonnage, however, due to the short duration of the surveys the anticipated significance of the impacts (e.g. emissions, discharges and vessel noise) was assessed to be of VERY LOW significance, with and without mitigation, except for solid waste disposal, which was assessed to be INSIGNIFICANT (refer to Table 60).

2.4.1.2 IMPACT ON MARINE FAUNA

The potential impacts to marine fauna were assessed in terms of the different survey components. The main potential impact on the marine fauna because of seismic surveys is related to noise emissions affecting the following key species:

- Plankton species;
- Marine invertebrates;
- Fish;
- Seabirds;
- Turtles; and
- Cetaceans (Whales and Dolphins).

Due to limited knowledge and scientific research on the effect of seismic sounds on the marine environment, as well as scientific literature that only considers short-term responses at the level of the individual animal, the long-term effect of seismic sounds cannot be accurately assessed. The Marine Specialist concludes that our understanding of how short-term effects of seismic surveys relate to long term impacts at the population level is limited and as such data obtained over the short term could be misinterpreted as being less significant than the cumulative effects over the long term. As such, it is crucial that the mitigation measures recommended are adhered to, to reduce the potential impact of acoustic sounds on marine animals, as far as possible.

Noise from the seismic surveys (i.e. only during actual surveying activities) may result in a number of knock-on effects, such as:

- *Potential physiological injury and mortality on plankton, invertebrate fauna, pelagic cephalopods, fish and physiological injury only in seabirds.*

  In terms of impacts on plankton, plankton distribution is naturally temporally, and spatially variable and natural mortality rates are high. Phytoplankton are not known to be affected by seismic surveys and such surveys would thus result in a limited impact.

  Little published data is available on the effects of seismic surveys on invertebrate fauna, however, it has been assumed that most invertebrates can only hear seismic sounds at very close range. As the surveys would not take place in very shallow water, it is unlikely that the surveys would have a significant impact on marine invertebrate. Should pelagic cephalopods come in contact with the survey area, there is evidence that the intensity of seismic noise could be a lot higher, although the probability of encounter with pelagic cephalopods is low.

  Large demersal and reef-fish species with swim bladders that frequent shallower nearshore water may suffer physiological injury or severe hearing damage, while neritic and demersal species occurring in deeper water would not be affected, as the received noise at the seabed would be within the far-field range and thus outside of the distances at which physiological injury or avoidance would be expected. Fish are highly mobile, and it is thus assumed that they would avoid seismic noise levels below those where physiological injury or mortality would occur, however, possible injury or mortality may occur on initiation of sound sources at full pressure in the immediate vicinity of fish.

  Of the plunge diving bird species that occur along the Western Cape coastline, only the Cape Gannet regularly feeds as far offshore as 100 km, the rest foraging in nearshore areas up to 40 km from the coast. Diving seabirds would only be affected around the survey area and when underwater.

  Turtles appear to only detect airguns at close range (<10 m), thus the initiation of a sound source at full power in the immediate vicinity of turtles would result in physiological injury, however, the abundance of adult turtles in the survey area is expected to be low. Any turtles encountered in the survey area are likely to be migrating turtles and any impacts through collision or entanglement would also be low.

Hearing capabilities vary significantly between baleen whales, toothed whales and dolphins, where balean whales may be more affected by seismic surveys. It is assumed that animals would need to be near suffer physiological injury and would move out of the area to avoid sound sources, although deep-diving cetaceans may be more susceptible to acoustic injury. Off the West Coast, the peak Humpback whale migration periods are June to July and September to October, while Southern Right whale numbers peak between June and September. However, resident whales and those making exploratory trips from summer feeding grounds are still likely to be encountered until late February.

- *Behavioural avoidance of marine invertebrates, diving seabirds, fish, turtles and cetaceans could occur because of seismic noise.*

  There is little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses and only marine cephalopods are receptive to the far-field sounds of airgun arrays. Behavioural changes in marine cephalopods have been observed between 2 and 5 km from an approaching large seismic source (McCauley et al. 2000).

  Fish may move out of the area or change their feeding behaviours because of seismic sounds, however, the surveys may only overlap slightly with the migration paths of large migratory pelagic fish.

  Behavioural avoidance by diving seabirds would be limited to the vicinity of the operating airgun within the survey area, particularly if this overlaps with the 'sardine run'.

  Some migrating turtles may be found within the area and behavioural changes, such as fleeing an operating sound source, may arise.

  The exploration area overlaps with areas used by Southern Right whales as mating, calving or nursery grounds and a potential overlap exists with the migration routes of both Humpback, Southern Right whales and other baleen species. Although behavioural avoidance is likely, it is of minimal impact in relation to the distances of migrations of most baleen whale species. Information on behavioural responses of toothed whales and dolphins to seismic surveys is more limited, however, toothed whale species have a more pelagic distribution thus occurring further offshore, with encounter rates likely to be highest on the shelf slope.

- *Seismic sounds can cause fish to deflect from their migration paths or result in a disturbance of spawning thereby impacting on fish reproductive success and/or spawning, however, the magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection.*

  Turtle reproductive success may be affected by collision or entanglement.

- *Seismic sounds mask environmental sounds and communication and may impact fish and cetaceans.*

  The use of environmental sounds by fish in the offshore environment is unknown but seismic sounds could have a low effect on fish.

  Masking of communication sounds by various cetaceans is likely to occur during certain seasons. For example, vocalisation of baleen whales increases once they reach breeding grounds and on their return journey. However, as seismic sounds are intermittent, the masking effect may be reduced.

The airborne gravity and magnetic survey is likely to result in potential disturbances to birds, seals and cetaceans, in response to aircraft noise and visual effects. This may impact on breeding success of birds and result in juvenile mortalities if indiscriminate or direct flying over seabird colonies or important bird areas occurs. Disturbance to seal colonies, of which there are a number along the West Coast, could result in pup mortalities or injury due to fleeing by frightened adults. Low altitude flying could also affect cetaceans during their breeding and mating season, but disturbance would depend on distance and altitude of the aircraft and prevailing sea conditions.

The sonar signals emitted for the high-resolution bathymetry survey could cause acoustic or physical disturbance to marine mammals, however, the probability of, for example, a cetacean passing beneath the narrow multi-

beam several times is highly unlikely. Thus, the sonar noise emitted during this survey would result in lower effects on marine mammals than the seismic surveys.

The proposed seafloor sampling and heatflow measurements would result in the loss of benthic infaunal and epifaunal biota, however, the sample area would be highly localised and thus the loss would be insignificant (i.e. total disturbed area would be less than 5 m^3).

Potential impacts on the marine environment ranged from insignificant to medium significance, without mitigation and INSIGNIFICANT TO LOW significance, with mitigation (refer to Table 60).

2.4.1.3 IMPACT ON OTHER USERS OF THE SEA

Fisheries

The proposed survey activities (excluding the airborne gravity and magnetic survey) would impact on a number of fisheries operating off the West Coast, namely:

- Demersal Trawl,
- Demersal Long-Line (hake-directed);
- Large Pelagic Long-Line;
- Tuna Pole;
- Traditional Line-Fish;
- Small Pelagic Purse-Seine; and
- West Coast Rock Lobster.

The survey vessels would have a 500 m safety / exclusion zone around the vessel and survey equipment at all times, which could impact on the number of fish caught, especially if the surveys are undertaken during main fishing seasons (for certain fishing sectors). For all sectors, fish movements and related behavioural patterns associated with feeding preferences could be affected if the fish show avoidance behaviour to the seismic and sonar noises, which could affect total catches. The proposed exploration activities are not likely to impact on the spawning or migratory behaviour of tuna and other large pelagic species.

The Dermersal Trawl fishery operates year-round, with relatively higher levels of effort during the autumn/winter months. Most of the Demersal Long-Line fishing is undertaken between June and August. Pelagic long-line vessels are concentrated where the continental slope is steepest, and the majority of effort is located offshore of the shelf break in waters deeper than 500 m (i.e. outside of Block 3A/4A). Tuna Pole Fishing is expected to occur along the shelf break with preferred fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. The fishery operates year- round, with relatively higher levels of effort recorded during the months of November to February and another peak in May. In terms of the Traditional Line Fishery, there are few recorded fishing events in Block 3A/4A. The Small Pelagic sector operates throughout the year with the main fishing activities undertaken between April and July. The West Coast Rock Lobster fishery is divided into a number of management zones, of which the southeastern corner of Block 3A/4A is located within zone 4, which operates between 15 November and 30 June.

Fishing Research Surveys

Two types of research surveys (undertaken twice a year) are undertaken by DFFE to set the annual TACs for demersal fisheries. The demersal fish resource survey takes place in January along the West Coast and the small pelagic species surveys are undertaken between mid-May and mid-June and the second survey is undertaken **between mid-October and mid-December.**

Marine Transport Routes

Shipping traffic inshore of the continental shelf is located between 12 and 24 nautical miles offshore, while most of the shipping traffic is located on the outer edge of the continental shelf. During the proposed exploration

activities, there is likely to be some interaction with marine traffic that could result in delays and/or disruptions to shipping / sailing activities.

Marine Prospecting, Mining, Exploration and Production Activities

At present there are no other prospecting, mining, exploration or production activities being undertaken within Block 3A/4A. However, future activities may take place, such as the installation of a pipeline from the Ibhubesi Gas Field, however, this project has yet to be approved. At present, there is no certainty if the proposed exploration activities would overlap with other activities within the area.

Potential impacts on the other users of the sea ranged from INSIGNIFICANT TO LOW significance, both with and without mitigation (see Table 60).

Although all potential impacts would be of a short-lived nature and thus temporary, resulting in a fairly low significance level, there are some potential impacts that may in fact be more significant.

Table 60 provides a summary of the significance of potential impacts associated with the proposed exploration activities.

Table 60: Summary of significance ratings of potential impacts associated with 2D and 3D Seismic Surveys, High Resolution Bathymetry Survey, Seabed Sampling and Heatflow Measurements and Airborne Gravity and Magnetic Survey.

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Impact of normal vessel operations		
Emissions		
Emission to the Atmosphere	**Very Low**	**Very Low**
Discharges / Disposal to the Sea		
Deck Drainage	**Very Low**	**Very Low**
Machinery Space Drainage	**Very Low**	**Very Low**
Sewage	**Very Low - Low**	**Very Low**
Galley Waste	**Very Low**	**Very Low**
Solid Waste	**Insignificant**	**Insignificant**
Noise		
Noise from Vessel Operations	**Very Low**	**Very Low**
Impact on Marine Fauna		
SEISMIC SURVEYS		
Plankton and Ichthyoplankton		
Physiological injury and mortality	**Insignificant**	**Insignificant**
Marine Invertebrates		
Benthic Invertebrates: Mortality and/or physiological injury	**Insignificant**	**Insignificant**
Neritic Invertebrates: Mortality and/or physiological injury	**Very Low**	**Very Low**
Behavioural avoidance	**Very Low**	**Very Low**
Fish		
Demersal species: Mortality and/or physiological injury	**Insignificant**	**Insignificant**
Pelagic species: Mortality and/or physiological injury	**Low**	**Very Low**
Avoidance behaviour	**Medium**	**Low**

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Masking of sounds	Very Low	Very Low
Reproductive success / spawning	Insignificant	Insignificant
Indirect impacts on food sources	Very Low	Very Low
Plunge-diving Seabirds		
Physiological injury to and avoidance behaviour	Low	Very Low
Avoidance behaviour in seabirds	Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Stranding and oiling	Insignificant	Insignificant
Turtles		
Physiological injury, collision and entanglement	Low	Very Low
Avoidance behaviour	Low	Very Low
Reproductive success	Low - Medium	Very Low - Low
Indirect impacts on food sources	Very Low	Very Low
Masking of sounds	Insignificant	Insignificant
Whales and dolphins:		
Baleen whales		
Physiological injury	Medium	Low
Avoidance behaviour	Medium	Low
Masking of sounds	Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Toothed whales and dolphins		
Physiological injury	Medium	Low
Avoidance behaviour	Very Low - Low	Very Low
Masking of sounds	Medium	Low
Indirect impacts on food sources	Very Low	Very Low
AIRBORNE GRAVITY AND MAGNETIC SURVEYS		
Birds		
Disturbance of roosting, nesting and feeding	Low - Medium	Very Low
Cetaceans		
Disturbance during breeding and mating	Low - Medium	Very Low
HIGH RESOLUTION BATHYMETRY SURVEY		
Marine Fauna		
Auditory and behavioural disturbance of cetaceans	Very Low	Very low
SEDIMENT SAMPLING AND HEATFLOW MEASUREMENTS		
Benthic Macro-fauna		
Injury and loss of benthic macrofauna through Drop-core sampling and Heat Flow Measurements	Insignificant	Insignificant
<u>Impact of Other Users of the Sea</u>		
FISHERIES		

IMPACT	SIGNIFICANCE (WITHOUT MITIGATION)	SIGNIFICANCE (WITH MITIGATION)
Demersal Trawl	**Very Low**	**Very Low**
Demersal Long-Line (Hake-Directed)	**Very Low**	**Very Low**
Large Pelagic Long-Line	**Insignificant**	**Insignificant**
Tuna Pole	**Low**	**Low**
Traditional Line-Fishing	**Insignificant**	**Insignificant**
Small Pelagic Purse-Seine	**Low**	**Low**
West Coast Rock Lobster	**Very Low**	**Very Low**
FISHERIES RESEARCH		
Demersal fish resources and small pelagic species surveys	**Low**	**Low**
MARINE TRANSPORT		
Marine Transport Routes	**Low**	**Low**
OTHER MINING-RELATED ACTIVITIES		
Marine prospecting, mining, exploration and production activities	**Very Low**	**Very Low**

The following section summarises the mitigation measures and recommendations for each component of the proposed exploration activities in order to reduce potential impacts on the marine and socio-economic (i.e. fishing activities) environments. Section 3 - Environmental Protection Activities provides a more detailed procedural plan to be followed and adhered to by the Operator.

2.4.2 RECOMMENDATIONS

2.4.2.1 COMPLIANCE WITH EMP AND MARPOL STANDARDS

The Operator is required to comply with all mitigation measures stipulated within this EMP, as well as comply with all relevant MARPOL Standards to ensure that potential impacts associated with all components of the exploration activities are reduced as far as possible and kept within manageable limits.

2.4.2.2 SEISMIC SURVEYS

The following mitigation measures must be implemented:

- All survey vessels must be fitted with Passive Acoustic Monitoring (PAM) technology. As a minimum, PAM technology must be used during the pre-watch period and when surveying at night or during adverse weather conditions and thick fog. The hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise and be fitted with two hydrophones to allow directional detection of cetaceans;
- Independent on-board MMOs and PAM operators must be appointed for the duration of the seismic survey. The MMOs and PAM operators must have experience in seabird, turtle and marine mammal identification and observation techniques;
- Implement a “soft-start” procedure of a minimum of 20 minutes duration when initiating seismic surveying. This build-up of power should occur in uniform stages to provide a constant increase in output. When surveying in inshore areas (<50 m depth), a “soft-start” procedure of 30 minutes’ duration is recommended;
- All breaks in airgun firing of longer than 20 minutes must be followed by the 30-minute pre-shoot watch and a “soft-start” procedure of at least 20 minutes prior to the survey operation continuing. Breaks shorter than 20 minutes should be followed by a visual assessment for marine mammals within the 500

m mitigation zone (not a 30-minute pre-shoot watch) and a “soft-start” of similar duration. Where possible, “soft-starts” should be planned so that they commence within daylight hours;

- Airgun firing should be terminated if mass mortalities of fish as a direct result of shooting are observed (e.g. mass floating fish);
- Prior to the commencement of “soft starts” an area of 500-m radius around the survey vessel (exclusion zone) should be scanned (visually and using PAM technology) for the presence of diving seabirds, turtles, seals and cetaceans. There should be a dedicated pre-shoot watch of at least 60 minutes (to account for deep-diving species). “Soft starts” should be delayed until such time as this area is clear of diving seabirds, turtles and seals and in the case of cetaceans should not begin until 30 minutes after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen;
- Marine mammal (e.g. seabird, turtle, cetaceans, etc.) incidence and behaviour should be recorded by an on-board MMO. Any obvious mortality or injuries to marine mammals as a direct result of the survey should result in temporary termination of operations;
- Seismic shooting should be terminated when obvious negative changes to cetacean behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching the firing airgun;
- Any attraction of predatory seabirds (by mass disorientation or stunning of fish because of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an on-board MMO;
- Ensure that ‘turtle-friendly’ tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector ‘turtle guards’;
- Seismic surveys should be planned to avoid cetacean migration periods or winter breeding concentrations (June to end November) and ensure that migration paths are not blocked. However, as several of the large whale species are also abundant on the West Coast between September and February (inclusive), the best time of year to conduct seismic operations is late summer and early winter (end February – mid June), across the entire block. However, any surveys planned between December and end February should only be scheduled to operate in the northern section of the block, i.e. avoiding the southern portion of the block off Cape Columbine.
- During night-time line changes low level warning airgun discharges should be fired at regular intervals to keep animals away from the survey operation while the vessel is repositioned for the next survey line;
- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area;
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Tripp seamount. On lines beyond that the low power guns can be stopped during turns, but the normal start-up procedure should nonetheless be maintained;
- All data recorded by MMOs should, as a minimum, form part of a survey close–out report. Furthermore, daily reports should be forwarded to the necessary authorities (e.g. DFFE, fishing bodies, NGO’s, etc.,) to advise them of interactions and compliance with the mitigation measures; and
- Marine mammal incidence data and seismic source output data arising from surveys shall be included as an appendix to the Close-out report to be submitted to PASA after completion of the survey and shall be made available on request to relevant government bodies and NGOs, if required (e.g. DAFF, Marine Mammal Institute, etc.).

2.4.2.3 HIGH RESOLUTION BATHYMETRY SURVEY

The following mitigation measures must be implemented:

- On-board MMOs should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses;
- Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment;
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area;
- Ensure that PAM is incorporated into all surveys; and
- Ensure an MMO is on-board the vessel to ensure compliance with mitigation measures during surveying.

2.4.2.4 SEABED SAMPLING AND HEATFLOW MEASUREMENTS THE FOLLOWING MITIGATION MEASURES MUST BE IMPLEMENTED:

- The final positioning of the sample sites must avoid existing seafloor infrastructure (including seafloor telecommunication cables) and any cultural heritage material identified during the multi-beam bathymetry survey;
- If any cultural heritage material is found during sampling activities SAHRA should be notified immediately. If any cultural heritage material older than sixty years is to be disturbed a permit would be required from SAHRA; and
- No anchoring is permitted within 1 nautical mile of seafloor telecommunication cables.

2.4.2.5 AIRBORNE GRAVITY AND MAGNETIC SURVEY AND HELICOPTER OPERATIONS THE FOLLOWING MITIGATION MEASURES MUST BE IMPLEMENTED:

- Pre-plan flight paths (for mobilisation and demobilisation to and from the Exploration Area) to ensure that no flying occurs over coastal reserves, bird colonies, marine reserves or Important Bird Areas;
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided, particularly during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November);
- During mobilisation to and from the Exploration Area, aircraft should maintain a minimum altitude of at least 300 m above sea level;
- An exemption permit shall be applied for from the Department of Forestry, Fisheries and the Environment) for the entire survey area for aircraft to be able to approach to within 300 m of whales;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

2.4.2.6 GENERAL

The following mitigation measures must be implemented:

- Ensure that the survey vessels are certified for seaworthiness via an internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas);
- Ensure that collision prevention equipment is on-board the vessels, such as, radar, multi- frequency radio, foghorns, etc. Additional precautions include:
    - The chase boat;

- The existence of an internationally agreed safety zone around the survey vessel;
- Cautionary notices to mariners; and
- Access to current weather service information.

- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night;
- Report any emergency situation to SAMSA;
- Communication between all parties active in or planning future offshore activities within Block 3A/4A should be undertaken so that pre-planning can be done to prevent disruption to activities. The Operator would need to ensure that they notify all stakeholders timeously of their survey times;
- Should any disagreement arise, PASA and / or the Department of Mineral and Petroleum Resources should be contacted;
- Ensure that a waste management plan is available for the vessel (required for any ship with a crew of more than 15 people).
- Discharge comminuted galley waste no closer than 3 nm from the coast. All food waste not comminuted to be discharged no closer than 12 nm from the coast. Vessels must be en-route; and
- Ensure that all waste disposal contractors are compliant with the relevant local bylaws and authority requirements in terms of municipal waste disposal.

2.4.2.7 IMPACT ON OTHER USERS OF THE SEA

2.4.2.7.1 Fisheries

The following mitigation measures must be implemented:

- Inform the sector of the safety protocols to adhere to and details of the survey area prior to commencement.
- Regular updates of the survey design must be communicated to vessels operating in the vicinity of Block 3A/4A;
- Fishing industry bodies and other key affected parties should be informed of the proposed survey activities and requirements with regards to the safe operational limits around the survey vessels prior to the commencement of the project. The following industrial bodies and affected parties include:
    - Department of Agriculture, Forestry and Fisheries;
    - Department of Environmental Affairs;
    - South African Tuna Association;
    - South African Tuna Long-Line Association;
    - Fresh Tuna Exporters Association;
    - South African Deep-Sea Trawling Industry Association;
    - South African Commercial Linefish Association;
    - West Coast and Peninsula Commercial Skiboat Association;

- Shark Longline Association;
- South African West Coast Rock Lobster Association;
- Transnet National Ports Authority (ports of Cape Town and Saldanha Bay); and
- South African Maritime Safety Association.

- Daily Navigational Warnings should be issued for the duration of the survey operations through the South African Naval Hydrographic Office.
- A Fisheries Liaison Officer (FLO) should be present on board the survey vessels to facilitate communications with vessels in the vicinity of the survey vessel – any fishing vessel targets at a radar range of 24 nautical miles from the survey vessel should be called via radio and informed of the navigational safety requirements.
- Affected parties should be notified through fishing industry bodies when survey activities are complete and the vessel is off location.
- Areas of high Tuna Pole fishing activity is due West of St Helena Bay between 32° 30´ S and 33° S and 16° 45 E and 17° 45´ E, which coincides with the southern portion of Block 3A/4A and this area should be monitored for the presence of tuna pole vessels during the survey via the Vessel Monitoring System unit at DFFE and via radar on board the survey vessel.
- It is recommended that any exploration activities proposed to take place in this southern portion are timed to avoid peak Tuna Pole fishing activity (i.e. between November and February and May), as far as possible.
- The surveys should commence in the northern-most extent of the block and then work southwards into the Small Pelagic Purse-Sein fishing grounds (highest fishing activity undertaken southwards of 31° 40´S and inshore of the 100 m depth contour).
- It is also recommended, depending on survey times, to commence with the North / South lines closer inshore and then move further offshore, thereby avoiding the main Small Pelagic Purse- Sein fishing activities from April to July.
- An “adaptive” management approach is recommended to minimise impacts by deciding on the best mitigation measures once specific survey dates are known and depending on the specific fishing activity being undertaken at the time.

2.4.2.7.2 Fisheries Research

- Timing of the proposed surveys should avoid periods when research surveys are being conducted (i.e. mid-May to mid-June and mid-October to mid-December).
- Notify the managers of the research programmes regarding planned survey periods prior to commencements[19].

[19] The relevant contacts at DFFE currently responsible for the planning of the demersal and acoustic cruises are Deon Durholtz (DeonD@daff.gov.za) and Janet Coetzee (JanetC@nda.agric.za) respectively.

3 SECTION 3: TABLE OF ENVIRONMENTAL PROTECTION ACTIVITIES

- Section 3 lists the specific actions required, or steps which should be taken by the Operator to avoid or limit damage to the environment from offshore survey activities.
- It has, as its basis, PetroSA's existing EMP for exploration seismic surveys in Block 9 and 11a. Where necessary, it has been updated in light of the findings and recommendations of the impact assessment and associated specialist studies undertaken by Jeffares and Green (Pty) Ltd for the exploration programme[20] in Block 3A/4A, as well as the recommendations of the 2025 EMPr and RoD conditions Audit of the Initial Exploration Period.
- Each sub-section starts with a 'rationale' giving the reasons why specific kinds of damage to the environment should be avoided and why there is a need to manage specific activities.
- Following this, the 'objectives' of what the Operator is specifically trying to achieve are set out.
- Then, instructions or 'auditable actions' are listed, staff responsibilities allocated, and the required timing or frequency of actions stipulated.

Table 61 below provides a layout of this section showing contents and inter-linkages between the subsections. Each section has been colour coded for ease of reference.

[20] Work programme originally provided to PASA but subsequently changed via a s102 approval to purchasing of 2D seismic data only.

Table 61: Summary of Table of Environmental Protection Activities

ACTIVITIES 3.1-3.3: PLANNING PHASE	3.1 LEGAL REQUIREMENTS
	3.2 SUBSIDIARY PLANS
	3.3 SURVEY CONTRACTOR CERTIFICATION
ACTIVITY 3.4: STAKEHOLDER ENGAGEMENT	3.4 STAKEHOLDER ENGAGEMENT
ACTIVITY 3.5: ENVIRONMENTAL TRAINING AND AWARENESS	3.5 ENVIRONMENTAL TRAINING AND AWARENESS
ACTIVITY 3.6: POLLUTION PREVENTION	3.6.1 VESSELS & OTHER SHIPPING
	3.6.2 HELICOPTER SERVICES AND AIRBORNE GRAVITY AND MAGNETIC SURVEYS
	3.6.3 TRANSFER OF MATERIALS / DROPPED OBJECTS
	3.6.4 WORKSHOPS, REPAIRS AND CHEMICAL HANDLING AND STORAGE
	3.6.5 REFUELLING / BUNKERING
ACTIVITIES 3.7: SURVEY OPERATIONS	3.7.1 AIRBORNE GRAVITY AND MAGNETIC SURVEYS
	3.7.2 SEISMIC SURVEYS AND ACOUSTIC EMISSIONS FROM AIRGUNS AND MULTI-BEAM BATHYMETRY SURVEYS
	3.7.3 SEAFLOOR SAMPLING PROGRAMME AND HEATFLOW MEASUREMENTS
	3.7.4 MAINTENANCE OF EXCLUSION ZONES
ACTIVITIES 3.8-3.10: WASTE MANAGEMENT	3.8 SOLID WASTE MANAGEMENT – GENERAL MEASURES
	3.9 DISCHARGE OF EFFLUENT
	3.10 GASEOUS EMISSIONS
ACTIVITY 3.11: INCIDENTS AND EMERGENCIES	3.11.1 LIQUID SPILLS OR LEAKS
	3.11.2 LOST MATERIALS AND EQUIPMENT
	3.11.3 INJURY OR DEATH OF MARINE FAUNA
	3.11.4 GENERAL INCIDENT REPORTING & AUDITING
ACTIVITY 3.12: DECOMMISSIONING & CLOSE OUT	3.12.1 RESTORATION OF PRE-SURVEY CONDITIONS
ACTIVITY 3.13: SYSTEM ADMINISTRATIVE REQUIREMENTS	3.13.1 MONITORING
	3.13.2 REPORTING
	3.13.3 AUDITING
	3.13.4 RECORD KEEPING
	3.13.5 EMP REVIEW AND REVISION

The roles, responsibilities, necessary qualifications and communication lines between the various responsible parties, are depicted in Table 62 below.

Table 62: Roles, responsibilities and lines of communication

ROLE	RESPONSIBILITIES	QUALIFICATIONS AND RECOMMENDATIONS
Operator Asset Manager	• Responsible for overall operational management	• Not specified
Operator SHEQ representative	• Representative for the Operator's SHEQ Manager • Provide some measure of assurance that the environmental responsibility transferred to the Survey contractors is being undertaken.	• Not specified
Marine Mammal Observer	• Contracted by and reports to the Operator's SHEQ representative • Responsible for all marine mammal observations to take place prior to and during acoustic surveys	• Independent service provider • The MMO should at least have experience in the field having worked on board similar survey vessels in the region before or, at most, have had JNCC-certified training as an MMO • It is recommended that any MMO appointed, should be a South African national and have experience in local conditions.
Fisheries Liaison Officer	• Contracted by and reports to the Operator's SHEQ representative, if required (usually as part of the MMO contract) • Responsible for liaising with all fisheries stakeholders and informing the fisheries industry of the survey operations	• The FLO should have relevant experience as an FLO working on board other similar survey vessels • It is recommended that any FLO appointed should be a South African national and have experience in local conditions
Passive Acoustic Monitoring (PAM) operator	• Contracted by and reports to the Operator's SHEQ representative, if required (usually as part of the MMO contract) • Responsible for all PAM related operations prior to and during acoustic surveys	• The PAM operator should have had relevant PAM training and experience as a PAM Operator working on board other similar survey vessels • It is recommended that any PAM Operator appointed should be a South African national and have experience in local conditions
Operator Operational Geophysicist	• Is the day-to-day manager of the survey activities • Responsible foremost, for ensuring accurate data collection	• Not specified

ROLE	RESPONSIBILITIES	QUALIFICATIONS AND RECOMMENDATIONS
Survey Contractors (seismic, bathymetry, aerial and seafloor sampling/heatflow contractors)	• Contracted to provide the specialist survey • Carries a lot of the environmental responsibility via the contract • Accountable for service provider's performance	• Not specified
Logistics and Survey Service Providers	• Appointed by and reports to the survey contractor • Responsible for their own environmental performance via the contract	• Not specified
Environmental Control Officer (ECO)	• Recommendations for review and update of the EMPr; • Liaison between the Applicant, Contractors, authorities and other lead stakeholders on high importance environmental concerns; • Ensures that correct shape files have been uploaded into the vessel navigation systems to support effective implementation of spatial controls; • Review the site induction training to ensure environmental issues receive adequate attention and important site-specific issues are included • Conduct environmental audits of the site/contractors including relevant documentation on a monthly basis; • Validating the regular site inspection reports, which are to be prepared by the relevant contractor's EO or Lead MMO/PAM (who will be tasked with the onsite responsibilities of the ECO); • Maintain a record of all non-conformances and incidents	• The Holder must appoint an independent Environmental Control Officer (ECO) prior to commencement of any offshore exploration activities. • The ECO should have appropriate training and/or experience in the implementation of environmental management specifications. The ECO must preferably have a tertiary qualification in an Environmental Management or appropriate field. The ECO's key role is auditing the implementation of the EMPr. • The ECO will be responsible for the auditing function as well as the clarification of environmental conditions contained in this EMPr to anyone working on the site. The ECO does not necessarily have to be onboard the survey vessel, provided that relevant information is provided by the MMO / PAM.

ROLE	RESPONSIBILITIES	QUALIFICATIONS AND RECOMMENDATIONS
	to ensure that measures are put in place to remedy such; • Maintain a public consultation register in which all complaints are recorded, as well as action taken; and • Verification that all environmental monitoring programmes (sampling, measuring, recording etc. when specified) are carried out according to protocols and schedules.	

3.1 ACTIVITY 1: PLANNING PHASE

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
1.1. ADHERENCE TO LEGAL REQUIREMENTS		
Rationale: A number of international conventions, national legislation and guidelines regulate the offshore oil and gas industry. These are primarily focussed on combating marine pollution and maintaining vessel safety at sea. The MARPOL standards are the primary international standards governing pollution at sea and specify limits for release of oily water, sewage, galley waste and solid waste. South Africa's Air Pollution Standards under the NEMA Air Quality Act (No. 39 of 2004) are applicable to air emissions from offshore installations and apply to exploration and geophysical survey vessels. The Operator will be responsible for ensuring all the necessary legal requirements, including permits, are obtained prior to initiating additional exploration and geophysical surveys in Block 3A/4A. This EMP is also a legal document**,** and the specified measures included here, once approved, are legally binding on the Operator and the survey Contractor.		
Objectives: To ensure all legal requirements described in Section 1.4 and all provisions specified in these Activity Schedules (1-13) are complied with to ensure environmental protection and human and vessel safety at sea.		
1.1.1 Prepare a register of all legislation applicable to all exploration and geophysical survey activities.	*Operator Legal Counsel*	*Prior to Survey*
1.1.2 Ensure all required permits and approvals are obtained prior to conducting exploration and geophysical activities and adhere to all conditions attached.	*Operator Asset Manager*	*Prior to Survey*
1.1.3 Prepare a schedule of all environmental and compliance monitoring measures required during survey operations as well as a schedule of all reports required during and after the survey has been completed. The schedule must specify the inspection and reporting frequency and party responsible for the inspection and reporting, using Activity 3.13.2 as minimum guideline.	*Operator SHEQ Representative*	*Prior to Survey*
1.1.4 All survey Contractors must be provided with a copy of the EMP and a written confirmation of receipt must be obtained. The survey Contractor as well as the Operator's representatives on the survey must be instructed to have the EMP available on board the survey and any support vessels at all times.	*Operator SHEQ Manager*	*Prior to Survey*
1.1.5 Copies of the EMP must be readily available on-board the survey vessel and support vessels at all times and the necessary equipment and personnel must be available to meet the requirements of the EMP.	*Survey Contractors*	*Throughout Survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
1.1.6 Contracts with service providers shall specifically require that the service provider complies with all relevant legislation. The Operator reserves the right to inspect survey activities at any time during the survey operation to assess compliance to the EMP. Deviations from the EMP without sound justification will be deemed a breach of contract.	*Operator SHEQ Manager; Operator Legal Counsel*	*Prior and during survey activities*
1.1.7 The Holder must appoint an independent Environmental Control Officer (ECO) prior to commencement of any offshore exploration activities. • The ECO should have appropriate training and/or experience in the implementation of environmental management specifications. The ECO must preferably have a tertiary qualification in an Environmental Management or appropriate field. The ECO's key role is auditing the implementation of the EMPr. • The ECO will be responsible for the auditing function as well as the clarification of environmental conditions contained in this EMPr to anyone working on the site. The ECO does not necessarily have to be onboard the survey vessel, provided that relevant information is provided by the MMO / PAM. • The ECO roles include: o Recommendations for review and update of the EMPr; o Liaison between the Applicant, Contractors, authorities and other lead stakeholders on high importance environmental concerns; o Ensures that correct shape files have been uploaded into the vessel navigation systems to support effective implementation of spatial controls; o Review the site induction training to ensure environmental issues receive adequate attention and important site-specific issues are included o Conduct environmental audits of the site/contractors including relevant documentation on a monthly basis; o Validating the regular site inspection reports, which are to be prepared by the relevant contractor's EO or Lead MMO/PAM (who will be tasked with the onsite responsibilities of the ECO); o Maintain a record of all non-conformances and incidents to ensure that measures are put in place to remedy such; o Maintain a public consultation register in which all complaints are recorded, as well as action taken; and o Verification that all environmental monitoring programmes (sampling, measuring, recording etc. when specified) are carried out according to protocols and schedules.	*Operator SHEQ Manager;*	*Prior and during survey activities*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
1.1.8 . It is recommended that a climate change specialist be engaged to determine if any updates are required to the EMPr in order to effectively deal with climate change adaptation and vulnerability and the EMPr should be updated with the impact assessment and recommendations of the specialist.	*The operator should appoint: Appropriately qualified and experienced, as well as independent specialists and Environmental Assessment Practitioner.*	*Once specific target areas for future surveys are defined, prior to surveys.*
1.1.9 Audit guidelines: Audits should, through examination of records retained by the Contractor verify that: ○ A Legal Register was prepared prior to survey operations and is applicable to the survey activities. ○ All the required permits were obtained prior to the start of survey operations. ○ All license conditions have been complied with throughout survey operations. ○ Schedule of monitoring requirements prepared for all survey activities. ○ All survey Contractors were provided with copies of the EMP and proof of receipt was obtained. ○ A copy of the EMP was available on-board throughout the survey. ○ All monitoring requirements have been undertaken in accordance with the scheduled frequency. ○ All audit guidelines specified throughout this report have been complied with.	*Operator SHEQ Manager*	*Prior to and throughout survey*

3.2 ACTIVITY 2: SUBSIDIARY PLANS

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Rationale: This EMP specifies the requirements for environmental management, pollution control and emergency procedures as far as possible for this generic exploration and geophysical survey EMPr. However, under the framework provided by this EMP, certain subsidiary plans will need to be developed by the Operator or the survey Contractor		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
for each Survey Operation which details the specific measures that need to be taken for certain activities; the roles and responsibilities of staff in this regard and reporting procedures and lines of communication.		
Objective: ○ Subsidiary plans are developed and are in place prior to the marine Survey Operation. ○ Subsidiary plans provide the necessary level of detail and are aligned with the requirements provided in this EMPr and relevant existing procedures of the Operator.		
Subsidiary Plans		
2.1.1 Ensure that the service providers (survey and support vessels, etc.) have the following subsidiary plans in place: ○ Oil Spill Contingency Plan. ○ Emergency Response Plan, including MedEvac plan. ○ Support Vessel and Helicopter Emergency Response Plans. ○ Waste Management Plan. ○ Incident Management and Reporting.	*Operator Asset Manager & Operator Operational Geophysicist.*	*Prior to commencing survey activities.*
2.1.2 Compile a Communications Plan that outlines the communication procedures for all stakeholder engagement, including a Stakeholder Engagement Register, responsibilities for review of stakeholder comments, feedback to the stakeholder and close out actions and requirements. The plan must include an effective Grievance Mechanism aligned with the requirements of the IFC, considering mechanisms for grievance input, assessment, action, monitoring, and closure.	*Operator SHEQ Representative*	*Prior to commencing survey activities.*
2.1.3 Ensure that subsidiary plans are aligned with national plans (e.g. National Oil Spill Contingency and Response Plan) and other regional, provincial, local and the Operator's plans and procedures as relevant (e.g. Integrated Waste Management Plans, Incident Management Plan, Communications Plan etc.).	*Operator SHEQ Representative & Operator Operational Geophysicist*	*Prior to commencing survey activities.*
2.1.4 All contingency response plans contain the following up to date details: ○ Contact names and numbers for different response contingencies. ○ Clear lines of communication for specific tasks are tabulated. ○ Clear roles and responsibilities allocated to specific staff with incumbents	*Survey Contractor*	*Before and throughout survey activities.*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
particular to the operation specified. o Training and awareness needs and activities, if relevant. o Formats for reporting e.g. filing incident reports, waste manifests, etc.		
2.1.5 All plans shall be readily available and accessible on the survey and support vessels at all times.	*Survey Contractors*	*Throughout survey*
2.1.6 The Operator to keep copies of all subsidiary plans (listed in Activity 3.2.1.1) in the Emergency Response Centre during survey activities.	*Operator SHEQ Representative*	*Throughout survey*
2.1.7 Retain copies of all subsidiary plans for five years.	*Operator Operational Geophysicist*	*Five years*
2.1.8 The pre-survey meeting agenda between the Operator and the survey Contractors must include a formal handover and acceptance of subsidiary plans. All staff of the survey Contractor and Operator staff must be familiar with the content of the plans.	*Survey Contractor*	*Pre survey*
2.1.9 Audit Guidelines Audits should, through examination of records retained by the facility, visual inspections and targeted interviews, verify that: o The required subsidiary plans are compiled prior to commencing survey activities o The plans contain the necessary level of detail to meet the intended purposes while ensuring optimal environmental protection. o The plans are aligned with the content of this EMP. o The plans are aligned with relevant National, Provincial and Local Plans, where relevant. o The plans are available at the Emergency Response Centre.	*Operator SHEQ Manager*	*Pre survey*

3.3 ACTIVITY 3. SURVEY CONTRACTOR CERTIFICATION

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Rationale: The exploration and geophysical surveys to be undertaken are highly specialised activities. For this reason, highly qualified contractors and staff, and certified equipment and materials, are required to ensure maximum safety and environmental protection.		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Objective: Ensure all contractors and staff operate to the required safety and environmental protection standards and are appropriately certified.		
Certification of survey Contractor and survey vessel		
3.1.1 The survey Contractors shall be registered with the International Association for Geophysics Contractors (IAGC) and shall be able to demonstrate a track record for maintaining optimum safety and environmental protection.	*Operator Operational Geophysicist*	*Prior to Contract Award*
3.1.2 Ensure the survey vessel is certified for seaworthiness through an appropriate internationally recognised certification programme (e.g. Lloyds Register, Det Norske Veritas)	*Operator Operational Geophysicist*	*Prior to Contract Award*
3.1.3 Ensure that the survey vessels holds certification for updated calibration of survey equipment.	*Operator Operational Geophysicist*	*Prior to Contract Award*
3.1.4 Audit Guidelines Audits should, through examination of documents retained by the Operator verify that: ○ The survey Contractors are registered with IAGC ○ The survey vessels held valid certificates for seaworthiness and calibrated equipment through an international certification body e.g. DNV.	*Operator SHEQ Manager*	*Pre survey*

3.4 ACTIVITY 4: STAKEHOLDER ENGAGEMENT

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Rationale: Exploration and geophysical surveys may have impacts upon a number of different stakeholders. In the case of offshore survey activities, this normally includes short term negative impacts, such as limitations on fishing efficiency and navigational restrictions on other marine users and potential disturbance to marine fauna and flora,		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
particularly cetaceans (whales and dolphins). It is incumbent on the Operator to engage with stakeholders, in terms of the principles of NEMA, in order to improve the level of transparency of the nature and timing of the Operator's operations and exploration campaigns.		
Objectives: ○ To establish and maintain a register of stakeholders. ○ To accommodate the fishing industry and other users of the sea, where possible, by presenting and discussing the anticipated survey programme/s. ○ To provide timeous notification to stakeholders regarding surveys. ○ To provide regular general feedback to relevant and key stakeholders. ○ To receive, process and respond to inputs from external and internal stakeholders.		
Stakeholder Engagement		
4.1.1 The Operator must implement and maintain a Stakeholder Engagement Register which shall include the following information: ○ Contact details of stakeholder ○ Date and time of stakeholder input ○ Nature of input ○ Stakeholder engagement form reference number ○ Name of reviewing manager for reviews of comments ○ Date of Review ○ Result of Review ○ Date of communication with stakeholder	*Operator SHEQ Representative*	*Prior and throughout survey*
4.1.2 The Operator shall meet with the fishing industry (demersal trawl, demersal hake-directed long-line, large pelagic long-line, tuna pole, traditional linefish, small pelagic purse-seine fisheries and West Coast rock lobster) and the managers of the DFFE fisheries research programmes to discuss their respective surveys and programmes in order to minimise or avoid disruptions to all parties.	*Operator SHEQ Representative & Operator Operational Geophysicist*	*Prior to marine survey programme finalisation*
4.1.3 Fishing industry bodies and other key affected parties should be informed of the proposed survey activities and requirements with regards to the safe operational limits around the survey vessels prior to the commencement of the project. The following industrial bodies and affected parties should be included:	*Operator SHEQ Representative*	*Prior to marine survey programme finalisation*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
~~o Department of Agriculture~~ o Department of Forestries, Fisheries and the Environment o South African Tuna Association o South African Tuna Long-Line Association o Fresh Tuna Exporters Association o South African Deep-Sea Trawling Industry Association o South African Commercial Linefish Association o West Coast and Peninsula Commercial Skiboat Association o Shark Longline Association o South African West Coast Rock Lobster Association o Transnet National Ports Authority (ports of Cape Town and Saldanha Bay) o South African Maritime Safety Association		
4.1.4 The specific details of the survey shall be compiled into an Environmental Notification for submission to PASA. The Environmental Notification will provide details on the following: o Survey lines, period and duration o Vessel specifications o Certification compliance o Relevant insurance	*Operator Representative* *SHEQ*	*14 days prior to survey activities*
4.1.5 Fishing stakeholders and other marine users who operate in the area shall be notified in writing of survey activities and the location and presence of exclusion and safety areas at least ~~14 days~~ 3 weeks prior to the scheduled commencement of survey activities. Should survey activities extend beyond the original timeframe stakeholders should be notified within 24 hours. Stakeholders include: o Overlapping and neighbouring users with delineated boundaries in the marine petroleum and mineral prospecting and mining industries. o Fishing industry operating in the survey area. South African and foreign fishing vessels can be informed through the recognized fishing associations (examples include the South African Deep Sea Trawling Association, Inshore Pelagics, Rock Lobster and Tuna Associations, DFFE, fishing companies and fishing agents). o Government Departments with jurisdiction over marine activities, particularly, PASA, DFFE, SAN	*Operator Representative* *SHEQ*	*14 days prior to survey activities and within 24 hours if extension of survey is required*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Hydrographer, SAMSA and local Port Captains. o DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town.		
4.1.6 The Operator shall advertise the commencement of each surveying programme regionally in English.	*Operator SHEQ Representative*	*14 days prior to survey activities*
4.1.7 The Operator shall, in writing, request the South African Naval Hydrographic Office to put out daily Radio Navigational Warnings throughout the operational period and issue Notices to Mariners. The Notice to Mariners should give notice of: o The co-ordinates of the proposed survey area/s. o An indication of the proposed survey timeframes and day-to-day location of the survey vessel. o An indication of the proposed safe operational limits of the survey vessel.	*Operator SHEQ Representative*	*Notice to Mariners 24 hours prior to start*
4.1.8 An experienced Fisheries Liaison Officer (FLO) should be present on board the survey or escort vessels to facilitate communications with fishing vessels in the vicinity of the survey ~~vessel~~ area– any fishing vessel targets at a radar range of 24 nautical miles from the survey vessel should be called via radio and informed of the navigational safety requirements around the survey vessel.	*Operator SHEQ Representative & FLO*	*Throughout survey*
4.1.9 Daily reports shall be submitted, via email, to those stakeholders that request to be notified during the survey (see Activity 3.4.1.2). Daily reports should include, but not limited to, the following: o Survey details (incl. start-up procedure). o Vessel interaction. o Meteorological conditions. o Observation times and sightings of marine fauna. o Waste management o Survey strategy (incl. survey progress and next line to be acquired).	*FLO*	*Daily throughout survey*
4.1.10 Stakeholder engagement process will be undertaken in accordance with a Communications Plan (see Activity 3.2.1.2).	*Operator SHEQ Representative*	*Throughout survey*
4.1.11 Any feedback from stakeholders concerning offshore exploration activities shall be reported in the Quarterly Report for that period.	*Operator SHEQ Representative*	*Quarterly*
4.1.12 Inform all key stakeholders of the completion of survey activities within 24 hours.	*Operator SHEQ Representative*	*Within 24 hours of end of survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
4.1.13 Audit Guidelines Audits should, through examination of records retained by the Operator, verify that: ○ A Stakeholder Engagement Register has been maintained. ○ Documents notifying stakeholders have been retained (e.g. Environmental Notification, notification letters, adverts and daily reports). ○ Any stakeholder inputs have been reviewed by the responsible manager. ○ The above stakeholder inputs have been responded to appropriately . ○ The stakeholder has been informed of the outcome of the review by the responsible manager.	*Operator SHEQ Representative*	*End of survey activities*

3.5 ACTIVITY 5. ENVIRONMENTAL TRAINING AND AWARENESS

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Rationale: Poor staff awareness or ignorance about potential survey effects on marine fauna, waste management and pollution control can result in accidents or avoidable incidents. It is important to raise environmental awareness to encourage active staff participation in implementation of environmental protection measures and human safety as well as how to respond in an emergency event.		
Objectives: • To equip all personnel on the marine survey and support vessels to perform their duties in an environmentally responsible manner through regular training. • To raise environmental awareness through feedback on environmental performance and any changes in legislation governing best practices.		
Environmental Training and Awareness		
5.1.1 Contractors must be registered with IAGC (see Activity 3.3.1.1) and all staff on the survey and support vessels must be suitably trained and qualified to fulfil their duties as demonstrated by the crew manifest and training records.	*Operator Operational Geophysicist*	*Prior to Contract Award*
5.1.2 Toolbox talks or similar shall be used to discuss environmental awareness and to report back on environmental performance applicable to the specific work area. Topics should include content of subsidiary plans as a minimum.	*Survey Contractor*	*Monthly*
5.1.3 All personnel shall receive regular training on the handling and management of waste, and incident response and reporting procedures.	*Survey Contractor*	*Prior to and during survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
5.1.4 Audit Guidelines Audits should verify that: ○ All survey personnel have received appropriate training ○ Regular tool box talks or similar have been undertaken on environmental awareness and management ○ Staff members are familiar with the provisions of the EMPr related to their area of work and the general incident and emergency reporting procedures.	*Operator SHEQ Manager*	*End of survey activities*

3.6 ACTIVITY 6. POLLUTION PREVENTION

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
6.1 Helicopter Services and Airborne Gravity and Magnetic Surveys		
Rationale: Helicopters may be used for crew changes, other support or to attend to life-threatening events should they arise. The airborne gravity and magnetic surveys will be undertaken from a nearby land based airport. Using any airborne craft may disturb coastal and marine life and interfere with coastal activities such as tourism and fishing. An accident involving an aircraft could cause marine pollution as well as threaten human safety.		
Objectives: ○ To minimise disturbance to coastal sea bird populations and large marine fauna from aircraft flights. ○ To minimise disturbance to coastal communities and activities such as tourism and recreational fishing.		
Helicopter Services and Airborne Gravity and Magnetic Surveys		
6.1.1 Existing aviation service providers' procedures, such as the Materials Handling & Transport and Marine Support Services procedures, shall be implemented to minimise the risk of objects and chemical substances being dropped overboard, during surveys, cargo transfer, leaking from storage containers and during handling.	*Logistics and Survey Service Providers*	*Throughout survey period*
6.1.2 The contractor shall comply fully with aviation and authority guidelines and rules.	*Logistics and Survey Service Providers*	*Throughout survey period*
6.1.3 All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast. All mitigation measures associated with ecological impacts linked to flying as listed in Activity 3.7.1 below must be complied with.	*Logistics and Survey Service Providers*	*Throughout survey period*
6.1.4 Helicopter flight logs will be kept to demonstrate compliance with set flight paths. Pre-planned flight paths must avoid sensitive areas and colonies. Helicopter flight logs will be kept to demonstrate compliance with set flight paths. Airborne gravity and magnetic flight logs shall also be kept to ensure compliance with the pre-	*Logistics and Survey Service Providers*	*Throughout survey period*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
determined survey lines. Pre-planned flight paths must avoid sensitive areas and colonies.		
6.1.5 Audit guidelines Audits should, through examination of records retained by the logistics and survey service providers, verify that: ○ Flight logs are maintained and can demonstrate compliance with set flight paths with reasons provided for any deviations from such routes	*SHEQ Manager*	*During and post survey activities*
6.2 Vessels and Other Shipping		
Rationale: Offshore survey and support vessels pose potential hazards to marine traffic, creating a navigational obstacle and a restriction to fishing activities. Vessels carrying personnel or supplies to and from the offshore installations may negatively impact on the environment through reckless behaviour, negligence and/or accidents. A collision involving a survey vessel and other vessels can create a pollution risk to the marine environment through the release of oils and fuels and the deposition of objects on the seabed. The Operator and/or the survey Contractor may be jointly responsible for the immediate response and remediation of any such environmental damage. Various measures need to be taken to minimise the risk of collisions through alerting shipping captains to the presence of the survey operations. The survey and support vessels should be equipped with and use all the required navigational aids, warnings and safety equipment. The chase vessel will be on duty at all times throughout survey operations to alert marine users ahead to the survey operations and to ensure the survey path is clear. It is important that the survey and chase vessels are operated by competent personnel, are seaworthy and appropriate for their tasks, and managed in such a way as to minimise the risk of any environmental damage occurring. In the event that damage does occur, the correct and appropriate response is undertaken by the Master(s) of the vessel(s) concerned.		
Objective: ○ To minimise navigational risks to other marine users ○ To inform the Masters of the supply and transport vessels of the actions to be taken to minimise environmental damage and the actions to be taken in the event of such damage occurring ○ To check that the requisite actions are taken and that they are effective in minimising environmental damage. ○ To ensure that the provisions are effective in maintaining “visibility” of the vessels.		
6.2.1 All measures prescribed by SAMSA to minimise the risks of collision of marine traffic with the survey and support vessel(s) must be implemented and maintained. Measures to be implemented include: ○ Maintenance of safety and exclusion zones through Notices to Mariners issued by SAN Hydrographic Office 24 hours prior to commencement of survey (see Activity 3.4.1.7). ○ 24-hour chase vessel on patrol in exclusion zone during surveying. ○ Maintenance of standard watch procedures.	*Survey Contractor*	*Throughout survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ Issue Radio Navigational Warnings if visibility of vessel(s) is diminished (e.g. power outages or failure of fog horn). ○ Radio communication to alert approaching vessels. ○ Use of flares and sirens where necessary. ○ Recording of interactions with vessels in a log book. ○ Collisions, near misses or other transgressions with associated pollution risks will be treated as incidents and handled according to the procedure detailed under Activity 3.11.		
6.2.2 The lighting on the survey and support vessels should be reduced to a minimum, compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimized.	*Survey Contractor*	*Throughout survey*
6.2.3 Impacts of marine biodiversity through the introduction of non-native species in ballast water and on ship hulls should be avoided by implementing the following measures: ○ Avoid the unnecessary discharge of ballast water. ○ Use filtration procedures during loading in order to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. ○ Ensure that routine cleaning of ballast tanks to remove sediments is carried out, where practicable, in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's Ballast Water Management Plan. ○ Ensure all infrastructure (e.g. arrays, streamers, tail buoys etc.) that has been used in other regions is thoroughly cleaned prior to deployment. ○ Comply with the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention).	*Survey Contractor*	*Throughout survey*
6.2.4 Pollution prevention: ○ Ensure that solid streamers rather than fluid-filled streamers are used. Alternatively, low toxicity fluid-fill streamers could be used.	*Survey Contractor*	*Throughout survey*
6.2.5 Audit guidelines Audits should verify that: ○ All measures prescribed by SAMSA were implemented and maintained. ○ All relevant measures were implemented as and when required.	*SHEQ Manager*	*During and post survey activities*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
6.3 Transfer of Materials / Dropped Objects		
Rationale: Marine survey vessel operations and loading and offloading of equipment and personnel poses a risk of solid objects and liquids falling into the sea, which could pose a risk to shipping or fisheries, while certain articles and liquids may also be detrimental to marine life and could pollute the sea. Since all such cargo has a monetary value, standard procedures are in place to limit any such loss and to retrieve objects falling overboard wherever possible.		
Objectives: • To minimise the risk of objects being lost overboard during transit or transfer. • To retrieve objects which have fallen overboard before they pose a risk to the environment or shipping. • To log the existence and location of fallen objects for future reference / action. • To notify interested parties of the existence and location of un-retrieved fallen objects.		
6.3.1 Procedures shall be implemented to minimise the risk of objects and other materials being dropped overboard during transfer of goods or leaking from storage containers or during handling.	*Logistics Service Provider*	*Throughout survey*
6.3.2 The incident management procedure should be followed in the event of a lost object or other materials (see Activity 3.11.2). Notify SANHO of any hazards left on the seabed or floating in the water column, and request that they send out a Notice to Mariners with this information.	*Logistics Service Provider*	*Throughout survey*
6.3.3 Audit guidelines Audits should, through examination of records retained by the vessel, verify that: ○ Incidents involving dropped objects were recorded in the incident reports. ○ The response time of incidents is appropriate to their significance. ○ The decision whether or not to retrieve objects was environmentally appropriate. ○ Incidents were subject to comprehensive evaluation by management. ○ Requisite changes were made to operational procedures to ensure that the incident is not repeated. ○ Incidents resulting from the same root cause(s) are not repeated. ○ Trial runs and/or drills for major incidents are conducted at least annually. ○ The response for major contingencies is formally reviewed by management annually.	*Operator SHEQ Manager and survey Contractor*	*During and post surveys*
6.4 Workshops, Repairs and Chemical Handling and Storage		
Rationale: Marine survey vessels may store small quantities of oils and fuels and other potentially polluting substances. Equipment and repair operations do not always take place		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
in a defined workshop area but may take place anywhere on the vessel. These activities pose a risk of polluting substances leaking or spilling into the sea and/or solid objects falling overboard (see Activity 3.6.3 above). However, the first line of pollution prevention is behavioral and contingent upon adequately trained staff and appropriate operational protocols. Many of the procedures for chemical handling and storage are legislated under the Occupational Health and Safety Act (No. 85 of 1993) as amended, but the focus of the EMP is to ensure that environmental issues are adequately addressed.		
Objectives: o To manage repairs in a manner that minimises the risk of liquids polluting the sea and to expedite clean-up of any such spillages that do occur. o To handle, store and dispose of chemicals in such a way as to minimise the risk of spillage or leakage. o To respond to any spills and or leaks in such a way that environmental damage does not occur.		
6.4.1 Repair and servicing of loose equipment or machinery shall be undertaken only in defined workshop areas or where adequate drainage is in place to contain spilled liquid and where risk of loss of object overboard is minimised	*Survey Contractor*	*Throughout survey activities*
6.4.2 All valves, taps and pipe connections should be inspected regularly in accordance with the maintenance and monitoring schedule to check for leaks and should be immediately rectified in the event of leak detection	*Survey Contractor*	*According to maintenance & monitoring schedule*
6.4.3 A chemical and hazardous material register shall be maintained and will detail: o All chemicals used and stored on the vessel. o Chemical characterisation of each chemical including SABS (or similar) class and hazard rating. o Specific storage handling or disposal requirements for each chemical including Personal Protective Equipment. o Emergency response actions for each chemical. o The process used to verify the information contained in the register.	*Survey Contractor*	*Throughout survey activities*
6.4.4 All fuels, greases, oils and other chemicals shall be stored and handled as per chemical handling procedures specified in the contractor's standard operating procedures and in accordance with the Material Data Safety Sheets (MSDS).	*Survey Contractor*	*Throughout survey activities*
6.4.5 All chemicals shall have current MSDS prominently displayed at the location of storage and use.	*Survey Contractor*	*Throughout survey activities*
6.4.6 Personnel using chemicals shall be trained in their use, disposal and clean-up.	*Survey Contractor*	*Annually*
6.4.7 Expired chemicals shall be labelled as waste and treated in accordance with the disposal requirements specified in their MSDS.	*Survey Contractor*	*Throughout survey activities*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
6.4.8 Appropriate absorbent materials and clean up equipment must be on board and easily available in the event of a chemical spill.	*Survey Contractor*	*Throughout survey activities*
6.4.9 Any liquid spills of more than 5 litres shall be treated as an incident and handled according to the incident procedure detailed under Activity 3.11.1 below. All vessels shall at all times be equipped with the required spill kits to handle on-board spills or leaks.	*Survey Contractor*	*Immediately on occurrence*
6.4.10 Any loss of chemicals overboard shall be treated as an incident and handled according to the procedure detailed under Activity 3.11.1	*Survey Contractor*	*Immediately on occurrence*
6.4.11 Audit Guidelines Audits should verify that: o Repair and servicing of mobile equipment and machinery takes place in defined areas with adequate drainage measures in place. o The chemical register is current and verified and storage accords with details contained in the MSDS. o All hazardous chemicals were labelled correctly and the emergency procedures to be adopted in the event of a spill are clearly detailed on MSDS at the site of storage. o Chemical dispensers or drums are positioned on/over drip trays. o Spills are reported and handled according to the liquid incident management procedure under Activity 3.11.1. o Spill absorbents are available at the location of use and that they are appropriate to the nature of the chemical being used. o Expired chemicals are labelled as expired and handled as hazardous waste.	*SHEQ Manager*	*During survey activities*
6.5 Refuelling / Bunkering		
Rationale: In the event that offshore bunkering is required, there is a risk of fuel spillage, especially when connecting and disconnecting hoses and valves. Spillage may be more likely to occur in rough marine or stormy conditions. Bunkering activities are regulated under International Convention for the Protection of Pollution from Ships MARPOL 73/78 (Annex 1); Prevention and Combating of Pollution of the Sea by Oil Act Amendment Act (No. 24 of 1991), and the Marine Pollution (Control and Civil Liability) Act (No. 6 of 1981).		
Objectives: To minimise the risk of spills and marine pollution during bunkering.		
6.5.1 No bunkering or refueling while vessels are out at sea is permitted within 50 nautical miles of the coast.	*Survey Contractor /*	*Bunkering*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
	Service Provider	
6.5.2 If bunkering at sea is found to be necessary, permission must be obtained from SAMSA five days prior to bunkering.	*Survey Contractor / Service Provider*	*Five days prior to bunkering*
6.5.3 Diesel and other fuels must be stored in enclosed and secured tanks, designed to withstand extreme events and conditions.	*Survey Contractor / Service Provider*	*Bunkering*
6.5.4 Drip trays must be in place to collect leakage from on-board connection and discharge points for both offshore and in-port bunkering and refueling.	*Survey Contractor / Service Provider*	*Bunkering*
6.5.5 Offshore bunkering will not be allowed in the following circumstances: o Wind force and sea state conditions of 6 or above on the Beaufort Wind Scale. o During any workboat or mobilisation boat operations. o During helicopter operations. o During the transfer of in-sea equipment. o At night or times of low visibility.	*Survey Contractor / Service Provider*	*Bunkering*
6.5.6 Floating hoses will be made of flexible double carcass sections and will be equipped with a breakaway coupling for protection against excessive tension or overpressures in the fuel system. The closure time will be set to minimise the volume of oil spilled to the sea whilst being slow enough to prevent surge pressure building up. Hoses will also be fitted with marker lights and will have built-in buoyancy with a minimum reserve of 25% (to cope with a situation where the hose becomes filled with seawater and immersed). This will also prevent accidental damage to unseen hoses by supply / crew boats.	*Survey Contractor / Service Provider*	*During bunkering*
6.5.7 Spillages of fuel during bunkering must be logged as an incident in accordance with the procedures given in Activity 3.11.1.	*Survey Contractor / Service Provider*	*Immediately*
6.5.8 Audit Guidelines: o Audits should, through examination of records retained by the Operator, verify that: o There is proof of SAMSA approval for bunkering and notification of bunkering events. o Fuel is stored and drip trays provided and available for bunkering. o Hoses and other equipment meet the required specifications. o Incidents recorded in the incident register were investigated and closed out.	*Operator SHEQ Manager*	*During and post-survey activities*

3.7 ACTIVITY 7. SURVEY OPERATIONS

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Order of Surveys: PetroSA proposes to undertake the surveys in the following order: • Airborne Gravity and Magnetic Survey – Not planned or applied for renewal period. • 2D Seismic Survey – Not planned or applied for renewal period. • High resolution bathymetry survey • Seabed sampling and heatflow measurements • 3D seismic surveys – Contingent		
7.1 Airborne Gravity and Magnetic Surveys (i.e. Aerial Surveys)		
Rationale: The expected frequency range and dominant tones of sound produced by fixed-wing aircraft and helicopters overlap with the hearing capabilities of most whales and dolphins. Repeated or prolonged exposures of these animals to aircraft overflights have the potential to result in significant disturbance of biological functions, especially in important nursery, breeding or feeding areas. Although unlikely to result in any long-term biologically significant impacts, seals have been known to show short term reactions to overflights. Impacts have also been observed on birds due to passing aircraft.		
Objectives: To minimise risk of behavioural disturbance to breeding mammals, particularly whales and seals.		
7.1.1 An exemption permit shall be applied for from the Department of Forestry, Fisheries and the Environmental Affairs (DFFEA) for the entire survey area for aircraft to be able to approach to within 300 m of whales (in terms of the Marine Living Resources Act, 1998).	*Aerial survey Contractor*	*Prior to Undertaking surveys*
7.1.2 Pre-plan flight paths (for mobilisation and demobilisation to and from the Exploration Area) and ensure that no flying occurs over coastal reserves, bird and seal colonies, coastal reserves, marine islands or the following Important Bird Areas (IBA): o West Coast National Park and Saldanha Bay Islands. o Bird Island. o Olifants River estuary. o Verlorenvlei. o Lower Berg River wetlands Dassen Island.	*Aerial survey Contractor*	*Throughout survey operations*
7.1.3 Extensive coastal flights (parallel to the coast within 1 nautical mile (nm) of the shore) shall be avoided, particularly during the movement of migratory cetaceans (particularly baleen whales) from	*Aerial survey Contractor*	*Planning of operations*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
their southern feeding grounds into low latitude waters (June to end November). Utilise a precautionary approach to avoiding impacts throughout the year as no seasonal patterns of abundance are known for odontocetes occupying the Exploration Area. Should a survey be required to extend into the cetacean migration and breeding period (the beginning of June to the end of November), a formal request / motivation must be submitted to PASA for consideration.		
7.1.4 During mobilisation to and from the Exploration Area, aircraft shall maintain a minimum altitude of at least 300m above sea level and shall not hover or circle over whales, dolphins, sharks, turtles or aggregations of seabirds.	*Aerial survey Contractor*	*Throughout survey operations*
7.1.5 All pilots must be briefed on the ecological risks associated with flying at a low level parallel to the coast.	*Aerial survey Contractor*	*Prior to undertaking Surveys*
7.1.6 Audit guidelines Audits should verify that: ○ The necessary permits are in place to be able to fly within 300m of whales. ○ Flight paths adhered to the requirements of Activities 3.7.1.2 and 3.7.1.3. ○ Environmental awareness training included ecological risks caused by low level flying.	*Operator SHEQ Manager*	
3.7.2 Seismic Surveys, Acoustic Emissions from Airguns and Multi-beam Bathymetry Surveys		
Rationale: Acoustic emissions during seismic and bathymetry operations may cause damage to the hearing organs and air- containing tissues of marine animals such as swim bladders in fish and lungs in turtles and mammals. Risks to such animals, particularly cetaceans (whales and dolphins) will be higher during the months when they breed and calve in South African waters (from the beginning of June to the end of November). These surveys are generally restricted to periods outside of whale breeding seasons when significant disturbance may be caused. Disorientation of fish due to acoustic firing may increase seabird predation. Therefore, seismic and multi-beam bathymetry surveys must take precautions to ensure that sensitive marine fauna are not present at the commencement of firing airguns.		
Objectives: ○ To reduce risk of injury to marine animals by discouraging them from entering the marine survey area. ○ To minimize risk of behavioural disturbance to breeding mammals, particularly whales.		
7.2.1 ~~Seismic~~ Surveys should be planned to avoid cetacean migration periods or winter breeding concentrations (1st of June to 30th of November) and ensure that migration paths are not blocked. However, as several of the large whale species are also abundant on the West Coast between September and February (inclusive), the best time of year to conduct seismic operations is late summer	*Operator Operational Geophysicist & Operator SHEQ Representative*	*Planning of operations*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
and early winter (end February – mid June), across the entire block. However, any surveys planned between December and end February should only be scheduled to operate in the northern section of the block, i.e. avoiding the southern portion of the block off Cape Columbine. Should a survey be required to extend into the cetacean migration and breeding period, a formal request / motivation must be submitted to PASA for consideration. In addition, seismic survey and multi-beam bathymetry survey operations must be planned such that they do not overlap with tuna pole peak season on the West of St Helena Bay. This tuna pole peak season is generally from October to March, or more specifically from December to March. This means that in addition to the restriction of these surveys during cetacean migration periods or winter breeding concentrations (1st of June to 30th of November) the surveys should be limited to the period from 1 April to 31 May.		
7.2.2 Once specific target areas for future surveys are defined the following must be undertaken prior commencement: o Undertake survey (technical specifications) and location specific sound transmission loss modelling (acoustic modelling) in order to define the magnitude and extent of potential underwater noise. o A cultural heritage impact assessment should be undertaken by a suitable qualified specialist with specific focus on the intangible heritage and the relevant management and mitigation measures are to be incorporated into the EMPr. o Revise the impact assessment on the basis of the outcomes of the acoustic modelling (with inputs from relevant specialists including but not limited to marine ecology, and fisheries). Impact on Small Scale Fisheries must be included. o Supplement the impact management actions and impacts contained in the EMPr to account for the site and survey specific controls. o Obtain relevant approvals from the competent environmental authority in accordance with relevant legal requirements (e.g. amendments to EA and/or EMPR in accordance with NEMA requirements).	*The operator should appoint: Appropriately qualified and experienced, as well as independent specialists and Environmental Assessment Practitioner.*	*Once specific target areas for future surveys are defined, prior to surveys.*
7.2.3 All survey vessels must be fitted with Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations. o The PAM technology must have enough bandwidth to be sensitive to the whole frequency range of sensitive marine life expected in the area. o The use of PAM 24-h a day must be implemented to detect deep diving species.	*PAM Operator*	*Throughout survey operations at night or during poor visibility.*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ Ensure the PAM streamer is fitted with at least four hydrophones, of which two are HF and two LF, to allow directional detection of cetaceans. ○ Ensure the PAM hydrophone streamer is towed in such a way that the interference of vessel noise is minimised. ○ Ensure spare PAM hydrophone streamers (e.g. 4 heavy tow cables and 6 hydrophone cables) are readily available in the event that PAM breaks down, in order to ensure timeous redeployment. ○ An independent Passive Acoustic Monitoring (PAM) Operator is required on board at all times. As a minimum, at least one PAM must be on watch at all times while the acoustic source is active. The duties of the PAM operator would be to: ▪ Provide effective regular briefings to crew members, and establish clear lines of communication and procedures for onboard operations; ▪ Ensure that the hydrophone cable is optimally placed, deployed and tested for acoustic detections of marine mammals; ▪ Confirm that there is no marine mammal activity within 500 m of the seismic source array prior to commencing with the "soft-start" procedures; ▪ Record species identification, position (latitude/longitude), distance and bearing from the vessel and acoustic source, where possible; ▪ Record general environmental conditions; ▪ Record seismic source activities, including sound levels, "soft-start" procedures and pre-start regimes; ▪ Request the delay of start-up and temporary termination of the seismic survey, as appropriate.		
7.2.4 Define and enforce the use of the lowest practicable seismic source volume for production. Design arrays to maximise downward propagation, minimise horizontal propagation and minimise high frequencies in seismic source pulses (have this verified by independent evaluators). Use only narrow-beam technology when conducting multi-beam bathymetry surveys.	*Survey Contractor*	*Throughout survey operations.*
7.2.5 An on-board Marine Mammal Observer (MMO) shall be appointed for the duration of the survey. The MMO must have experience in seabird, turtle, seal and marine mammal identification and observation techniques. The duties of the MMO shall include: Marine fauna: ○ Observing and recording responses of marine fauna to acoustic shooting, including	*Operator SHEQ Manager* *MMO*	*Throughout survey operations.*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
seabird, turtle, seal and cetacean incidents and behaviour and any mortality of marine fauna as a result of the surveys. Data captured shall include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities. Both the identification and the behaviour of the animals must be recorded accurately along with current survey sound levels. o Any attraction of predatory seabirds, large pelagic fish or cetaceans (by mass disorientation or stunning of fish as a result of acoustic survey activities) and incidents of feeding behaviour among the hydrophone streamers should also be recorded. o Recording airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes. o Requesting the temporarily termination of the survey, as appropriate. It is important that MMO's have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports). o Recording sightings of any injured or dead protected species (marine mammals and sea turtles), regardless of whether the injury or death was caused by the vessel itself. If the injury or death was caused by a collision with the vessel, the date and location (latitude/longitude) of the strike and the species identification or a description of the animal should be recorded. Fishing and other users of the sea: o Providing back-up on-board facilitation with the fishing industry and other users of the sea. This includes communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed activities. o Daily electronic reporting of vessel activity and recording of any communication and/or interaction in order to keep I&APs informed of survey activity and progress. Other: o Recording meteorological conditions. o Preparing daily reports of all observations. These reports shall be forwarded to the necessary authorities on a daily or weekly basis. o Monitoring compliance with international marine pollution regulations (MARPOL 73/78		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
standards).		
7.2.6 "Soft-start" procedures shall only commence once it has been confirmed (visually during the day and using PAM technology and night-vision/infra-red binoculars at night) by a MMO and PAM operator, that there is no seabird (diving), seal, turtle or marine mammal activity within 500 m of the seismic source. For cetaceans, the period of confirmation shall be for at least 30 minutes prior to the commencement of the "soft-start" procedures. "Soft starts" should be delayed until such time as this area is clear of diving seabirds, turtles and seals and in the case of cetaceans should not begin until 30 minutes after the animals depart the 500m exclusion zone or 30 minutes after they are last seen. A dedicated pre- shoot watch of at least 60 minutes (to account for deep-diving species) is recommended.	*MMO and PAM operator*	*Prior to initiation of any acoustic impulses*
7.2.7 Acoustic shooting shall follow the procedure below: ○ The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced. Airgun use shall be prohibited outside of the licence area. ○ All initiations of acoustic surveys shall be carried out as "soft-starts" for a minimum of 20 minutes. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans to move away from the sound source. When surveying in inshore areas (<50 m depth), a "soft-start" procedure of 30 minutes' duration shall be implemented. ○ Where possible, "soft-starts" should be planned so that they commence within daylight hours. ○ "Soft-start" procedures shall only commence once it has been confirmed (visually during the day and using PAM technology and night-vision/infra-red binoculars at night) that there is no seabird (diving), seal, turtle or marine mammal activity within 500m of the vessel. For cetaceans, the period of confirmation shall be for at least 30 minutes prior to the commencement of the "soft-start" procedures. "Soft starts" should be delayed until such time as this area is clear of diving seabirds, turtles and seals and in the case of cetaceans should not begin until 30 minutes after the animals depart the 500m exclusion zone or 30 minutes after they are last seen. ○ All breaks in airgun firing of longer than 20 minutes must be followed by the 30-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey	*Survey Contractor*	*Throughout survey operations*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
operation continuing. Breaks shorter than 20 minutes should be followed by a visual assessment for marine mammals within the 500m mitigation zone (not a 30-minute pre-shoot watch) and a "soft-start" of similar duration. ○ In order to avoid unnecessary delays to the survey programme, it is recommended that a spare PAM cable and sensor are kept onboard should there be any technical problems with the system. If there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night vision / infra-red binoculars must be used at night while PAM is being repaired. ○ During night-time line changes low level warning airgun discharges shall be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line. ○ The firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Tripp seamount shall be maintained. On lines beyond that the low power guns can be stopped during turns, but the normal start-up procedure shall nonetheless be maintained. ○ During surveying, airgun firing should be temporarily terminated when: ▪ Obvious negative changes to turtle, seal and cetacean behaviour is observed. ▪ Turtles or cetaceans (excluding small toothed whales) are observed within 500m of the operating airgun and appear to be approaching the firing airgun; or ▪ There is mortality or injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey. Large mortality of invertebrate and fish species should also result in temporary termination. ○ Shut-down protocols should be developed for the above scenarios.		
7.2.8 No survey-related activities are to take place within proclaimed MPAs.	*Survey Contractor*	*Throughout survey operations*
7.2.9 'Turtle-friendly' tail buoys shall be used**,** or existing tail buoys shall be fitted with either exclusion or deflector 'turtle guards'.	*Survey Contractor*	*Throughout survey operations*
7.2.10 The survey shall be terminated if any marine mammals show affected behaviour within 500m of ~~the survey vessel~~ survey source or equipment until the mammal has vacated the area.	*Survey Contractor*	*Throughout survey operations*
7.2.11 Seabird, turtle, seal, marine mammal and fish incidence and behaviour must be recorded by an onboard MMO. Any attraction of predatory seabirds (by mass disorientation or stunning of fish because of seismic survey activities) and incidents of feeding behaviour among the hydrophone	*MMO*	*Throughout survey operations*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
streamers must also be recorded. All data recorded by MMOs shall as a minimum form part of a survey close–out report. Furthermore, daily reports should be forwarded to the necessary authorities (refer to Activity 3.4.1.3) to advise them of interactions and compliance with the mitigation measures.		
7.2.12 Marine mammal incidence data and acoustic source output data arising from surveys shall be included as an appendix to the Close-out report to be submitted to PASA after completion of the survey.	*MMO*	*When requested*
7.2.13 Audit guidelines Audits should verify that: ○ MMOs, and where necessary a PAM operator, were employed for the duration of the surveys and records indicate that pre-watch periods and record keeping accord with the requirements indicated in Activities 3.7.2.2, 3.7.2.3 and 3.7.2.5. ○ The survey took place outside the cetacean migration, breeding and feeding period (June to end of February), unless approval was received from PASA. ○ There was compliance with the 15-minute pre-watch period. ○ The contractor was using the lowest practicable airgun volume, as defined by the Operator. ○ All initiations of acoustic surveys were carried out as "soft-starts" for a minimum of 20 minutes. ○ PAM was used during surveying at night or during the period between June and November. ○ Acoustic surveying was temporarily terminated when required.	*Operator SHEQ Manager / MMO*	*Throughout survey operations*
7.3 Seafloor sampling programme and heatflow measurements		
Rationale: The location of sample sites for piston coring and heatflow measurements could disturb cultural heritage material and infrastructure on the seafloor, as well as sensitive benthic habitats (e.g. coral reefs, sponge beds), MPAs and EBSAs. Therefore, the Operator / Survey Contractor should take necessary precautions to ensure sample sites avoid known cultural heritage sites, identified sensitive benthic habitats and existing infrastructure.		
Objectives: ○ To minimise risk of disturbance to cultural heritage material, particularly historical shipwrecks. ○ To reduce risk of disturbance or damage to seafloor infrastructure, particularly seafloor telecommunication cables. ○ To avoid and or minimize the impact on sensitive benthic habitats.		
7.3.1 Prior to sampling and measurements i.e. the construction and operational phase and once specific target areas within Block 3A/4A where surveys are to be conducted have been identified, the following specialist studies including impact assessments and high resolution sensitivity mapping	*Operator SHEQ Representative*	*Prior to selection of sample sites*

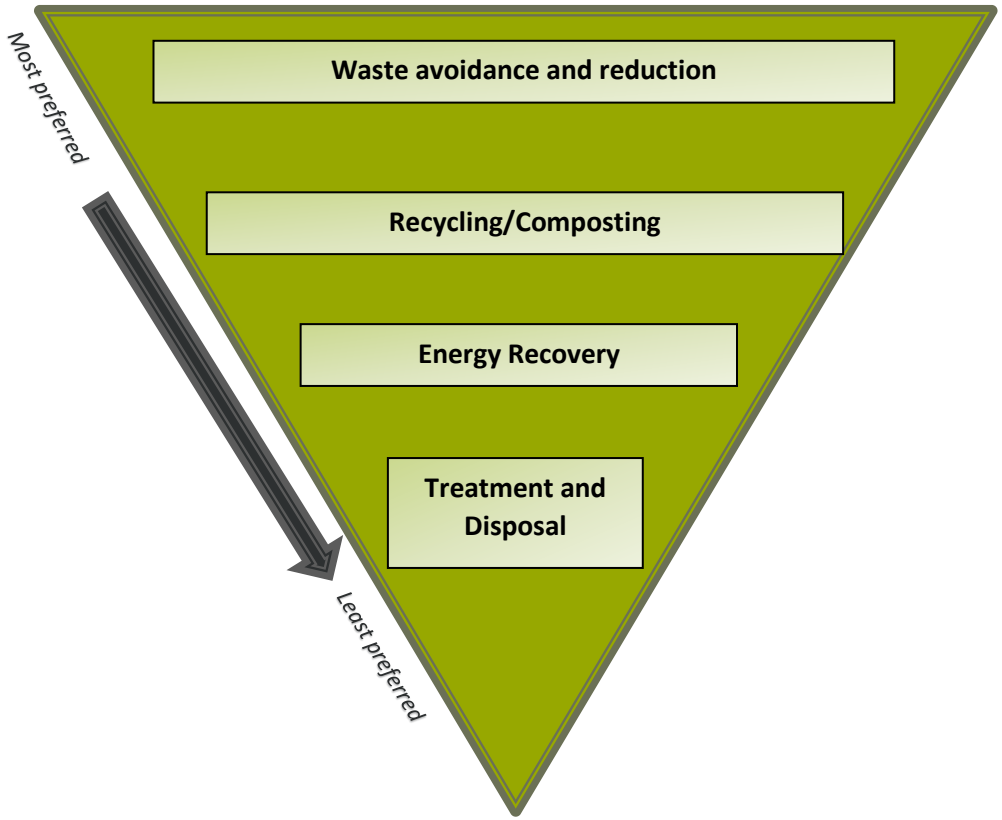
Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
should be conducted: ○ A cultural heritage impact assessment assessing the tangible and intangible heritage of the area; and ○ A marine biodiversity impact assessment.		
7.3.2 The final positioning of the sample sites must avoid existing seafloor infrastructure (including seafloor telecommunication cables), pre-identified sensitive benthic habitats and buffer zones and any cultural heritage material, identified during the multi-beam bathymetry survey.	*Operator Operational Geophysicist & Operator SHEQ Representative*	*Selection of sample sites*
7.3.3 If any cultural heritage material is found during sampling activities, SAHRA should be notified immediately. If any cultural heritage material older than sixty years is to be disturbed a permit would be required from SAHRA.	*Operator*	*Immediately on occurrence*
7.3.4 No anchoring is permitted within 1 nautical mile of seafloor telecommunication cables or within identified sensitive benthic habitats, or within buffer zones of heritage material older than sixty years, if no permit was obtained.	*Survey Contractor*	*Throughout sampling operations*
7.3.5 No survey-related activities are to take place within proclaimed MPAs or Ecologically or Biologically Significant Marine Areas (EBSAs) and its buffer zones.	*Survey Contractor*	*Throughout sampling operations*
7.3.5 Audit guidelines Audits should verify that: ○ The final positioning of the sample sites avoided existing seafloor infrastructure and known cultural heritage material, as well as pre-identified sensitive benthic areas and MPAs and EBSAs. ○ A permit was obtained from SAHRA if any material older than sixty years was disturbed.	*Operator*	*Prior to and throughout sampling*
7.4 Maintenance of Exclusion Zones		
Rationale: Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), survey vessels engaged in surveying operations are defined as a "vessel restricted in its ability to manoeuvre " which requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way of the survey operations. 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. A communications plan is required to inform stakeholders of the survey vessel movement plan and a chase vessel will warn off vessels that may breach the exclusion zone.		
Objectives: ○ To minimise safety risks to other vessels at sea and to avoid conditions that could pose a risk of marine pollution.		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ To avoid disruptions and delays to the sampling/survey programme.		
7.4.1 Comply with standard marine navigation warning requirements issued to keep other marine users informed of survey activities (see Activity 4), including Radio Navigational Warnings, Notices to Mariners and email notices to known marine users operating in the area.	*Geophysical Contractor*	*Throughout survey operations*
7.4.2 Keep constant watch for approaching vessels during operations (including radar) and issue warnings by radio and chase boat, if required.	*Survey Contractor*	*Throughout survey operations*
7.4.3 Vessels shall fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in maneuverability.	*Survey Contractor*	*Throughout survey operations*
7.4.4 Use warning lights during twilight, at night and in periods of low visibility. Lighting on board survey vessels shall be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night.	*Survey Contractor*	*Throughout survey operations*
7.4.5 Transgressions of the exclusion zone must be recorded as an incident and adhere to the incident reporting and investigation procedure in Activity 3.11.4.	*Survey Contractor*	*Throughout survey operations*
7.4.6 Report any emergency situation to SAMSA.	*Operator SHEQ Manager*	*Throughout survey operations*
7.4.7 Audit guidelines Audits should verify that: ○ The appropriate communications were undertaken**,** and proof of notifications were retained. ○ Incidents were recorded and investigated as per requirements in Activity 3.11.4.	*Operator SHEQ Manager*	*Throughout survey operations*

3.8 ACTIVITY 8 - 10. WASTE MANAGEMENT

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
3.8 Solid Waste Management		
8.1 General Measures for Solid Waste Management		
Rationale: Globally there is a recognition that wastage of resources must cease. A major concern is that final disposal to landfill of potentially renewable resources unnecessarily		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
uses up landfill airspace and wastes resources that still have value. Since the enactment of the National Environmental Management: Waste Act (No. 59 of 2008) there is now a positive obligation on waste generators to assess their resource usage and attempt to eliminate or reduce waste production and where this is not possible, to develop ways of re-using or recycling waste. Disposal to landfill should only be adopted as a final resort. This requires an active and ongoing assessment of waste production to identify creative ways of satisfying the objectives of this Act. The procedure below provides an overview of the steps which should be taken.		
Objectives: ○ To prevent any waste from entering the marine environment except for macerated galley waste and macerated and treated sewage waste. ○ To reduce the amount of waste disposed **of** to landfill by reducing waste generation and maximizing recycling and reuse. ○ To comply with waste management legislation. ○ To dispose of all solid waste in an environmentally responsible manner.		
8.1.1 The contractor is required to provide an integrated waste management plan in line with the waste management hierarchy presented in **Figure 66** to the Operator prior to commencing survey operations.	*Survey Contractor*	*Prior to Survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
 **Figure 66: Waste Management Hierarchy**		
8.1.2 The survey vessel shall maintain a Waste Register which shall detail: ○ Categories and volume estimates of different waste types generated on the survey and support vessels ○ Their source. ○ Their SABS class and hazard rating. ○ Their storage requirements. ○ Their disposal methods.	*Survey Contractor*	*Prior and throughout survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ Any specific precautions or legislative requirements.		
8.1.3 The Waste Register shall be updated to record actual waste volumes generated during the Survey Operation	*Survey Contractor*	*As required*
8.1.4 Waste shall be segregated into the following categories shown in Figure 67. Recyclables shall be stored separately as shall hazardous waste. Where possible, certain hazardous waste such as oil, e-waste, etc. shall be recycled.	*Survey Contractor*	*Throughout Survey*

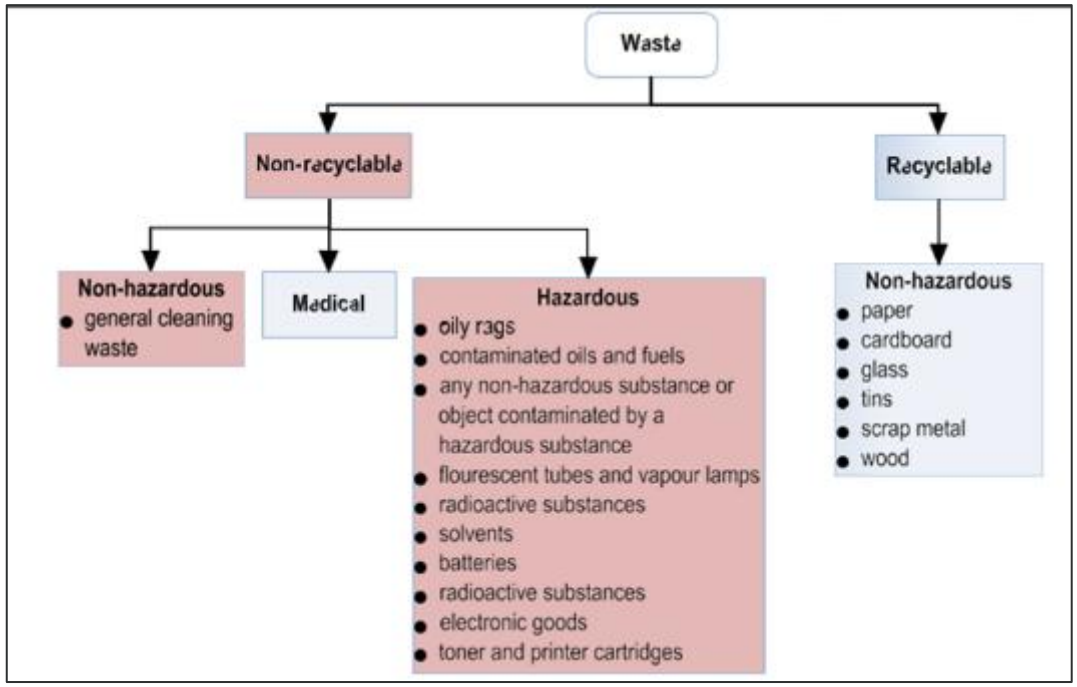
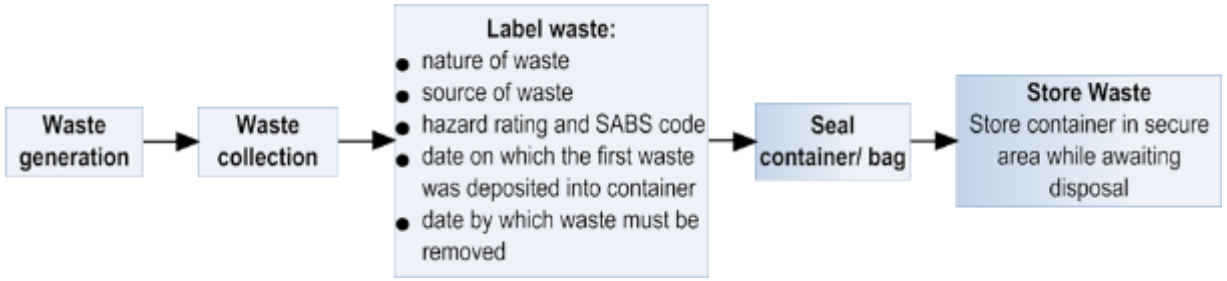


Figure 67: Possible waste segregation categories

8.1.5 All wastes to be disposed of at land-based facilities shall be handled according to the flow diagram in Figure 68 below while awaiting transport to disposal sites.	*Survey Contractor*	*Throughout Survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
 **Figure 68: Waste Handling**		
8.1.6 No waste may be stored for more than 30 days on any vessel without formal permission from DFFE	*Survey Contractor*	*Throughout Survey*
8.1.7 Wastes shall be stored in sealed containers or bags and protected from the environment according to specifications for storage in the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste published by Department of Water Affairs and Forestry (DWAF) (now Department of Water and Sanitation [DWS]) in 1998 (or the latest update thereof).	*Survey Contractor*	*Throughout Survey*
8.1.8 Incompatible waste may not be stored in the same location (see the hazard ratings for wastes in the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste published by DWAF (now DWA) in 1998 for compatibility, or the latest update thereof).	*Survey Contractor*	*Throughout Survey*
8.1.9 Galley waste shall be macerated at sea to pieces smaller than 25mm and deposited overboard at a distance at least 12 nautical miles from shore in accordance with MARPOL requirements. Vessels undertaking survey operations in Block 3A/4A should, where possible, discharge galley wastes into the sea as far as possible from the coast.	*Survey Contractor*	*Throughout Survey*
8.1.10 Sewage shall be discharged as outlined in Activity 3.9.2.	*Survey Contractor*	*Throughout Survey*
8.1.11 The survey Contractor shall develop and maintain a waste manifest system as part of the waste register which includes: ○ The quantities of different categories of waste leaving the vessel ○ The nature and source of the waste types ○ The date upon which the waste was removed.	*Survey Contractor*	*Throughout Survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ The date upon which they were received by the disposal facility. ○ Proof of correct disposal by the landfill site (including a safe disposal certificate for any hazardous waste). ○ Obtaining completed waste disposal certificates including quantities and method of disposal for different waste types.		
8.1.12 Hazardous waste shall be disposed of at a registered waste disposal site and a safe disposal certificate shall be issued for all hazardous waste.	*Survey Contractor / Logistics Service Provider*	*Throughout survey*
8.1.13 Waste manifests shall be provided to the Operator and reported in the survey Contractor's Monthly Report.	*Survey Contractor*	*Monthly*
8.1.14 Audit Guidelines/; ○ During surveys, audits should, through examination of records retained, verify that: ▪ The waste register is current and verified. ▪ Storage accords with legal requirements and the. details contained in the register and waste management plan. ▪ Any hazardous wastes were labelled as such. ▪ No wastes are stored on the vessel for longer than 30 days without approval from DFFE. ▪ Each container of waste is labelled with its source and contents. ▪ Safe disposal certificates were obtained for any hazardous waste load.	*Operator SHEQ Manager*	*During and after survey*
○ The post-survey audit should verify that: ▪ All personnel received training in waste management and handling on at least one occasion during the survey. ▪ A complete record of waste management throughout the Survey Operation for record keeping	*Operator SHEQ Manager*	*After survey*
3.9 Discharge of effluent		
Rationale: Liquid wastes arise from cleaning the decks, works areas, ablutions, and bilges. The discharge has the potential to be detrimental to the marine environment if it does not meet MARPOL discharge standards.		
Objectives: ○ To contain effluents which could pose a threat to the marine environment. ○ To treat effluents before discharge in order to minimise damage to the marine environment. ○ To comply with legislative obligations for effluent discharge.		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
9.1 Deck & Bilge Water		
9.1.1 Drainage water from deck and bilges shall be routed to separate drainage systems on survey vessels and shall include contaminated oily water from closed drains and drainage water from non-process areas (open drains).	*Survey Contractor*	*Throughout survey*
9.1.2 Drip trays or bunds shall be provided to contain contaminated water from all work areas that do not drain or route to a closed drainage system.	*Survey Contractor*	*Throughout survey*
9.1.3 No deck or bilge water may be discharged to the sea unless the oil concentration is below 15ppm (MARPOL standard).	*Survey Contractor*	*Throughout survey*
9.1.4 In the event that the discharged oil concentration exceed 15ppm it shall be treated as an incident as per 3.11.1.	*Survey Contractor*	*Immediately on occurrence*
9.1.5 Oil concentration records shall be retained and submitted to the Operator in the Monthly Report.	*Survey Contractor*	*Throughout survey*
9.1.6 Where possible, environmentally-friendly, low toxicity and biodegradable cleaning materials shall be used.	*Survey Contractor*	*Throughout survey*
9.1.7 Discharge deck and bilge wastes from vessels undertaking survey operations in Block 3A/4A to be disposed of in the marine environment should comply with the relevant MARPOL standards.	*Survey Contractor*	*Throughout survey*
9.2 Sewage		
9.2.1 Discharge comminuted and disinfected sewage waste no closer than 3 nm from the coast. All sewage waste not comminuted and disinfected to be discharged no closer than 12 nm from the coast in accordance with MARPOL standards. Vessels must be enroute at a speed not less than 4 knots.	*Survey Contractor*	*Throughout survey*
9.3 Audit Guidelines		
9.3.1 Audits should, through examination of records retained by the survey Contractor and Monthly and Close-Out Reports to the Operator, verify that: ○ The wastewater streams complied with the required MARPOL standards. ○ Sewage macerators are maintained and fully functional. ○ On-board equipment has been designed to comply with MARPOL standards. ○ Any elevated levels were investigated and the sources identified and appropriate action was taken. ○ Any such remedial action was documented and the effectiveness monitored. ○ No wastewater was discharged from bilge tanks with a concentration of greater than 15 ppm oil (MARPOL). ○ Any discharges of concentrations greater than those specified were formally investigated, reported and remedial action taken. ○ Any such remedial action was documented and the effectiveness monitored.	*Operator SHEQ Manager*	*During and post survey*
3.10 Gaseous Emissions		
Rationale: Gaseous emissions of concern on aerial and marine survey vessels are limited to gases generated from the combustion of diesel fuel used to power the survey vessel and are not expected to be any greater than any other vessel of similar tonnage. Some marine survey vessels may incinerate waste on board. Gas emissions from these		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
sources may include SO2, CO^2, CO, and NOx and sooty particulates. At present there are no legislated limits for the emissions produced by the offshore oil and gas industry in South Africa.		
Objectives: To reduce the volumes of greenhouse gases emitted and minimise air pollution.		
10.1 Gaseous Emissions		
10.1.1 Ensure that vessels, aircraft and associated infrastructure used for the relevant surveys have an up-to-date maintenance plan to ensure all equipment functions optimally to prevent build-up of soot, unburnt diesel and other particulate matter that may increase atmospheric emissions.	*Operator SHEQ Representative*	*Prior to Surveys*
10.1.2 Incinerators, if used on board marine vessels, shall be maintained to ensure efficient combustion of waste. Instances of release of excessive black smoke shall be investigated and rectified.	*Survey Contractor*	*Throughout survey*
10.1.3 Incineration of waste on marine vessels must comply with MARPOL standards.	*Survey Contractor*	*Throughout survey*
10.1.4 Sustained emissions of black smoke for a period of more than 24 hours shall be recorded as an incident (see Activity 3.11.4) and incinerator waste should be stored separately until the problem is rectified	*Survey Contractor*	*Immediately*
10.1.5 Audit Guidelines Audits should, through examination of records, verify that: o The maintenance plans (for vessels, aircraft and associated infrastructure) are up to date. o Emissions are monitored according to the specified schedule. o Incinerators, if used, have been maintained in accordance with the maintenance schedule. o Incidents of black smoke for extended duration were investigated appropriately and measures taken to rectify the identified problem.	*Operator SHEQ Manager*	*During and on completion of survey*

3.9 ACTIVITY 11: INCIDENTS AND EMERGENCIES

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
3.11 Incidents and Emergencies		
Rationale: An incident is an unplanned event which could or does result in harm or loss to people, property, process or environment and covers every incident from minor spills and leaks to large-scale emergencies and pollution or damage to marine life. In the case of survey activities, incidents could include injury or death of marine fauna due to acoustic emissions from airguns; near miss and collisions involving vessels; spills during fuel bunkering or any other maintenance activity and loss of objects overboard. Prevention of incidents and emergencies during surveys is generally achieved through: o Following appropriate navigation notification procedures (Activity 3.4.1). o Preparing emergency response plans and other subsidiary plans prior to survey activities (Activity 3.2).		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ Contracting internationally certified survey Contractors (Activity 3.3). ○ Scheduling surveys outside of peak cetacean breeding and migration seasons (Activity 3.7.2). ○ Maintaining exclusion and safety zones (Activity 3.7.4.). ○ Adhering to pollution prevention requirements (Activity 6). ○ Following precautions relating to acoustic firing e.g. "soft start" procedures (Activity 3.7.2). Nonetheless, despite adherence to the above procedures, there is still a risk of incidents and emergencies occurring in any survey activity. The procedures to be followed should such an incident or emergency occur are outlined below.		
Objectives: ○ To undertake survey operations in such a way as to minimize risks to marine life (see Activity 3.7.2). ○ To provide a coherent, planned response to any incident which could adversely affect the environment. ○ To improve response time and efficiency of the plans and the activities of staff members through drills and test runs. ○ To provide a process for the management of an incident or emergency depending upon the severity of the occurrence. ○ To minimize the risk of loss of solid objects overboard and to expedite the retrieval (if possible) of any objects which fall overboard. ○ To log the existence and location of fallen objects for future reference / action. ○ To notify interested parties of the existence and location of un-retrieved fallen objects. ○ Through post-emergency evaluations, minimise the risk of a recurrence of the incident.		
11.1 Uncontrolled Release of Polluting Liquids		
11.1.1 The survey Contractor must comply with the incident management steps outlined in Activity 3.11.1.2 below and with the Contractor's Incident Management Plan and Emergency Response Plan in place prior to commencing survey activities.	*Survey Contractor*	*Throughout survey*
11.1.2 Incident management shall entail the following key steps: ○ Incident detection ○ Rapid assessment of incident severity ○ Implement response actions, as follows: Routine Incident: In the case of an on-board spill or leak confined to the survey vessel the following steps may be taken: ○ Mobilisation of on-board response person or team to: ▪ Contain the spill and shut off or control the source of the incident event. ▪ Clean up the spill or take steps to rectify the incident consequences. ○ Complete an incident report form. ○ Conduct an investigation; and ○ Close out the incident. Overboard Spill (Emergency): In the case of a spill to sea , the following key steps will be required: ○ Classify the spill scenario, size and nature of the spill.	*Survey Contractor, Operator & other agencies (as required)*	*Immediately on occurrence*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
○ Notify the Operator, who will in turn notify DFFE, SAMSA and other relevant authorities to respond depending on the nature of the emergency. ○ Mobilise on-board resources and take all practical steps on the survey vessel to contain the spill. ○ Adhere to all notification, investigation procedures and reporting requirements.		
11.1.3 An incident and the results of any investigation shall be recorded and submitted to the Operator in the Monthly Report	*Survey Contractor*	*Monthly*
11.2 Materials and Equipment Lost Overboard		
11.2.1 If a solid object falls overboard, the incident shall be managed as follows: ○ Retrieve object, if possible to do so. ○ If object not retrievable, record location (GPS Coordinates) and assess whether it will pose a hazard to other marine users. ○ If object poses a hazard then notify the Operator who in turn will inform SAMSA / HydroSAN. ○ Complete the Incident Report Form and Dropped Object Log. ○ Conduct an Incident Investigation through to close out.	*Survey Contractor, Operator & other agencies (if required)*	*Immediately*
11.2.2 Notifiable incidents as set out in the Incident Management Plan shall be reported by the survey Contractor to the Operator within 24 hours and must be included in the monthly report to the Operator. Incidents posing a threat to human life or significant marine pollution should immediately be reported to the Operator's Operational Geophysicist	*Survey Contractor*	*24 hours of incident or immediately on occurrence*
11.3 Injury or Death of Marine Fauna		
11.3.1 Notifiable incidents related to death or injury of marine fauna that may be discovered during surveys shall follow the general incident reporting requirements outlined in Activity 3.11.4 below and shall include: ○ Completion of an incident reporting form including recording of details such as time of observation, status of acoustic firing, location in relation to survey vessel and streamers, GPS coordinates, type and number of animals involved and other comments relating to possible correlation with survey activities. ○ Immediately reported to the Operator and included in the monthly report to the Operator. ○ Operator shall immediately report to the DFFE: Oceans and Coasts who will in turn follow the correct procedures to investigate or retrieve injured or dead animals. ○ Follow up investigations and close-out of the incident.	*MMO*	*Immediately on occurrence*
11.3.2 All seabirds stranded on vessels shall be retrieved and released according to appropriate guidelines.	*MMO*	*Immediately on occurrence*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
11.4 General Incident Reporting and Auditing		
11.4.1 General Reporting All incidents that may occur during surveys will require the following investigation and reporting and which shall be detailed in the Incident Management Plan: ○ Recording the date and time. ○ Description of incident. ○ Assessment of the nature and source of the incident. ○ Assessment and evaluation of the impact and affected environmental receptors. ○ Actions taken to remedy the incident and report the incident. ○ Investigation into root cause. ○ Identification of measures to prevent reoccurrence and communication of such.	*Survey Contractor*	*During and after an incident*
11.4.2 Audit Guidelines Audits should, through examination of records retained by the survey Contractor or the Operator, verify that: ○ Maintenance and system checks were undertaken in accordance with specifications and all spill preventive measures recorded as fully operational. ○ All incidents have been reported and recorded as per specifications indicated in the sections above. ○ All incidents have been comprehensively investigated to identify root causes. ○ The advised changes are implemented. ○ A trend analysis on incidents is conducted monthly. ○ Incidents are reported within an appropriate time frame, along with the root cause analysis. ○ Sufficient oil and chemical spill containment and absorbent equipment and materials are stored in sufficient quantities in areas where spills are most likely to occur. ○ The emergency response plan and oil spill contingency plan is current and in particular all contact details are up to date.	*Operator SHEQ Manager*	*After incident or during post survey audit*

3.10 ACTIVITY 12. DECOMMISSIONING AND CLOSE OUT

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
12.1 Restoration of Pre-Survey Conditions		
Rationale: At the end of a survey, several actions must be taken to ensure that the survey area is left in its original condition and no restrictions remain on other marine users who		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
previously used the area. This includes: ○ Retrieval of all equipment. ○ Disposal of all on-board waste. ○ Informing other marine users of the removal of the exclusion and safety zone.		
Objectives: ○ To restore the marine environment and seabed to its pre-survey condition by removing any equipment used or dropped during the survey and correctly disposing of on-board waste. ○ To allow other marine users to use the area for fishing or marine traffic by informing stakeholders of the cessation of activities.		
12.1.1 Retrieve all deployed equipment and any dropped objects from the marine environment prior to cessation of survey activities	*Survey Contractor*	*End of survey*
12.1.2 Inform all key stakeholders (see Activity 3.4.1.12) of the closure of survey activities within 24 hours.	*Operator SHEQ Representative*	*Within 24 hours of end of survey*
12.1.3 Dispose of all waste retained on-board at a licensed landfill site using a licensed waste disposal contractor and obtain a final waste disposal certificate.	*Survey Contractor*	*End of survey*
12.1.4 Compile a Survey Close-Out Report at the end of the survey which shall document compliance with the provision of this EMP, deviations from specified standards and details of any incidents arising (see Activity 13.3.4 for contents).	*Operator Geophysics Manager*	*Within 60 days post-survey*
12.2 Financial Provision		
Rationale: In terms of the MPRDA PetroSA is required to make financial provision to meet its obligations as described in the EMPr. This provision is applicable to the exploration and operational phase and includes construction ~~or drilling,~~ as applicable, up to and including the closure or abandonment phase.		
Objective: To ensure there is sufficient legal and financial provision for rehabilitation or clean up in the event of a pollution event.		
12.2.1 Environmental management actions that would be required as a result of an incident or accident would be covered by PetroSA's insurance[21], as described below: ○ Third Party liability which includes personal injury, property damage and seepage and pollution as a result of any offshore exploration and production operations is covered up to USD150,000,000 per occurrence. ○ Well control insurance which would include blowouts and seepage and pollution is covered up to USD150,000,000 per occurrence.	*PetroSA Insurance Department*	*Prior and throughout survey*

[21] All figures as for 2010/11 insurance

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
12.2.2 In addition, as a condition of contract, PetroSA requires contractors to carry the following insurance and will not permit any of its contractors to undertake any work until certificates of insurance are provided: ○ Workmen's compensation insurance as required in terms of the provisions of the Compensation for Occupational Injuries and Diseases Act, Act No. 130 of 1993. ○ Employer's liability insurance with a limit of liability at all times of not less than USD1,000,000 (one million US Dollars) for each occurrence or such larger amounts for which Contractor already have cover. ○ Non-ownership aviation liability with a limit of liability at all times of not less than US$50,000,000 (fifty million US Dollars) for each occurrence or such larger amounts for which Contractor already has cover. ○ Comprehensive general public liability insurance including pollution with a limit of liability of not less than USD1,000,000 (one million US Dollars) per occurrence. ○ Motor vehicle liability insurance including passenger liability indemnity. ○ Physical Damage Insurance for loss or damage to contractor's equipment and machinery. Such coverage shall be on All Risks Insurance basis or its equivalent for full value of Contractor Group material and equipment. ○ Hull and Machinery Insurance in the form of Full Form Hull and Machinery Insurance, including collision liability, with limits of liability at least equal to the full value of the vessel. ○ Standard Protection and Indemnity Insurance, at least equal to the value of each vessel owned or chartered (including Towers Liability, where applicable.	*PetroSA Legal Department*	*Prior and throughout survey*
12.2.3 Reporting of Financial Provision Proof of Financial Provision will be provided to PASA in the following manner: ○ A copy of the insurance certificate for the year will be provided on the renewal date of each year ○ Copies of the insurance cover carried by the contractors will be provided together with the environmental notification submitted to PASA at least 7 days prior to the commencement of any survey activity.	*PetroSA SHEQ Manager*	*Annually / Prior to Survey*

3.11 ACTIVITY 13. SYSTEM ADMINISTRATIVE REQUIREMENTS

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
<u>Rationale:</u> A survey subcontractor generally has their own administrative requirements for environmental protection that complies with international best practice and legislation. This section outlines the administrative requirements that must be complied with during survey activities to ensure adherence to legal and best practice and to demonstrate proof of compliance.		

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
Administrative systems and record keeping enable an organisation to: ○ Assure itself of its conformance with its own stated environmental policy. ○ Demonstrate conformance. ○ Ensure compliance with environmental laws and regulations amongst other things. This section summarises some key system requirements to ensure the effective implementation of the EMPr plan at different stages of a survey programme: planning and design, during and post-survey operations based on the ISO system model of the Plan – Do – Check – Act cycle. ○ Plan: establish objectives and make plans (analyse your organization's situation, establish your overall objectives and set your interim targets and develop plans to achieve them). ○ Do: implement your plans (do what you planned to do). ○ Check: measure your results (measure/monitor how far your actual achievements meet your planned objectives). ○ Act: correct and improve your plans and how you put them into practice (correct and learn from your mistakes to improve your plans in order to achieve better results next time).[22]		
Objectives: ○ To provide a comprehensive and coherent system which accesses and stores information pertinent to environmental management from diverse sources to verify responsible environmental practices. ○ To provide a formal platform for reporting on environmental performance. ○ To monitor and audit environmental performance against pre-determined criteria. ○ To use formal management reviews to continuously improve the system itself and thereby environmental performance as a whole.		
13.1 Monitoring		
The following parameters shall be monitored during survey activities:		
13.1.1 Deck & bilge water discharge: oil concentrations to ensure compliance with MARPOL standards of <15 ppm (refer to Activity 9.1.3).	*Survey Contractor*	*MARPOL requirements*
13.1.2 Solid waste production and disposal (refer to Activities 8.1.3 and 8.1.12).	*Survey Contractor*	*Daily*
13.1.3 Marine fauna: sightings (refer to Activity 7.4.2).	*MMO*	*Daily*
13.1.4 Survey procedure (refer to Activity 7.1).	*MMO*	*Daily*
13.1.5 Monitoring results shall be reported to the Operator in the contractor's Monthly Report.	*Survey Contractor*	*Monthly*

[22] http://www.iso.org/iso/iso_catalogue/management_standards/understand_the_basics.htm

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
13.1.6 The operator shall report monitoring results to PASA in the Quarterly Report.	*Operator SHEQ Representative*	*Quarterly*
13.1.7 Monitoring results shall be retained for 5 years after the validity of the petroleum right ends.	*Operator*	*For five years*
13.2 Reporting		
13.2.1 Reporting Requirements for a Survey Operation are Indicated in the Flow Chart below:		

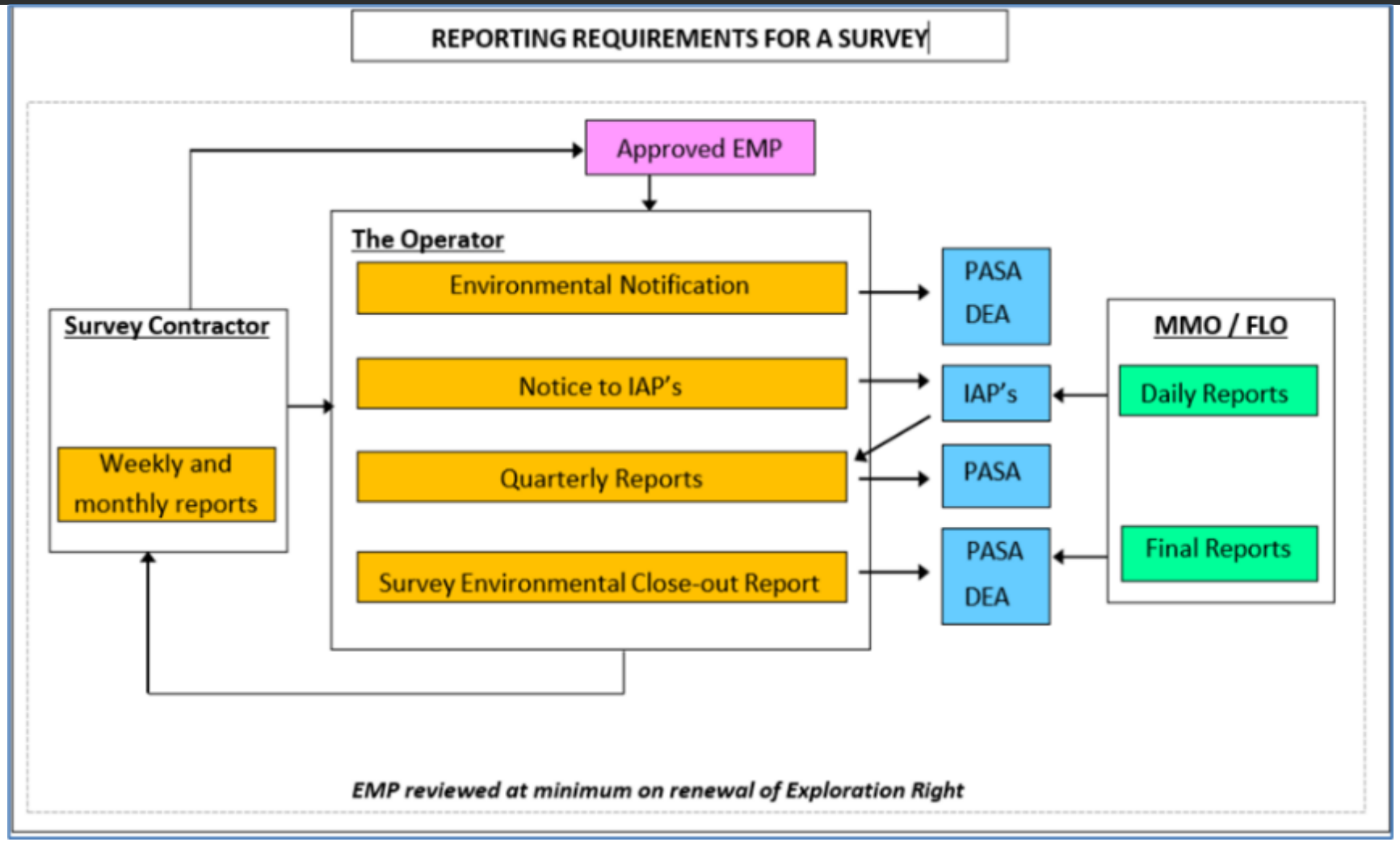


Figure 69: Organogram of Reporting Requirements *(http://www.iso.org/iso/iso_catalogue/management_standards/understand_the_basics.htm)*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
13.2.2 Reporting by the Operator to PASA		
13.2.2.1 EMPr In accordance with the requirements of the MPRDA (Act 49 of 2008), the Operator shall submit an EMPr to obtain approval for an exploration right (as per this EMPr).	*Operator SHEQ Representative*	*Prior to survey activities*
13.2.2.2 Notification of PASA The Operator shall notify PASA in writing of the commencement of survey activities 14 days prior to starting activities (see Activity 3.4.1.2). The specific details of the survey shall be compiled into an Environmental Notification for submission to PASA. The Environmental Notification shall provide details on the following: ○ Survey lines, period and duration. ○ Vessel / Aircraft specifications. ○ Certification compliance. ○ Relevant insurance.	*Operator SHEQ Representative*	*14 days prior to survey activities*
13.2.2.3 Quarterly Reports: The Operator shall submit Quarterly Reports to PASA, which shall include key information on: ○ The progress of survey activities and any changes to the survey schedule. ○ Any incidents (e.g. pollution spills, navigational incidents, loss of equipment etc.). ○ Non-compliance with or exceedance of monitoring standards and steps taken to rectify these.	*Operator SHEQ Representative*	*Quarterly*
13.2.2.4 Close-Out Report The Operator shall submit a Close-Out Report to PASA within 60 days of completing a Survey Operation. The information contained in this report shall be based on the monthly reports compiled by the MMO, survey Contractor and other data and records compiled during the Survey Operation. The Close- Out Report shall contain a full description of all aspects of the Survey Operation, including: ○ The survey Contractor and vessel details. ○ MMO details. ○ Description of the Survey Operation (location, timetable & duration). ○ Establishment information (e.g. receipt of EMPr by Contractor and notification of other sea users / stakeholders). ○ Operational Phase Activities (e.g. environmental awareness, communications, provision for emergencies, waste management, lost equipment, helicopter use, acoustic emissions; faunal monitoring results (including final MMO report). ○ Monitoring and performance assessments. ○ Decommissioning and Closure (e.g. notification, close out reporting, and final waste disposal).	*Operator SHEQ Representative*	*Within 60 days of completing survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
13.2.2 Contractor Reporting to the Operator and Documentation Requirements		
13.2.3.1 Pre-Survey Agreements and Documentation Prior to surveys, the following documentation will be provided to the Operator by the survey Contractor: ○ Signed Contractor's Acknowledgement of Receipt of EMPr. ○ Environmental Safety and Health Policy. ○ Sea Worthiness, Air Worthiness and Safety & Pollution Prevention Certificates. ○ Plan for supply of information to compile the Environmental Close-Out report.	*Survey Contractor*	*Prior to survey*
13.2.3.2 Monthly Report The following information shall be compiled by the survey Contractor, and submitted to the Operator on a monthly basis in the form of a Monthly Report: ○ Incidents, including tangling of gear, incidents with marine fauna, spills and discharges, encroachments in the exclusion zone, etc. ○ Amount and type of waste generated and disposed of. ○ Times and durations of firing including number and duration of soft starts.	*Survey Contractor*	*Monthly*
13.2.4 Reporting by the Operator to other government department and institutes		
○ Marine mammal incidence data and data arising from surveys shall be included as an Appendix in the Close-out report to be submitted to PASA after completion of the survey. ○ The environmental monitoring data collected (including the MMO and PAM) must be made available to the DFFE, SANBI and SAEON for their use in future scientific research.	*Operator SHEQ Representative*	*Post survey*
13.3 Auditing		
13.3.1 General		
13.3.1.1 Compliance with the EMPr may be subject to an internal audit before, during or at the end of a Survey Operation. The findings of these audits shall contribute towards the Operator's annual performance report on EMP compliance.	*Operator SHEQ Representative*	*Throughout survey*
13.3.1.2 The audits shall review and report on the auditing guidelines detailed in each section of this EMPr.	*Corporate: Environmental Leader*	*Throughout survey*
13.3.2 Pre-survey audit		
13.3.2.1 The pre-survey audit shall check the following: ○ The EMPr has been approved by PASA and all reporting requirements have been complied with ○ The survey Contractor has received a copy of the EMP and understands the content; the content of the EMPr is aligned with the survey Contractor's standard operating procedures and has agreed to its implementation. ○ The survey Contractor has the necessary equipment and protocols in place and staff on the vessel are suitably trained to implement the monitoring requirements outlined in the EMPr.	*Operator SHEQ Representative*	*Pre-survey*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
13.3.3 During survey audit		
13.3.2.2 Audits during the Survey Operation shall check the following: ○ Monitoring is being undertaken in accordance with the requirements described in this EMP for the variables summarised in Activity 3.13.1. ○ Monitoring data are retained and all deviances reported correctly in the Monthly Reports. ○ Incidents, where relevant, have been reported as per the incident reporting and investigating requirements (see Activity 3.11). ○ Observations made on the vessels check the contractor's commitments to good housekeeping and waste management protocols. ○ General audit measures indicated in Activity 13.3.5.	*Operator SHEQ Representative*	*During survey*
13.3.5 Post-survey audit		
The post-survey audit shall take the form of a close out report and shall check and include the following: ○ Monitoring was undertaken in accordance with the requirements described in this EMP for the variables summarised in Activity 3.13.1. ○ Monitoring data are retained and all deviances reported correctly in the Monthly Reports. ○ Incidents, where relevant, have been reported as per the incident reporting and investigating requirements and have been closed out (see Activity 11). ○ All records comply with EMPr requirements and are stored in an accessible and logical manner.	*Operator SHEQ Representative*	*Post survey*
13.3.5 Audit Guidelines		
Audits should, through examination of records retained by the survey Contractor and the Operator, verify that: ○ All records required by this EMP have been retained and are stored in an accessible and logical manner. ○ All reports required by this EMP have been completed and submitted to the designated recipient. ○ All monitoring has been completed and any deviances responded to accordingly. ○ Management reviews have been conducted and were comprehensive and any action required has been implemented.	*Operator SHEQ Representative*	*Annually*
3.13.4 Record keeping		
13.4.1 All records shall be retained for 5 years after the validity of the petroleum right ends.	*SHEQ Manager*	*Ongoing*

Operational Activities/ Aspects & Auditable Actions	Responsibility	Timing
3.13.4.2 The following records shall be maintained as part of the EMPr and cross- referenced for auditing purposes: ○ Effluent discharge volumes, quality results, including non-compliance. ○ Incident reports, including incident close out results. ○ Water manifests and disposal certificates. ○ Training records. ○ Prosecutions / notices of non-compliance. ○ Stakeholder inputs and the review thereof. ○ Audit reports. ○ Results of management reviews. ○ Weekly, monthly and annual internal reports. ○ Planned maintenance reports / logs. ○ All previous versions of the EMPr. ○ All EIAs and application for environmental authorisations. ○ Correspondence with permitting authorities such as PASA, DFFE, SAMSA etc.	*SHEQ Manager and Survey Contractor*	*Ongoing*
13.5 EMP Review and Revision		
The EMP shall be subject to review at least upon renewal of exploration right and updated if required. The review shall consider the following information: ○ Audit reports. ○ Feedback from stakeholders. ○ Technology changes. ○ Performance assessment reports. ○ Changes in regulations / legal compliance.	*Operator Asset Manager*	*Renewal of exploration rights (every 2-3 years)*

4 SECTION 4: REFERENCES

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