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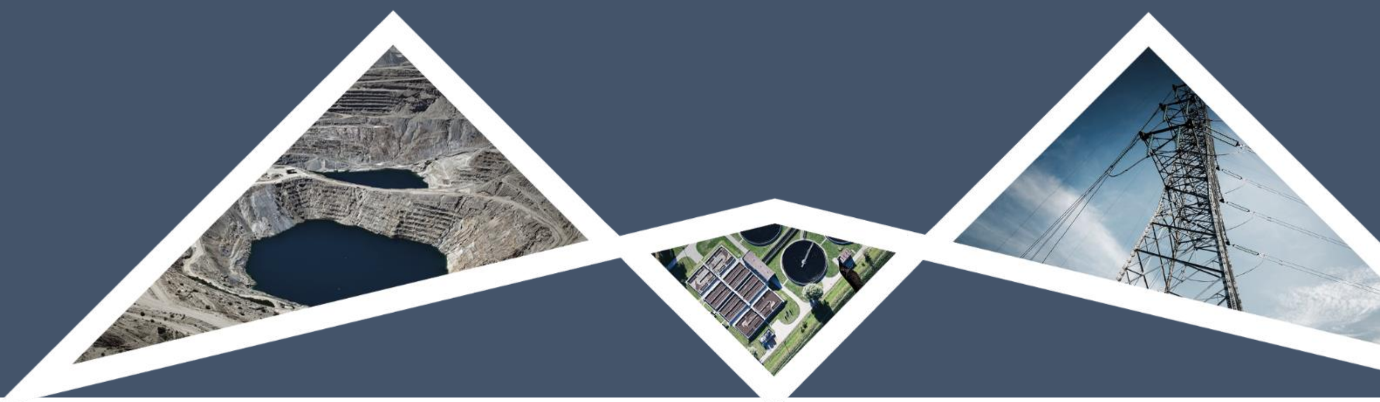
T 011 789 7170 E info@eims.co.za W www.eims.co.za

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED TOSACO ENERGY BLOCK 1 EXPLORATION RIGHT

TOSACO ENERGY (PTY) LTD

PASA REFERENCE: 12/3/362



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AUTHORIZED:	Liam Whitlow		2021/07/27

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2021/07/27	ORIGINAL DOCUMENT	Environmental Impact Assessment Report for public review

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ACRONYMS AND ABBREVIATIONS

2D	two-dimensional
3D	three-dimensional
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species
CPUE	Catch per unit effort
CUD	cumulative utilization distribution
DFFE	Department of Forestry, Fisheries and the Environment
DFA	Development Facilitation Act (Act No. 67 of 1995)
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EAP	economically active population
EAP	Environmental Assessment Practitioner
EBSA	Ecologically and Biologically Significant Area
ECA	Environment Conservation Act (Act No. 73 of 1989)
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EMPr	Environmental Management Programme
ER	Exploration Right
ESAs	Ecological Support Areas
EWP	Exploration Works Programme
FAMDA	Fishing and Mariculture Development Association
FRAP	Fishery Rights Allocation Process
GN	Government Notice
GPS	Global Positioning System
GRT	Gross Registered Tonnage
HABs	Harmful Algal Blooms
I&APs	Interested and Affected Parties
IBA	Important Bird Area
ICCAT	International Commission for the Conservation of Atlantic Tunas
IDP	Integrated Development Plan
IEM	Integrated Environmental Management
IOTC	Indian Ocean Tuna Commission
IUCN	International Union for the Conservation of Nature
kts	knots
LFPR	labour force participation rate
MLRA	Marine Living Resources Act (Act No. 18 of 1998)

MMO	Marine Mammal Observer
MPA	Marine Protected Area
MPRDA	Minerals and Petroleum Resources Development Act (Act No. 28 of 2002)
NBA	National Biodiversity Assessment
NDM	Namakwa District Municipality
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEMPAA	National Environmental Management Protected Areas Act (Act No. 57 of 2003)
NGOs	Non-Governmental Organisations
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
PAM	Passive Acoustic Monitoring
PASA	Petroleum Agency of South Africa
PIM	Particulate Inorganic Matter
PNSF	Port Nolloth Sea Farms
POM	Particulate Organic Matter
PPP	Public Participation Process
ROVs	Remote Operated Vehicles
S&EIA	Scoping and Environmental Impact Assessment
SACW	South Atlantic Central Water
SAHRA	South African Heritage Resources Agency
SANBI	South African National Biodiversity Institute
SANHO	South African Navy Hydrographic Office
TCP	Technical Co-operation Permit
TOPS	Threatened and Endangered Species
TSPM	Total Suspended Particulate Matter
VMEs	Vulnerable Marine Ecosystems
WESSA	Wildlife and Environment Society of South Africa

1 INTRODUCTION

Tosaco Energy (Pty) Ltd (hereafter Tosaco) has applied for an Exploration Right (ER) for offshore oil and gas in Block 1, located off the West Coast of South Africa. Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed by Tosaco to prepare and submit an application for Environmental Authorisation (EA) as per the requirements of the Environmental Impact Assessment (EIA) Regulations, 2014, as amended, promulgated under the National Environmental Management Act (Act No. 107 of 1998- NEMA) and the requirements of the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002 – MPRDA).

A number of previous investigations and exploration activities have been undertaken within Block 1 in the past. Cairn South Africa (Pty) Ltd was the previous operator and holder of an Exploration Right in Block 1. Cairn took over as operator of Block 1 from the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd (PetroSA). Prior to Cairn's involvement in Block 1, PetroSA obtained the Exploration Right for the area in terms of the MPRDA in December 2008. At the time, an Environmental Management Programme (EMPr) and subsequent Addendum Reports were compiled and approved for the undertaking of two- (2D) and three-dimensional (3D) seismic surveys and exploration drilling of four to six wells within a portion of the Exploration Area. Exploration drilling also received EA under the NEMA.

Tosaco was granted a Technical Co-operation Permit (TCP) for the Block 1 Area under the MPRDA to conduct desktop geotechnical review and studies. Tosaco through its evaluation of the block has identified a number of oil and gas plays and features, which includes:

- Albian channelized gas plays;
- Barremian Aeolian gas play;
- Mid Cretaceous structural oil / gas play; and
- Inner graben rift basin play (an analogue to the Block 2B A-J1 oil discovery).

Through this evaluation, a considerable number of resources was focussed specifically on the oil prospectivity of the inner graben rift basin. This play type together with the previously identified gas plays provided sufficient evidence to warrant the interest to convert the TCP into an ER. As such, Tosaco submitted an application for Exploration Right to the Petroleum Agency of South Africa (PASA) dated 5 May 2020, which was accepted on 16 July 2020. Subsequently, Tosaco has submitted an application for EA to the PASA on 17 March 2021.

A full Scoping and Environmental Impact Assessment (S&EIA) application process is being undertaken to accompany the ER application for the EIA Listing Notices listed activities applicable to the project namely:

- **Listing Notice 2: Activity 18**[1]: Any activity including the operation of that activity which requires an exploration right as contemplated in section 79 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including — (a) associated infrastructure, structures and earthworks; or (b) the primary processing of a petroleum resource including winning, extraction, classifying, concentrating or water removal; but excluding the secondary processing of a petroleum resource, including the beneficiation or refining of gas, oil or petroleum products in which case activity 5 in this Notice applies.

The Scoping Phase of the project was completed and the Scoping Report and Plan of Study (PoS) for EIA was accepted by the Department of Mineral Resources and Energy (DMRE) on 27 May 2021.

[1] It should be noted that LN 2 Activity 18 was updated by GN 517 on 11 June 2021. The application was submitted to the Competent Authority prior to this change.

1.1 REPORT STRUCTURE

This report has been compiled in accordance with the NEMA EIA Regulations, 2014, as amended. A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in Table 1 below.

Table 1: Report structure

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(a)	Details of – i. The Environmental Assessment Practitioner (EAP) who prepared the report; and ii. The expertise of the EAP, including a curriculum vitae;	1.2
Appendix 3(1)(b)	The location of the activity. Including – i. The 21-digit Surveyor General code of each cadastral land parcel; ii. Where available, the physical address and farm name; iii. Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	2
Appendix 3(1)(c)	A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – i. A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or ii. On a land where the property has not been defined, the coordinates within which the activity is to be undertaken;	2
Appendix 3(1)(d)	A description of the scope of the proposed activity, including – i. All listed and specified activities triggered and being applied for; and ii. A description of the associated structures and infrastructure related to the development;	3
Appendix 3(1)(e)	A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	4
Appendix 3(1)(f)	A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report;	5

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(g)	A motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;	3, 6 and 9
Appendix 3(1)(h)	A full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including: – i. Details of the development footprint alternatives considered; ii. Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii. A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv. The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; v. The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – a. Can be reversed; b. May cause irreplaceable loss or resources; and c. Can be avoided, managed or mitigated; vi. The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; vii. Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; viii. The possible mitigation measures that could be applied and level of residual risk; ix. If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and x. A concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report;	6, 7, 8 and 9

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(i)	A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including – i. A description of all environmental issues and risks that were identified during the environmental impact assessment process; and ii. An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	6, 7, 8 and 9
Appendix 3(1)(j)	An assessment of each identified potentially significant impact and risk, including – i. Cumulative impacts; ii. The nature, significance and consequences of the impact and risk; iii. The extent and duration of the impact and risk; iv. The probability of the impact and risk occurring; v. The degree to which the impact and risk can be reversed; vi. The degree to which the impact and risk may cause irreplaceable loss of resources; and vii. The degree to which the impact and risk can be mitigated;	6, 7, 8 and 9
Appendix 3(1)(k)	Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	11
Appendix 3(1)(l)	An environmental impact statement which contains – i. A summary of the key findings of the environmental impact assessment; ii. A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and iii. A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	11.3
Appendix 3(1)(m)	Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	11.4

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 3(1)(n)	The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	11.2
Appendix 3(1)(o)	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	11
Appendix 3(1)(p)	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	12
Appendix 3(1)(q)	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	11
Appendix 3(1)(r)	Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	N/A
Appendix 3(1)(s)	An undertaking under oath or affirmation by the EAP in relation to – i. The correctness of the information provided in the reports; ii. The inclusion of comments and inputs from stakeholders and interested and affected parties; iii. The inclusion of inputs and recommendations from the specialist reports where relevant; and iv. Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	13
Appendix 3(1)(u)	An undertaking under oath or affirmation by the EAP in relation to – i. Any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and ii. A motivation for the deviation;	None
Appendix 3(1)(v)	Any specific information that may be required by the competent authority; and	None
Appendix 3(1)(w)	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	None

1.2 DETAILS OF THE EAP

EIMS has been appointed by Tosaco as the independent Environmental Assessment Practitioner (EAP) to prepare and submit the EA application, Scoping and EIA Reports, and undertaking a Public Participation Process (PPP) to accompany the Exploration Right Application. The contact details of the EIMS consultant and EAP who compiled this Report are as follows:

- Name: Gideon Petrus (G.P.) Kriel
- Tel No: +27 43 783 9826
- Fax No: +27 86 571 9047
- E-mail address: tosacoer@eims.co.za

In terms of Regulation 13 of the EIA Regulations, 2014, as amended, an independent EAP, must be appointed by the applicant to manage the application. EIMS is compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations, as well as Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS is:

- Objective and independent;
- Has expertise in conducting EIA's;
- Comply with the NEMA, the environmental regulations and all other applicable legislation;
- Considers all relevant factors relating to the application; and
- Provides full disclosure to the applicant and the relevant environmental authority.

EIMS is a private and independent environmental management-consulting firm that was founded in 1993. EIMS has in excess of 27 years' experience in conducting EIA's. Please refer to the EIMS website (www.eims.co.za) for further details of expertise and experience.

GP holds an M.Env.Sci (Water Sciences) Cum Laude from the North-West University (Potchefstroom Campus). He has been employed as an Environmental Consultant since 2007 and is the manager of the EIMS East London office. He has delivered presentations locally and internationally concerning the use of bio-indicators for the determination of water quality, and has experience in a wide variety of environmental management projects including: Environmental Impact Assessments, Basic Assessments, Geographic Information Systems (GIS), Environmental Compliance Monitoring, Environmental Awareness Training, Aquatic Ecological Assessments, Drinking and Waste Water Treatment Process Audits, Wetland Delineation and Assessments, ISO 14001 Aspect Registers, Water Use Licence Applications, Waste Management Licence Applications and Integrated Waste and Water Management Plans.

The Curriculum Vitae of the EAP that is responsible for the compilation of this Report is included in Appendix A.

1.3 SPECIALIST CONSULTANTS

Specialist studies have been undertaken to address the key impacts that require further investigation and these include:

- Marine Ecological Impact Assessment; and
- Fisheries Impact Assessment.

The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were assessed according to pre-defined impact rating methodology (Section 9.1). Mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this EIA Report. The specialist reports that informed this EIA level report are included in Appendix C.

2 DESCRIPTION OF THE PROJECT AREA

Table 2 indicates the details of the project area for the proposed project including details on the project location as well as the distance from the proposed project area to the nearest towns.

Table 2: Locality details

Project Area	The application area is located within Block 1 the Exclusive Economic Zone located along the Northern Cape Coast. Block 1 is located offshore between Alexander Bay, extending south along the western coastline to approximately Hondeklip Bay and approximately 250 km offshore of the coast of the Northern Cape.
Application Area	Block 1 Application Area: 19 909.31 km^2 Proposed 3D Seismic Survey Area: 134 562 ha
Magisterial District	Adjacent to the Namakwaland Magisterial District.
District Municipality	Adjacent to the Namakwaland District Municipality
Local Municipalities	Adjacent to the Nama Khoi and Richtersveld Local Municipalities.

The locality of the proposed exploration area is shown in Figure 1.

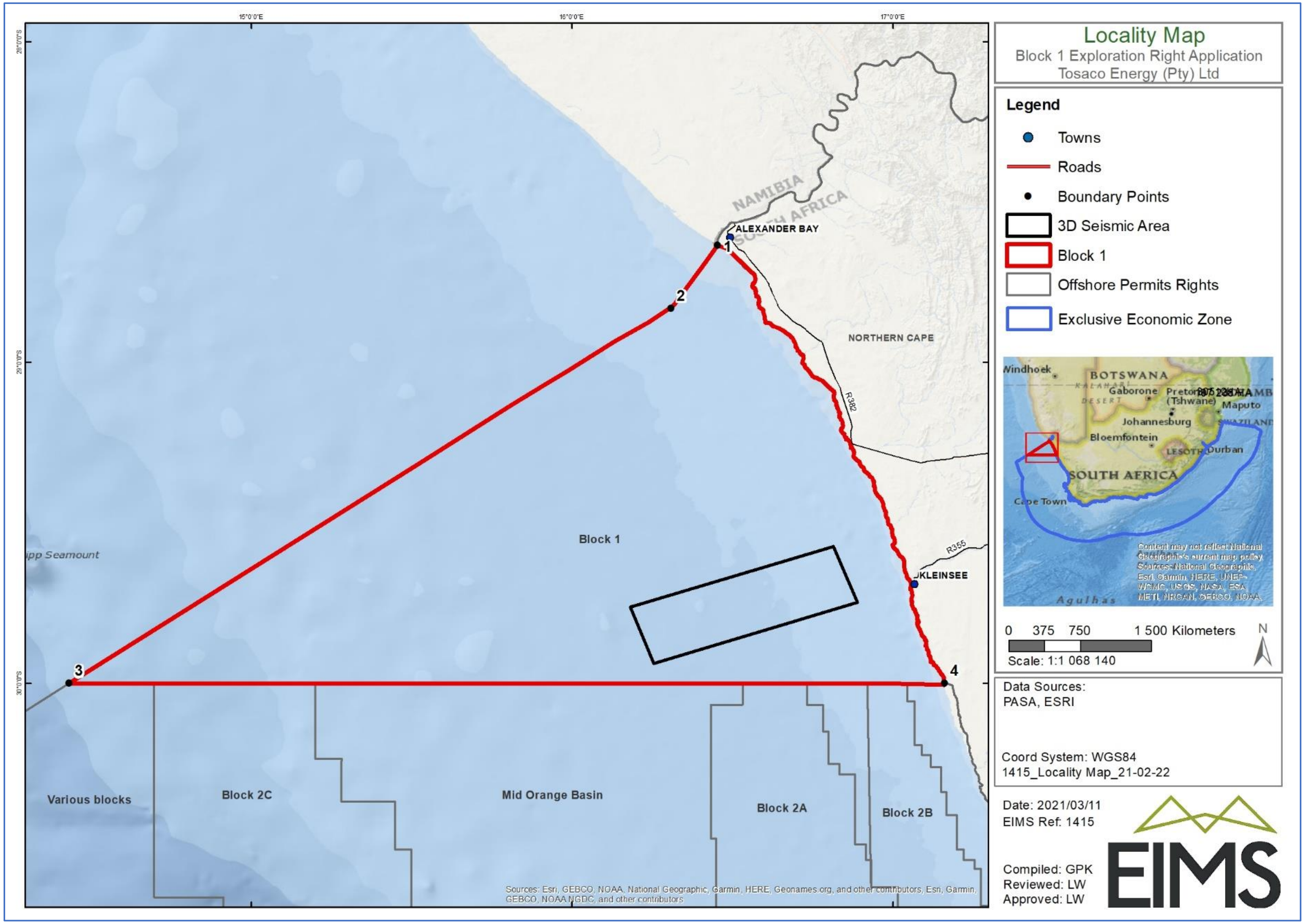


Figure 1: Locality map.

3 DESCRIPTION AND SCOPE OF THE PROPOSED ACTIVITY

This section provides an overview of the proposed activity. A brief history of the applicant's involvement in Block 1 is provided followed by the proposed activities to be undertaken as part of this application.

3.1 DESCRIPTION OF PREVIOUS ACTIVITIES UNDERTAKEN

A number of previous investigations and exploration activities have been undertaken within Block 1 in the past. Cairn South Africa (Pty) Ltd was the operator and holder of an Exploration Right in Block 1. Cairn took over as operator of Block 1 from the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd (PetroSA). Prior to Cairn's involvement in Block 1, PetroSA obtained the Exploration Right for the area in terms of the MPRDA in December 2008. At the time, an Environmental Management Programme (EMPr) and subsequent Addendum Reports were compiled and approved for the undertaking of two- (2D) and three-dimensional (3D) seismic surveys and exploration drilling of four to six wells within a portion of the Exploration Area. Exploration drilling also received EA under the NEMA. This right has subsequently lapsed.

Tosaco, was granted a Technical Co-operation Permit (TCP) for the Block 1 Area under the MPRDA to conduct desktop geotechnical review and studies. Tosaco through its evaluation of the block has identified a number of oil and gas plays and features, which includes:

- Albian channelized gas plays;
- Barremian Aeolian gas play;
- Mid Cretaceous structural oil / gas play; and
- Inner graben rift basin play (an analogue to the Block 2B A-J1 oil discovery).

Through this evaluation, a considerable number of resources was focussed specifically on the oil prospectivity of the inner graben rift basin. This play type together with the previously identified gas plays provided sufficient evidence to warrant the interest to convert the TCP into an Exploration Right (ER). As such, Tosaco submitted an application for Exploration Right to the PASA dated 5 May 2020, which was accepted on 16 July 2020. Subsequently, Tosaco has submitted an Application for EA to the PASA on 17 March 2021.

3.2 INVESTIGATIONS UNDERTAKEN AS PART OF THE TCP

Block 1 is extensively covered by historical 2D and 3D seismic data, with three wells drilled during 1987 on the licence area by previous rights holders. The Block 1 data coverage is presented in Figure 2 and Figure 3 below and the data set includes:

- 10 795 line kilometres of 2D seismic data;
- Two 3D seismic volumes, OB133D-02 and AF2009-3D surveys; and
- Well data for wells A-O1, A-F1, and A-E1.

A summary of well results is presented in Table 3 below, highlighting the evidence and potential of a working petroleum system in Block 1.

Table 3: Borehole data summary of Block 1 wells drilled previously.

Well Name	Date Drilled	Water Depth (m)	Total Depth (m)	Core	Permeability	Average Porosity (%) DST	Status	Reservoir Quality
A-F1	April 1987	166	4003	4 (49m in total)	296 mD	18-25%	Gas Discovery	Good Quality (Albian and

Well Name	Date Drilled	Water Depth (m)	Total Depth (m)	Core	Permeability	Average Porosity (%) DST	Status	Reservoir Quality
								Younger Sands)
A-E1	October 1987	180	4778	2 (24.5m in total)	~	20%	Dry well, poor shows	Fair
A-O1	July 1987	142	4605	~	~	~	Dry well	Poor

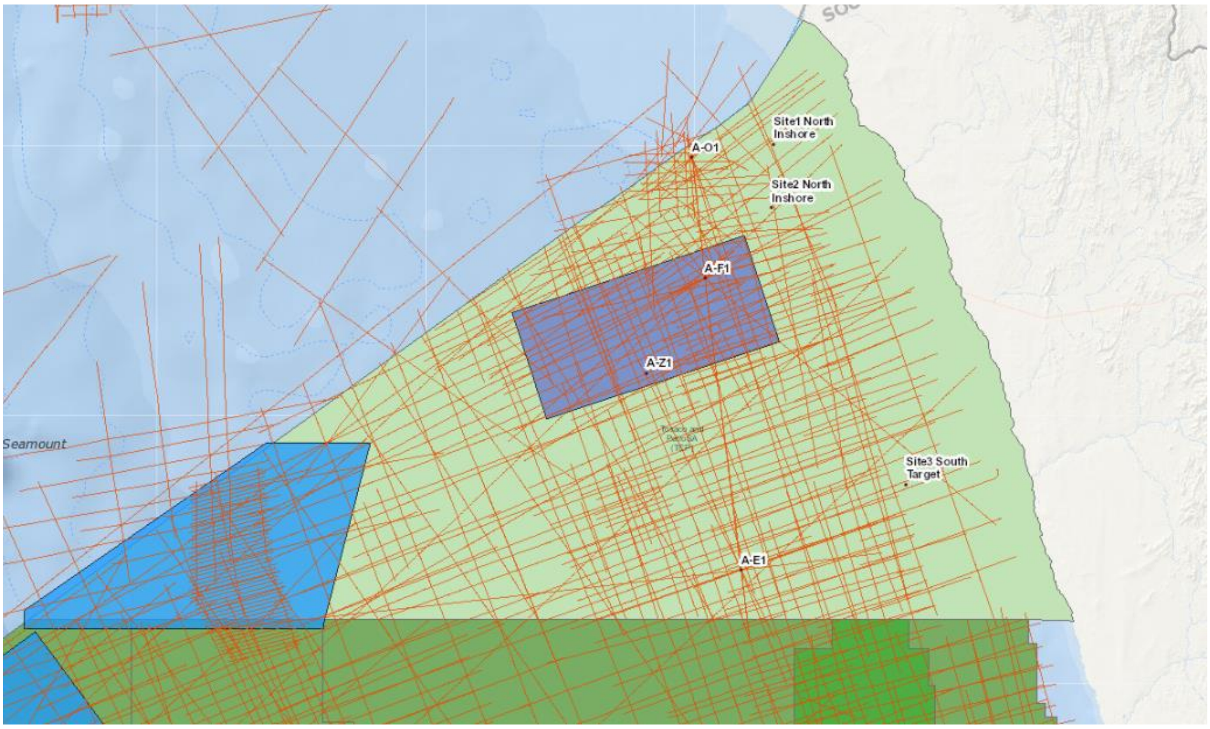


Figure 2: Block 1 seismic and well data set (PASA Geoportal).

3.2.1 REGIONAL SETTING

According to the literature and exploration activity associated with Block 1 to date, it was reported that there is evidence and confirmation that several petroleum systems sourced from known source rocks, are at work in the Orange Basin as shown in Figure 3 below. Evidence for Aptian source rocks has been reported by a number of authors and there is evidence for the presence of an active Cenomanian/Turonian source rock. These oil and gas systems contain a number of exploration plays and prospects, which have been evaluated and reviewed by a number of companies previously active in exploration in South Africa. The Albian stratigraphic structural play has been confirmed in several gas discoveries off South Africa, the best of which is the A-K1 (Ibhubesi gas field), as shown in Figure 4 below.

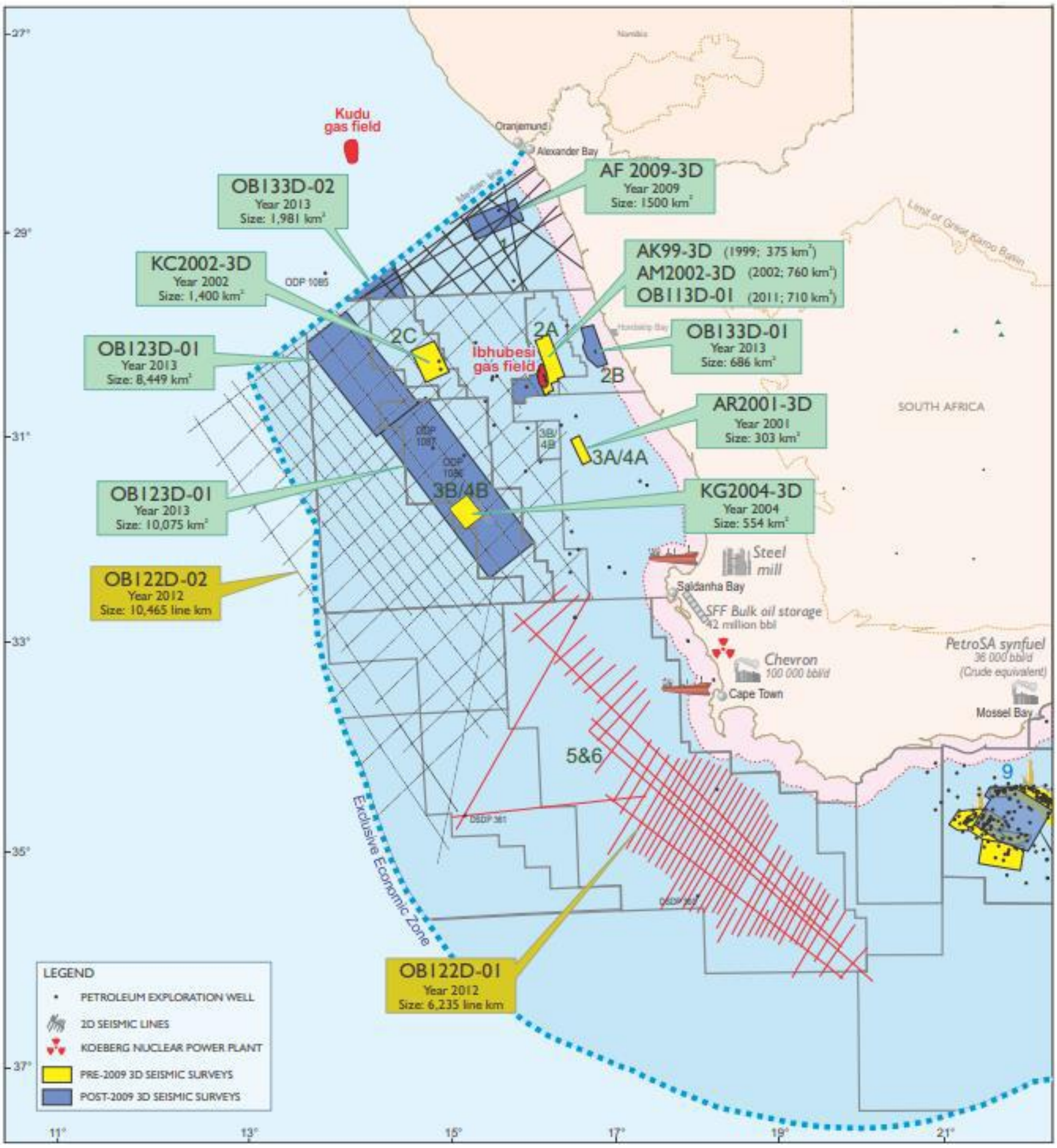


Figure 3: Regional setting highlighting wells, seismic surveys, exploration wells and discoveries in the orange basin.

The A-F1 gas discovery confirmed the following key parameters:

- Tested approximately 32 MMscf/d;
- 17 m fluvial sandstone;
- Albian play;
- Porosities 20-26%; and
- Incised valley system.

Within the synrift succession, the only oil system confirmed to-date occurs in the isolated A-J half-graben (Figure 5 and Figure 6). The oil is sourced from typically rich Hauterivian lacustrine shales within the half-graben and is trapped stratigraphically within lake shore-line sandstones interbedded with the source shales. The maximum flow rate reached whilst testing was approximately 200 barrels per day of viscous oil.

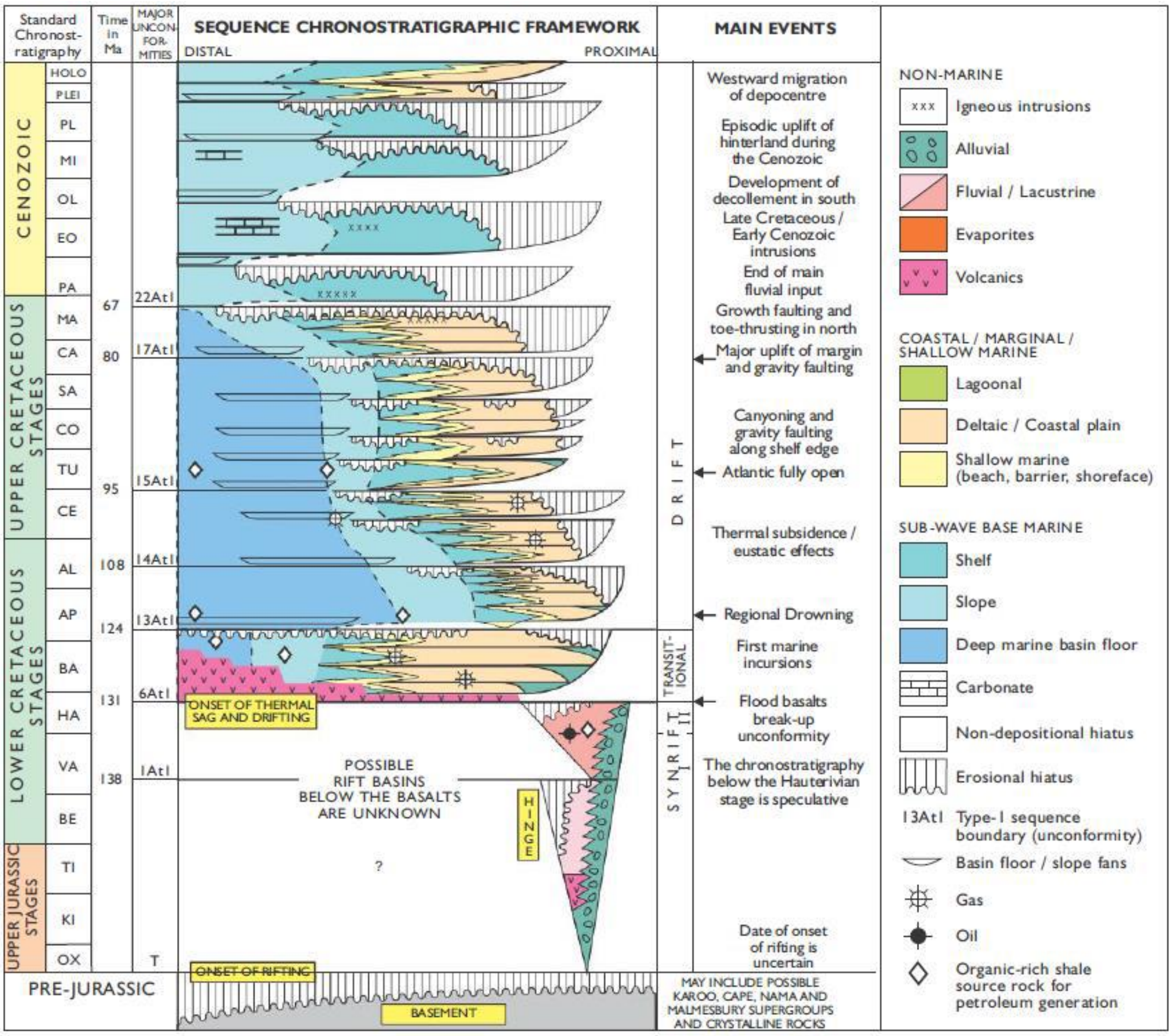


Figure 4: Generalised chronostratigraphic location of the Orange Basin.

It is anticipated that there is also significant potential in other rift grabens to the north and south of the A-J graben and potential for significant gas discoveries in the shallower sequences above the rift graben succession over the whole block. It is on the basis of this assumption that Tosaco has spent considerable amount of resource developing analogue A-J graben type plays in Block 1.

Two main source rock units are known to occur in the Orange Basin which includes:

- Late Hauterivian synrift source rock;
- Barremian-early Aptian source rock; and
- Indication of a regionally developed Cenomanian-Turonian source rock.

Each of the above are related to one of the three main phases of development in the Orange Basin including the rift, early drift, complete drift phases.

Considering the above information, Tosaco is of the opinion that the Orange Basin, including Block 1, is a large under-explored area with a very sizeable potential for both oil and gas. The oil potential may be greatest beyond the present day shelf, but the gas potential may be greatest on the shelf.

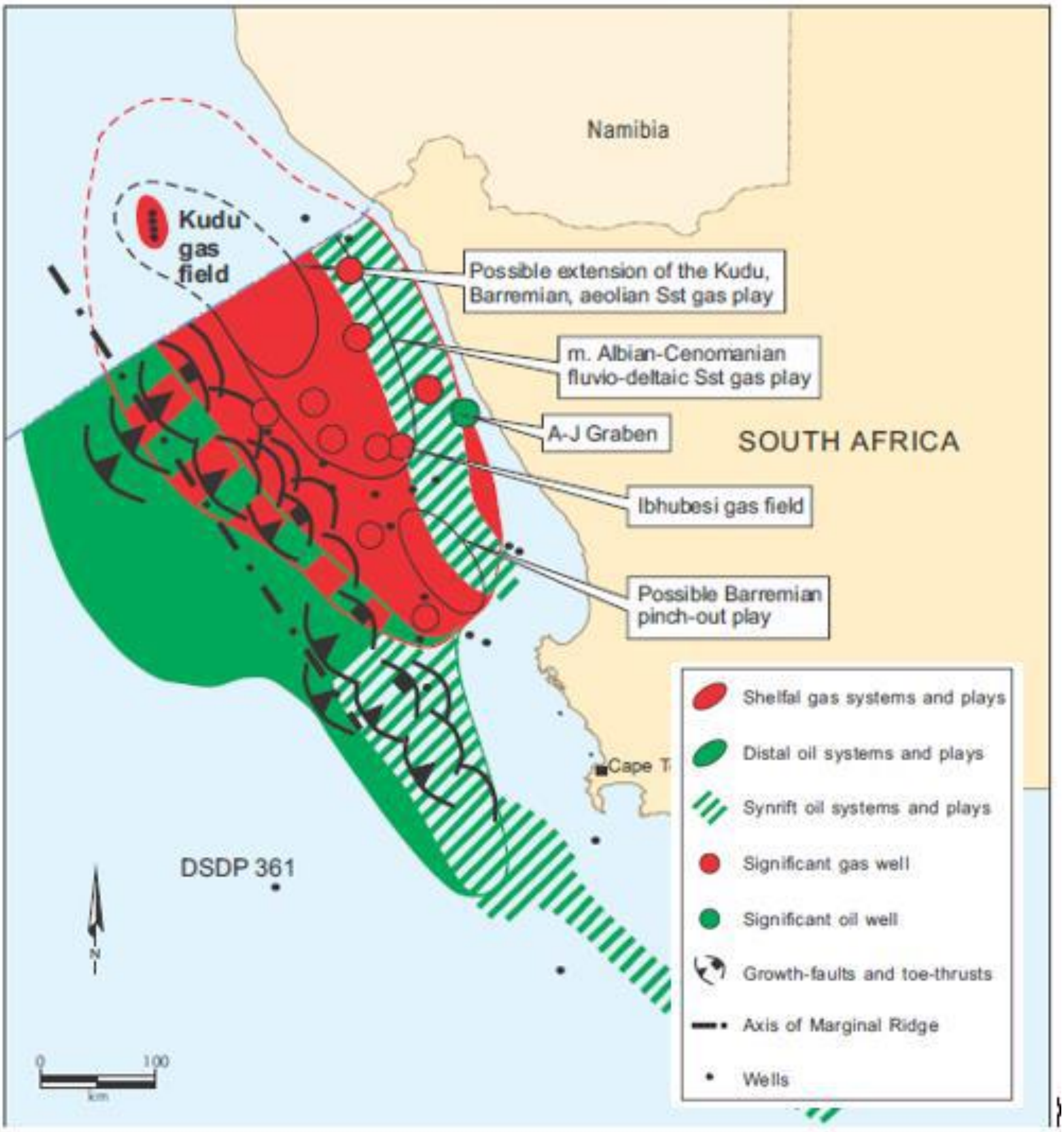


Figure 5: Main and predicted petroleum systems of the Orange Basin.

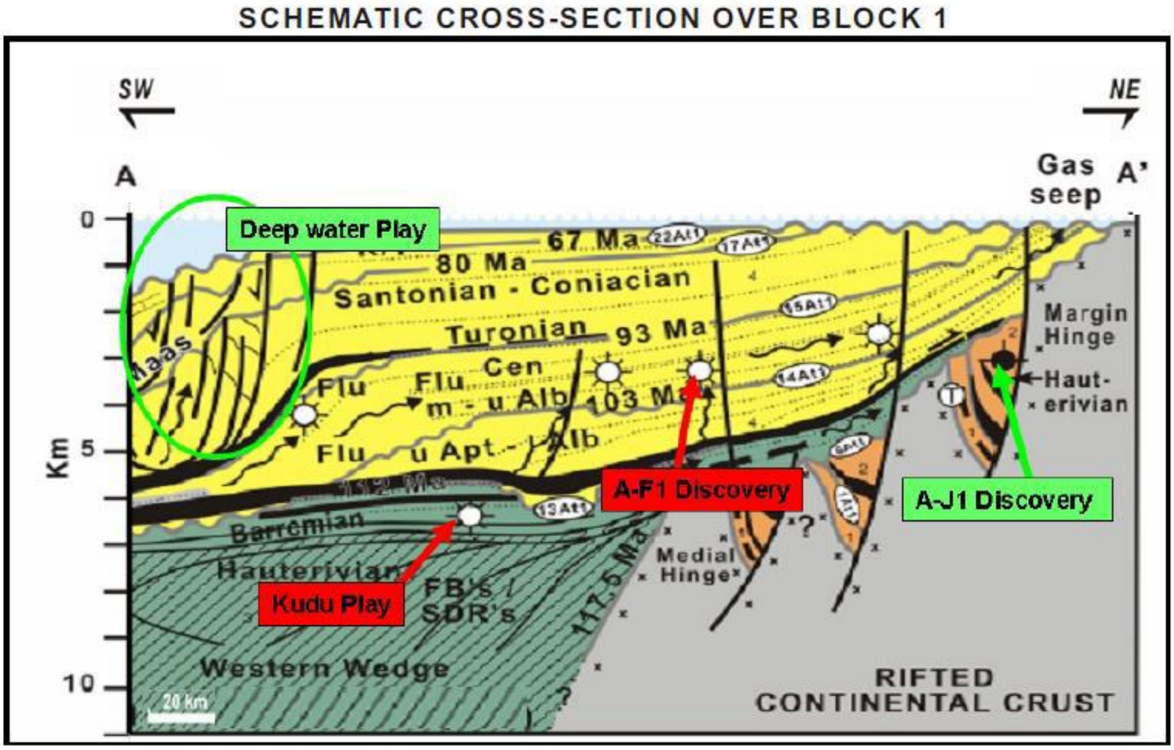


Figure 6: Generalised cross section highlighting the Block 1 play types.

3.2.2 SEISMIC DATA REVIEW

Based on the evaluations undertaken by Tosaco, it is envisaged that Block 1 may contain a number of exploration plays and prospects. During this period Tosaco has reviewed and assessed the seismic data quality and coverage over the block. Considering the seismic lines reviewed to date, it appears the 2D and 3D seismic data sets are of relatively good quality highlighting several stratigraphic and structural features. As such, it is the intention that these features will be evaluated in more detail during the exploration right.

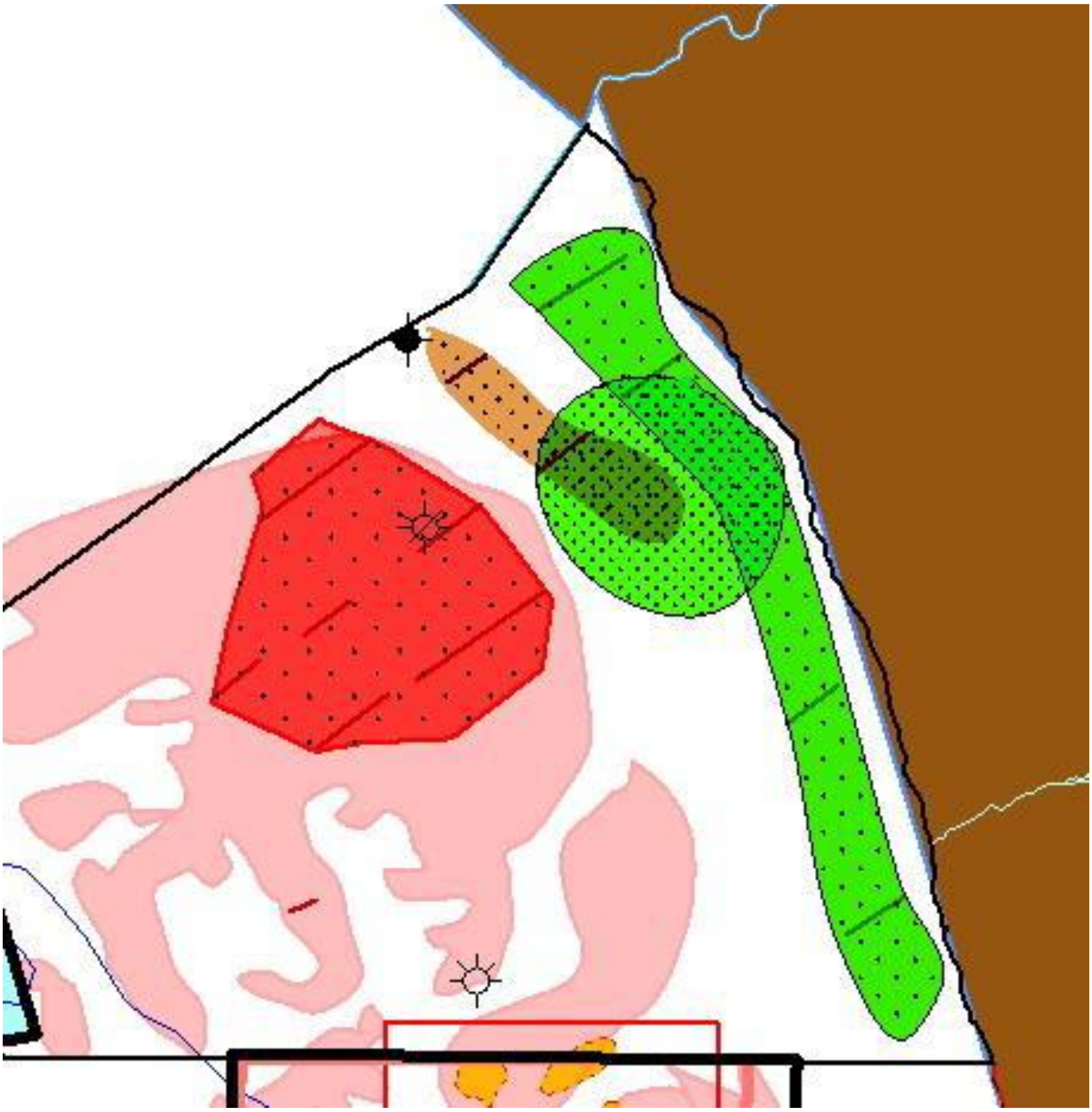


Figure 7: Oil and gas play types and possible future prospects identified on Block 1.

3.2.3 BLOCK 1 HYDROCARBON POTENTIAL AND PROSPECTIVITY

As a result of its evaluation and work completed during the TCP of the block, Tosaco has identified several oil and gas plays and features, highlighted in Figure 7 above, which include:

- Albian channelized gas plays;
- Barremian Aeolian gas play;
- Mid Cretaceous structural oil / gas play; and
- Inner graben rift basin play (an analogue to the Block 2B A-J1 oil discovery).

Tosaco has identified and spent a considerable amount of resources developing an analogue A-J syn-rift graben type play in Block 1. The seismic data reviewed suggests evidence of the existence an inbound syn-rift graben in the south east corner of Block 1, as highlighted in Figure 8 below.

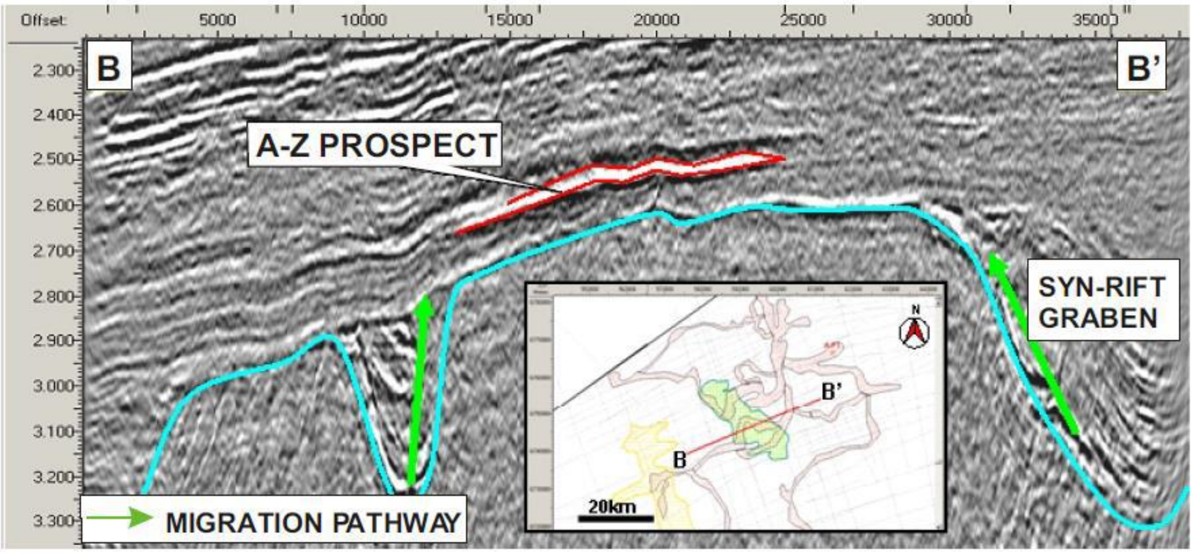


Figure 8: Seismic line across Block 1, highlighting the synrift graben structures.

Previous operators, including PetroSA have identified similar play types during their tenure as operator of the block. A prospect map is provided in Figure 9 below.

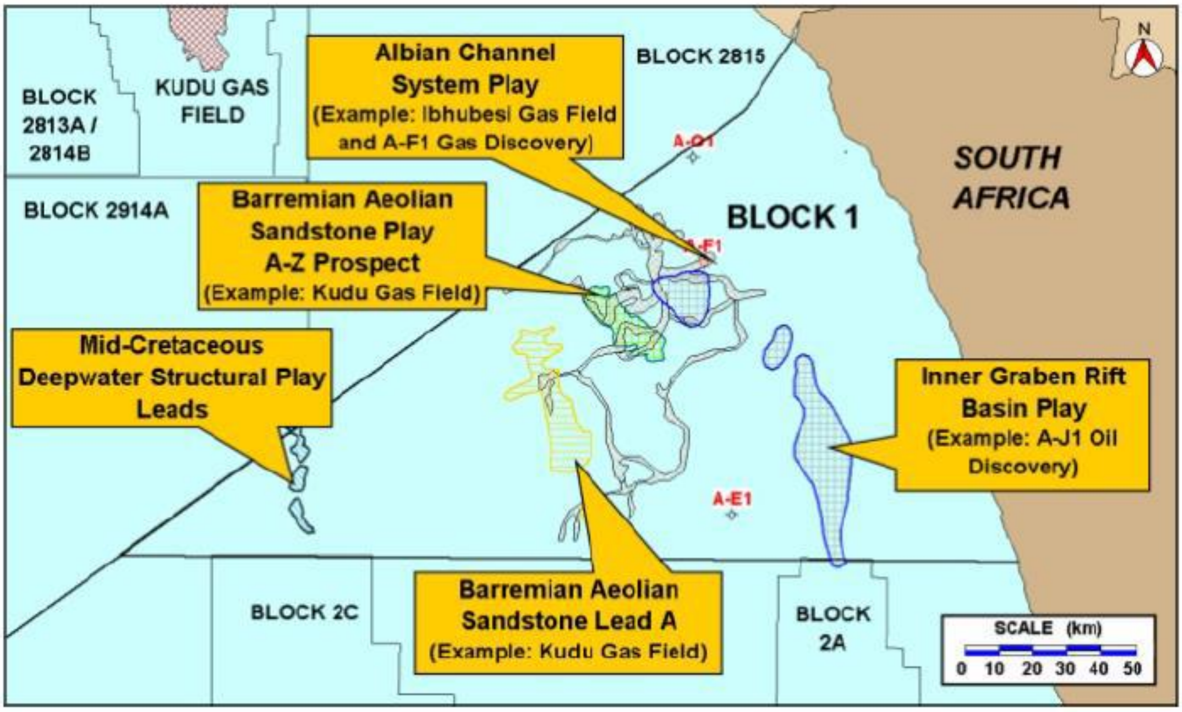


Figure 9: Plays and prospects of Block 1.

3.2.4 INNER GRABEN RIFT BASIN PLAY

Oil was discovered and tested by Soekor in the A-J1 borehole (not located in Block 1) drilled in 1988. Thick reservoir sandstones were intersected between 2 985 m and 3 350 m. The well was tested and flowed 191 barrels of oil per day of 36 degree American Petroleum Institute (API) oil from a 10 meters sandstone interval at about 3 250 m. Significant upside potential has been identified within six prospect areas at depths of up to 800 m shallower than the reservoirs in A-J1 on the 686 km^2 of 3D seismic data that covers the whole of the A-J graben area. According to Africa Energy, operator of Block 2B, follow-up wells will target this potential.

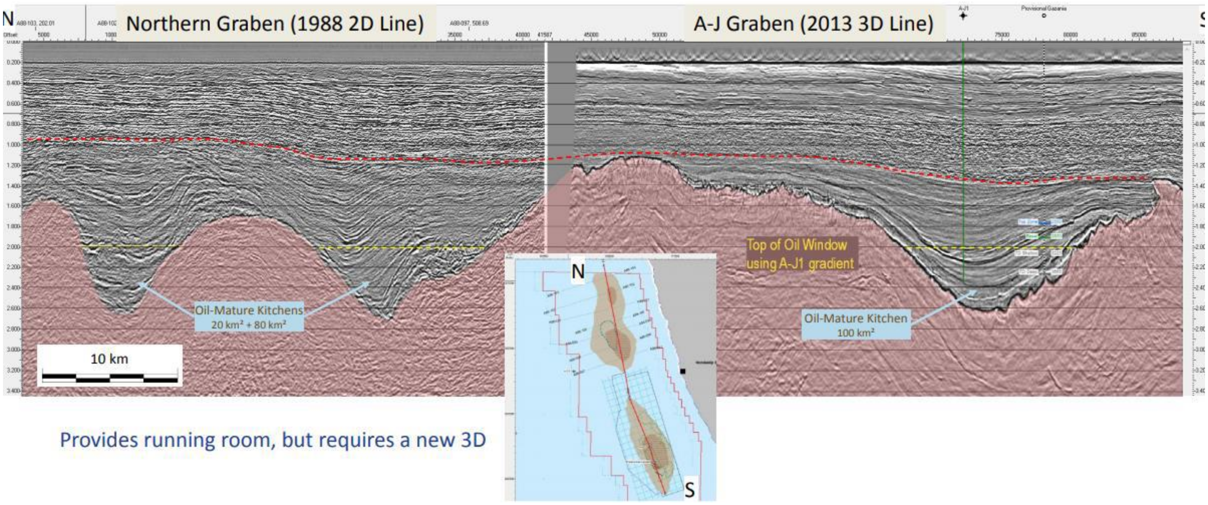


Figure 10: Africa Energy Composite 2D and 3D line from the northern basin to the A-J graben in Block 2B

The A-J graben is a typical rift basin, similar to others in which major oil accumulations have recently been discovered by Africa Energy's technical team in Uganda and Kenya. The oil was generated in lacustrine source rocks that are present in the deepest parts of the basin. The oil migrated and accumulated in fluvial and lacustrine sandstone reservoirs around the basin flanks.

There is also significant potential in other rift graben to the north and south of the A-J graben and potential for significant gas discoveries in the shallower sequences above the rift graben succession over the whole block. Based on Tosaco's evaluation of the Block 1 seismic data, there appears to analogue features and evidence of syn-rift graben features.

In summary, the Orange Basin is a large under-explored area with a very sizeable potential for both oil and gas. The oil potential may be greatest beyond the present-day shelf, however the syn-rift graben play will also offer significant oil potential with additional data acquired in that part of Block 1.

It is on this basis that Tosaco has designed a 3D seismic survey to specifically target the inner graben syn-rift basin as highlighted in Figure 1 above. It is envisaged that the optimization of the acquisition parameters will focus the seismic survey to better define and outline the syn-rift grabens. Through this definition it is also anticipated that a better understanding of the internal structure of possible reservoirs, traps, fault structures and possible sediment input points.

3.3 DESCRIPTION OF ACTIVITIES TO BE UNDERTAKEN

Hydrocarbon deposits occur in reservoirs in sedimentary rock layers. Being lighter than water they accumulate in traps where the sedimentary layers are arched or tilted by folding or faulting of the geological layers. Marine seismic surveys are one of the primary geophysical methods for locating such deposits.

Seismic survey programmes comprise of data acquisition in either two-dimensional (2D) and/or three-dimensional (3D) scales, depending on information requirements. 2D surveys are typically applied to obtain regional data from widely spaced survey grids and provide a vertical profile through the subsurface, highlighting geophysical, geological information and features along the seismic-line. Infill surveys on closer grids subsequently provide more detail over specific areas of interest. In contrast, 3D seismic surveys are conducted on a very tight survey grid spacing in specific target areas identified during 2D applications and provide a cube image of the subsurface geology within the survey volume. 3D seismic acquisition is applied to prospective petroleum areas of interest to assist in fault interpretation, distribution of potential reservoirs, estimates of oil and gas in place and the location of potential exploration wells. **The current exploration programme does not include any provision for exploration drilling.**

During seismic surveys high-level, low frequency sound pulses are generated by an acoustic instrument towed behind a survey vessel, just below the sea surface. The sounds are directed towards the seabed and the seismic signal is reflected by the geological interfaces below the seafloor. The reflected signals are received by an array of receivers or sets of hydrophones towed behind the vessel in a single streamer (2D) or in multiple streamers

(3D) and are fed back to the recording instruments on board. The spacing between the hydrophone groups is commonly 25 m or shorter, depending on the purpose of the seismic survey. Each group contains many hydrophones, spaced less than 1 m apart. The hydrophone streamers must be towed at constant depth (6 – 10 m), with flotation usually achieved by filling the cables with kerosene, gel or flexible polymer foam, so that they are neutrally buoyant. To compensate for minor adjustments, Automatic Cable Levellers, or "birds" are used. The ends of the hydrophone streamers are marked with tail buoys, to warn shipping about the presence of the cable in the water. The tail buoys also act as a platform for surface positioning systems so that the cable locations can be accurately monitored.

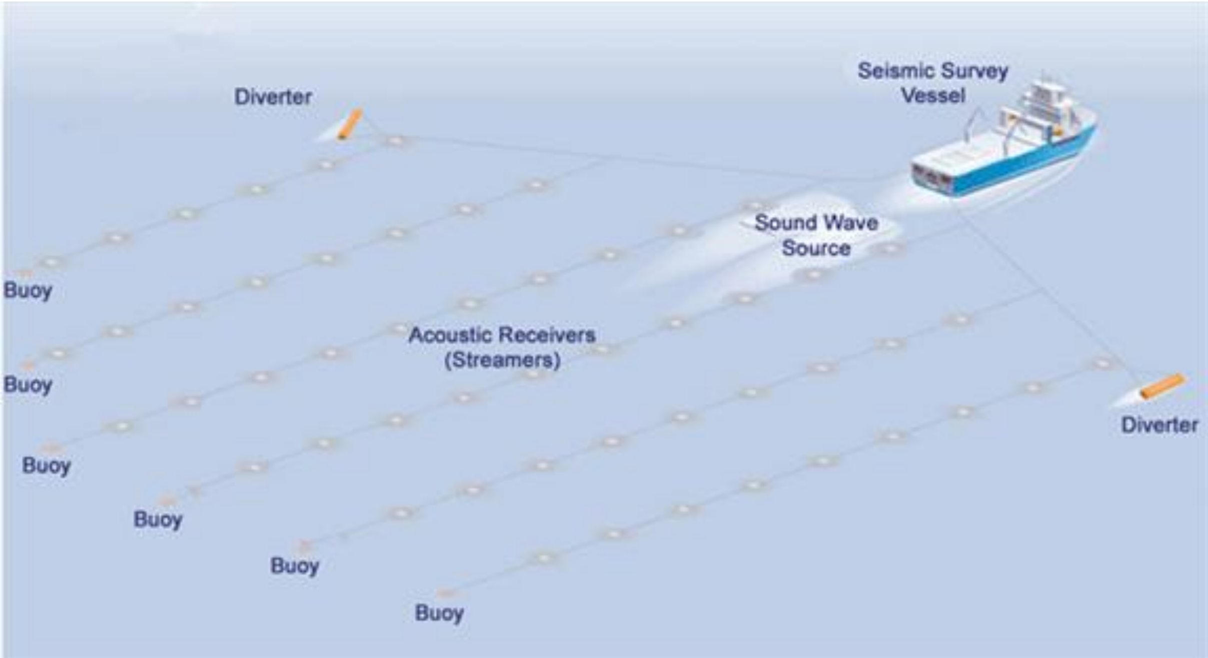


Figure 11: Example of seismic survey vessel and associated equipment (Fish Safe, 2021)

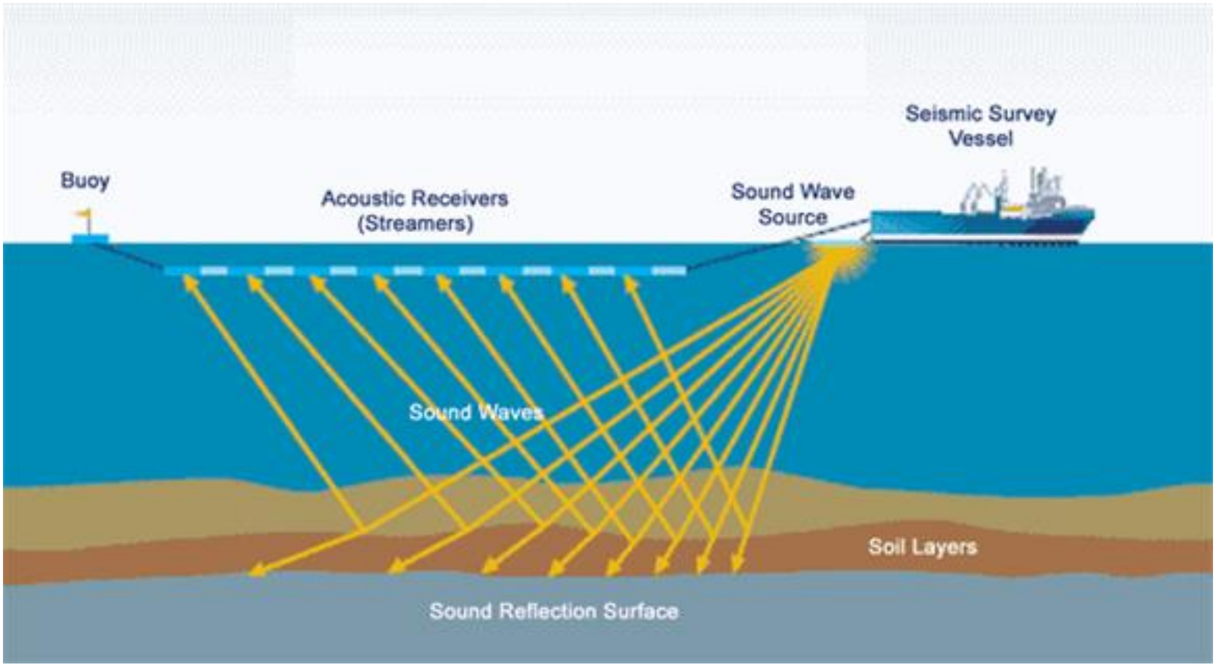


Figure 12: Example demonstration of seismic survey activities (Fish Safe, 2021)

While acquiring the seismic data, the survey vessel would travel along transects of a prescribed grid within the survey area that have been chosen to cross any known or suspected geological structure in the area. The vessel typically travels at a speed of between four and six knots (i.e. 2 to 3 metres per second / 7.2 to 10.8 kilometres per hour) while surveying.

The proposed survey would involve a seismic sound source (airgun array) and multiple hydrophone streamers, which would be up to 10,000 m long. The streamers would be towed at a depth of 9 m to 10 m below the surface and would not be visible, except for the tail-buoy at the terminal end of the cable. The sound source or airgun array would be towed 80 – 150 m behind the vessel at a depth of between 5 – 25 m below the surface. As the survey vessel would be restricted in manoeuvrability (a turn radius of 4.5 km is expected), other vessels should remain clear of it and therefore a supply/chase vessel usually assists in the operation of keeping other vessels at a safe distance.

Each triggering of a sound pulse is termed a seismic shot, and these are fired at intervals of 10 – 20 seconds and at an operating pressure of between 2 000 to 2 500 psi and a volume of 3 000 to 5 000 cubic inches. Each seismic shot is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each shot being high, the total energy delivered into the water is low.

Airguns have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-80 Hz. The maximum sound pressure levels at the source of airgun arrays in use today in the seismic industry are typically around 220 dB re 1µPa at 1 m, with the majority of their produced energy being low frequency of 10-100 Hz. The location where this level of sound is attained is directly beneath the airgun array, generally near its centre, but the exact location and depth beneath the array are dependent on the detailed makeup of the array, the water depth, and the physical properties of the seafloor. However, based on analogue sound sources, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1 325 m from the source array.

For this investigation Tosaco is proposing to undertake the reprocessing of approximately 5 000 km of existing 2D seismic lines taken previously in the block, as well as approximately 750 km^2 of 3D seismic data previously undertaken in the block. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be beneficial, then an additional 3D seismic surveys might be conducted over an area approximately 1 340 km^2 as shown in Figure 1.

The commencement of the 3D surveys will depend on an Exploration Right award date (if awarded) and availability of seismic contractors. It is anticipated that the 3D survey would take approximately 4 months to complete. In the event that the survey cannot be completed during the months when offshore seismic surveys are allowed, the survey will be completed in the following year. The exploration will be undertaken in accordance with the Exploration Works Programme (EWP) submitted with the application for exploration right as shown in Table 4 below.

Table 4: Exploration Works Programme

Year	Activity

1	• Review of all available technical data:
	  o Geographical Information System (GIS) data;
	  o Geophysical data, geological data, borehole data and log data;
	  o Third party technical reports;
	• Reprocessing of existing geological/geophysical data.
	• Preliminary estimation of contingent resources.
	• Prepare conceptual design and programme of future geophysical and geological exploration and appraisal.

2	• Planning and preparation of possible seismic survey.
3	• Possible 2D and/ or 3D seismic survey.

Year	Activity
	• Processing and interpretation of seismic data. • Evaluation and estimation of contingent resources based on new data.

4 POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which relates to the proposed project. Additional legislation and other guidelines and policies are discussed in Table 6 below.

4.1 CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The constitution of any country is the supreme law of that country. The Bill of Rights in chapter 2 section 24 of the Constitution of South Africa Act (Act No. 108 of 1996) makes provisions for environmental issues and declares that: *"Everyone has the right -*

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

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

- ***i.*** *prevent pollution and ecological degradation;*
- ***ii.*** *promote conservation; and*
- *iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development"*

The EIA and associated impact mitigation actions are conducted to fulfil the requirement of the Bill of Rights.

4.2 THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT

The aim of the MPRDA is to *"make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources"*. The MPRDA outlines the procedural requirements that need to be met to acquire mining rights in South Africa. In this regard, Tosaco have compiled and submitted an Exploration Right application to PASA, a subsidiary of the DMRE, which was subsequently accepted on 16 July 2020. An application for EA, in term of Section 16 of the NEMA EIA Regulations, 2014 was submitted to PASA on 17 March 2021.

As per Section 79 of the MPRDA, the Applicant is required to conduct an EIA and submit an EMPR for approval as well as to notify in writing and consult with interested and affected parties (I&APs) within 180 days of acceptance. The MPRDA also requires adherence with related legislation, chief amongst them is NEMA.

Several amendments have been made to the MPRDA. These include, but are not limited to, the amendment of Section 102, concerning amendment of rights, permits, programmes and plans, to requiring the written permission of the Minister for any amendment or alteration; and the section 5A(c) requirement that landowners or land occupiers receive twenty-one (21) days' written notice prior to any activities taking place on their properties. One of the most recent amendments requires all mining related activities to follow the full NEMA process as per the EIA Regulations, 2014, which came into effect on 4 December 2014.

On 3 June 2015, GNR 466 was published. The notice details amendments made to petroleum exploration and production relating, in particular, to the EIA process required, well design and construction, management and operations, water, waste, pollution incidents and air quality.

4.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998 – NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, the applicant is required to appoint an EAP to undertake the EIA process, as well as conduct the public participation process towards an application for EA. In South Africa, EIA's became a legal requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant EA. On 21 April 2006, the Minister of Environmental Affairs and Tourism (now Department of Environment, Forestry and Fisheries – DFFE) promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended in June 2010 and again in December 2014 as well as April 2017. The NEMA EIA Regulations, 2014, as amended, are applicable to this project. Exploration activities officially became governable under the NEMA EIA Regulations in December 2014 with the competent authority identified as the DMRE.

The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the listed activities that are triggered by the proposed project. The purpose of these procedures is to provide the competent authority with adequate information to make informed decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIA's in order to apply for, and be considered for, the issuing of an EA. These EIA Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity.

An environmental Scoping and Impact Assessment process is reserved for activities which have the potential to result in significant impacts which are complex to assess. Scoping and Impact Assessment studies accordingly provide a mechanism for the comprehensive assessment of activities that are likely to have more significant environmental impacts. Figure 13 below provides a graphic representation of all the components of a full EIA process. The Table 5 below identifies the listed activities the proposed project triggers and consequently requires authorisation prior to commencement.

Table 5: NEMA listed activities to be authorised

Activity	Activity Description	Applicability
Listing Notice 2 Activity 18	Any activity including the operation of that activity which requires an exploration right as contemplated in section 79 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including — (a) associated infrastructure, structures and earthworks; or (b) the primary processing of a petroleum resource including winning, extraction, classifying, concentrating or water removal; but excluding the secondary processing of a petroleum resource, including the beneficiation or refining of gas, oil or petroleum products in which case activity 5 in this Notice applies.	The undertaking of exploration activities within the Block 1 offshore area, requires an Exploration Right in terms of the MPRDA.

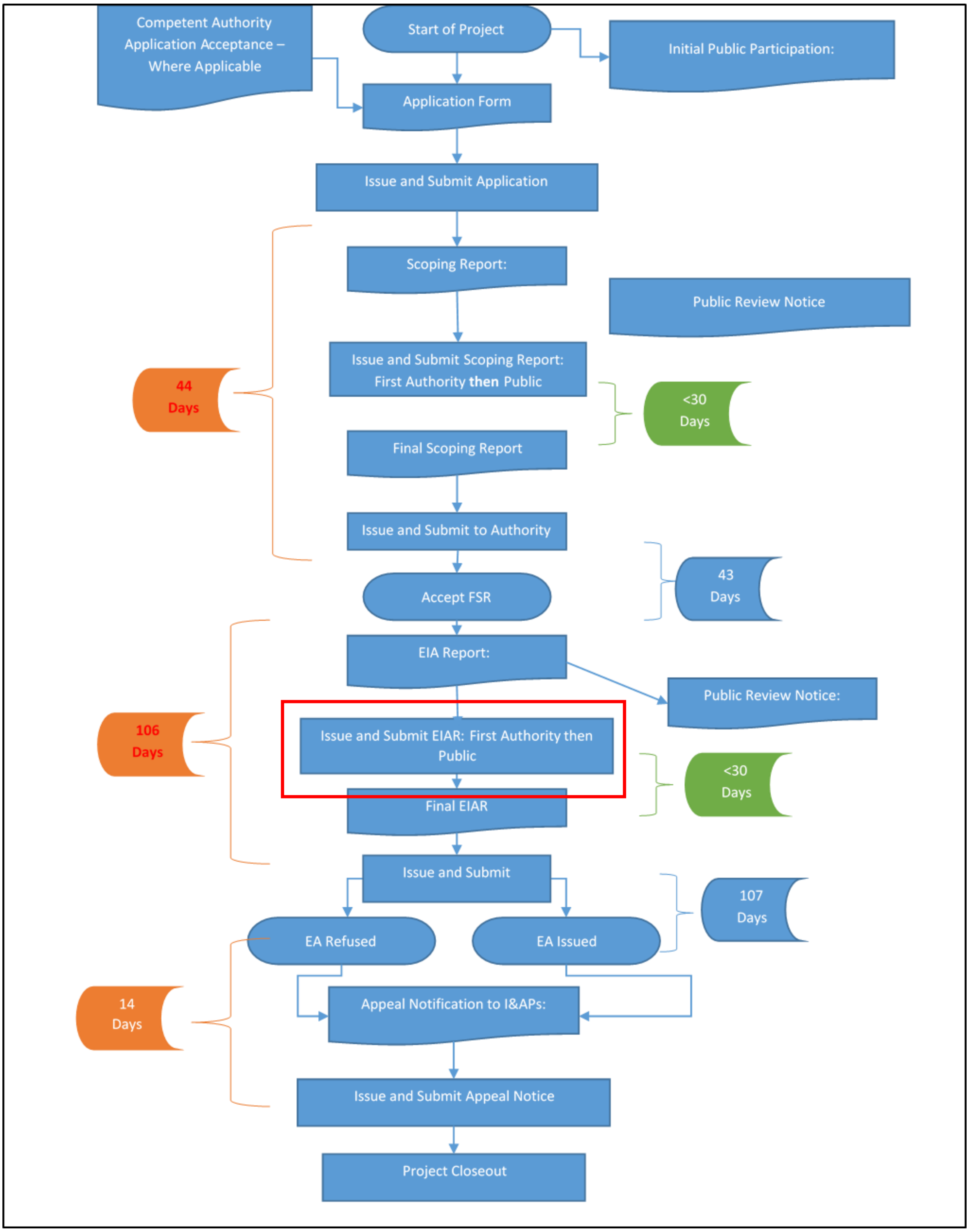


Figure 13: EIA process diagram.

4.4 THE NATIONAL HERITAGE RESOURCES ACT

The National Heritage Resources Act (Act 25 of 1999 – NHRA) stipulates that cultural heritage resources may not be disturbed without authorisation from the relevant heritage authority. Section 34(1) of the NHRA states that, *"no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…"* The NHRA is utilised as the basis for the identification, evaluation and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of

NHRA, and those developments administered through the NEMA, MPRDA and the Development Facilitation Act (DFA) legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorisations are granted for a development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impact Processes required by the NEMA and MPRDA. This change requires an evaluation of the Section of these Acts relevant to heritage (Fourie, 2008).

The NHRA provides for the protection of South Africa's natural heritage, including wrecks or associated debris or artefacts that may be found or disturbed on the seabed. Section 2.1.4 states that the South African Heritage Resources Agency (SAHRA) is the statutory organisation responsible for the protection of South Africa's cultural heritage. SAHRA thus has jurisdiction over any shipwrecks that may occur within the territorial waters and the maritime cultural zone fall. According to Section 35 of the NHRA, any person who discovers archaeological objects or material (including wrecks) in the course of a development must immediately report the find to SAHRA. No person may, without a permit issued by SAHRA, destroy, damage, excavate, alter, deface or otherwise disturb any archaeological site.

The Block 1 application area also contains a Marine Protected Area - The Namaqua Fossil Forest Marine Protected Area (MPA) provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an Ecologically and Biologically Significant Area (EBSA).

As will be discussed Section 8 below, it should be noted that the proposed 3D Seismic Survey area as shown in Figure 1 above is intersected by the Namaqua Fossil Forest MPA. As such, it has been recommended that the 3D Seismic area falling within the MPA, as well as the recommended 5 km buffer, be excluded from the 3D Seismic area.

Furthermore, Section 38 lists certain activities that would require authorisation from the heritage authorities, namely, Section 38(1)(c)(i). In terms of this section, the South African Heritage Resources Agency (SAHRA) would need to be notified regarding any development or activity that will change the character of a site exceeding 5 000 m^2 in extent. Having considered such a notification, SAHRA will confirm whether a Heritage Impact Assessment would be required in order for an authorisation to be considered.

4.5 NATIONAL ENVIRONMENTAL MANAGEMENT: PROTECTED AREAS ACT

The National Environmental Management Protected Areas Act (Act No. 57 of 2003 – NEMPAA) is intended to *"provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes"* and creating a *"national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity".*

The NEMPAA defines various kinds of protected areas, namely: *"special nature reserves, national parks, nature reserves (including wilderness areas) and protected environments; world heritage sites; marine protected areas; specially protected forest areas, forest nature reserves and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act 84 of 1998); and mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act 63 of 1970)".*

A number of MPA are located within the Block 1 offshore area. For oil and gas exploration activities, although vessels are permitted to sail through these areas, no invasive exploration activities are permitted in any proclaimed MPA. Should an exploration right be issued, such areas must thus exclude any proclaimed MPAs.

As will be discussed Section 8 below, it should be noted that the proposed 3D Seismic Survey area as shown in Figure 1 above is intersected by the Namaqua Fossil Forest MPA. As such, it has been recommended that the area falling within the MPA, as well as the recommended 5 km buffer, be excluded from the 3D Seismic area as shown in Figure 14 below.

4.6 ADDITIONAL SOUTH AFRICAN LEGISLATION

Additional legislation may be applicable to the exploration activities proposed for this project. These are presented in Table 6 below.

Table 6: Applicable legislation and guidelines overview

Legislation / Guidelines	Description
Potentially Applicable Legislation	
Dumping at Sea Control Act (Act No. 73 of 1980)	This Act controls the dumping of substances at sea. The Act lists substances that are prohibited to be dumped at sea (Schedule 1) and substances that are restricted when dumping at sea (Schedule 2). The Director-General may on application grant a special permit authorising the dumping of substances listed in Schedule 1 or 2.
Environment Conservation Act (Act No. 73 of 1989)	The Environment Conservation Act (Act No. 73 of 1989 – ECA) was, prior to the promulgation of the NEMA, the backbone of environmental legislation in South Africa. To date the majority of the ECA has been repealed by various other Acts, however Section 25 of the Act and the Noise Regulations (GN R. 154 of 1992) promulgated under this section are still in effect. These Regulations serve to control noise and general prohibitions relating to noise impact and nuisance.
Hazardous Substances Act (Act No. 85 of 1983)	This Act provides for the control of substances which may cause injury or ill-health to or death of human. No person may, without a licence: (1) sell any Group I Hazardous Substance; (2) use, operate or apply any Group III Hazardous Substance (listed electronic products); and (3) install or keep any Group Ill Hazardous Substance.
Marine Living Resources Act (Act No. 18 of 1998)	This Act provides for the conservation of marine ecosystems, the long-term sustainable utilisation of marine living resources and the orderly access to exploitation, utilisation and protection of certain marine living resources.
Marine Traffic Act (Act No. 2 of 1981)	This Act regulates marine traffic in South Africa's territorial waters. It regulates the entry and dropping of anchor within 500 m safety zone of installations.
Marine Pollution (Control and Civil Liability) Act (Act No. 6 of 1981)	The purpose of this Act is to provide protection of the marine environment from pollution by oil and other harmful substances, by giving power to South African Maritime Safety Authority (SAMSA) to take steps to prevent harmful substances being discharged from vessels. The applicant would have to disclose to SAMSA before the commencement of proposed activities the amounts and types of chemicals that would be used and disposed of during operations. No disposal of waste at sea is proposed.
Marine Pollution (Prevention of Pollution from Ships) Act (Act No. 2 of 1986)	This Act regulates pollution from ships, tankers and offshore installations, and for that purpose gives effect to MARPOL 73/78. In terms of the Act, it is an offence to discharge any oil from a ship, tanker or offshore installation within 12 miles (19 km) off the South African coast. The discharge of oily water or oil and any other substance which contains more than a hundred parts per million of oil is prohibited between 19 – 80 km offshore. No dumping at sea is proposed as part of this application.
Marine Pollution (Intervention) Act (Act No. 65 of 1987)	This Act gives effect to the international convention relating to the Intervention of the High Seas in cases of oil pollution casualties, and to the Protocol relating to Intervention of the High Seas in cases of Marine Pollution by substances other than Oil in South African Waters.
Maritime Safety Authority Act (Act No. 5 of 1998)	This Act provides for the establishment and functions of SAMSA. The objectives of the Act are to, inter alia: (1) ensure safety of life and property at sea; (2) prevent and combat pollution of the marine environment by ship; and (3) promote South Africa's maritime interests.

Legislation / Guidelines	Description
Maritime Safety Authority Levies Act (Act No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.
Maritime Zones Act (Act No. 15 of 1994)	The Act defines the maritime zones, including territorial waters, contiguous zone, exclusive economic zone and continental shelf. Section 9(1) states that any law in force in South Africa shall also apply on and in respect of an installation.
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	This Act regulates the carrying out of restricted activities that may harm listed threatened or protected species or activities that encourage the spread of alien or invasive species subject to a permit.
Maritime Safety Authority Levies Act (Act No. 6 of 1998)	This Act provides for the imposition of levies by SAMSA. SAMSA is permitted to raise and collect a levy on all vessels calling at South African ports and operating in South African waters.
National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008)	This Act supports the authorisation requirements of NEMA but specifies additional criteria for regulating activities or developments (Section 63) and provides for pollution control within the coastal zone (Sections 69 to 73), where the coastal zone includes the Exclusive Economic Zone defined in the Maritime Zone Act.
National Ports Act (Act No. 12 of 2005)	This Act regulates and controls navigation within port limits and the approaches to ports, cargo handling, and the pollution and the protection of the environment within the port limits. The Act specifies a requirement for an agreement with or a licence from the National Ports Authority to operate a port facility or service.
Sea-Shore Act (Act No. 21 of 1935)	This Act declares the State President the owner of the seashore and the sea within the territorial waters of South Africa and provides for the grant of rights in respect of the seashore and the sea and for the alienation of portions of the seashore and the sea.
Applicable Guidelines	
Integrated Environmental Management Information Guidelines Series	The various guidelines will be considered throughout this environmental Scoping and Impact Assessment process. This series of guidelines was published by the Department of Environmental Affairs (DEA – now DFFE) and refers to various environmental aspects. Applicable guidelines in the series for the project include: Guideline 5: Companion to NEMA EIA Regulations (October 2012); Guideline 7: Public participation (October 2012); and Guideline 9: Need and desirability (October 2014). Additional guidelines published in terms of the NEMA EIA Regulations, 2014 (as amended), in particular: Guideline 3: General Guide to Environmental Impact Assessment Regulations, 2006; Guideline 4: Public Participation in support of the EIA Regulations, 2006; and Guideline 5: Assessment of alternatives and impacts in support of the EIA Regulations, 2006.

4.7 INTERNATIONAL LEGISLATION

4.7.1 UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

The United Nations Convention on the Law of the Sea 1982 sets out the roles and responsibilities of the signatory nations in the use of the oceans. The convention establishes guidelines for governments, businesses, and other organisations for the management of marine natural resources. The fundamental principle established in the

Convention is that States should cooperate to ensure conservation and promote the objective of the optimum utilization of fisheries resources both within and beyond the exclusive economic zone.

The Agreement attempts to achieve this objective by providing a framework for cooperation in the conservation and management of those resources. It promotes the effective management and conservation of international marine resources by establishing, among other things, detailed minimum international standards for the conservation and management of straddling fish stocks and highly migratory fish stocks; ensuring that measures taken for the conservation and management of those stocks in areas under national jurisdiction and in the adjacent international waters are compatible and coherent; ensuring that there are effective mechanisms for compliance and enforcement of those measures in international waters; and recognizing the special requirements of developing States in relation to conservation and management as well as the development and participation in fisheries of straddling and highly migratory fish stocks.

4.7.2 INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA

Under the convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972), a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" and power-driven and sailing vessels are therefore required to give way to it. Vessels engaged in fishing shall, in so far as possible, keep out of the way of the seismic survey operation. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an "offshore installation" and as such it is protected by a 500 m horizontal safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, seismic contractors generally request a safe operational limit (that is greater than the 500 m safety zone) that they would like other vessels to stay beyond. Support vehicles are usually commissioned as 'chase' boats to ensure that other vessels adhere to the safe operational limits.

4.7.3 INTERNATIONAL MARINE CONVENTIONS

The following international marine conventions may be applicable to the proposed exploration activities:

- 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);
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol);
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973);
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989);
- Convention on Biological Diversity (1992); and
- Benguela Current Convention (2013).

5 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

Tosaco is proposing to undertake the reprocessing of approximately 5 000 km of existing 2D seismic lines taken previously in the block, as well as approximately 750 km^2 of 3D seismic data previously undertaken in the block. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be beneficial, then an additional 3D seismic survey might be conducted over an area approximately 1 340 km^2 as shown in Figure 1.

The Orange Basin is a large under-explored area with a very sizeable potential for both oil and gas. Based on the initial information review undertaken under the TCP, Tosaco has designed a 3D seismic survey to specifically target the inner graben syn-rift basin as highlighted in Figure 1. It is envisaged that the optimization of the acquisition parameters will focus the seismic survey to better define and outline the syn-rift grabens. Through this definition it is also anticipated that a better understanding of the internal structure of possible reservoirs, traps, fault structures and possible sediment input points, but will not automatically enable Tosaco to produce any oil/gas.

The needs and desirability analysis component of the “Guideline on need and desirability in terms of the EIA Regulations (Notice 819 of 2014)” includes, but is not limited to, describing the linkages and dependencies between human well-being, livelihoods and ecosystem services applicable to the area in question, and how the proposed development’s ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.). Table 7 present the needs and desirability analysis undertaken for the project.

Table 7: Needs and desirability analysis for the proposed co-disposal facility.

Ref No.	Question	Answer
1	Securing ecological sustainable development and use of natural resources	
1.1	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem, Environmental Management Framework, Spatial Development Framework (SDF) and global and international responsibilities.	A number of specialist studies have informed this application and include: • Marine Ecological Impact Assessment; and • Fisheries Impact Assessment. • The conclusions of these studies are included in this report.
1.2	How will this project disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to baseline marine ecological statement in Section 8 below, and the impact assessment in Section 9 of this report.
1.3	How will this development pollute and / or degrade the biophysical environment? What measures were explored to either avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	
1.4	What waste will be generated by this development? What measures were explored to avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and / or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	Waste will be generated during the operational phase. The types of waste generated include sewage waste, biodegradable galley wastes, and non-biodegradable solid waste. Waste has been identified as an impact and assessed in Section 9 below. However, it is anticipated that the following measures can be utilised to reduce the impact of the waste on the receiving environment: • Visual inspection that waste does not leave the vessel. • Waste must be securely stored. • All hazardous waste such as oil must be stored separately and disposed of at a registered facility. • Proof of disposal must be kept by the Applicant.

Ref No.	Question	Answer
1.5	How will this project disturb or enhance landscapes and / or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	The Block 1 application area contains a Marine Protected Area - The Namaqua Fossil Forest MPA provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an EBSA. As will be discussed Section 8 below, it should be noted that the proposed 3D Seismic Survey area as shown in Figure 1 above is intersected by the Namaqua Fossil Forest MPA. As such, it has been recommended that the 3D Seismic area falling within the MPA, as well as the recommended 5 km buffer, be excluded from the 3D Seismic area.
1.6	How will this project use and / or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report. As a result of the fact that this project entails the exploration for oil and gas (excluding drilling), it is anticipated that this project will not lead to a significant impact or depletion of non-renewable resources.
1.7	How will this project use and / or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and / or impacts on the ecosystem jeopardise the integrity of the resource and / or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report. It is anticipated that the project will have a low impact on the localised marine ecology and fisheries.
1.7.1	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)?	The proposed project aims to identify oil and gas resources to be used in the energy production and/ or processing or manufacturing of materials.
1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used?	The proposed project aims to identify oil and gas resources and will not, at this stage, involve the use of the natural resources identified as part of the proposed exploration project.

Ref No.	Question	Answer
1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The proposed project aims to identify oil and gas resources and will not, at this stage, involve the use of the natural resources identified as part of the proposed exploration project.
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts:	
1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	The limitations and/or gaps in knowledge are presented in Section 12.
1.8.2	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low at this stage and will be further interrogated during the EIA phase (where applicable).
1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	As a result of the fact that this project entails the exploration for oil and gas (excluding drilling), it is anticipated that this project will not lead to a significant impact on the receiving environment. Furthermore, the proposed 3D seismic survey will only be undertaken, should the results of the reprocessing of existing information identify the need for such.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	
1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The proposed exploration activities are anticipated to have low negative ecological impacts. Refer to the impact assessment in Section 9 in this report.
1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	A low impact on third party wellbeing, livelihoods and ecosystem services is foreseen at this stage of this application. Refer to the impact assessment in Section 9 of this report.
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	The proposed exploration activities are anticipated to have low negative ecological impacts. Refer to the impact assessment in Section 9 in this report.

Ref No.	Question	Answer
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	Refer to Section 6, details of the alternatives considered.
1.13	Describe the positive and negative cumulative ecological / biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Refer to Section 9 of this report.
2	Promoting justifiable economic and social development	
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following:	
2.1.1	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks or policies applicable to the area,	The offshore area of activity, as well as the Exclusive Economic Zone (EEZ) as a whole, do not fall within the borders of any municipality or province of South Africa. Thus, the related planning documentation, especially at the District and Local Municipality level, typically don't directly address offshore areas and activities in a significant level of detail. However, Block 1 is located adjacent to the Namakwaland District Municipality. In 2018, the Namakwa District Municipality's population consisted of 7.32% African (9 670), 8.96% White (11 800), 83.06% Coloured (110 000) and 0.65% Asian (862) people. The largest share of population is within the young working age (25-44 years) age category with a total number of 39 200 or 29.7% of the total population. The age category with the second largest number of people is the older working age (45-64 years) age category with a total share of 23.1%, followed by the babies and kids (0-14 years) age category with 27 200 people. The age category with the least number of people is the retired / old age (65 years and older) age category with only 14 300 people. In Namakwa District Municipality the economic sectors that recorded the largest number of employment in 2018 were the community services sector with a total of 9 780 employed people or 27.0% of total employment in the district municipality. The trade sector with a total of 6 200 (17.1%) employs the second highest number of people relative to the rest of the sectors. The electricity sector with 472 (1.3%) is the sector that employs the least number of people in Namakwa District Municipality, followed by the transport sector with 1 360 (3.7%) people employed.

Ref No.	Question	Answer
		The IDP further aligns with the Nine Point Plan Identified by the National Government and identifies the Growing the Oceans Economy and Tourism – Small Harbour Development & Coastal and Marine Tourism and Hondeklipbay (Abalone). The IDP does not specifically mention the offshore activities or exploration. The impact of the exploration activities on the local economy is anticipated to be limited.
2.1.2	Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	Exploration activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised.
2.1.3	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	Refer to the baseline environment in Section 8 of this report.
2.1.4	Municipal Economic Development Strategy ("LED Strategy").	Considering the limited scope and extent of the proposed exploration activities, it is not anticipated to significantly promote or facilitate spatial transformation and sustainable urban development.
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	Refer to the impact assessment in Section 9 in this report.
2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	Considering the limited scope and extent of the proposed exploration activities, it is not anticipated to significantly promote or facilitate spatial transformation and sustainable urban development.
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	Refer to the public participation process and feedback contained in Appendix B.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	Refer to the impact assessment and mitigation measures in Section 9 of this report.
2.5	In terms of location, describe how the placement of the proposed development will:	

Ref No.	Question	Answer
2.5.1	Result in the creation of residential and employment opportunities in close proximity to or integrated with each other.	Exploration activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, it at all.
2.5.2	Reduce the need for transport of people and goods.	The exploration activities are not anticipated to have an impact on the transportation of goods and people.
2.5.3	Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),	The exploration activities are not anticipated to have an impact on the public transport.
2.5.4	Compliment other uses in the area,	As stated earlier in this report, the Block 1 offshore area has been subjected to a number of previous exploration activities and some wells have been drilled in the past.
2.5.5	Be in line with the planning for the area.	Refer to item 2.1.1 of this table (above).
2.5.6	For urban related development, make use of underutilised land available with the urban edge.	Not applicable. The proposed project is not located in an urban area.
2.5.7	Optimise the use of existing resources and infrastructure,	Refer to Section 3 of this report.
2.5.8	Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	
2.5.9	Discourage "urban sprawl" and contribute to compaction / densification.	Not applicable. The proposed project is not located in an urban area.
2.5.10	Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	Refer to items 2.5.7 – 2.5.9 of this table (above).
2.5.11	Encourage environmentally sustainable land development practices and processes	As a result of the fact that this project entails the exploration for oil and gas (excluding drilling), it is anticipated that this project will not lead to a significant impact on the receiving environment. Furthermore, the proposed 3D seismic survey will only be undertaken, should the results of the reprocessing of existing information identify the need for such.

Ref No.	Question	Answer
2.5.12	Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The proposed project aims to identify potentially strategic oil and gas resources.
2.5.13	The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential).	The proposed project aims to identify oil and gas resources. Given the location offshore, it is not anticipated that the exploration activities will contribute to the significantly to settlements or areas in terms of socio-economic returns.
2.5.14	Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	Refer to impact assessment in Section 9 of this report.
2.5.15	In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Given the location offshore, it is not anticipated that the exploration activities will contribute to the significantly to settlements or areas in terms of socio-economic returns.
2.6	How was a risk-averse and cautious approach applied in terms of socio-economic impacts:	
2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer to Section 12 of this report.
2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	The level of risk is low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The level of risk is low as the project is not expected to have far reaching negative impacts on socio-economic conditions. Since the exploration activities will not include any drilling at this stage, a risk averse and cautious approach has been implemented to limit the impact on the surrounding environment.
2.7	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1	Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Refer to the impact assessment in Section 9 of this report.
2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	Refer to the impact assessment in Section 9 of this report.

Ref No.	Question	Answer
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	Refer to the impact assessment in Section 9 of this report.
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	Refer to the impact assessment in Section 9 of this report.
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Refer to the impact assessment in Section 9 of this report. Exploration activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, it at all.
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	By conducting a Scoping and Environmental Impact Assessment Process, the applicant ensures that equitable access has been considered. Refer to the impact assessment in Section 9 of this report.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Refer to the impact assessment in Section 9 of this report. The EIA and EMPr will specify timeframes within which mitigation measures must be implemented.
2.13	What measures were taken to:	
2.13.1	Ensure the participation of all interested and affected parties.	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project.
2.13.2	Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project. The advertisement and site notice have been made available in English and Afrikaans to assist in understanding of the project.
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	

Ref No.	Question	Answer
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	Further public consultation will be held in the EIA phase of the project.
2.13.5	Ensure openness and transparency, and access to information in terms of the process,	
2.13.6	Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge,	
2.13.7	Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein will be promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	Refer to Section 7 of this report, describing the public participation process undertaken for the proposed project.
2.15	What measures have been taken to ensure that current and / or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Potential future workers will have to be educated on a regular basis as to the environmental and safety risks that may occur within their work environment. Furthermore, adequate measures will have to be taken to ensure that the appropriate personal protective equipment is issued to workers based on the conditions that they work in and the requirements of their job.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1	The number of temporary versus permanent jobs that will be created.	Exploration activities typically require highly skilled employment. However, where feasible, it is anticipated that the use of local labour could be utilised, but it is anticipated that this will be extremely limited, it at all. The majority of the work will be done remotely through the acquisition and processing of existing information. However, should local labour be required during the possible 3D seismic survey, then travel will be from suitable ports.
2.16.2	Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area).	
2.16.3	The distance from where labourers will have to travel.	

Ref No.	Question	Answer
2.16.4	The location of jobs opportunities versus the location of impacts.	
2.16.5	The opportunity costs in terms of job creation.	
2.17	What measures were taken to ensure:	
2.17.1	That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The Scoping and EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP.
2.17.2	That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures.	
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Refer to Section 7 of this report, describing the public participation process implemented for the application, as well Section 8, the impact on any national estate.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	Refer to the impact assessment and mitigation measures in Section 9 of this report.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	The proposed exploration activities are not anticipated to produce significant pollution, environmental damage or adverse health effects in the long term.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Refer to Section 6, description of the process followed to reach the proposed preferred site.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Refer to the impact assessment and mitigation measures in Section 9 of the EIA Report.

6 PROJECT ALTERNATIVES

This section provides a description of the alternatives considered as part of this Scoping and EIA process.

6.1 LOCATION ALTERNATIVES

It should be noted that the exploration for oil and gas within the Block 1 offshore area will be undertaken by reprocessing of existing information as described in Section 3.3 above. If it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be beneficial, then an additional 3D seismic surveys might be conducted over an area approximately 1 340 km^2 as shown in Figure 1.

The potential 3D seismic survey area will specifically target the inner graben syn-rift basin as highlighted in Section 3 above. It is envisaged that the optimization of the acquisition parameters will focus the seismic survey to better define and outline the syn-rift grabens. Through this definition it is also anticipated that a better understanding of the internal structure of possible reservoirs, traps, fault structures and possible sediment input points. As such, no further location alternatives are considered in this assessment.

6.2 LAYOUT ALTERNATIVES

A number of MPAs are located within the Block 1 offshore area. For oil and gas exploration activities, although vessels are permitted to sail through these areas, no invasive exploration activities are permitted in any proclaimed MPA. Should an exploration right be issued, no exploration activities may be undertaken in any proclaimed MPAs. As is discussed in Section 8 below, it should be noted that the proposed 3D Seismic Survey area is intersected by the Namaqua Fossil Forest MPA (Figure 14 below). As such, it has been recommended that the area falling within the MPA, as well as the recommended 5 km buffer required by the NEMPAA, be excluded from the 3D Seismic area. Apart from the exclusion of the NEMPAA, no other layout alternative is considered feasible to be considered further.

6.3 TECHNOLOGY ALTERNATIVES

The activities proposed in this application require specialised technology and skills. The available technology alternatives are limited by most suitable technology for conducting seismic surveys.

To this end, it was concluded by Weilgart (2010) that airgun design can be optimized to reduce unwanted energy. Imaging deep geological targets requires an acoustic source outputting relatively low frequency content (200Hz) and in directions (both inline and horizontal to the plane of interest) that are not of use. During collection of seismic data for deep imaging purposes one should strive to reduce unnecessary acoustic energy (noise) through array, source, and receiver design optimization. Weilgart (2010) further concluded that that regardless of the imaging target, anyone collecting seismic data should strive to reduce unwanted energy or noise. It should be noted that even if unwanted frequencies (> 200 Hz) are removed, there will still be frequency overlap with several marine animals (including most baleen whales) that can and should be minimized. It was further concluded that, lower source levels could be achieved through better system optimization, i.e. a better pairing of source and receiver characteristics, and better system gain(s). For example, new receiver technologies, such as fibre optic receivers, may allow the use of lower amplitude sources through a higher receiver density and/or a lower system noise floor. Some evidence exists which indicates that re-engineered air guns with "mufflers" can be used to attenuate unwanted high frequency energy without affecting frequencies of interest.

The above optimisation techniques should be implemented including better airgun design and system optimisation with the selected survey contractor. In addition, kerosene free hydro-streamers should be used.

6.4 NO GO ALTERNATIVE

The no go alternative would imply that no exploration activities are undertaken. As a result, the opportunity to identify potential oil and gas resources within the Block 1 and proposed 3D survey area would not exist. This will negate the potential negative and positive impacts associated with the proposed exploration activities.

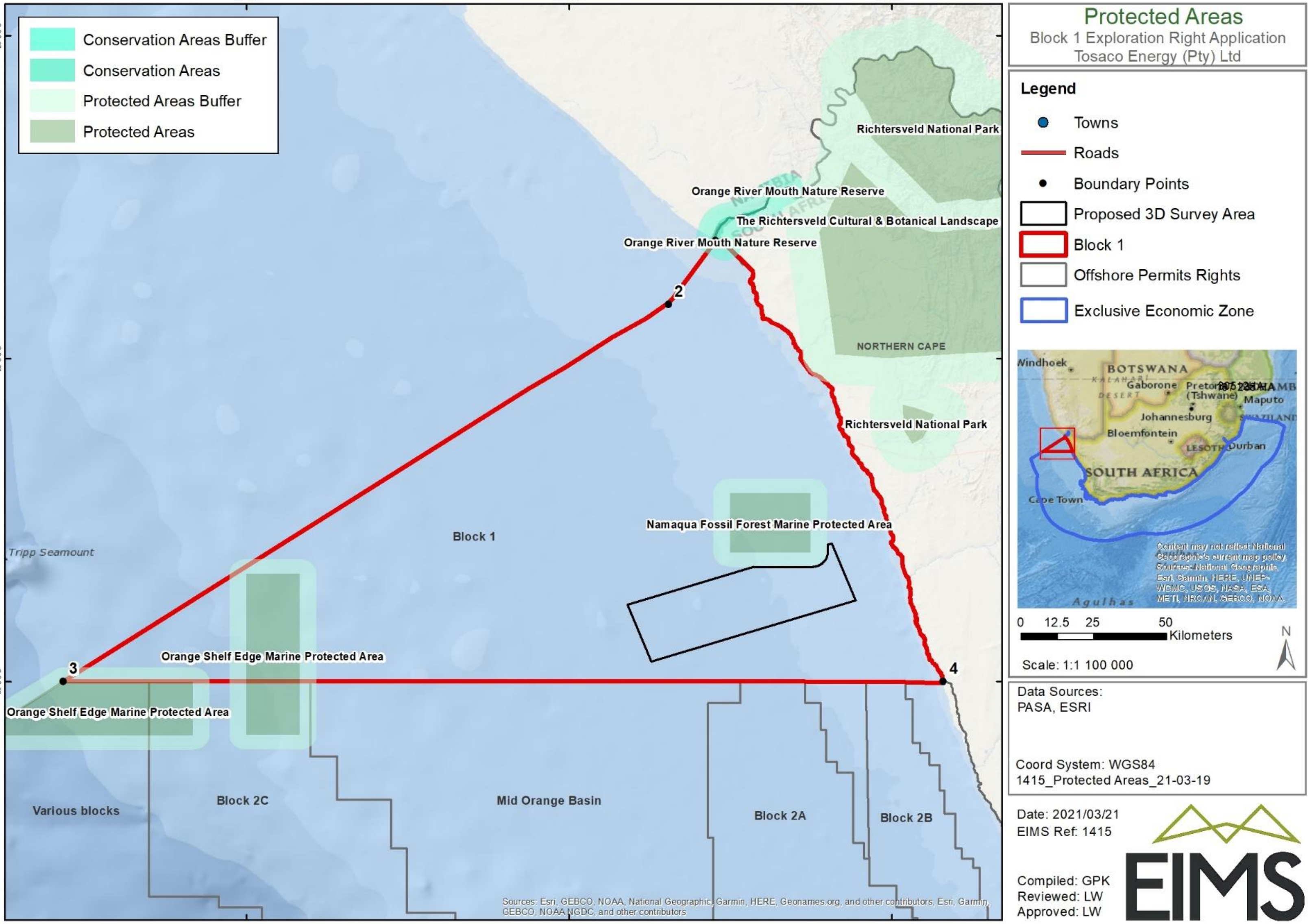


Figure 14: Marine Protected Areas in relation to the application area.

7 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African legislation and aims to ensure that all relevant Interested and Affected Parties (I&APs) are consulted, involved and their comments are considered, and a record included in the reports submitted to the Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed project needs to be managed sensitively and according to best practises to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project;
- Explain the authorisations required;
- Explain the environmental studies already completed and yet to be undertaken (where applicable);
- Solicit and record any issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximize and/or promote positive environmental impacts associated with the project.

7.1 GENERAL APPROACH TO SCOPING AND PUBLIC PARTICIPATION

The PPP for the proposed project has been undertaken in accordance with the requirements of the MPRDA and NEMA EIA Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

An initial I&AP database has been compiled based on known key I&AP's, Windeed searches and stakeholder databases available from existing sources. The I&AP database includes amongst others, adjacent landowners, rights holders, communities, regulatory authorities and other special interest groups.

7.1.1 LIST OF PRE-IDENTIFIED ORGANS OF STATE/ KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

Pre-identified Organs of State/ Key Stakeholders were notified of the proposed project and include:

- Birdlife South Africa;
- Cape Nature;
- Commission on Restitution of Land Right (Northern Cape);
- Council of Geoscience;
- Council for Scientific and Industrial Research (CSIR);

- Endangered Wildlife Trust;
- Eskom Holdings SOC Limited;
- Ezemvelo KZN;
- FishSA;
- Fresh Tuna Exporters Association;
- Kamiesberg Local Municipality;
- Nama Khoi Local Municipality;
- Namakwa District Municipality;
- Namibian Government;
- National Department of Agriculture, Forestry and Fisheries;
- National DFFE: Oceans and Coast;
- National Department of Rural Development and Land Affairs;
- National Department of Water and Sanitation;
- Northern Cape Provincial Heritage Resource Agency;
- Northern Cape Department of Agriculture;
- Department of Agriculture, Environmental Affairs, Rural Development and Land Reform;
- Northern Cape Department of Economic Development and Tourism;
- Northern Cape Department of Environment and Conservation;
- Northern Cape Department of Nature and Conservation;
- Northern Cape Department of Roads and Public Works;
- Northern Cape Department of Social Development;
- Northern Cape Department of Water and Sanitation;
- Northern Cape: Department of Transport, Safety and Liaison;
- Northern Free State Mineral Resources Stakeholder Forum;
- Petroleum Agency SA (PASA);
- Richtersveld Local Municipality;
- SA Deepsea Trawling Industry Association;
- SA Hake Longline Association;
- SA Tuna Longline Association;
- SAHRA;
- South African National Biodiversity Institute (SANBI);
- SANPARKS;
- Transnet;
- Wildlife and Environment Society of South Africa (WESSA); and
- World Wildlife Fund.

7.1.2 INITIAL NOTIFICATION

The PPP commenced on 19 February 2021 with an initial notification and call to register for a period of 30 days. The initial notification was given in the following manner:

7.1.2.1 **REGISTERED LETTERS, FAXES AND EMAILS**

Notification letters (English and Afrikaans), faxes, and emails were distributed to all pre-identified key I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that might be affected.

The notification letters included the following information to I&APs:

- List of anticipated activities to be authorised;
- Scale and extent of activities to be authorised;
- Information on the intended exploration operation to enable I&APs to assess/surmise what impact the activities will have on them or on the use of their land;
- The purpose of the proposed project;
- Details of the affected properties (including details of where a locality map could be obtained);
- Details of the relevant MPRDA and NEMA Regulations;
- Initial registration period timeframes; and
- Contact details of the EAP.

7.1.2.2 **NEWSPAPER ADVERTISEMENTS / GOVERNMENT GAZETTE**

Advertisements describing the proposed project and EIA process were placed in newspapers with circulation in the vicinity of the study area. The initial advertisements were placed in the Gemsbok and Plattelander (in English and Afrikaans) on 19 February 2021. The newspaper adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity and application; and
- Relevant EIMS contact person for the project.

7.1.2.3 **SITE NOTICE PLACEMENT**

A1 Correx site notices in English and Afrikaans were placed at 29 onshore locations adjacent to the Block 1 application area during the week of 15-19 February 2021. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

7.1.2.4 POSTER PLACEMENT

A3 posters in English and Afrikaans were placed at local public gathering places in Alexander Bay and Port Nolloth. The notices and written notification afforded all pre-identified I&APs the opportunity to register for the project as well as to submit their issues/queries/concerns and indicate the contact details of any other potential I&APs that should be contacted. The contact person at EIMS, contact number, email and faxes were stated on the posters. Comments/concerns and queries were encouraged to be submitted in either of the following manners:

- Electronically (fax, email);
- Telephonically; and/or
- Written letters.

7.1.3 AVAILABILITY OF SCOPING REPORT

Notification regarding the availability of this Scoping Report for public review was given in the following manner to all registered I&APs (which includes key stakeholders and landowners):

- Registered letters with details on where the scoping report can be obtained and/or reviewed, public meeting date and time, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above; and/or
- Email notifications with a letter attachment containing the information described above.

The scoping report was made available for public review from 26 March 2021 to 29 April 2021 for a period of 30 days. Comments received on the Scoping Report were included in the final Scoping Report and submitted for approval to the competent authority.

7.1.4 PUBLIC OPEN DAYS SCOPING PHASE

A series of public open days were held between from 13 April 2021 to 15 April 2021 at the following venues:

- 13 April 2021: Alexander Bay – Development Centre (Weshoek Straat);
- 14 April 2021: Port Nolloth – Richtersveld – Town Hall (169 Main Road); and
- 15 April 2021: Hondeklip Bay – Eric Baker – Community Hall (75 Main Road).

7.1.5 AVAILABILITY OF THE EIA REPORT

Notification regarding the availability of EIA Report for public review will be given in the following manner to all registered I&APs (which includes key stakeholders and landowners):

- Registered letters with details on where the EIA report can be obtained and/or reviewed, public meeting date and time, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above; and/or
- Email notifications with a letter attachment containing the information described above.

The EIA Report will be made available for public review from 3 August 2021 to 3 September 2021 for a period of 31 days. Comments received on the EIA Report will be included in the final EIA Report and submitted for approval to the competent authority.

7.2 PUBLIC PARTICIPATION PROGRESS

Comments raised to date have been addressed in a transparent manner and included in the Public Participation Report (Appendix B).

8 ENVIRONMENTAL ATTRIBUTES AND BASELINE ENVIRONMENT

This section of the Report provides a description of the environment that may be affected by the proposed project. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed development have been described. This information has been sourced from existing information available for the area, specialist baseline assessments, as well as previous reports undertaken for Block 1.

8.1 LOCATION

The application area is located within Block 1 in the Exclusive Economic Zone located along the Northern Cape Coast. Block 1 is located offshore between Alexander Bay, extending south along the western coastline to approximately Hondeklip Bay and approximately 250 km offshore of the coast of the Northern Cape and is located adjacent to the Namakwaland District Municipality. The locality of the proposed exploration area is shown in Figure 1.

8.2 GEOPHYSICAL CHARACTERISTICS

This section provides a description of the geophysical characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix C.

8.2.1 BATHYMETRY

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (refer to Figure 15 below). The nature of the shelf break varies off the South African West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate inshore[2] 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 (-50 to - 150 m) and outer shelf (-150 to -350 m) normally lacks relief and slopes gently seawards reaching the shelf edge at a depth of between -350 to -500 m. The three shelf zones characterising the West Coast are recognised following both abiotic and biotic patterns.

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 ~150 km offshore at about 31°S, and ~75 km south of the Licence Block. Child's Bank is a major feature on the West Coast margin and is the only known submarine bank within South Africa's Exclusive Economic Zone (EEZ), rising from a depth of 350 - 400 m water to less than -200 m at its shallowest point. It is a rounded, flat topped, sandy plateau, which lies at the edge of the continental shelf. The bank has a gentle northern, eastern and southern margin but a steep, slump-generated outer fact. At its southwestern edge, the continental slope drops down steeply from -350 to -1 500 m over a distance of less than 60 km creating precipitous cliffs at least 150 m high. The bank consists of resistant, horizontal beds of Pliocene sediments, similar to that of the Orange Banks, and represents another perched erosional outlier formed by Post-Pliocene erosion. The top of this feature has been estimated to cover some 1 450 km^2. Tripp Seamount is a geological feature ~25 km to the west of the western point of the Licence Block, which rises from the seabed at ~1 000 m to a depth of 150 m. It is a roughly circular feature with a flat apex that drops steeply on all sides.

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

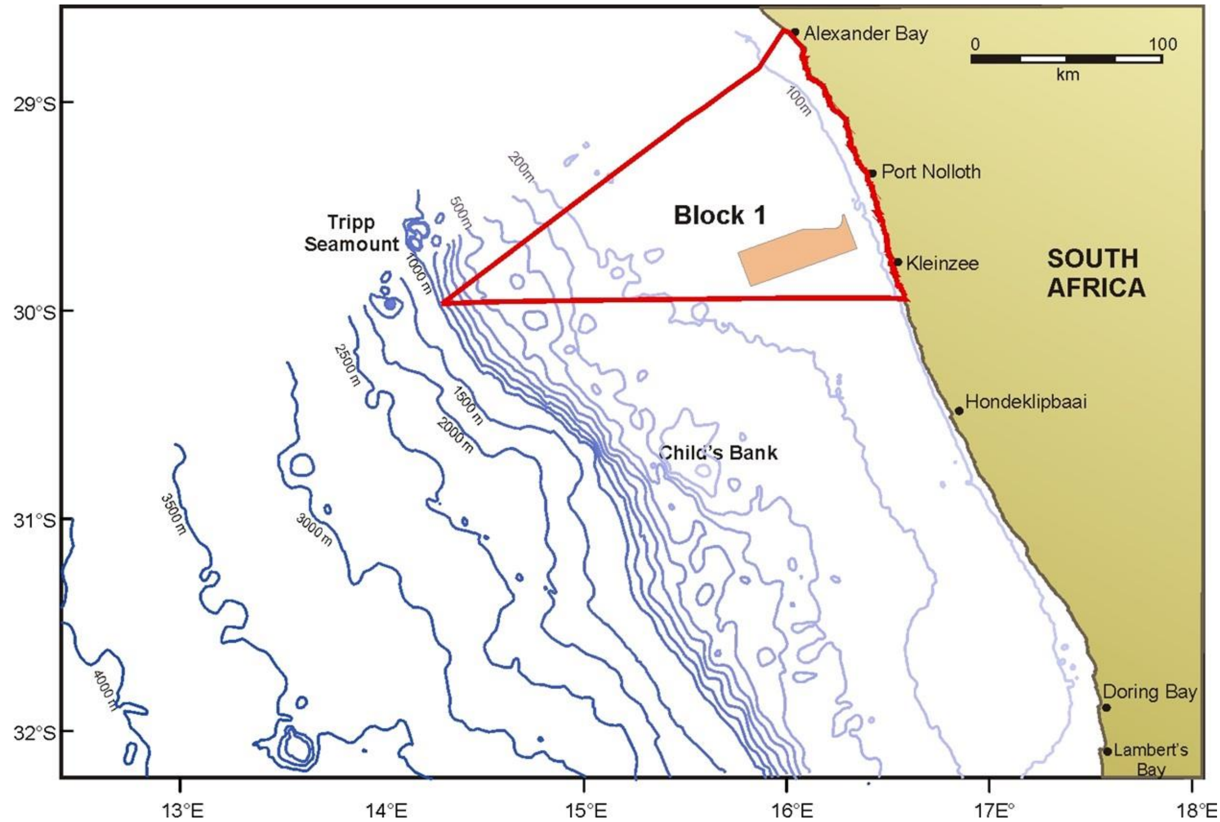


Figure 15: Map indicating location of the Block 1 and the proposed 3D survey area (orange polygon) in relation to bathymetric features off the West Coast (Pisces, 2021).

8.2.2 COASTAL AND INNER-SHELF GEOLOGY AND SEABED GEOMORPHOLOGY

Figure 16 below illustrates the distribution of seabed surface sediment types off the South African north-western coast. The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments. As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the innershelf shelf between the Orange River and St Helena Bay. Further offshore and within the Licence Area, sediment is dominated by muddy sands and sand. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

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

The benthic habitat types of the West Coast were classified and mapped in detail through the 2011 National Biodiversity Assessment (NBA). These were refined in the 2018 NBA to provide substratum types (Figure 17 below).

In Block 1 the water depth ranges from approximately 20 m up to ~750 m. The Southern Benguela Muddy and Sandy Shelves substrata dominate across the block, with the deepest portions in the west being characterised by Southeat Atlantic Unclassified Slopes and a small portion of Southern Benguela Rocky Shelves. Namaqua Sandy Mid-Shelf substratum is present as a narrow band in the eastern third of the concession area and with Namaqua Mid-Shelf Fossils present in the Namaqua Fossil Forest MPA.

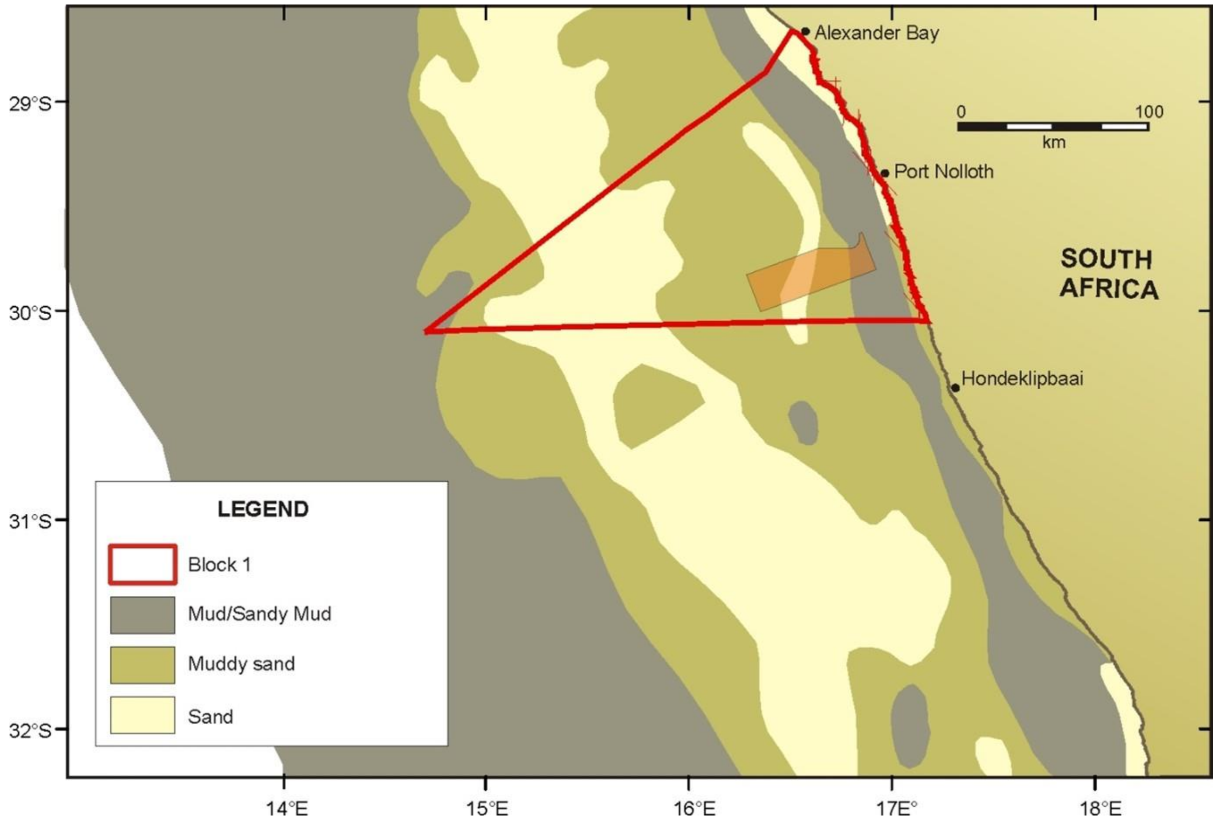


Figure 16: Sediment distribution on the continental shelf of the South African West Coast (Pisces, 2021).

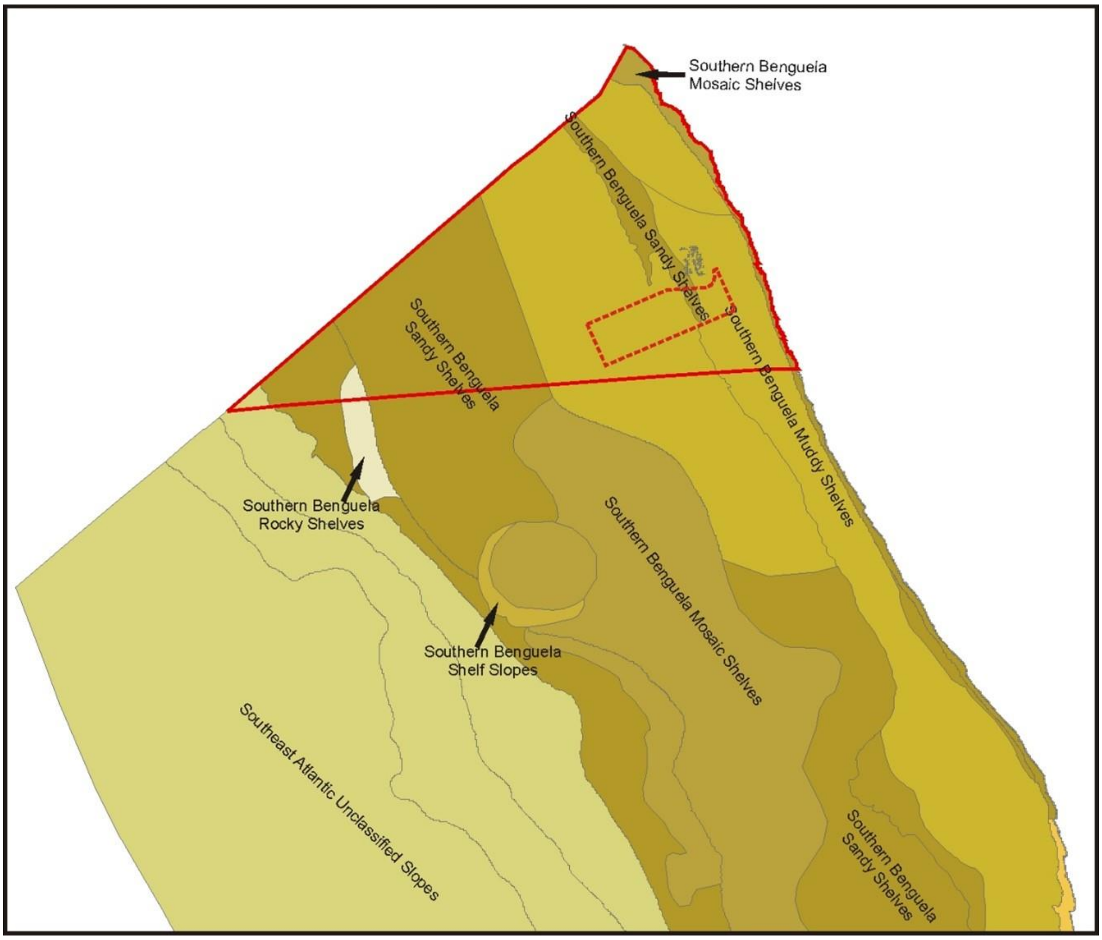


Figure 17: Block 1 (red polygon) and the proposed 3D survey area (dotted line) in relation to the distribution of seabed substratum types along the West Coast (Pisces, 2021).

8.3 BIOPHYSICAL CHARACTERISTICS

This section provides a description of the biophysical characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix C.

8.3.1 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, with a total of 226 gales (winds exceeding 18 m/s or 35 knots (kts)) being recorded over the period. Virtually all winds in summer come from the south to south-southeast (Figure 18 below). These southerlies occur over 40% of the time, averaging 20 – 30 kts and reaching speeds in excess of 60 kts, bringing cool, moist air into the coastal region and driving the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer. The winds also play an important role in the loss of sediment from beaches. These strong equator-wards winds are interrupted by the passing of coastal lows with which are associated periods of calm or north or northwest wind conditions. These northerlies occur throughout the year, but are more frequent in winter.

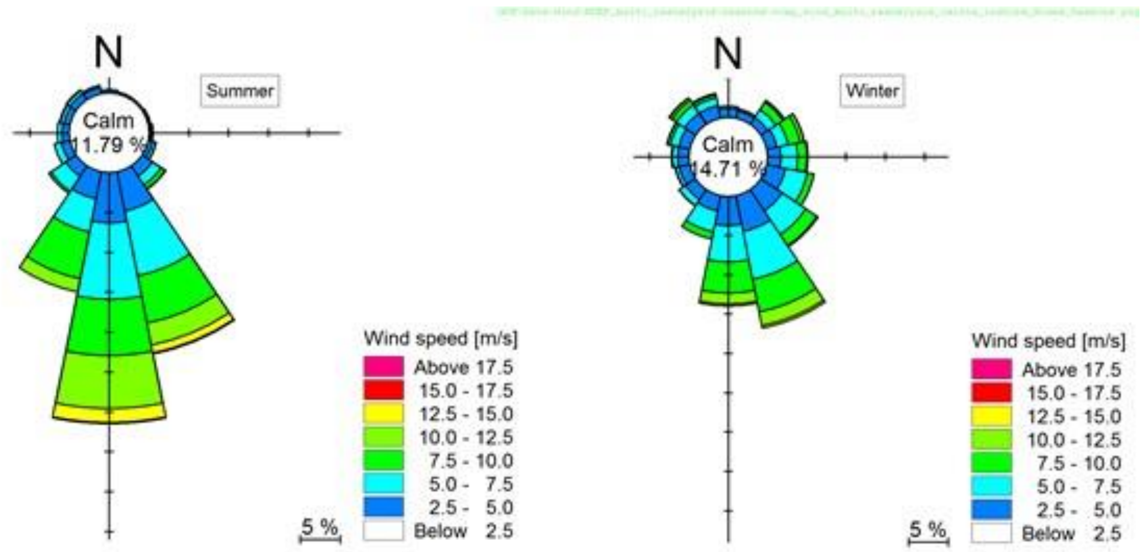


Figure 18: Wind Speed vs. Wind Direction for NCEP hind cast data at location 16.5°E, 29°S (Pisces, 2021).

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (Figure 18 above). This 'reversal' from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shore-wards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

During autumn and winter, catabatic, or easterly ‘berg’ winds can also occur. These powerful offshore winds can exceed 50 km/h, producing sandstorms that considerably reduce visibility at sea and on land. Although they occur intermittently for about a week at a time, they have a strong effect on the coastal temperatures, which often exceed 30°C during ‘berg’ wind periods. The winds also play a significant role in sediment input into the coastal marine environment with transport of the sediments up to 150 km offshore (Figure 19 below).

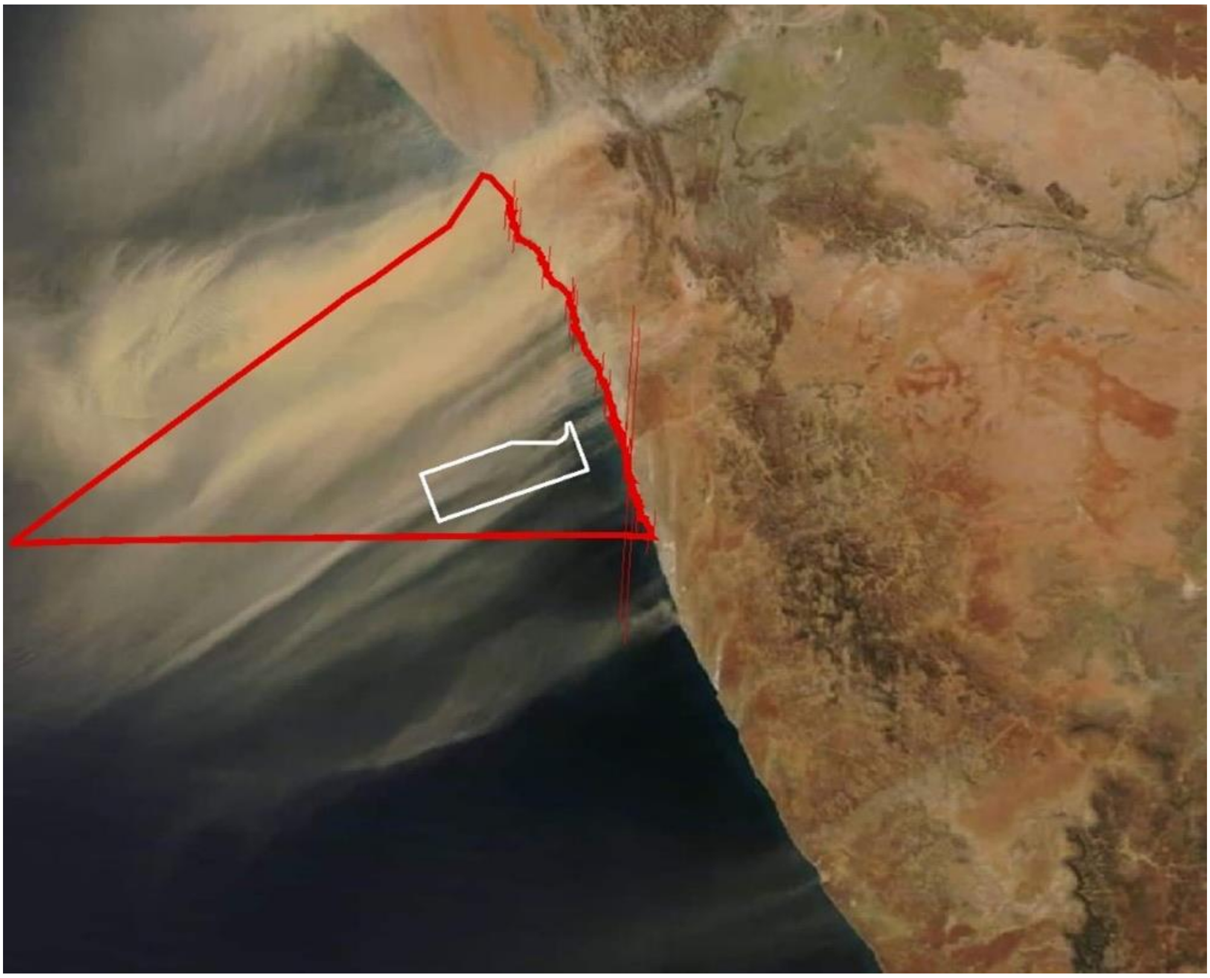


Figure 19: Block 1 (red polygon) and proposed 3D survey area (white polygon) in relation to aerosol plumes of sand and dust due to a 'berg' wind event on the southern African west coast in October 2019 (Image Source: LandWaterSA).

8.3.2 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, 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. This results 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 (Figure 20 below). 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. The poleward flow becomes more consistent in the southern Benguela.

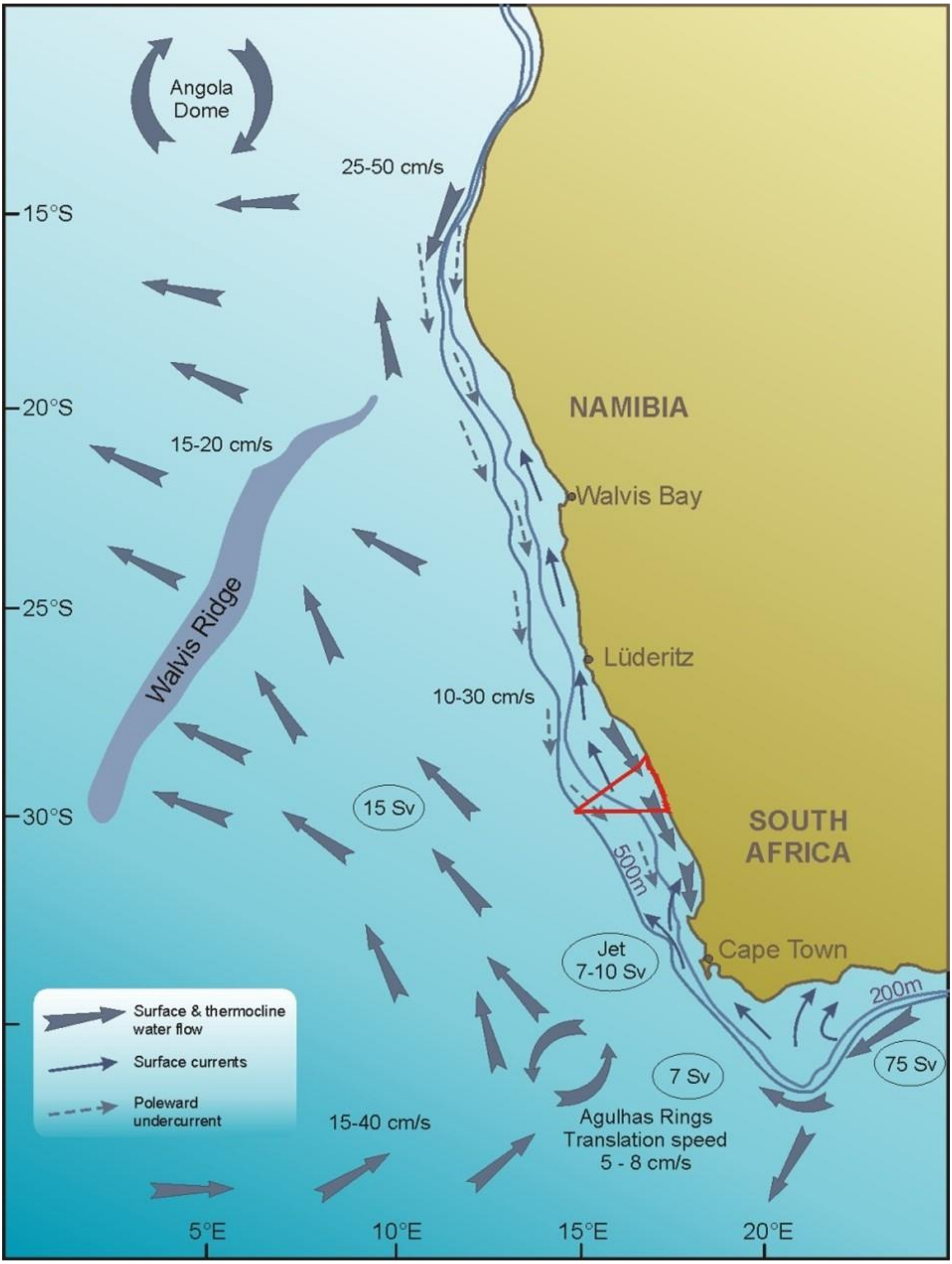


Figure 20: Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (Pisces, 2021).

The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Figure 21 below; left). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. An example of one such strong upwelling event in December 1996, followed by relaxation of upwelling and intrusion of warm Agulhas waters from the south, is shown in the satellite images in Figure 21 below. The Block 1 area overlaps with the Namaqua Cell, and seasonal upwelling events can be expected.

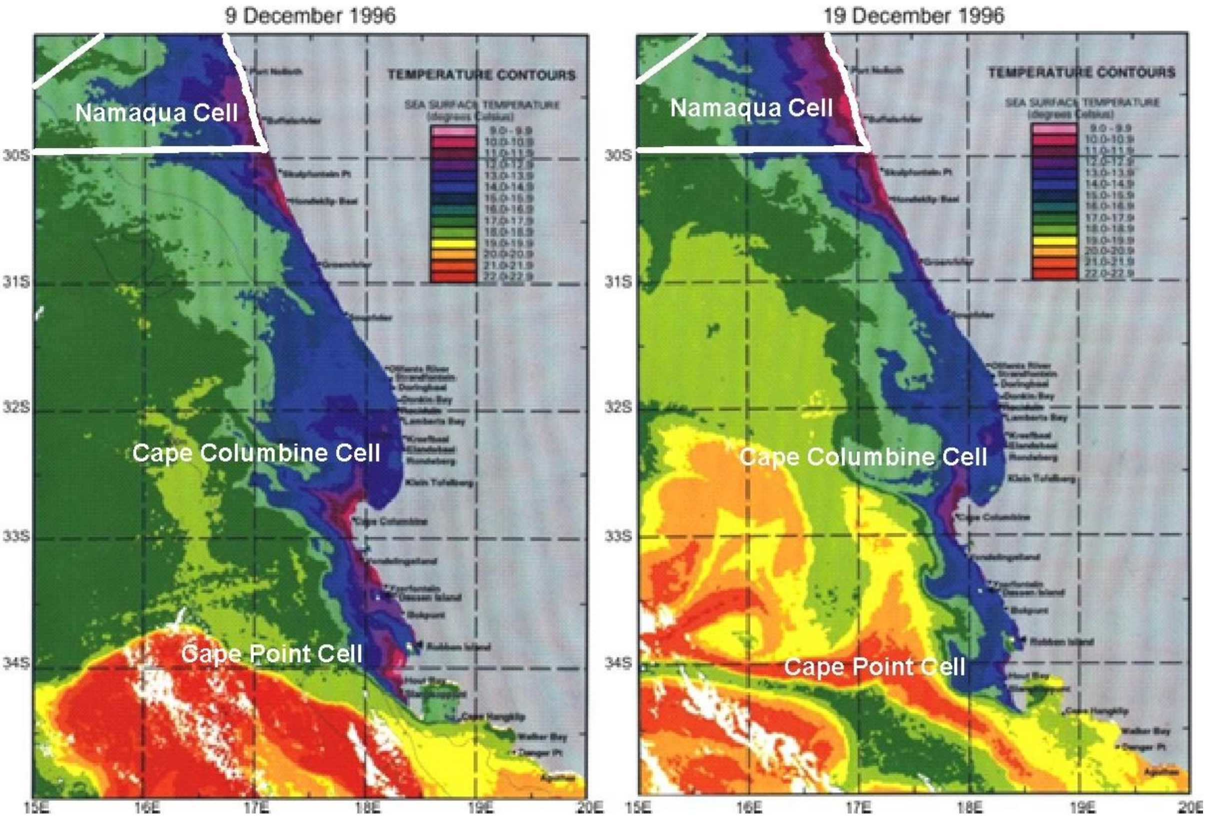


Figure 21: Satellite sea-surface temperature images showing upwelling intensity along the South African west coast on four days in December 1996, in relation to Block 1 (white polygon) (Pisces, 2021).

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 (Figure 21 above, right). These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantarctic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species.

8.3.3 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 (Figure 22 below). The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

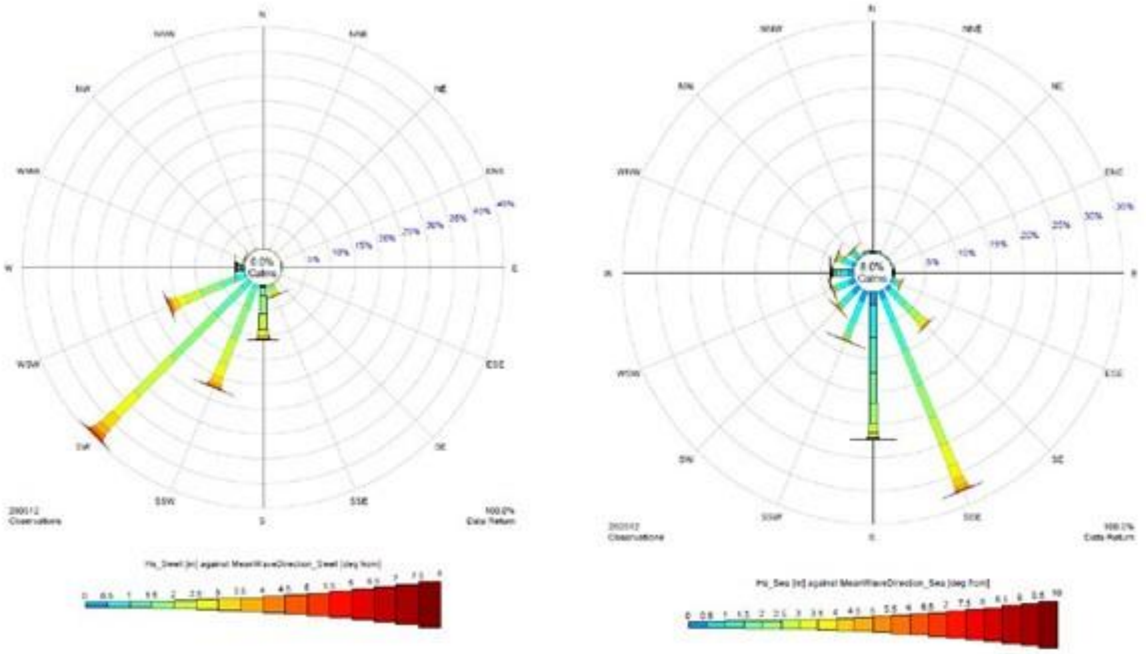


Figure 22: Annual roseplots of significant wave height partitions of swell (left) and wind-sea (right) for GROW1012 hind cast data at location 15°E, 31°S (Pisces, 2021).

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. 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.

8.3.4 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. Salinities range between 34.5‰ and 35.5‰.

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.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur. 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. This is mediated by nutrient regeneration from biogenic material in the sediments. 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.

8.3.5 UPWELLING & PLANKTON PRODUCTION

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates. During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays. Block 1 is located within the Namaqua upwelling cell and waters are expected to be cold and nutrient rich (see Figure 21 above).

8.3.6 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/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone. Thirty six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean (Figure 23 below, left). 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 (Figure 23 below, right). Being associated primarily with upwelling cells, HABs could occur in Block 1.

Figure 23: Red tides can reach very large proportions (Left) and can lead to mass stranding, or 'walk-out' of rock lobsters, such as occurred at Elands Bay in February 2002 (Right) (Pisces, 2021).

8.3.7 LOW OXYGEN EVENTS

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently. The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system. The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches (refer to Figure 16 above), there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay. The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

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

8.3.8 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 (refer to Figure 19 above). Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 - 26 million tons/year. '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. For example, a 'berg' wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20 000 km^2.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ. 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. Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/ℓ at Alexander Bay just south of the mouth to peak values of 7 400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood.

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

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.

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. 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.

Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs. The waters in the offshore portions of Block 1 are thus expected to be comparatively clear.

8.4 BIOLOGICAL ENVIRONMENT

This section provides a description of the biological characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix C. Biogeographically, the study area falls into the cold temperate Namaqua Bioregion, which extend from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine. Block 1 falls within the Southern Benguela Ecoregion (Figure 24 below), which extends from Namibia to the southern tip of the Agulhas Bank. The coastal, wind-induced upwelling characterising the western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

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

8.4.1 DEMERSAL COMMUNITIES

8.4.1.1 BENTHIC INVERTEBRATE MACROFAUNA

The seabed communities in Block 1 lie within the Namaqua sub-photic and continental slope biozones, which extend from a 30 m depth to the shelf edge. The benthic habitats of South Africa were mapped as part of the 2018 National Biodiversity Assessment to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (Figure 25 below) and assigned an ecosystem threat status based on their level of protection (Figure 26 below). Block 1 is characterised by numerous ecosystem types, namely, Orange Cone Inner Shelf Mud Reef Mosaic, Orange Cone Muddy Mid-Shelf, Namaqua Muddy Mid-Shelf Mosaic, Namaqua Sandy Mid-Shelf, Namaqua Muddy Sands, Southern Benguela Sandy Outer Shelf and Southern Benguela Rocky and Sandy Shelf Edge.

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

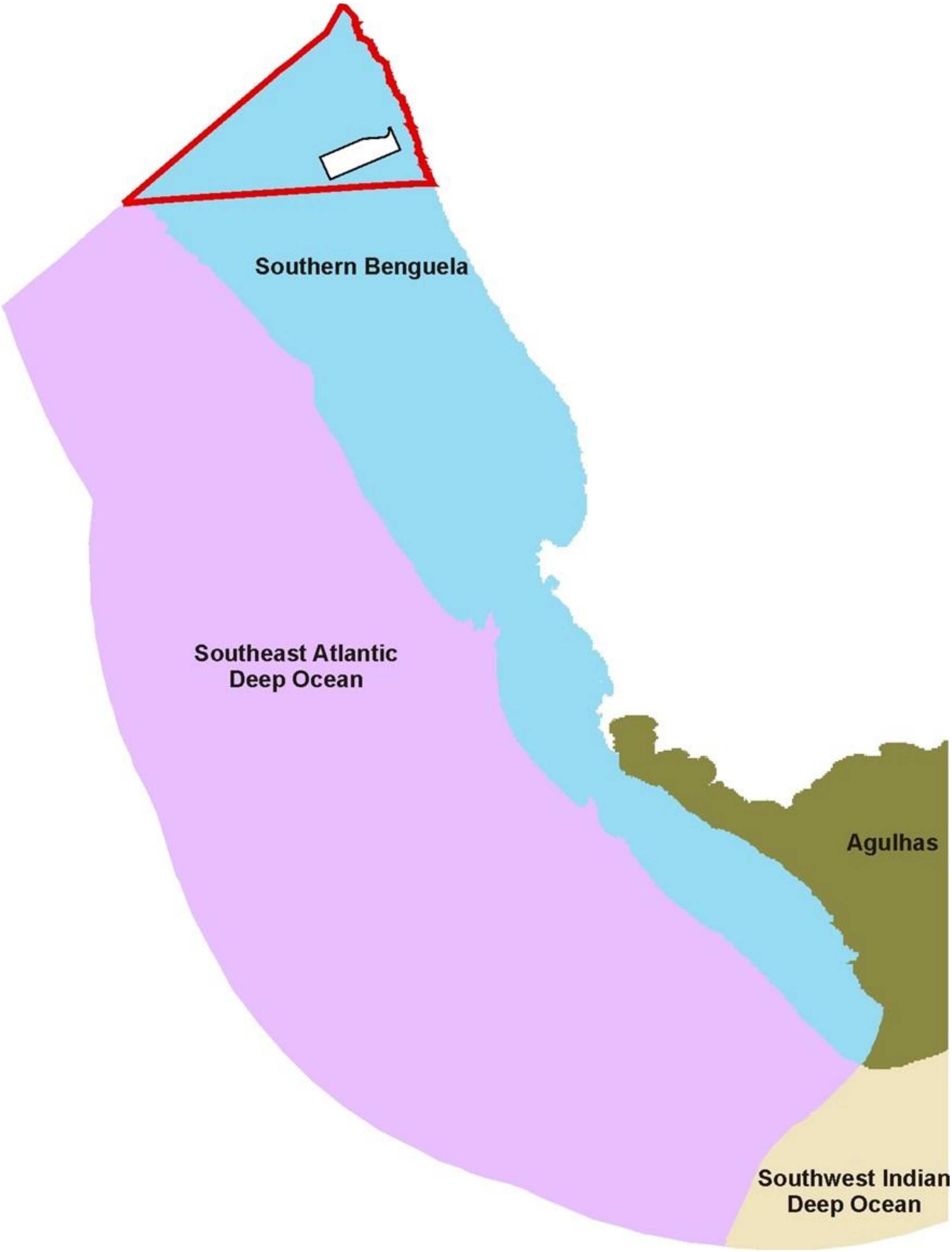


Figure 24: Block 1 (red outline) and proposed 3D survey area (white polygon) in relation to the inshore and offshore ecoregions of the South African West Coast (Pisces, 2021).

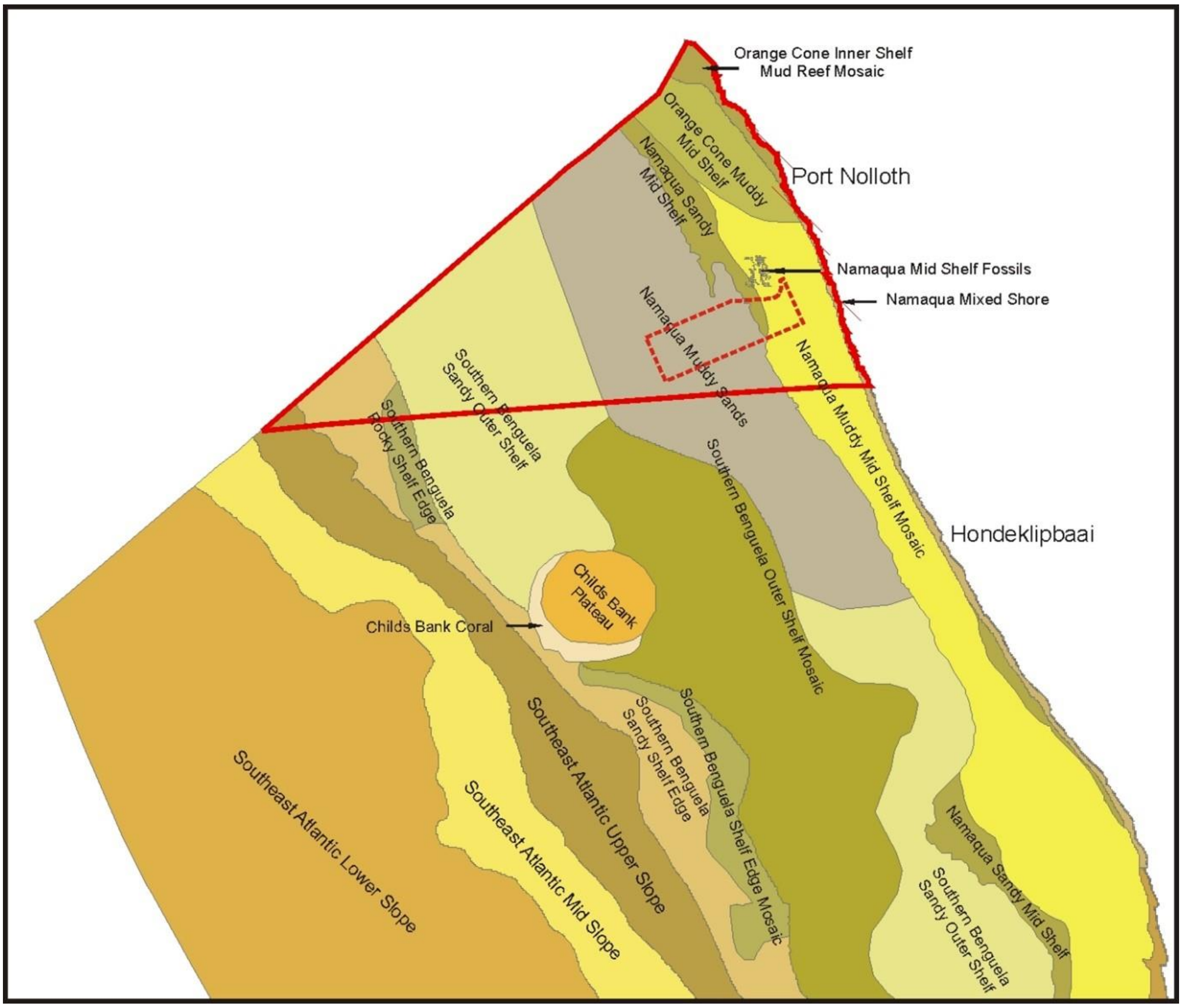


Figure 25: Block 1 (red polygon) and proposed 3D survey area (dotted line) in relation to the distribution of ecosystem types along the West Coast (Pisces, 2021).

To date very few areas on the continental slope off the West Coast have been biologically surveyed. Although sediment distribution studies suggest that the outer shelf is characterised by unconsolidated sediments (see Figure 16 above), recent surveys conducted between 180 m and 480 m depth revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification (Karenyi unpublished data).

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth). Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile gastropod and polychaete predators and sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by mud prawns. A second mid-shelf community occurring in sandy sediments, is characterised by various deposit-feeding polychaetes. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments, with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast.

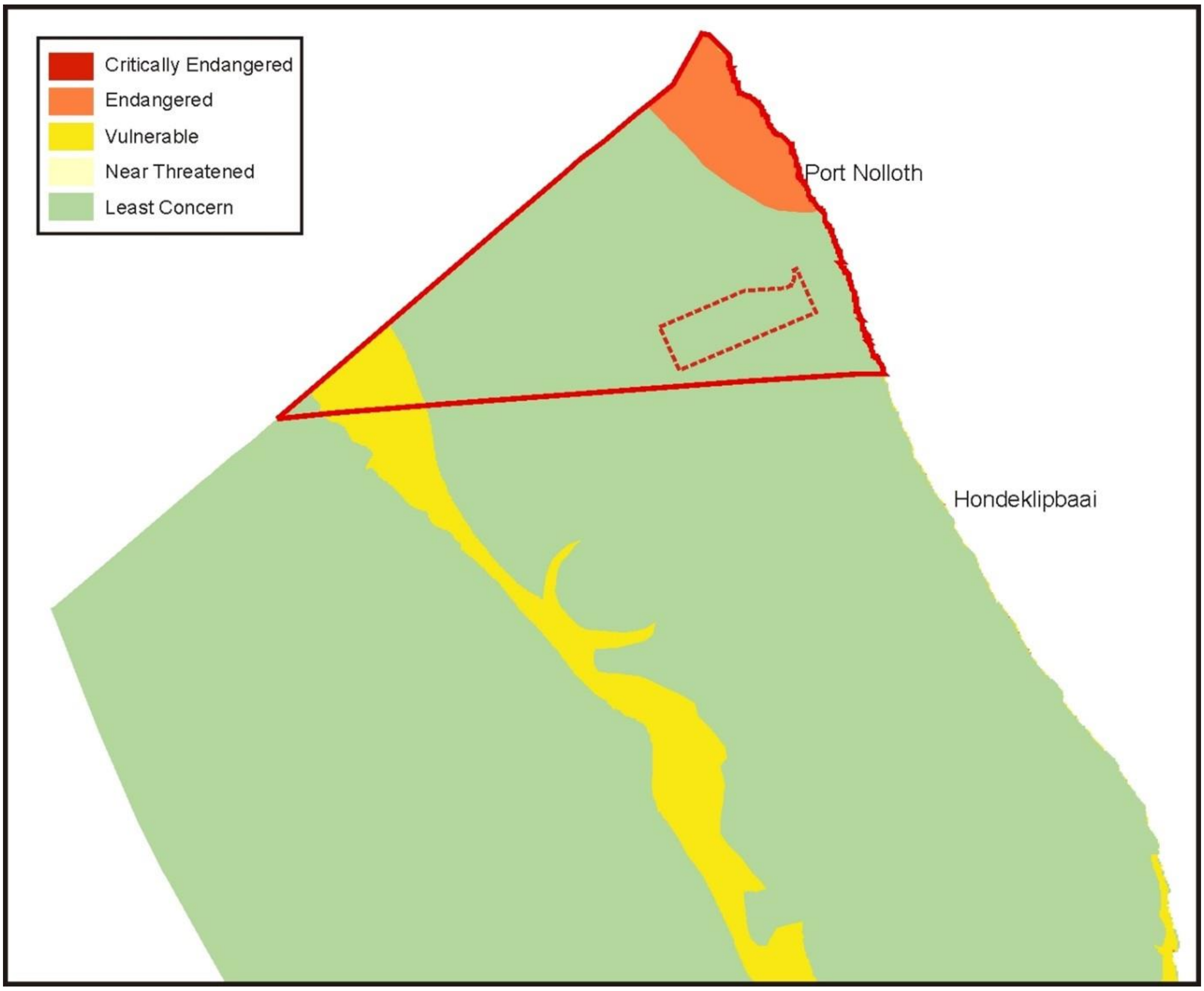


Figure 26: Block 1 (red outline) and proposed 3D survey area (dotted line) in relation to the ecosystem threat status for coastal and offshore benthic and pelagic habitat types on the South African West Coast (Pisces, 2021)

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna on the continental shelf, the marine component of the 2018 National Biodiversity Assessment, rated the habitat types that characterise most of Block 1 as being of 'Least concern' (Figure 26 above). The proposed 3D seismic survey area lies within habitat types considered of 'Least Concern'. This primarily reflects the great extent of these habitats in the South African EEZ. However, those communities occurring along the shelf edge (-500 m) in the western extreme of the Block have been rated as 'Vulnerable', and the Orange Cone Muddy Mid-Shelf and Inner Shelf Mud Reef Mosaic, which lie in the northern corner of the Block are considered 'Endangered'.

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

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African west coast and elsewhere in the world. However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration, productivity, organic carbon and seafloor temperature may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deep-water shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability. 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.

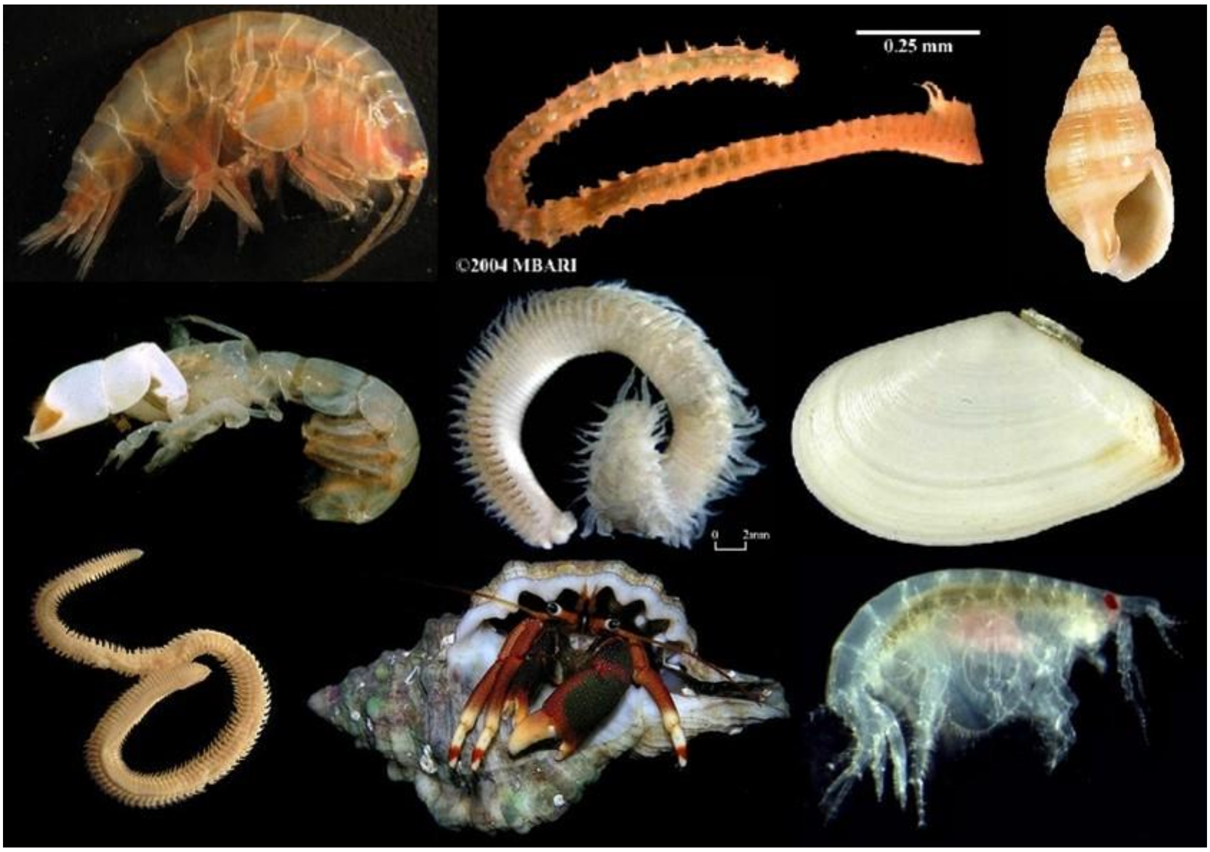


Figure 27: Benthic macrofaunal genera commonly found in nearshore sediments include: (top: left to right) Ampelisca, Prionospio, Nassarius; (middle: left to right) Callianassa, Orbinia, Tellina; (bottom: left to right) Nephtys, hermit crab, Bathyporeia (Pisces, 2021).

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.

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.

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

8.4.1.2 **DEEP-WATER CORAL COMMUNITIES**

There has been increasing interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths below 150 m with some species being recorded from as deep as 3 000 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity. Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement. Corals have been discovered associated with the Namaqua Fossil Forest and other rocky outcrop areas in 100 - 120 m depth off southern Namibia and to the south-east of Child's Bank (De Beers Marine, unpublished data). 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.

8.4.1.3 DEMERSAL FISH SPECIES

Demersal fish are those species that live and feed on or near the seabed. As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast. Changes in fish communities occur both latitudinally and with increasing depth, with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth. 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 and with the eastward shifts observed in small pelagic fish species and rock lobster populations.

The diversity and distribution of demersal cartilagenous fishes on the West Coast is discussed by Compagno et al. (1991). The species that may occur in the general project area and on the continental shelf inshore thereof, and their approximate depth range, are listed in Table 8 below.

Table 8: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Pisces, 2021).

Common Name	Scientific name	Depth Range (m)
Frilled shark	*Chlamydoselachus anguineus*	200-1 000
Six gill cowshark	*Hexanchus griseus*	150-600
Gulper shark	*Centrophorus granulosus*	480
Leafscale gulper shark	*Centrophorus squamosus*	370-800
Bramble shark	*Echinorhinus brucus*	55-285
Black dogfish	*Centroscyllium fabricii*	>700
Portuguese shark	*Centroscymnus coelolepis*	>700
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700
Birdbeak dogfish	*Deania calcea*	400-800
Arrowhead dogfish	*Deania profundorum*	200-500

Common Name	Scientific name	Depth Range (m)
Longsnout dogfish	*Deania quadrispinosum*	200-650
Sculpted lanternshark	*Etmopterus brachyurus*	450-900
Brown lanternshark	*Etmopterus compagnoi*	450-925
Giant lanternshark	*Etmopterus granulosus*	>700
Smooth lanternshark	*Etmopterus pusillus*	400-500
Spotted spiny dogfish	*Squalus acanthias*	100-400
Shortnose spiny dogfish	*Squalus megalops*	75-460
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600
Sixgill sawshark	*Pliotrema warreni*	60-500
Goblin shark	*Mitsukurina owstoni*	270-960
Smalleye catshark	*Apristurus microps*	700-1 000
Saldanha catshark	*Apristurus saldanha*	450-765
"grey/black wonder" catsharks	*Apristurus spp.*	670-1 005
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
African softnose skate	*Bathyraja smithii*	400-1 020
Smoothnose legskate	*Cruriraja durbanensis*	>1 000
Roughnose legskate	*Crurirajaparcomaculata*	150-620
African dwarf skate	*Neoraja stehmanni*	290-1 025
Thorny skate	*Raja radiata*	50-600
Bigmouth skate	*Raja robertsi*	>1 000
Slime skate	*Raja pullopunctatus*	15-460
Rough-belly skate	*Raja springeri*	85-500
Yellowspot skate	*Raja wallacei*	70-500
Roughskin skate	*Raja spinacidermis*	1 000-1 350
Biscuit skate	*Raja clavata*	25-500
Munchkin skate	*Raja caudaspinosa*	300-520
Bigthorn skate	*Raja confundens*	100-800
Ghost skate	*Raja dissimilis*	420-1 005
Leopard skate	*Raja leopardus*	300-1 000
Smoothback skate	*Raja ravidula*	500-1 000
Spearnose skate	*Raja alba*	75-260

Common Name	Scientific name	Depth Range (m)
St Joseph	*Callorhinchus capensis*	30-380
Cape chimaera	*Chimaera sp.*	680-1 000
Brown chimaera	*Hydrolagus sp.*	420-850
Spearnose chimaera	*Rhinochimaera atlantica*	650-960

8.4.1.4 SEAMOUNT COMMUNITIES

Two geological features of note in the vicinity of Block 1 are Child's Bank, situated ~75 km south of the southern boundary of Block 1 at about 31°S, and Tripp Seamount situated at about 29°40'S, ~25 km west of the western tip of Block 1. Child's Bank was described by Dingle et al. (1987) to be a carbonate mound (bioherm). The top of this feature is a sandy plateau with dense aggregations of brittle stars, while the steeper slopes have dense invertebrate assemblages including unidentified cold-water corals/rugged limestone feature, bounded at outer edges by precipitous cliffs at least 150 m high. 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. 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, 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.

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. Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species.

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. Deep- and cold-water corals (including stony corals, black corals and soft corals) Figure 28 below, 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. There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters). Some of the smaller cnidarians species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats.

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

The concept of a VME centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities.

VMEs are known to be associated with higher biodiversity levels and indicator species that add structural complexity, resulting in greater species abundance, richness, biomass and diversity compared to surrounding uniform seabed habitats. Compared to the surrounding deep-sea environment, VMEs typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Levels of endemism on VMEs are also relatively high compared to the deep sea. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework (Figure 28 below, right) thereby creating spatially fragmented areas of high biological diversity. The skeletal remains of Scleractinia coral rubble and Hexactinellid poriferans can also represent another important deep-sea habitat, acting to stabilise seafloor sediments allowing for colonisation by distinct infaunal taxa that show elevated abundance and biomass in such localised habitats.

Figure 28: 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.

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species. They can provide a wide range of ecosystem services ranging from provision of aggregation- and spawning sites to providing shelter from predation and adverse hydrological conditions. Indicator taxa for VMEs are also known to provide increased access to food sources, both directly to associated benthic fauna, and indirectly to other pelagic species such as fish and other predators due to the high abundance and biomass of associated fauna.

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders. Poriferans and cold-water corals further shown to provide a strong link between pelagic and benthic food webs. VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning.

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. 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 29), and in 190-527 m depth on Child’s Bank suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges do occur on the continental shelf.

Figure 29: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast.

The deep water habitats on the West Coast are thought to be characterised by a number of VME indicator species such as sponges, soft corals and hard corals (Table 9 below). The distribution of 22 potential VME indicator taxa for the South African EEZ were recently mapped, with those from the northern West Coast listed in Table 9 below.

Table 9: Table of Potential VME species from the continental shelf and shelf edge on the West Coast

Phylum	Name	Common Name
Porifera	*Suberites dandelenae*	Amorphous solid sponge
	Rossella cf. antarctica	Glass sponge
Cnidaria	*Melithaea spp.*	Colourful sea fan
	Thouarella spp.	Bottlebrush sea fan
Family: Isididae		Bamboo coral
	Anthoptilum grandiflorum	Large sea pen*
	Lophelia pertusa	Reef-building cold water coral
	Stylaster spp.	Fine-branching hydrocoral
Bryozoa	*Adeonella spp.*	Sabre bryozoan
	Phidoloporidae spp.	Honeycomb false lace coral
Hemichordata	*Cephalodiscus gilchristi*	Agar animal

8.4.2 PELAGIC COMMUNITIES

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

8.4.2.1 **PLANKTON**

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2-m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton (Figure 30 below).

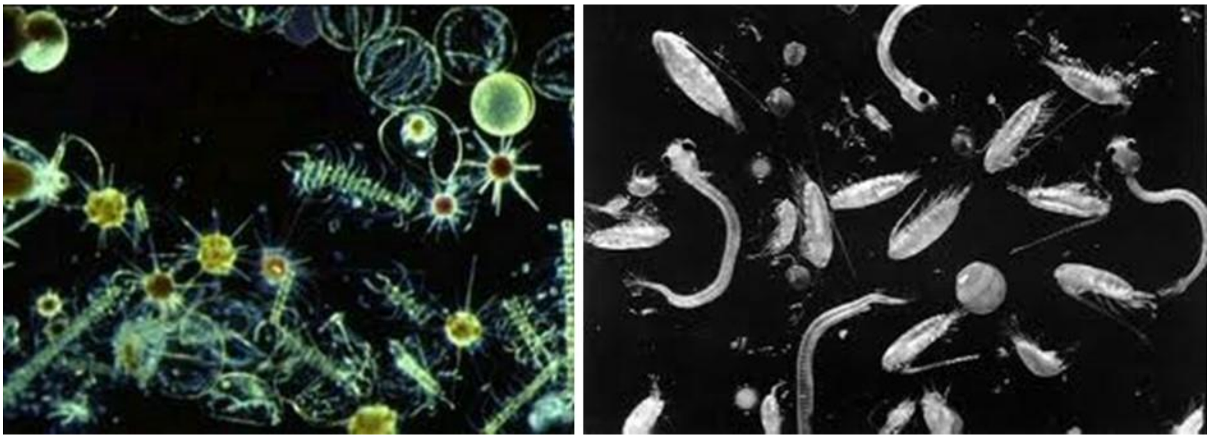


Figure 30: Phytoplankton (left) and zooplankton (right) is associated with upwelling cells.

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m. 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*. 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. 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 Ce*ntropages 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, with the exception of *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.

Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m^2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1-1.0 g C/m^2, with production increasing north of Cape Columbine. 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, 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 (see Figure 31), and their eggs and larvae form an important contribution to the ichthyoplankton in the region. Ichthyoplankton abundance in the offshore oceanic waters of the proposed area of interest are, however, expected to be low.

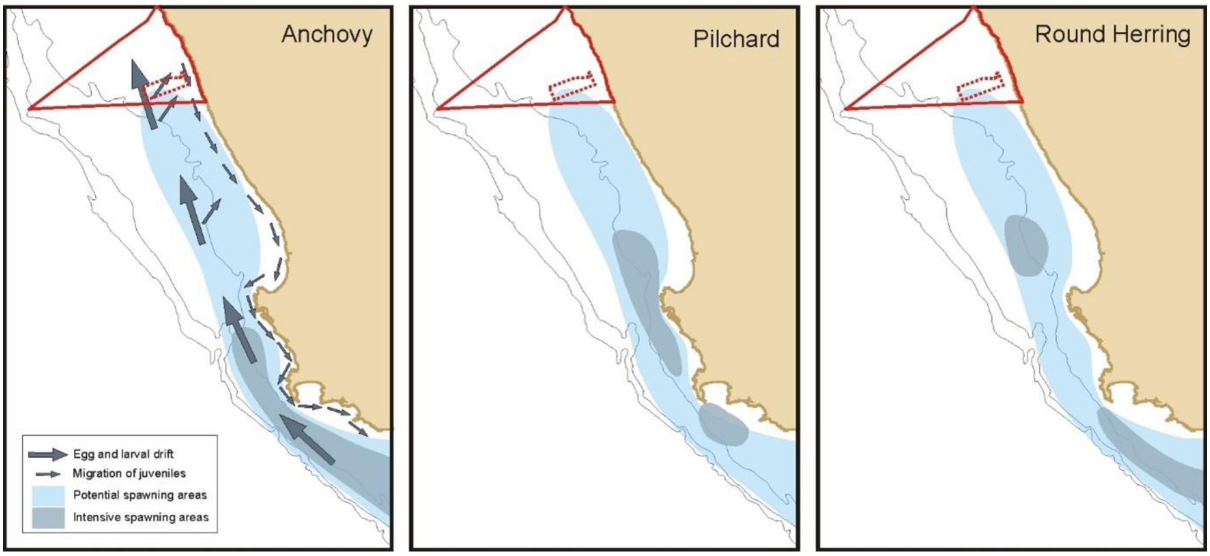


Figure 31: Block 1 (red polygon) and the proposed 3D survey area (dotted line) in relation to major spawning areas in the southern Benguela region (Pisces, 2021).

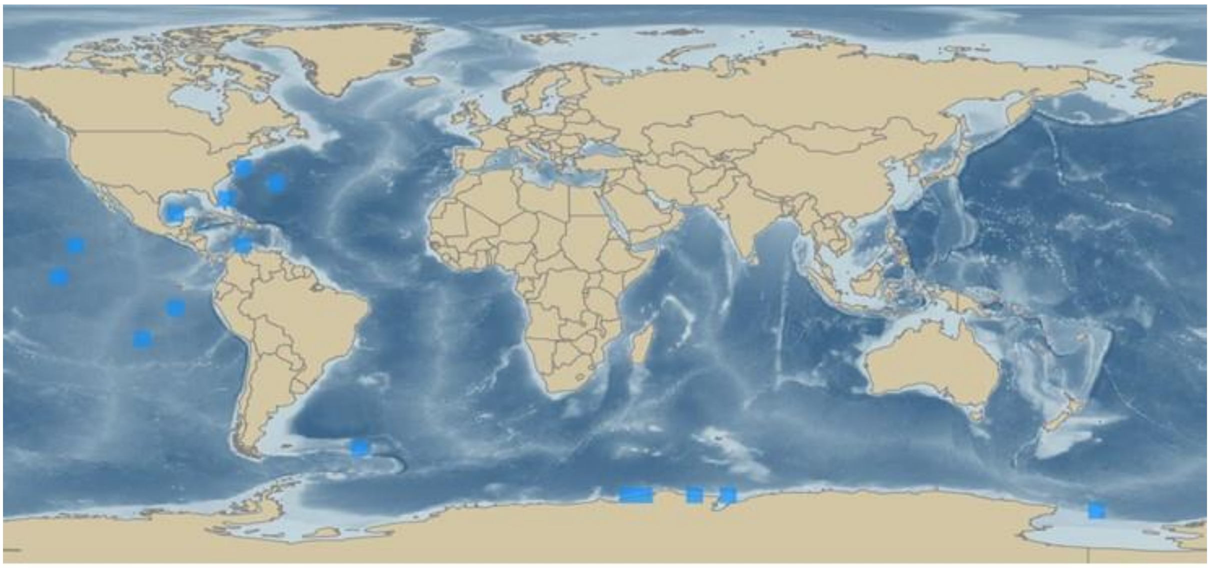
8.4.2.2 **CEPHALOPODS**

Fourteen species of cephalopds have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish. 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. They form an important food item for demersal fish.

The colossal squid *Mesonychoteuthis hamiltoni* and the giant squid *Architeuthis sp*. may also be encountered in the project area. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-antarctic Southern Ocean (Figure 32 below, top) while the giant squid is usually found near continental and island slopes all around the world's oceans (Figure 32 below, bottom). Both species could thus potentially occur in the pelagic habitats of the project area, although the likelihood of encounter is extremely low.

Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies.



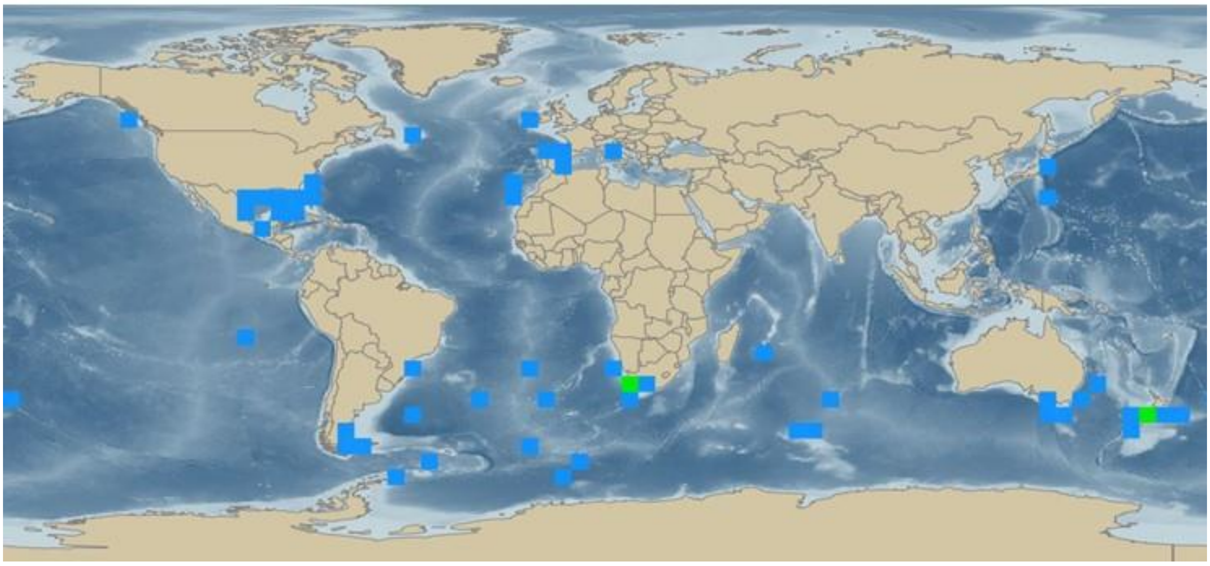


Figure 32: Distribution of the colossal squid (top) and the giant squid (bottom). Blue squares <5 records, green squares 5-10 records (Pisces, 2021)

8.4.2.3 **PELAGIC FISH**

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*) (Figure 33 below, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (Figure 33 below, right) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes, and generally occur within the 200 m contour. Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast. They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

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

Figure 33: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right).

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek Thyrsites atun and chub mackerel Scomber japonicas. Both these species have been rated as 'Least concern' on the national assessment. 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. 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.

The fish most likely to be encountered on the shelf and in the offshore waters of Block 1 are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing (Table 10 below). 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 10: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the West Coast. The National and Global IUCN Conservation Status are also provided.

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

Common Name	Species	National Assessment	IUCN Conservation Status
Sailfish	*Istiophorus platypterus*	Least concern	Least concern
Swordfish	*Xiphias gladius*	Data deficient	Least concern
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*		Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Data deficient	Vulnerable
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*		Vulnerable
Whale Shark	*Rhincodon typus*		Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Species occurring off western southern Africa include the albacore/longfin tuna *Thunnus alalunga* (Figure 34 below, right), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack Katsuwonus pelamis tunas, as well as the Atlantic blue marlin Makaira nigricans (Figure 34 below, left), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius*. The distributions of these species are dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts.

A number of species of pelagic sharks are also known to occur on the West and South-West Coast, including blue *Prionace glauca*, short-fin mako *Isurus oxyrinchus* and oceanic whitetip sharks *Carcharhinus longimanus*. Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great whites *Carcharodon carcharias* and whale sharks *Rhincodon typus* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts.

Figure 34: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters.

8.4.2.4 **TURTLES**

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (Figure 35 below, left), and occasionally the Loggerhead (*Caretta caretta*) (Figure 35 below, right) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast. The most recent conservation status, which assessed the species on a sub-regional scale, is provided in Table 11 below.

Figure 35: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Pisces, 2021).

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 jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa). 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 (Figure 36 below).

Table 11: Global and Regional Conservation Status of the turtles occurring off the South Coast showing variation depending on the listing used.

Listing	Leatherback	Loggerhead	Green
IUCN Red List:			
Species (date)	V (2013)	V (2017)	E (2004)
Population (RMU)	CR (2013)	NT (2017)	*
Sub-Regional/National			
NEMBA TOPS (2017)	CR	E	E
Sink & Lawrence (2008)	CR	E	E
Hughes & Nel (2014)	E	V	NT
NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered DD – Data Deficient UR – Under Review * - not yet assessed			

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. Their abundance in the study area is unknown but expected to be low. Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. Leatherback Turtles are listed as 'Critically endangered' worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). The 2017 South African list of Threatened and Endangered Species (TOPS) similarly lists the species as 'Critically endangered', whereas on the National Assessment leatherbacks were listed as 'Endangered', whereas Loggerhead and green turtles are listed globally as 'Vulnerable' and 'Endangered', respectively, whereas on TOPS both species are listed as 'Endangered'. As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

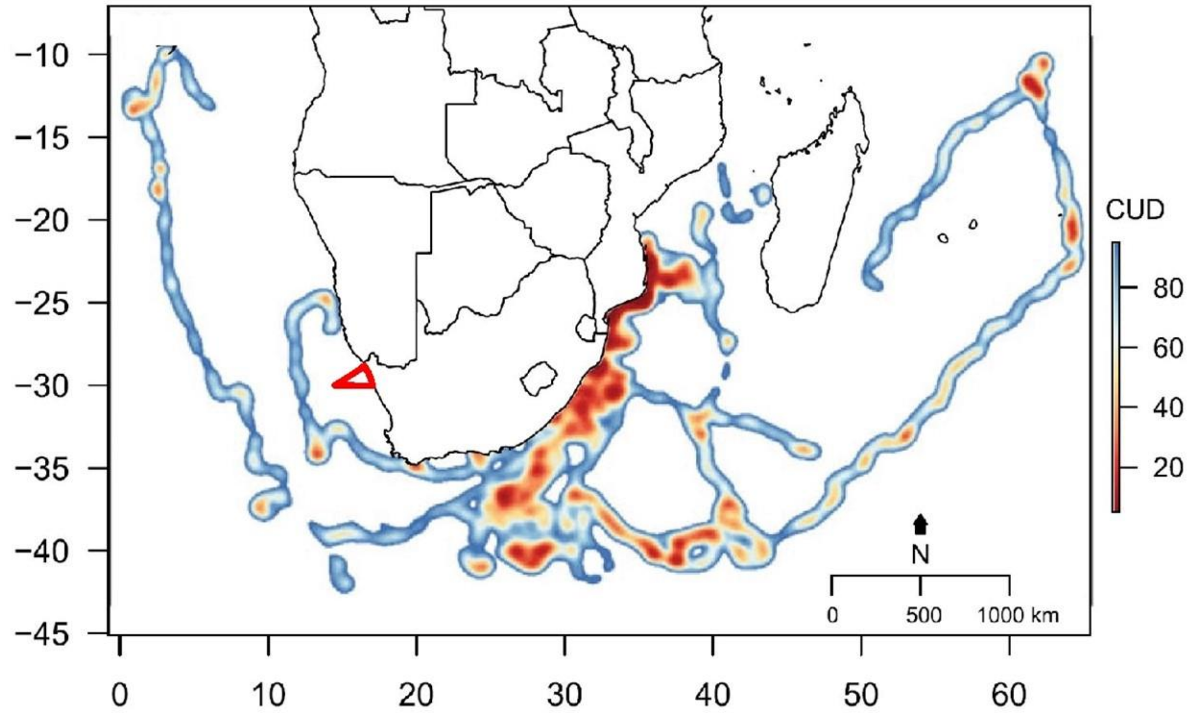


Figure 36: Block 1 (red polygon) in relation to the migration corridors of leatherback turtles in the south-western Indian Ocean. Relative use (CUD, cumulative utilization distribution) of corridors is shown through intensity of shading: light, low use; dark, high use (Pisces, 2021).

8.4.2.5 **SEABIRDS**

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the Southern Ocean. The species classified as being common in the southern Benguela are listed in Table 12 below. 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), well inshore of the proposed area of interest, with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

14 species of seabirds breed in southern Africa; Cape Gannet (Figure 37 below, left), African Penguin (Figure 37 below, right), four species of Cormorant, White Pelican, three Gull and four Tern species (Table 13 below). The breeding areas are distributed around the coast with islands being especially important. The closest breeding islands to the project area are Bird Island at Lambert's Bay, ~225 km west of the eastern boundary of the Block, and Sinclair Island over 300 km to the north in Namibia. 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 within 200 km offshore, and African Penguins have also been recorded as far as 60 km offshore. Block 1 lies well to the north of South African West Coast gannet foraging areas (Figure 38 below).

Figure 37: Cape Gannets *Morus capensis* (left) and African Penguins *Spheniscus demersus* (right) breed primarily on the offshore Islands (Pisces, 2021).

Table 12: Pelagic seabirds common in the southern Benguela region. IUCN Red List and Regional Assessment status are provided (Pisces, 2021).

Common Name	Species name	Regional Assessment	Global IUCN
Shy Albatross	*Thalassarche cauta*	Near Threatened	Near Threatened
Black browed Albatross	*Thalassarche melanophrys*	Endangered	Least concern
Yellow-nosed Albatross	*Thalassarche chlororhynchos*	Endangered	Endangered
Giant Petrel sp.	*Macronectes halli/giganteus*	Near Threatened	Least concern
Pintado Petrel	*Daption capense*	Least concern	Least concern
Greatwinged Petrel	*Pterodroma macroptera*	Near Threatened	Least concern
Soft-plumaged Petrel	*Pterodroma mollis*	Near Threatened	Least concern
Arctic Prion	*Pachyptila desolata*	Least concern	Least concern
Broad-billed Prion	*Pachyptila vittata*	Least concern	Least concern
White-chinned Petrel	*Procellaria aequinoctialis*	Vulnerable	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Least concern	Least concern
Great Shearwater	*Puffinus gravis*	Least concern	Least concern
Sooty Shearwater	*Puffinus griseus*	Near Threatened	Near Threatened
European Storm Petrel	*Hydrobates pelagicus*	Least concern	Least concern
Leach's Storm Petrel	*Oceanodroma leucorhoa*	Critically Endangered	Vulnerable
Wilson's Storm Petrel	*Oceanites oceanicus*	Least concern	Least concern
Blackbellied Storm Petrel	*Fregetta tropica*	Near Threatened	Least concern
Subantarctic Skua	*Catharacta antarctica*	Endangered	Least concern
Sabine's Gull	*Larus sabini*	Least concern	Least concern

Table 13: Breeding resident seabirds present along the South Coast. IUCN Red List and National Assessment status are provided.

Common Name	Species Name	National Assessment	Global Assessment
African Penguin	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher	*Haematopus moquini*	Least Concern	Near Threatened
White-breasted Cormorant	*Phalacrocorax carbo*	Least Concern	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Endangered	Endangered
Bank Cormorant	*Phalacrocorax neglectus*	Endangered	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Near Threatened	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Vulnerable	Least Concern

Common Name	Species Name	National Assessment	Global Assessment
Cape Gannet	*Morus capensis*	Endangered	Endangered
Kelp Gull	*Larus dominicanus*	Least Concern	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable	Least Concern
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Endangered	Least Concern
Damara Tern	*Sterna balaenarum*	Vulnerable	Vulnerable

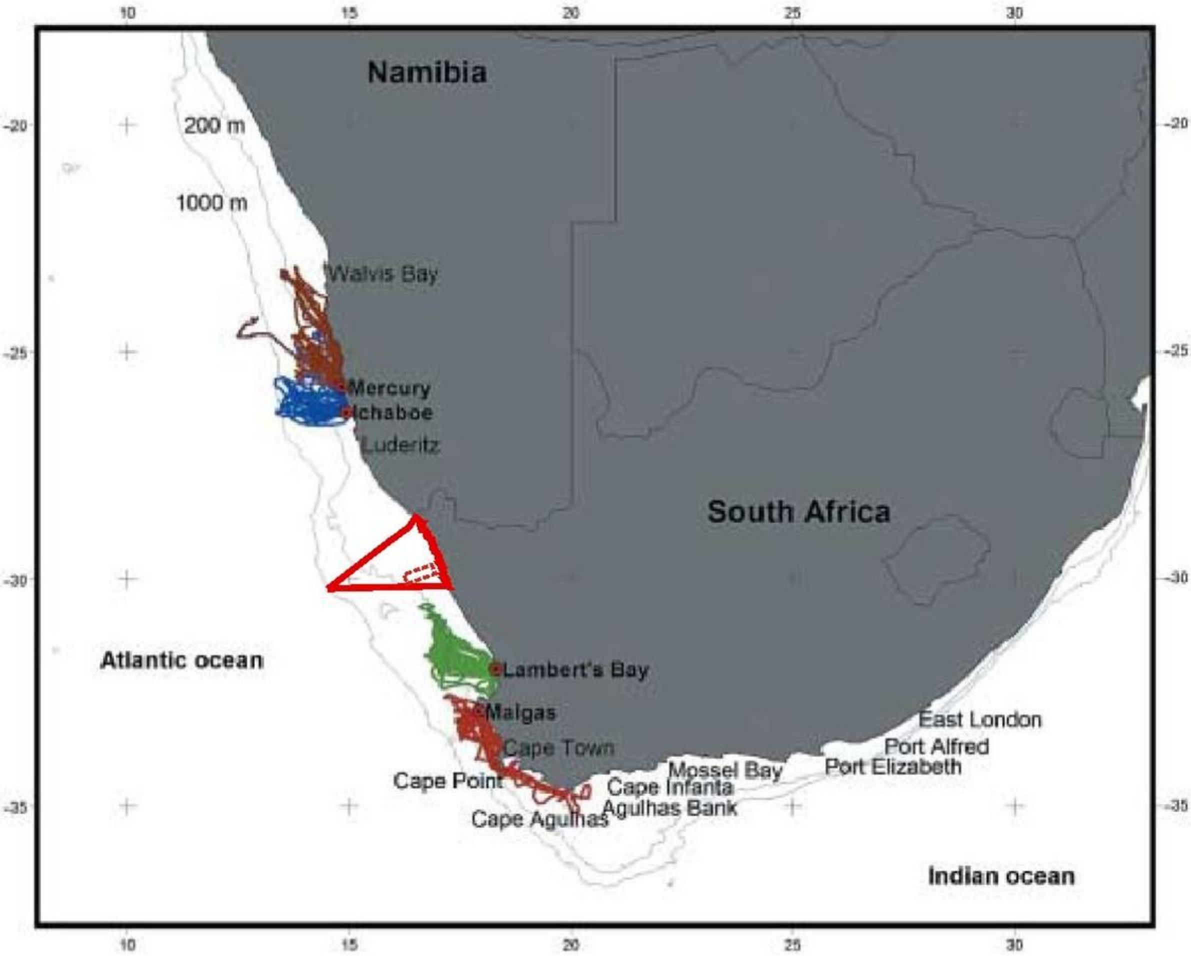


Figure 38: Block 1 (red polygon) in relation to GPS tracks recorded for 93 Cape Gannets foraging off four breeding colonies in South Africa and Namibia (Pisces, 2021).

8.4.2.6 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 three species of whales and dolphins are known (based on historic sightings or strandings records) or likely (based on habitat projections of known species parameters) to occur in these waters (Table 14), and their known seasonality (Figure 40 below). Of the species listed, the blue whale is considered 'Critically endangered', fin and sei whales are 'Endangered' and one is considered vulnerable (IUCN Red Data list Categories). Altogether 17 species are listed as "data deficient" underlining how little is known about cetaceans, their distributions and population trends. The offshore areas have been particularly poorly studied with 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 is particularly poor and the precautionary principal must be used when considering possible encounters with cetaceans in this area.

Records from stranded specimens show that the area between St Helena Bay (~32° S) and Cape Agulhas (~34° S, 20° E) is an area of transition between Atlantic and Indian Ocean species, 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). The project area lies north of this transition zone and can be considered to be truly on the 'west coast'. However, the warmer waters that occur offshore of the Benguela ecosystem (more than ~100 km offshore) 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 there have been included here for the sake of completeness.

The distribution of cetaceans can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found on the continental slope (200 – 2 000 m) making this the most species rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across 1 000s of kilometres. As Block 1 is located on the continental shelf, cetacean diversity in the area can be expected to be comparatively high, with abundances also high compared to further offshore beyond the shelf. The most common species within the project area (in terms of likely encounter rate not total population sizes) are likely to be humpback whales and Heaviside's dolphins.

Cetaceans are comprised of two taxonomic groups, the mysticetes (filter feeders with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term 'whale' is used to describe species in both groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontoceti, family Delphinidae and are thus dolphins). Due to differences in sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

Table 14 lists the cetaceans likely to be found within the project area. The majority of data available on the seasonality and distribution of large whales in the project area is the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (e.g. migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although almost all data is limited to that collected on the continental shelf close to shore.

A review of the distribution and seasonality of the key cetacean species likely to be found within the project area is provided below.

8.4.2.6.1 MYSTICETE (BALEEN) WHALES

The majority of mysticetes whales fall into the family Balaenopeteridae. Those occurring in the area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales. The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters. All of these species show some degree of migration either to or through the latitudes encompassed by the broader project area when *en route* between higher latitude (Antarctic or Subantarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality may be either unimodal, usually in winter months, 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.

Table 14: Cetaceans occurrence off the South Coast of South Africa, their seasonality, likely encounter frequency with proposed exploration activities and South African and Global IUCN Red List conservation status.

Common Name	Species	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids						
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Year round	Least Concern	Data Deficient
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	*Delphinus delphis*	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*	No	Unknown	Unknown	Least Concern	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	*Globicephala melas*	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	Unknown	Unknown	Unknown	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	Unknown	Unknown	Unknown		Least Concern
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	*Feresa attenuata*	Unknown	Yes	Unknown	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	Unknown	Data Deficient	Least Concern
Sperm whales						
Pygmy sperm whale	*Kogia breviceps*	Edge	Yes	Year round	Data Deficient	Data Deficient

Common Name	Species	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Dwarf sperm whale	*Kogia sima*	Edge	Unknown	Unknown	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*	Edge	Yes	Year round	Vulnerable	Vulnerable
Beaked whales						
Cuvier's	*Ziphius cavirostris*		Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Beradius arnouxii*		Yes	Year round	Data Deficient	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*		Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*		Yes	Year round	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*		Yes	Year round	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*		Yes	Year round	Data Deficient	Data Deficient
Blainville's	*Mesoplodon densirostris*		Yes	Year round	Data Deficient	Data Deficient
Baleen whales						
Antarctic Minke	*Balaenoptera bonaerensis*	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	*B. acutorostrata*	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	*B. physalus*	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	*B. musculus intermedia*	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	*B. borealis*	Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	*B brydei (subspp)*	Yes	Yes	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. brydei*	Yes	Yes	Summer (JF)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	Yes	Unknown	Year round	Least Concern	Least Concern

Common Name	Species	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Humpback sp.	*Megaptera novaeangliae*	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	Yes	Yes	Spring Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	Yes	No	Year round, SONDJF	Least Concern	Least Concern

Table 15: Seasonality of baleen whales in the broader project area based on data from multiple sources, predominantly commercial catches and data from stranding events. Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

Whale Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's Offshore	H	H	H	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	H	H	L	H	H	H	L	L
Fin	M	M	M	H	H	H	M	H	H	H	M	M
Blue	L	L	L	L	L	H	H	H	L	M	L	L
Minke	M	M	M	H	H	H	M	H	H	H	M	M
Humpback	M	M	L	L	L	H	H	M	M	L	M	H
Southern Right	H	M	L	L	L	H	H	H	M	M	H	H
Pygmy right	H	H	H	M	L	L	L	L	L	L	M	M

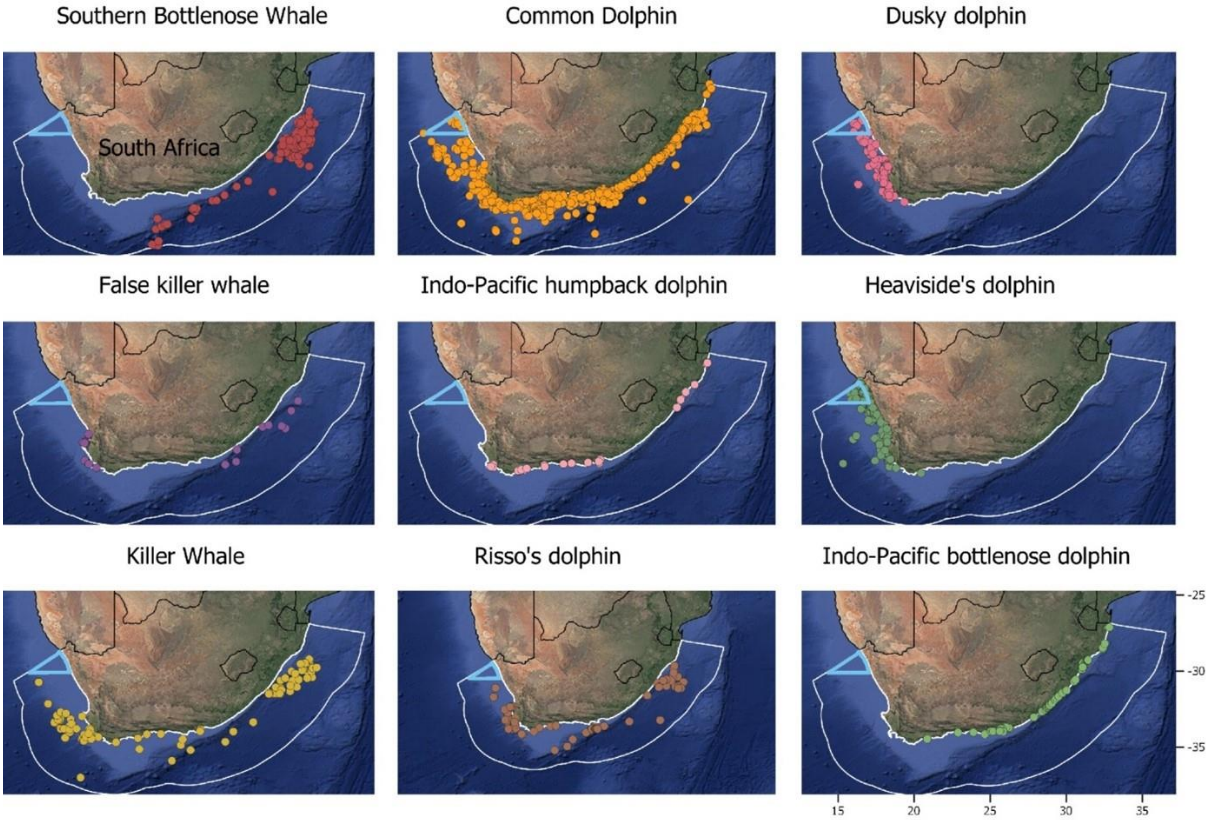


Figure 39: Block 1 (cyan polygon) in relation to projections of predicted distributions for nine odontocete species off the West Coast of South Africa.

Bryde's whales: Two genetically and morphologically distinct populations of Bryde's whales (Figure 40 below, left) live off the coast of southern Africa. The "offshore population" lives beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the West Coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the broader project area in January - March. Several strandings of adult offshore Bryde's whales in central Namibia confirm that the species passes through the project area. The "inshore population" of Bryde's, which lives on the continental shelf and Agulhas Bank, is unique amongst baleen whales in the region by being non-migratory. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the west coast with possible movements further north up the West Coast and into Namibia during the winter months.

Sei whales: Sei whales spend time at high altitudes (40-50˚S) during summer months and migrate north through South African waters (where they were historically hunted in relatively high numbers) to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most deeper than 1 000 m. Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

Fin whales: Fin whales were historically caught off the West Coast of South Africa, with a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. However, the location of the breeding ground (if any) and how far north it is remains a mystery. Some juvenile animals may feed year round in deeper waters off the shelf. There are no recent data on abundance or distribution of fin whales off western South Africa.

Figure 40: The Bryde's whale *Balaenoptera brydei* (left) and the Minke whale *Balaenoptera bonaerensis* (right).

Blue whales: Although Antarctic blue whales were historically caught in high numbers off the South African West Coast, with a single peak in catch rates during July in Namibia and Angola suggesting that these latitudes are close to the northern migration limit for the species in the eastern South Atlantic. Although there had been only two confirmed sightings of the species in the area since 1973, evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January and in northern Namibia between May and July supporting observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia in water >1 000 m deep confirm their existence in the area and occurrence in Autumn months. The chance of encountering the species in the proposed survey area is considered low.

Minke whales: Two forms of minke whale (Figure 40 above, right) occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*) and the dwarf minke whale (*B. acutorostrata subsp*.); both species occur in the Benguela . Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge shows acoustic presence in June - August and November - December, supporting a bimodal distribution in the area. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa. Both species are generally solitary and densities are likely to be low in the project area.

Pygmy right whale: The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult. The species is typically associated with cool temperate waters between 30°S and 55°S with records from southern and central Namibia being the northern most for the species.

The most abundant baleen whales in the Benguela are southern right whales and humpback whales (Figure 41 below). 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 Bay. Increasing numbers of summer records of both species, from the southern half of Namibia suggest that animals may also be feeding in the Lüderitz upwelling cell and will therefore occur in or pass through the project area.

Figure 41: 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.

Humpback whales: The majority of humpback whales passing through the Benguela are migrating to breeding grounds off tropical west Africa, between Angola and the Gulf of Guinea. In coastal waters, the northward migration stream is larger than the southward peak, suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards, but no clear migration ‘corridor. On the southward migration, many humpbacks follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs) possibly lingering in the feeding grounds off west South Africa in summer. 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. Recent abundance estimates put the number of animals in the west African breeding population to be in excess of 9 000 individuals in 2005 and it is likely to have increased since this time at about 5% per annum. Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area, ranging from the coast out beyond the shelf, with year round presence but numbers peaking in July – February and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.

Southern right whales: Many southern right whales remain in the Southern Benguela during summer to feed off Cape Columbine and St Helena Bay on the South African West Coast. Although there are no recent data available on the numbers of right whales feeding in the St Helena Bay area, mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding. Given this high proportion of the population known to feed in the southern Benguela, and the historical records, it is highly likely that several hundreds of right whales can be expected to pass directly through the southern portion of the licence block between May and June and then again November to January. The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered to be a single population within this range. The most recent abundance estimate for this population is available for 2017 which estimated the population at ~6 100 individuals including all age and sex classes, and still growing at ~6.5% per annum. When the population numbers crashed in 1920, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Namibia and Mozambique. Southern right whales are seen regularly in the nearshore waters of the West Coast (<3 km from shore), extending north into southern Namibia. Southern right whales have been recorded off the West Coast in all months of the year, 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. 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. It was previously thought that whales feed only rarely while migrating, but these localised summer concentrations suggest that these whales may in fact have more flexible foraging habits.

8.4.2.6.2 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 whales: All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985. Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They live in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come onto the shelf in water 500 - 200 m deep (Figure 42, left). They are considered to be relatively abundant globally, although no estimates are available for South African waters. Seasonality of catches 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. Sperm whales are thus likely to be encountered in relatively high numbers in deeper waters (>500 m), predominantly in the winter months (April - October). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually, however the regular echolocation clicks made by the species when diving make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).

Figure 42: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters.

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. Presence in the project area may fluctuate seasonally, but insufficient data exist to define this clearly. Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often *en masse*, have been recorded in association with naval mid-frequency sonar and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiles. Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, the existing evidence clearly shows that animals change their dive behaviour in response to acoustic disturbance, and all possible precautions should be taken to avoid causing any harm. Sightings of beaked whales in the project area are expected to be very low.

Pygmy and Dwarf Sperm Whales: The genus Kogia currently contains two recognised species, the pygmy (*K. breviceps*) and dwarf (*K. sima*) sperm whales, both of which most frequently occur in pelagic and shelf edge waters, although their seasonality is unknown. 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. Kogia species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the survey area at low levels; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem in waters deeper than ~1 000 m. Abundance in Block 1 is likely to be very low.

Killer whales: Killer whales (Figure 42, right) have a circum-global distribution being found in all oceans from the equator to the ice edge. Killer whales occur year round in low densities off western South Africa, Namibia and in the Eastern Tropical Atlantic. Killer whales in South African waters were referred to a single morphotype, Type

A, although recently a second 'flat-toothed' morphotype that seems to specialise in an elasmobranch diet has been identified. Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the project area at low levels.

Although the false killer whale is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed. False killer whales are more likely to be confused with melon-headed or pygmy killer whales than with killer whales. The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few recorded close to shore. They usually occur in groups ranging in size from 1 - 100 animals. The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region.

Pilot Whales: Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it. They are regularly seen associated with the shelf edge by marine mammal observers (MMOs) and fisheries observers and researchers. The distinction between long-finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species, it is likely that the vast majority of pilot whales encountered in the project area will be long-finned.

Common dolphin: The common dolphin is known to occur offshore in West Coast waters, although the extent to which they occur in the project area is unknown, but likely to be low. Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region. They are more frequently seen in the warmer waters offshore and to the north of the country, seasonality is not known.

Dusky dolphin: In water <500 m deep, dusky dolphins (Figure 43, right) are likely to be the most frequently encountered small cetacean as they are very "boat friendly" and often approach vessels to bowride. The species is resident year round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep (Findlay et al. 1992). 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 (Elwen et al. 2010; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlay et al. 1992). 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). Dusky dolphins are resident year round in the Benguela.

Heaviside's dolphins: Heaviside's dolphins (Figure 43, left) are relatively abundant in the Benguela ecosystem region with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay. This species occupies waters from the coast to at least 200 m depth, and may show a diurnal onshore-offshore movement pattern, but this varies throughout the species range. Heaviside's dolphins are resident year round.

Figure 43: The endemic Heaviside's Dolphin *Cephalorhynchus heavisidii* (left), and Dusky dolphin *Lagenorhynchus obscurus* (right).

Several other species of dolphins that might occur in deeper waters at low levels include the pygmy killer whale, Risso's dolphin, rough toothed dolphin, pan tropical spotted dolphin and striped dolphin. Nothing is known about the population size or density of these species in the project area, but encounters are likely to be rare.

Beaked whales: Beaked whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. With recorded dives of well over an hour and in excess of 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals. They also appear to be particularly vulnerable to certain types of anthropogenic noise, although reasons are not yet fully understood. All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known.

In summary, the humpback and southern right whale are likely to be encountered 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. 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.

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.

8.4.2.6.3 SEALS

The Cape fur seal (*Arctocephalus pusillus pusillus*) (Figure 44) 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. 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*).

Figure 44: Colony of Cape fur seals *Arctocephalus pusillus pusillus*.

There are a number of Cape fur seal colonies within the study area: at Kleinzee (incorporating Robeiland), at Bucchu Twins near Alexander Bay, and Strandfontein Point (south of Hondeklipbaai). The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast. The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status. Non-breeding colonies occur south of Hondeklip Bay at Strandfontein Point and on Bird Island at Lamberts Bay, with the McDougall's Bay islands and Wedge Point being haul-out sites only and not permanently occupied by seals. All have important conservation value since they are largely undisturbed at present. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore, with bulls ranging further out to sea than females. The timing of the annual breeding cycle is very regular, occurring between November and

January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season.

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

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status is not regarded as threatened. The Cape Fur Seal population in South Africa is regularly monitored by the DFFE. The overall population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population.

8.5 FISHERIES

This section provides a description of the fisheries activities of the application area. The information has been sourced from the Fisheries Impact Assessment undertaken by CapMarine included in Appendix C.

8.5.1 OVERVIEW OF FISHERIES SECTORS

South Africa has a coastline that spans two ecosystems over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. South Africa's fisheries are regulated and monitored by the DFFE. All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the Marine Living Resources Act (Act No. 18 of 1998 – MLRA).

Approximately 14 different commercial fisheries sectors currently operate within South African waters. Table 16 below lists these along with ports and regions of operation, catch landings and the number of active vessels and rights holders (2017). The proportional volume of catch and economic value of each of these sectors for 2017 is indicated in Figure 45 below. The primary fisheries in terms of economic value and overall tonnage of landings are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*) and the pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The traditional line fishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi)* and other reef fish. Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank (South Coast) and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast. In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of the landed catch.

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. These ports also have significant infrastructure for the processing of anchovy into fishmeal as well as the canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors. There are more than 230 small-scale fishing communities on the South African coastline. Small-scale fisheries commonly use boats but occur mainly close to the shore. Recreational fisheries comprise shore-based, estuarine and boat-based line fisheries as well as spearfishing and net fisheries, including cast, drag and hoop net techniques.

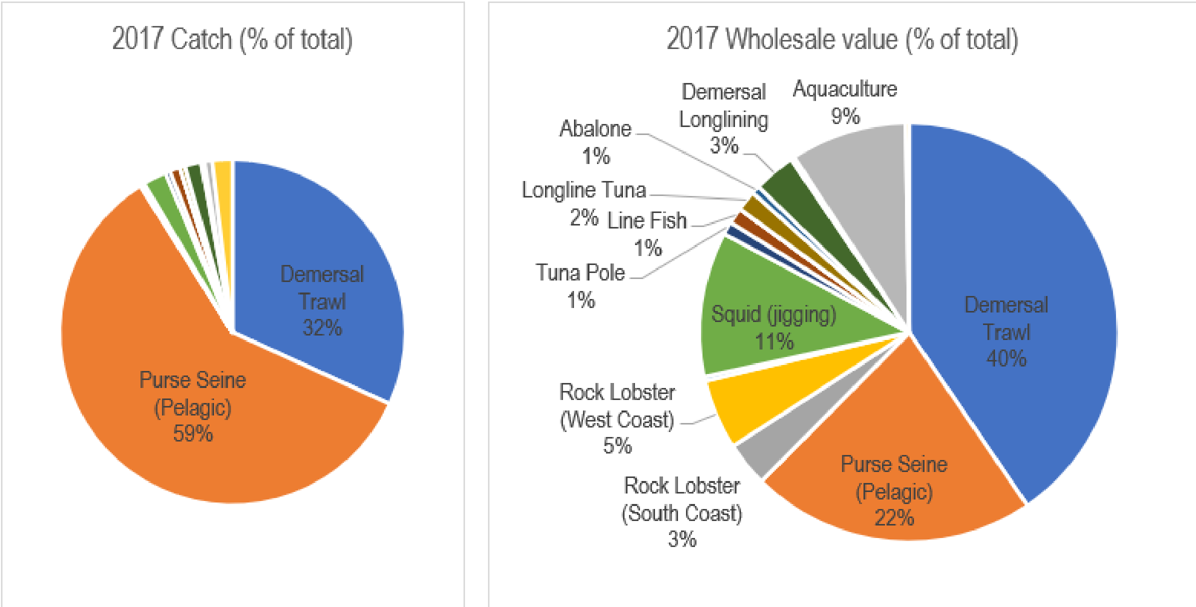


Figure 45: Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2017).

Table 16: South African offshore commercial fishing sectors: wholesale value of production in 2017

Sector	No. of Rights Holders (Vessels)	Catch (tons)	Landed Catch /sales (tons)	Wholesale Value of Production in 2017 (R'000)	% of Total Value
Small pelagic purse-seine	111 (101)	313476	313476	2164224	22.0
Demersal trawl (offshore)	50 (45)	163743	98200	3891978	39.5
Demersal trawl (inshore)	18 (31)	4452	2736	90104	0.9
Mid-water trawl	34 (6)				
Demersal long-line	146 (64)	8113	8113	319228	3.2
Large pelagic long-line	30 (31)	2541	2541	154199	1.6
Tuna pole	170 (128)	2399	2399	97583	1.0
Linefish	422 (450)	4931	4931	122096	1.2
Longline shark demersal		72	72	1566	0.0
South coast rock lobster	13 (12)	699	451	*337912*	3.4
West coast rock lobster	240 (105)	1238	1238	*531659*	5.4
Crustacean trawl	6 (5)	310	310	32012	0.3
Squid jig	92 (138)	11578	11578	1099910	11.2
Miscellaneous nets	190 (N/a)	1502	1502	25589	0.3

Sector	No. of Rights Holders (Vessels)	Catch (tons)	Landed Catch /sales (tons)	Wholesale Value of Production in 2017 (R'000)	% of Total Value
Oysters	146 pickers	42	42	3300	0.0
Seaweeds	14 (N/a)	9877	6874	27095	0.3
Abalone	N/a (N/a)	86	86	*61920*	0.6
Aquaculture		3907	3907	881042	9.0
Total		**528966**	**458456**	**9841417**	**100**

Table 17: South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species.

Sector	Areas of Operation	Main Ports in Priority	Target Species
Small pelagic purse-seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye round herring (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*Merluccius capensis*), juvenile horse mackerel (*Trachurus capensis*)
Mid-water trawl	West, South Coast	Cape Town, Port Elizabeth	Adult horse mackerel (*Trachurus capensis*)
Demersal long-line	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	Shallow-water hake (*Merluccius capensis*)
Large pelagic long-line	West, South, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius),* southern bluefin tuna (*T. maccoyii*)
Tuna pole	West, South Coast	Cape Town, Saldanha	Albacore tuna (*T. alalunga*)
Linefish	West, South, East Coast	All ports, harbours and beaches around the coast	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi),* Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	*Jasus lalandii*
Crustacean trawl	East Coast	Durban, Richards Bay	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)

Sector	Areas of Operation	Main Ports in Priority	Target Species
Squid jig	South Coast	Port Elizabeth, Port St Francis	Squid/chokka (*Loligo vulgaris reynaudii)*
Gillnet	West Coast	False Bay to Port Nolloth	Mullet / harders (*Liza richardsonii*)
Beach seine	West, South, East Coast	Coastal	Mullet / harders (*Liza richardsonii*)
Oysters	South, East Coast	Coastal	Cape rock oyster (*Striostrea margaritaceae*)
Seaweeds	West, South, East	Coastal	Beach-cast seaweeds (kelp, *Gelidium* spp. and *Gracilaria* spp.
Abalone	West Coast	Coastal	*Haliotis midae*

8.5.2 SPAWNING AND RECRUITMENT OF FISH STOCKS

The South African coastline is dominated by seasonally variable and sometimes strong currents, and most species have evolved highly selective reproductive patterns to ensure that eggs and larvae can enter suitable nursery grounds situated along the coastline. Three nursery grounds can be identified in South African waters, viz the Natal Bight; the Agulhas Bank and the inshore Western Cape coasts. Each is linked to a spawning area, a transport and/or recirculation mechanism, a potential for deleterious offshore or alongshore transport and an enriched productive area of coastal or shelf-edge upwelling.

The principal commercial fish species undergo a critical migration pattern in the Agulhas and Benguela ecosystems. Adults spawn on the central Agulhas Bank in spring (September to November) and the spawn moves southwards with the Agulhas current before drifting northwards in the Benguela current across the shelf. As the eggs drift, 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 March. Juveniles shoal and then begin a southward migration – it is at this stage that anchovy and sardine are targeted by the small pelagic purse seine fishery. Demersal species such as hake migrate offshore into deeper water.

A variety of pelagic species, including anchovy, pilchard, and horse mackerel, are reported to spawn east of Cape Agulhas between the shelf-edge upwelling and the cold-water ridge, where copepod availability is highest. The eggs and larvae spawned in this area are thought to largely remain on the Agulhas Bank, although some may be carried to the West Coast or be lost to the Agulhas Current retroflection. Pilchards also spawn on the Agulhas Bank, with adults moving eastwards and northwards after spawning. Round herring are also reported to spawn along the South Coast. Demersal species that spawn along the South Coast include the cape hakes and kingklip. Spawning of the shallow-water hake occurs primarily over the shelf (<200 m) whereas that by the deep-water hake occurs off the shelf. Similarly, kingklip spawn off the shelf edge to the south of St Francis and Algoa Bays.

Squid (*Loligo spp*.) spawn principally in the inshore waters (<50 m) between Knysna and Port Elizabeth. Their distribution and abundance are highly erratic and linked to temperature, turbidity, and currents. This niche area on the eastern Agulhas Bank optimises their spawning and early life stage as nowhere else on the shelf are both bottom temperature and bottom dissolved oxygen simultaneously at optimal levels for egg development. The greatest concentration of their food (copepods) tends to be found further west in the cold-water ridge on the central Agulhas Bank. Larvae and juveniles are carried offshore and westwards (via the Benguela jet) to feed and mature, before returning to the spawning grounds to complete their lifecycle.

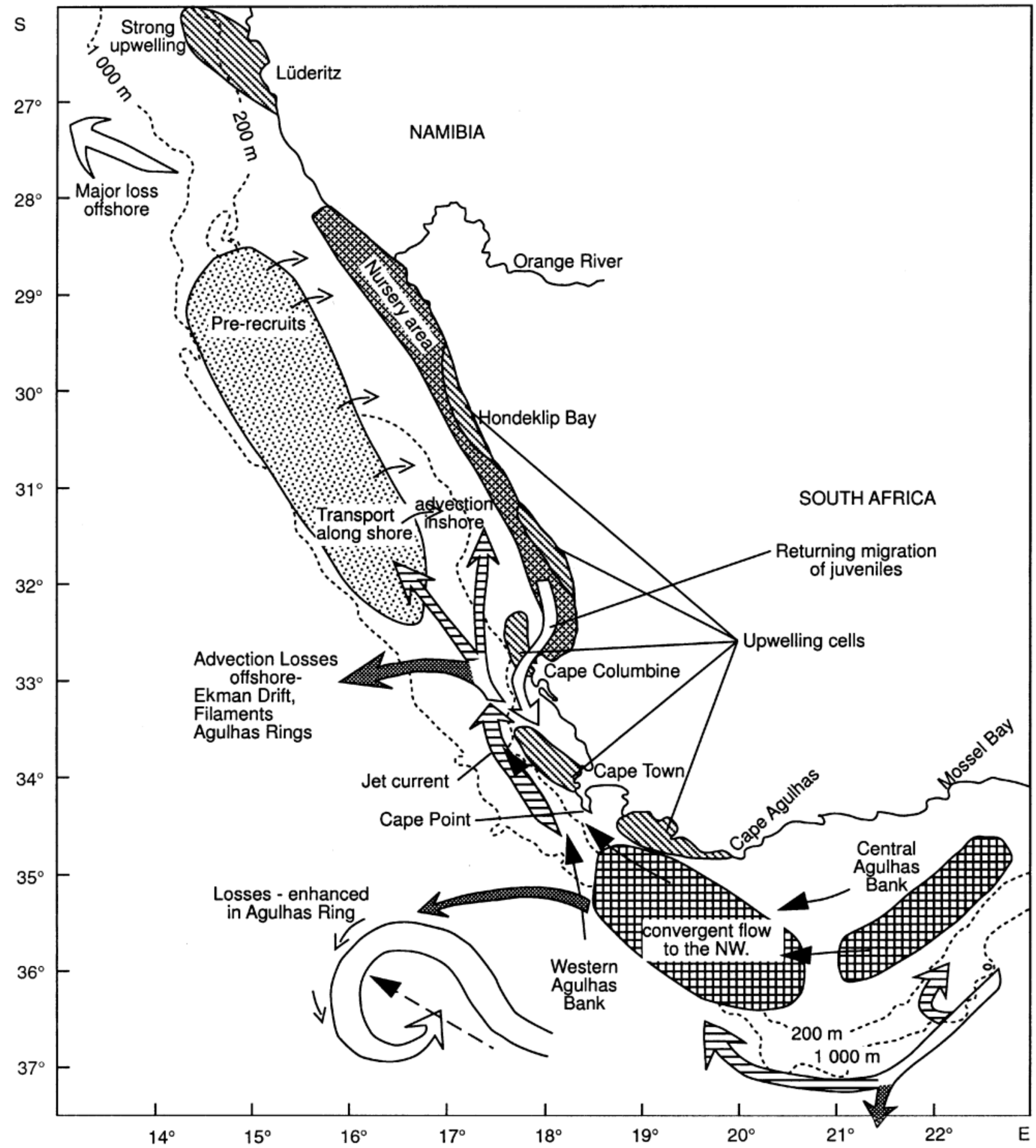


Figure 46: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa.

The inshore area of the Agulhas Bank, especially between the cool water ridge and the shore, serves as an important nursery area for numerous linefish species (e.g. elf *Pomatomus saltatrix*, leervis *Lichia amia*, geelbek *Atractoscion aequidens*, carpenter *Argyrozona argyrozona*). A significant proportion of these eggs and larvae originate from spawning grounds along the east coast, as adults undertake spawning migrations along the South Coast into KwaZulu-Natal waters. The eggs and larvae are subsequently dispersed southwards by the Agulhas Current, with juveniles occurring on the inshore Agulhas Bank, using the area between the cold-water ridge and the shore as nursery grounds. In the case of the carpenter, a high proportion of the reproductive output comes from the central Agulhas Bank and the Tsitsikamma Marine Protected Area (MPA), and two separate nursery grounds appear to exist, one near Port Elizabeth and a second off the deep reefs off Cape Agulhas, with older fish spreading eastwards and westwards.

Figure 46 above shows the West Coast nursery area and the western/central Agulhas Bank spawning grounds. Light stippled area on the West Coast marks the main recruiting area for the small pelagic fishery and dark stippled area on the Agulhas Bank marks the main spawning grounds for small pelagic fish.

8.5.3 COMMERCIAL FISHING SECTORS

8.5.3.1 **DEMERSAL TRAWL**

The primary fisheries in terms of highest economic value are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The demersal trawl fishery comprises an offshore and inshore fleet, which differ primarily in terms of vessel capacity and the areas in which they operate. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 Billion, or 40.5% of the total value of all fisheries combined. Nominal catch for both sectors combined amounted to 145 088 tons during 2018.

The offshore fishery is comprised of 45 vessels operating from most major harbours on both the West and South Coasts. On the West and South-West Coasts, these grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours although most effort is in the >300 m to 600 m depth range. Monkfish-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed parallel to the depth contours (thereby maintaining a relatively constant depth) in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea sector is prohibited from operating in waters shallower than 110 m or within five nautical miles of the coastline.

The inshore fishery consists of 31 vessels, which operate on the South Coast mainly from the harbours of Mossel Bay and Port Elizabeth. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. Vessels also target sole close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Hake is targeted further offshore in traditional grounds between 100 m and 200 m depth in fishing grounds known as *the Blues* located on the Agulhas Bank.

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening. Bottom contact is made by the footrope and by long cables and bridles between the doors and the footrope. Behind the trawl doors are bridles connecting the doors to the wings of the net (to the ends of the footrope and headrope). A headline, bearing floats and the weighted footrope (that may include rope, steel wire, chains, rubber discs, spacers, bobbins or weights) maintain the vertical net opening. The “belly”, “wings” and the “cod-end” (the part of the net that retains the catch) may contact the seabed (see Figure 3.3). The configuration of trawling gear is similar for both offshore and inshore vessels however inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 90 m in length. Inshore vessels range in length from 15 m to 40 m. Trips average three to five days in length and all catch is stored on ice.

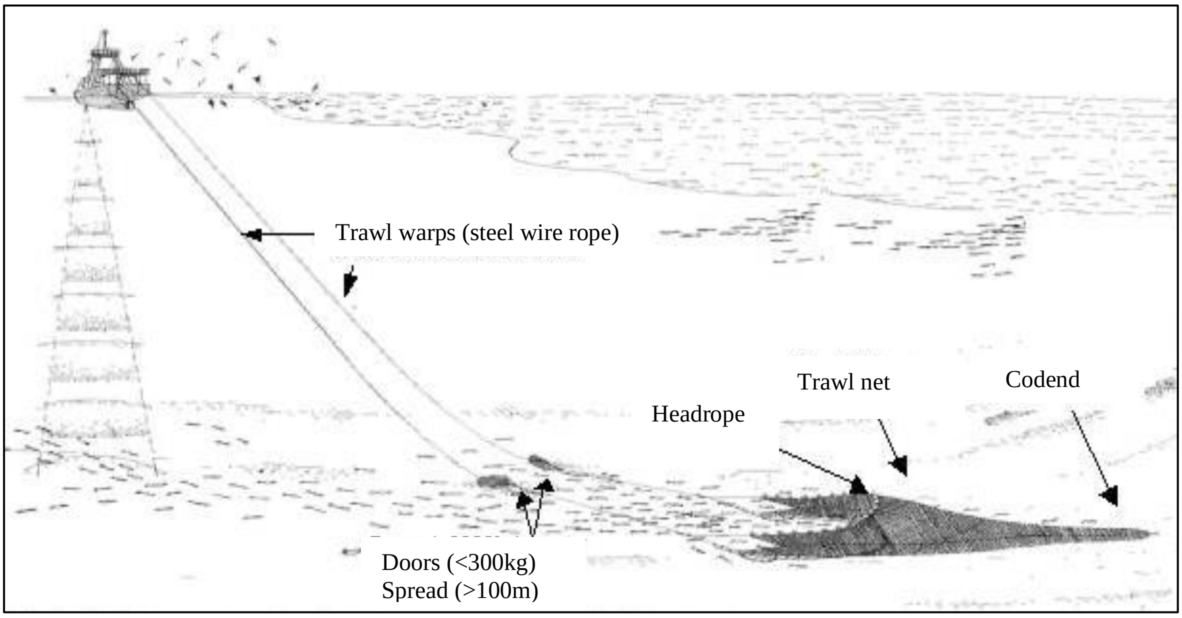


Figure 47: Typical gear configuration used by offshore demersal trawlers targeting hake.

The activity of the fishery is restricted by permit condition to operating within the confines of a historical "footprint" – an area of approximately 57 300 km2 and 17 000 km2 for the offshore and inshore fleets, respectively. Figure 48 below shows an overview of the spatial distribution of fishing activity within the EEZ and in relation to Licence Block 1 and the proposed seismic acquisition area.

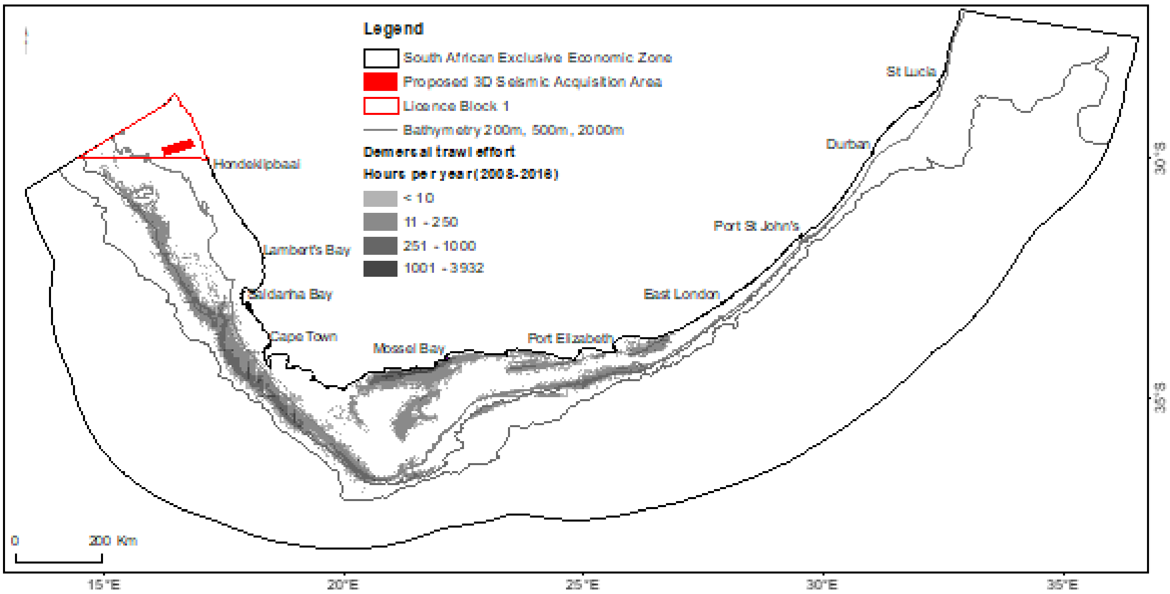


Figure 48: Overview of the spatial distribution of fishing effort expended by the demersal trawl sector within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

Figure 49 below shows the demersal trawling activity at a reporting resolution of ~2 nm^2 in relation to Licence Block 1 and the proposed seismic acquisition area.

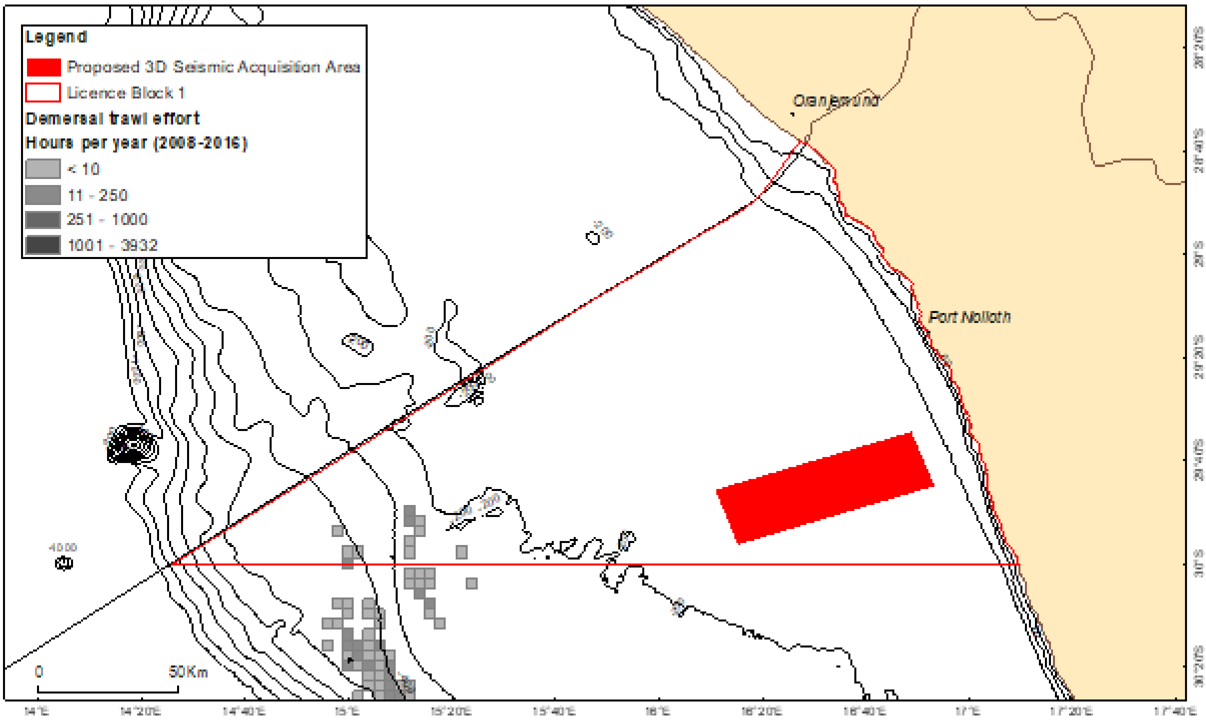


Figure 49: Spatial distribution of fishing effort expended by the demersal trawl sector in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

8.5.3.2 MID-WATER TRAWL

This sector included six vessels and 34 rights holders which target adult horse mackerel (*Trachurus trachurus capensis*) of which a total catch of 19 555 tons were landed in 2019. Mid-water trawl is defined in the MLRA as any net which can be dragged by a fishing vessel along any depth between the sea bed and the surface of the sea without continuously touching the bottom. In practice, mid-water trawl gear does occasionally come into contact with the seafloor. Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column (refer to Figure 50 for a schematic diagram of gear configuration). Several demersal trawlers are able to undertake mid-water trawling by switching gear and operating under dual rights, but currently the FMV Desert Diamond is the only dedicated mid-water trawler and is the largest registered South African commercial fishing vessel. The *Desert Diamond* is 120 m in length and has a Gross Registered Tonnage (GRT) of 8 000 t. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and cod end. Trawl warps are between 32 mm and 38 mm in diameter. The trawl doors (3.5 t each) maintain the net opening which ranges from 120 to 130 m in width and from 40 m to 80 m in height. Weights in front of, and along the ground-rope provide for vertical opening of the trawl. The cable transmitting acoustic signal from the net sounder might also provide a lifting force that maximizes the vertical trawl opening. To reduce the resistance of the gear and achieve a large opening, the front part of the trawls are usually made from very large rhombic or hexagonal meshes. The use of nearly parallel ropes instead of meshes in the front part is also a common design. Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break.

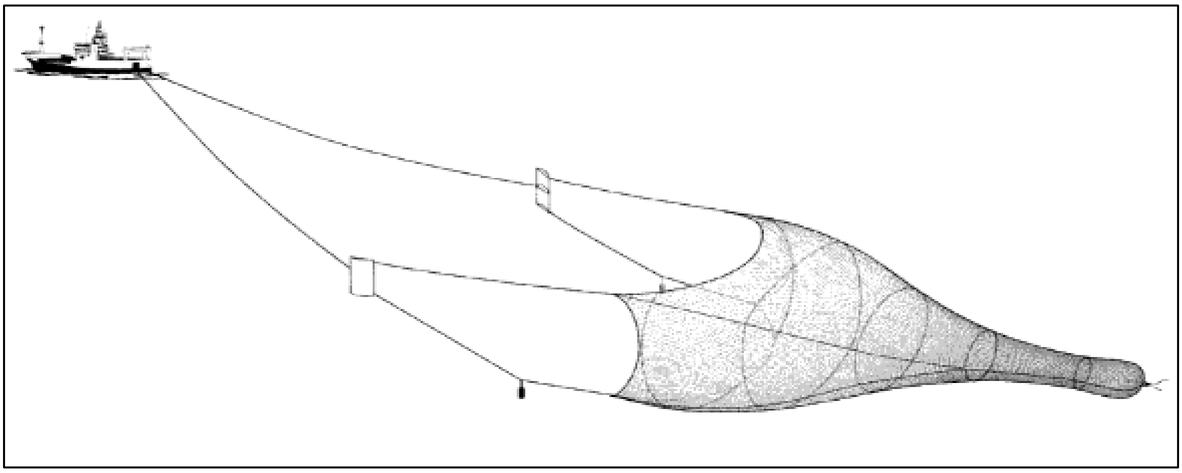


Figure 50: Schematic diagram showing the typical gear configuration of a mid-water trawler.

The fishery operates predominantly on the edge of the Agulhas Bank, where shoals are found in commercial abundance. Fishing grounds off the South Coast are situated along the shelf break and three dominant areas can be defined. The first lies between 22 E and 23°E at a distance of approximately 70 nm offshore from Mossel Bay and the second extends from 24°E to 27°E at a distance of approximately 30 nm offshore. The third area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. From 2017, DFFE has permitted experimental fishing to take place westward of 20°E. Figure 51 below shows the spatial extent of grounds fished by mid-water trawlers within the EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

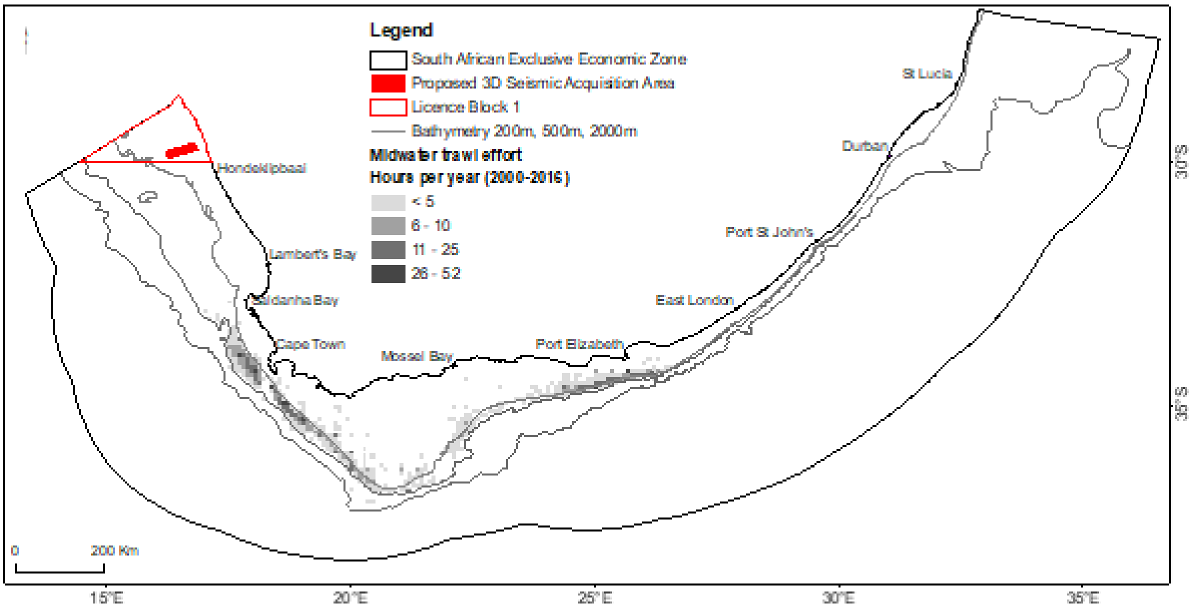


Figure 51: Overview of the spatial distribution of fishing effort expended by the mid-water trawl sector targeting horse mackerel within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

8.5.3.3 DEMERSAL LONGLINE

Like the demersal trawl fishery, the target species of the longline fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8 113 tons of catch was landed with a wholesale value of R319.2 Million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tons were reported in 2018.

A demersal longline vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor. 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 five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete. A schematic representation of the gear configuration used by the demersal longline fleet is shown in Figure 52 below.

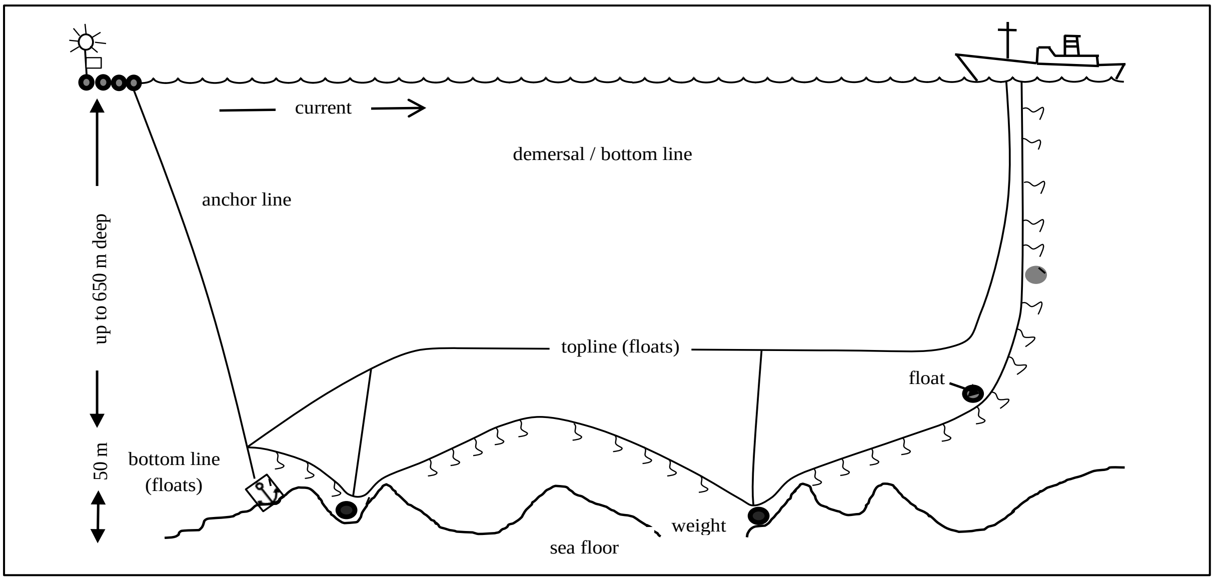


Figure 52: Typical configuration of demersal longline gear used in the South African hake-directed fishery.

Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay. Fishing grounds are similar to those targeted by the hake-directed trawl fleet. The hake longline footprint extends down the west coast from approximately 150 km offshore of Port Nolloth (15°E, 29°S). It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank to the south of the country (21°E, 37°S). Along the South Coast the footprint moves inshore again towards Mossel Bay. The eastern extent of the footprint lies at approximately (26°E, 34.5°S). Lines are set parallel to bathymetric contours, along the shelf edge up to the 1 000 m depth contour in places. The more patchy nature of effort in the north western extents of the footprint and the eastern edge of the Agulhas Bank may be attributed to proximity to fishing harbours. Figure 53 below shows the spatial extent of demersal longline grounds within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

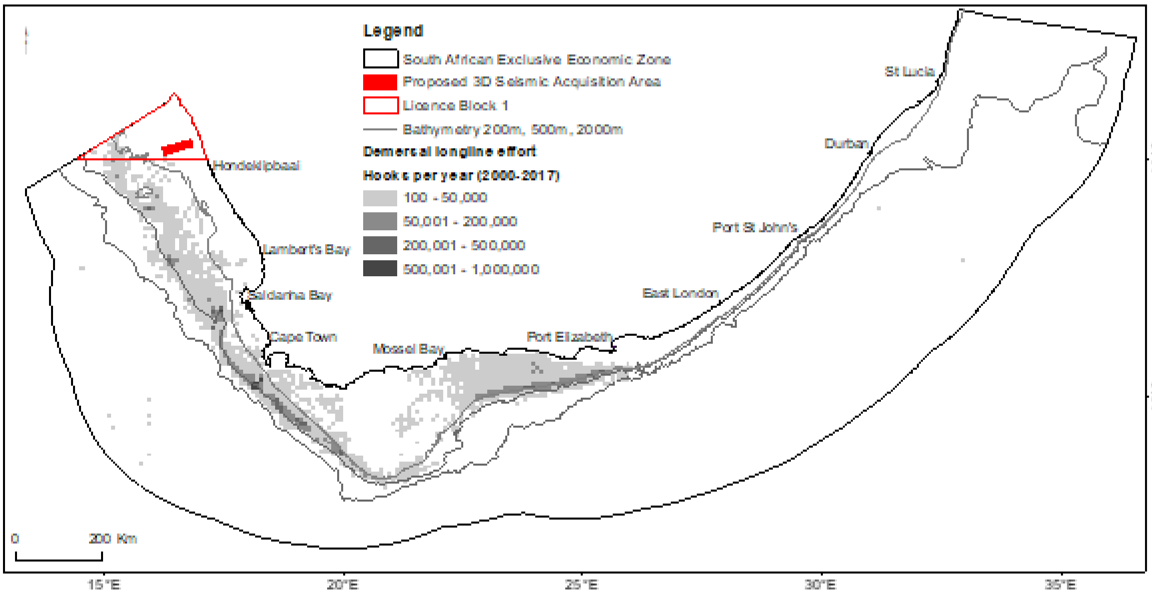


Figure 53: An overview of the spatial distribution of fishing effort expended within the South African EEZ by the demersal longline sector and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

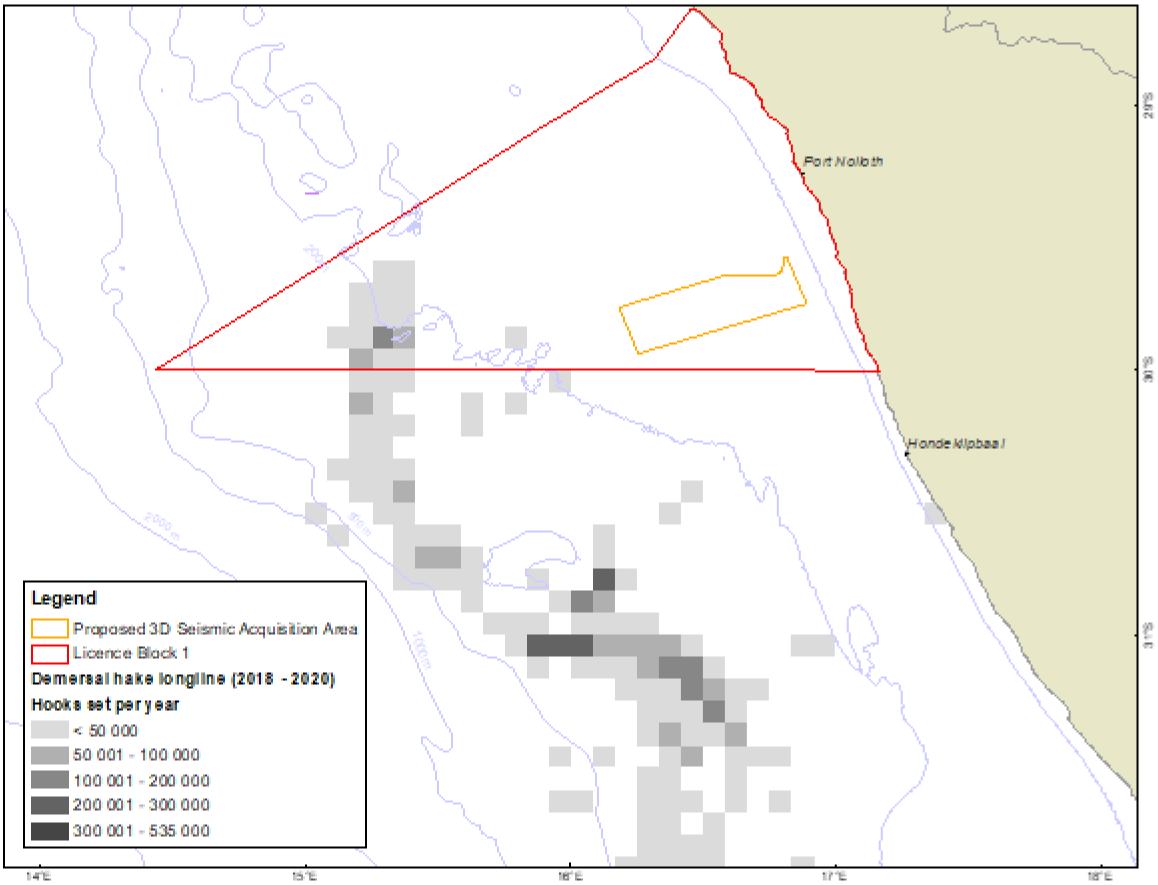


Figure 54: Spatial distribution of fishing effort expended by the longline sector targeting demersal fish species in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Effort is shown as the number of hooks set at a gridded resolution of 5x 5 minutes (each grid block covers an area of approximately 85 km^2).

8.5.3.4 SMALL PELAGIC PURSE-SEINE

The pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadi*) is the largest South African fishery by volume (tons landed) and the second most important in terms of economic value. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion, or 22% of the total value of all fisheries combined. Landings during 2019 amounted to 226 872 tons.

The abundance and distribution of small pelagic species fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km.

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m. 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 60 m to 90 m (Figure 55 below). 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.

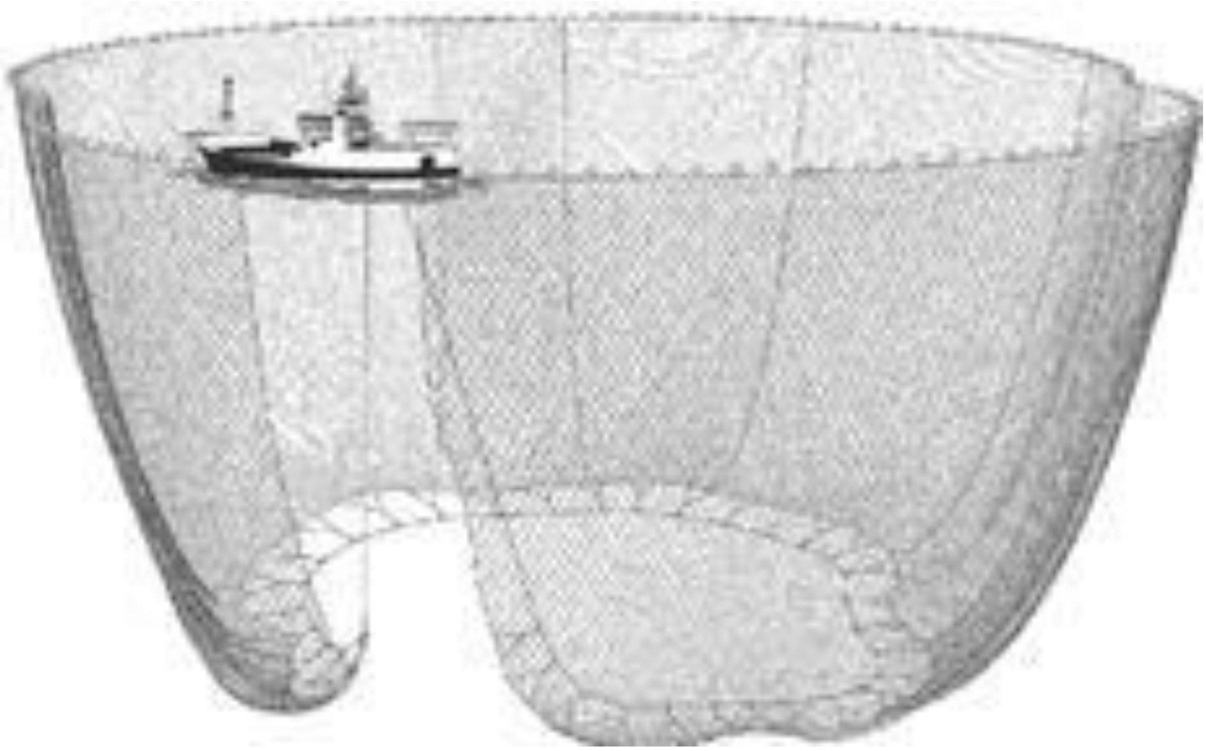


Figure 55: Schematic diagram showing typical configuration and deployment of a small pelagic purse-seine for targeting anchovy and sardine as used in South African waters.

The majority of the fleet operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. 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 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. The fishery operates throughout the year with a short seasonal break from mid-December to mid-January.

Figure 56 below shows the spatial extent of fishing grounds within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

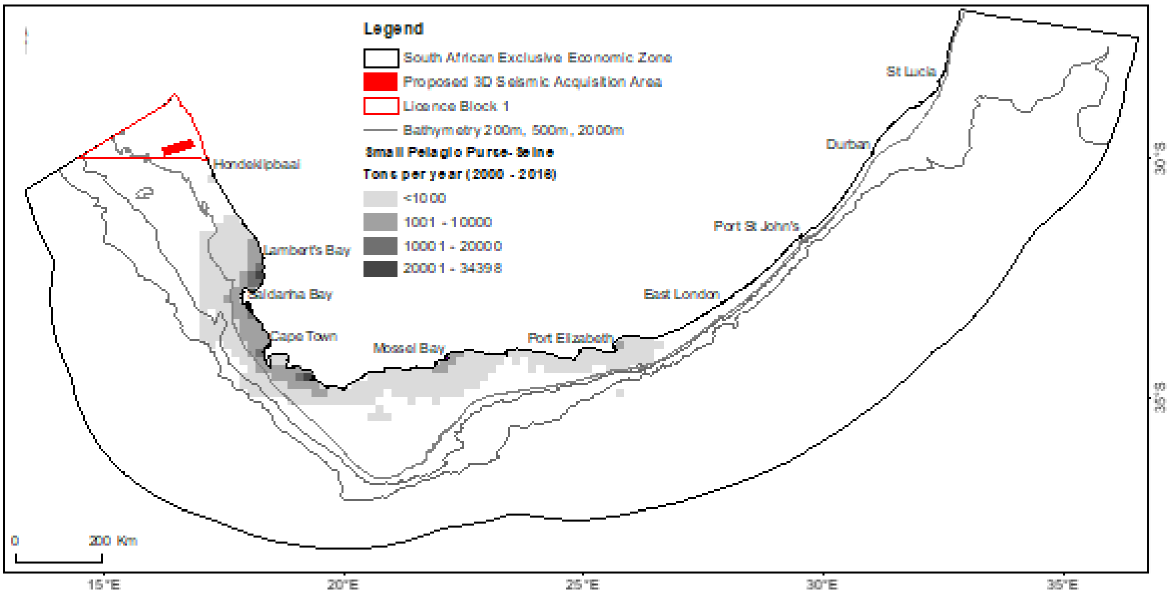


Figure 56: An overview of the spatial distribution of catch reported by the purse-seine sector targeting small pelagic species in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

8.5.3.5 LARGE PELAGIC LONGLINE

Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African EEZ by the pelagic longline and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The wholesale value of catch landed by the sector during 2017 was R154.2 Million, or 1.6% of the total value of all fisheries combined, with landings of 2541 tons (2017) and 2815 tons (2018). Tuna, tuna-like species and billfishes are migratory stocks and are therefore managed as a "shared resource" amongst various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). In the 1970s to mid-1990s the fishery was exclusively operated by Asian fleets (up to 130 vessels) under bilateral agreements with South Africa. From the early 1990s these vessels were banned from South African waters and South Africa went through a period of low fishing activity as fishing rights issues were resolved. Thereafter a domestic fishery developed and 50 fishing rights were allocated to South Africans only. These rights holders now include a fleet of local long-liners and several Japanese vessels fishing in joint ventures with South African companies. In 2017, 60 fishing rights were allocated for a period of 15 years. The total number of active long-line vessels within South African waters is 22, 18 of which fished in the Atlantic (West of 20°E) during 2017. These were exclusively domestic vessels, with three Japanese vessels fishing exclusively in the Indian Ocean (East of 20°E) during 2017.

Gear consists of monofilament mainlines of between 25 km and 100 km in length which are suspended from surface buoys and marked at each end. As gear floats close to the water surface it would present a potential obstruction to surface navigation as well as a snagging risk to the gear array towed by the seismic survey vessel. The main fishing line is suspended about 20 m below the water surface via dropper lines connecting it to surface buoys at regular intervals. Up to 3 500 baited hooks are attached to the mainline via 20 m long trace lines, targeting fish at a depth of 40 m below the surface. 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. Typical configuration of set gear is shown in Figure 57 below.

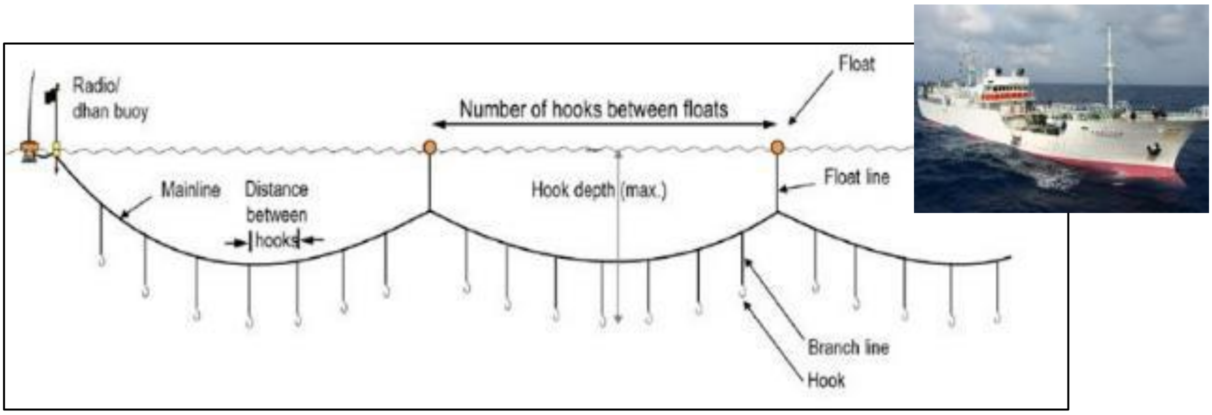


Figure 57: Schematic diagram showing typical configuration of long-line gear targeting pelagic species (left), and photograph of typical high seas long-line vessel (upper right).

Lines are usually set at night and may be left drifting for a considerable length of time before retrieval, which is done by means of a powered hauler at a speed of approximately one knot. During hauling, vessel manoeuvrability is severely restricted. In the event of an emergency, the line may be dropped and hauled in at a later stage.

The fishery operates year-round with a relative increase in effort during winter and spring. Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE. During the period 2000 to 2016, the sector landed an average catch of 4 527 tons and set 3.55 million hooks per year. Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in Figure 58 below. Eighteen vessels were active in 2018.

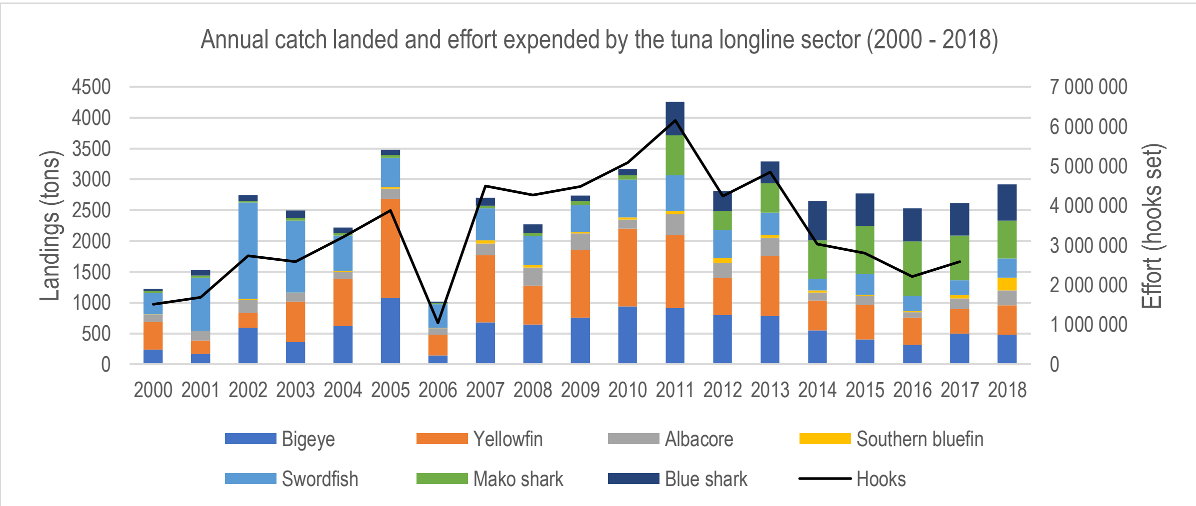


Figure 58: Inter-annual variation of catch landed and effort expended by the large pelagic longine sector in South African waters as reported to the two regional management organisations, ICCAT and IOTC (2000 - 2018).

Rights Holders in the large pelagic long-line fishery are required to complete daily logs of catches, specifying catch locations, number of hooks, time of setting and hauling, bait used, number and estimated weight of retained species, and data on bycatch. The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. Fishing effort is shown in Figure 3.15 at a grid resolution of 1 x 1 degree.

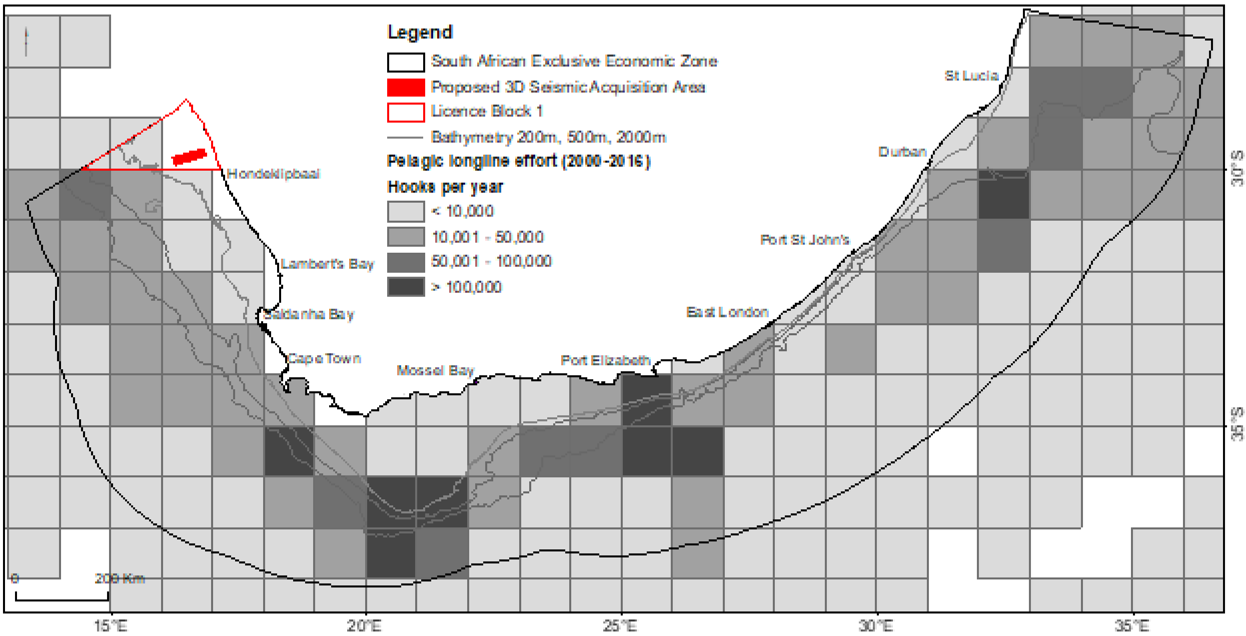


Figure 59: An overview of the spatial distribution of fishing effort expended by the longline sector targeting large pelagic fish species in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area. Effort is shown at a 1° grid resolution (60 x 60 nautical minutes).

8.5.3.6 TUNA POLE

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore (*T. alalunga*). Other catch species include yellowfin tuna, bigeye tuna, skipjack tuna (*Katsuwonus pelamis*), snoek and yellowtail. Landings for 2016 amounted to 2806 tons, with a wholesale value of R124 Million, or 1.2% of the total value of all fisheries combined. A historical time series of catch and effort reported by the South African sector operating within the Atlantic region is shown in Table 18 below. The total baitboat effort of 3751 catch days within the ICCAT convention area in 2018 represents an increase by 23% compared to 2017. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January.

Table 18: Total number of fishing days (effort), active vessels and total catch (t) of the main species caught by tuna pole vessels in the ICCAT region (West of 20E), 2008 – 2018.

	Total Effort		Catch (t)			
Year	**Fishing days**	**Active vessels**	**Albacore**	**Yellowfin tuna**	**Bigeye tuna**	**Skipjack tuna**
2008	3052	115	2083	347	8	4
2009	4431	123	4586	223	17	4
2010	4408	116	4087	177	8	1
2011	5001	118	3166	629	15	5
2012	5157	123	3483	162	12	8
2013	4114	107	3492	374	142	3
2014	4416	95	3620	1351	50	5
2015	4738	91	3898	885	57	2

	Total Effort		Catch (t)			
Year	Fishing days	Active vessels	Albacore	Yellowfin tuna	Bigeye tuna	Skipjack tuna
2016	4908	98	2001	599	10	2
2017	3062	92	1640	235	22	7
2018	3751	92	2353	242	14	2

The active fleet consists of approximately 92 pole-and-line vessels (also referred to as "baitboat"), which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. Vessels normally operate within a 100 nm radius of these locations with effort concentrated in the Cape Canyon area (South-West of Cape Point), and up the West Coast to the Namibian border with South Africa.

Vessels are typically small (an average length of 16 m but ranging up to 25 m). Catch is stored on ice, refrigerated sea water or frozen at sea and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on catch rates and the distance of the fishing grounds from port. Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (Figure 60 below). The nature of the fishery and communication between vessels often results in a large number of vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and are highly manoeuvrable. 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.

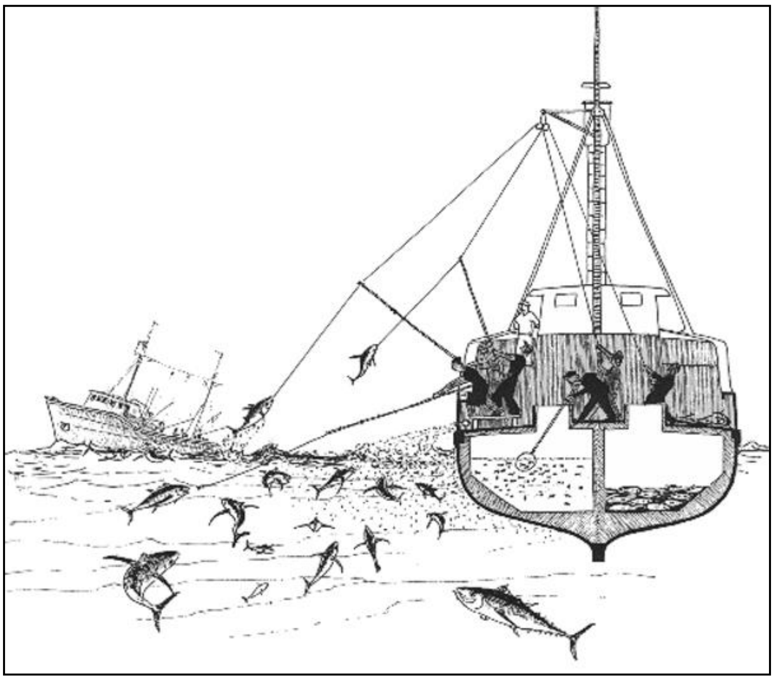


Figure 60: Schematic diagram of pole and line operation.

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. 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. Figure 61 below shows the extent of fishing on the within the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

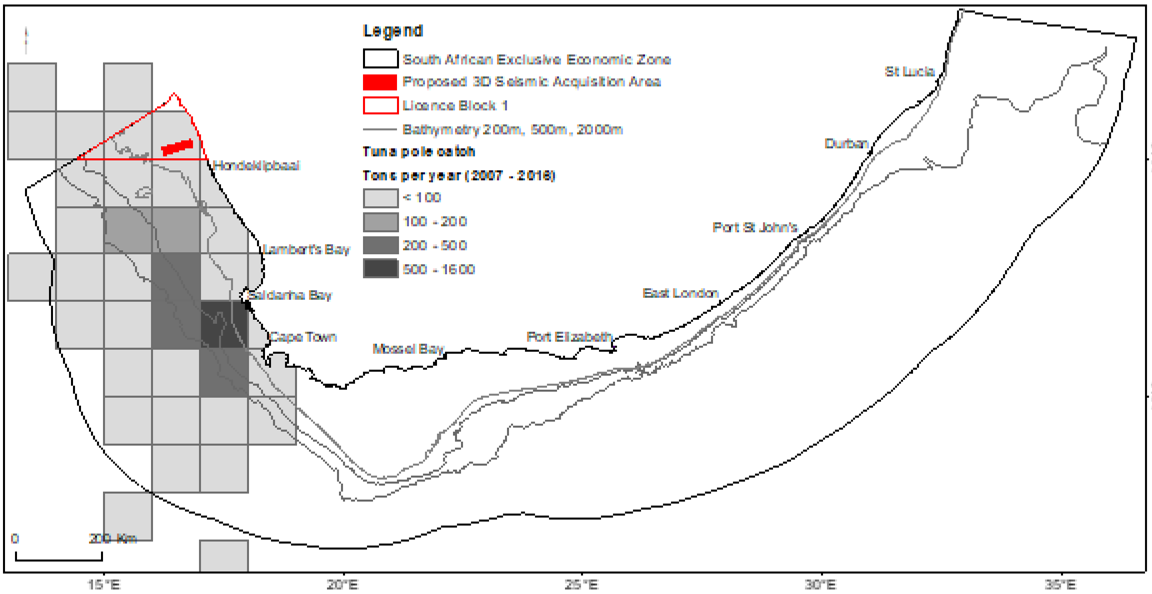


Figure 61: An overview of the spatial distribution of fishing effort expended by tuna pole sector targeting large pelagic fish species in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

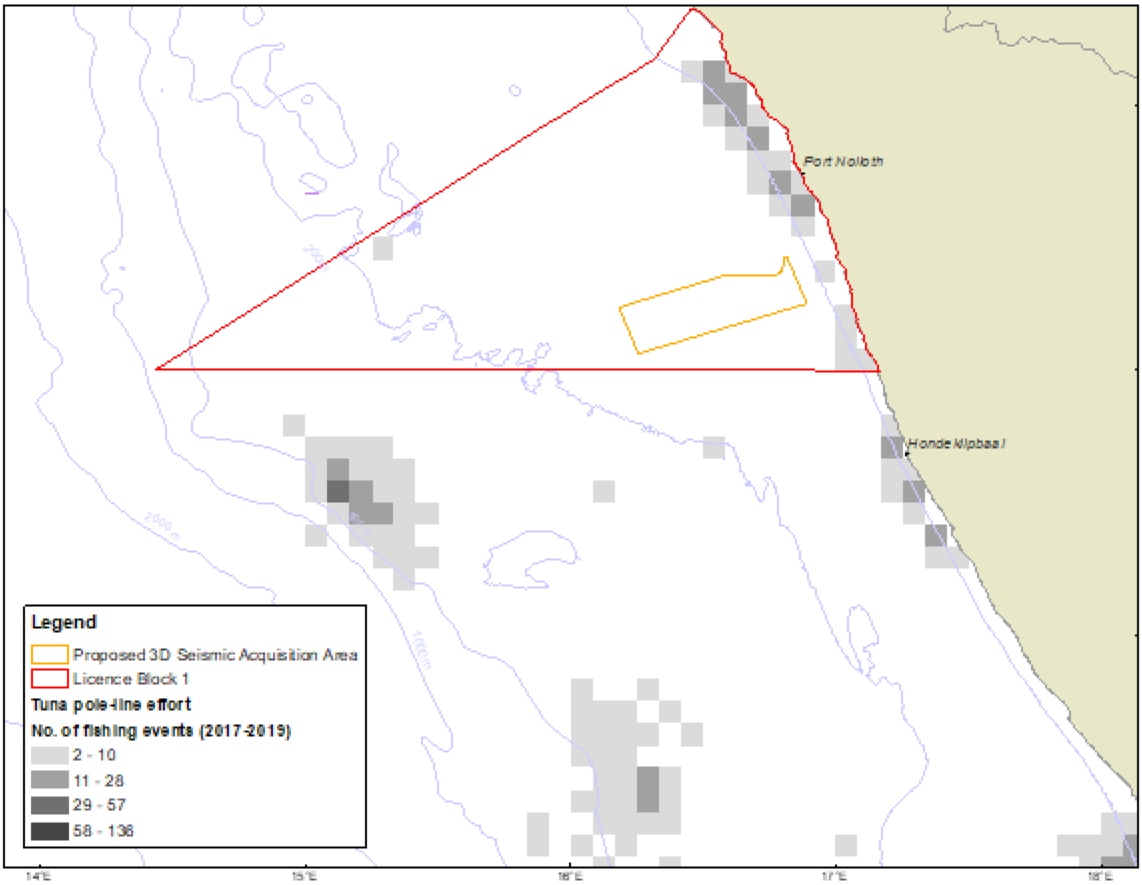


Figure 62: An overview of the spatial distribution of fishing effort expended by the pole-and-line sector targeting pelagic tuna and snoek in relation to Licence Block 1 and the proposed 3D seismic survey acquisition

8.5.3.7 TRADITIONAL LINEFISH

The traditional line fishery is the country's third most important fishery in terms of tonnage landed and economic value. It is a long-standing, nearshore fishery based on a large assemblage of different species using hook and line, but excludes the use of longlines. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*) while other species such as Cape bream (hottentot) (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)* and yellowtail (*Seriola lalandi)* are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). In 2017, the wholesale value of catch was reported as R122.1 million. Table 19 below lists the catch of important linefish species for the years 2010 to 2018.

Table 19: Annual catch of linefish species (t) from 2010 to 2018.

Year	Snoek	Yellowtail	Kob	Carpenter	slinger	Hottentot Seabream	Geelbek	Santer	Total Catch
2010	6360	171	419	263	180	144	408	69	13688
2011	6205	204	312	363	214	216	286	62	12530
2012	6809	382	221	300	240	160	337	82	11855
2013	6690	712	157	481	200	173	263	84	9142
2014	3863	986	144	522	201	192	212	74	6849
2015	2045	594	121	519	175	142	238	68	4421
2016	1643	474	133	690	211	209	246	65	4289
2017	2055	377	111	844	218	204	158	74	4391
2018	2089	654	213	723	173	213	214	68	5304

The traditional line fishery is a boat-based activity and has since December 2000 consisted of 3450 crew operating from 455 commercial vessels. The number of rights holders is 425 (valid rights until 31 December 2020). For the 2019/2020 fishing season, 395 vessels and 3007 crew was apportioned to commercial fishing, whilst 60 vessels and 443 crew was apportioned to small-scale fishing (refer to Section 3.3.12). DFFE proposed an increase in the apportionment of TAE to small-scale fishing from 13% to 50% commencing in 2021 in order to boost economic possibilities for coastal communities.

Crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. To distinguish between line fishing and long lining, line fishers are restricted to a maximum of 10 hooks per line. Target species include resident reef-fish, coastal migrants and nomadic species. Annual catches prior to the reduction of the commercial effort were estimated at 16 000 tons for the traditional commercial line fishery. Almost all of the traditional linefish catch is consumed locally. The fishery is widespread along the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. Zone A extends from Port Nolloth to Cape Infanta, Zone B extends from Cape Infanta to Port St Johns and Zone C covers the KwaZulu-Natal region. Table 20 below lists the annual Total Allowable Effort (TAE) and activated effort per linefish management zone from 2007 to 2019. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing takes place throughout the year but there is some seasonality in catches.

Table 20: Annual Total Allowable Effort (TAE) and activated effort per linefish management zone from 2007 to 2012. (The effort levels since 2019 remain largely unchanged)

Total TAE boats (fishers). **Upper limit: 455 boats or 3450 crew**			**Zone A:** **Port Nolloth to Cape Infanta**		**Zone B:** **Cape Infanta to Port St Johns**		**Zone C:** **KwaZulu-Natal (Sikombe River to Ponto da Ouro)**	
Allocation	455 (3182)		301 (2136)		103 (692)		51 (354)	
Year	Allocated	Activated	Allocated	Activated	Allocated	Activated	Allocated	Activated
2007	455	353	301	231	103	85	51	37
2008	455	372	301	239	103	82	51	51
2009	455	344	300	222	104	78	51	44
2010	455	335	298	210	105	82	51	43
2011	455	328	298	207	105	75	51	46
2012	455	296	298	192	105	62	51	42
2013	455	289	301	189	103	62	51	38
2014**	455	399	340	293	64	58	51	48
2015**	455	356	340	291	64	61	51	45
2016**	455	278	340	274	64	59	51	45
2017**	455	329	340	232	64	60	51	37
2018**	455	324	340	232	64	50	51	42
2019**	455	306	340	218	64	50	51	38

** In the finalisation of the 2013 commercial Traditional Linefish appeals, the effort apportioned for the small-scale fisheries sector was allocated to the commercial sector. All the small-scale Rights were considered to be activated on allocation

Vessels range in length between 4.5 m and 11 m and the offshore operational range is restricted by vessel category to 40 nautical miles (75 km). Fishing effort at this outer limit is sporadic. Figure 63 below shows the spatial extent of traditional linefish grounds at a national scale and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area and Figure 64 below shows reported catch in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area

Spatial mapping of effort and catches in the line fishery is less accurate than in other sectors because of the reporting structure implemented by DFFE. Fishing locations are described by skippers in relation to numbered sections along the coast and estimated distance offshore. No bearings are given, and no GPS data are recorded. Furthermore, due to the large number of vessels, associated reporting complexities and also the unwillingness of local fisherman to share fishing locations, inaccuracies in the spatial representation are to be expected. This fishery's operational footprint may at times be limited by operating costs and is sensitive to local reports of fish availability. Operating ranges vary greatly but most of the activity is conducted within 15 km of a launch site.

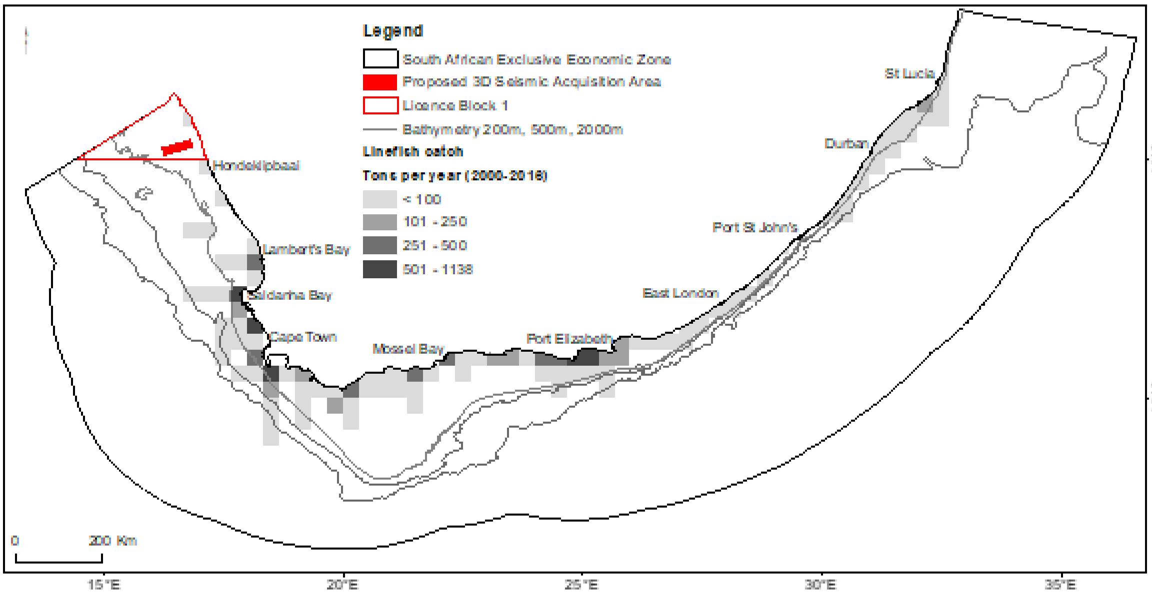


Figure 63: An overview of the spatial distribution of catch taken by the line-fish sector in the South African EEZ and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

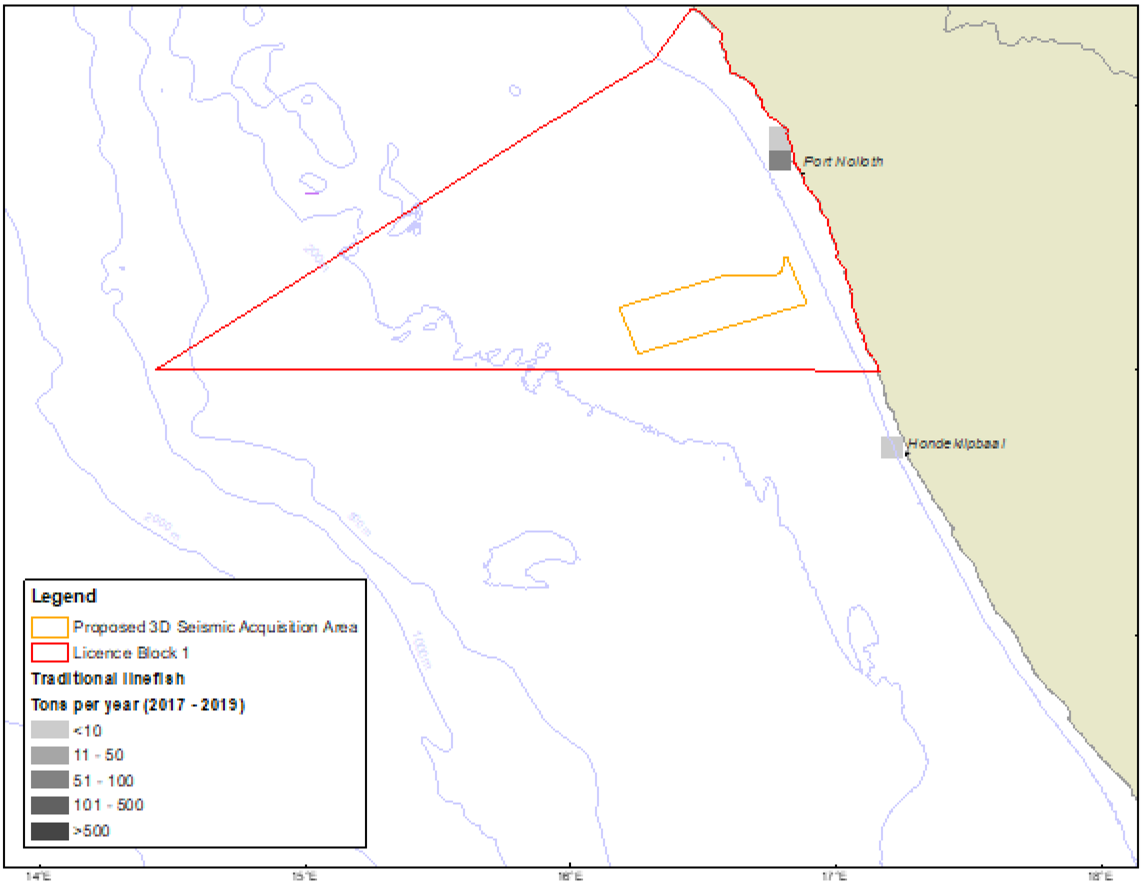


Figure 64: An overview of the spatial distribution of catch taken by the line-fish sector in in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

8.5.3.8 WEST COAST ROCK LOBSTER

The West Coast rock lobster *Jasus lalandii* is a valuable resource of the South African West Coast and consequently an important income source for West Coast fishermen. The resource occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. The fishery is composed of four sub-sectors – commercial nearshore, commercial offshore, small-scale and recreational fishing, all of which have to share from the same global TAC. The 2021 TAC was set at 837 tonnes[3] and apportionment of TAC by sub-sector is listed in Table 3.6.. Refer to Figure 65 below for recent TACs set for rock lobster. Annual and monthly landings over the period 2006 to 2016 are shown in and , respectively.

Table 21: Apportionment of TAC of rock lobster by sub-sector (DFFE, 2020).

Description	2019/2020 TAC (t)	2020/2021 TAC (t)
Commercial fishing (offshore)	563.91	435.88
Commercial fishing (nearshore)	170.25	131.03
Recreational fishing	38.76	30.08
Subsistence (interim relief measure) fishing	170.25	131.03
Small-scale fishing sector (nearshore)		
Small-scale fishing sector (offshore)	140.83	108.97
Total	1084	837.0

The offshore sector is comprised of trap boats that operate at a depth range of approximately 30 m to 100 m and the nearshore sector makes use of hoopnets to a maximum fishing depth of about 30 m. The resource is managed geographically, with TACs set annually for different management areas. The fishery operates seasonally, with closed seasons applicable to different management zones. Fishing grounds stretch from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape. Effort is seasonal with boats operating from the shore and coastal harbours. The offshore sector makes use of traps consisting of rectangular metal frames covered by netting, which are deployed from trap boats, whilst the inshore fishery makes use of hoop nets deployed from small dinghies. Traps are set at dusk and retrieved during the early morning.

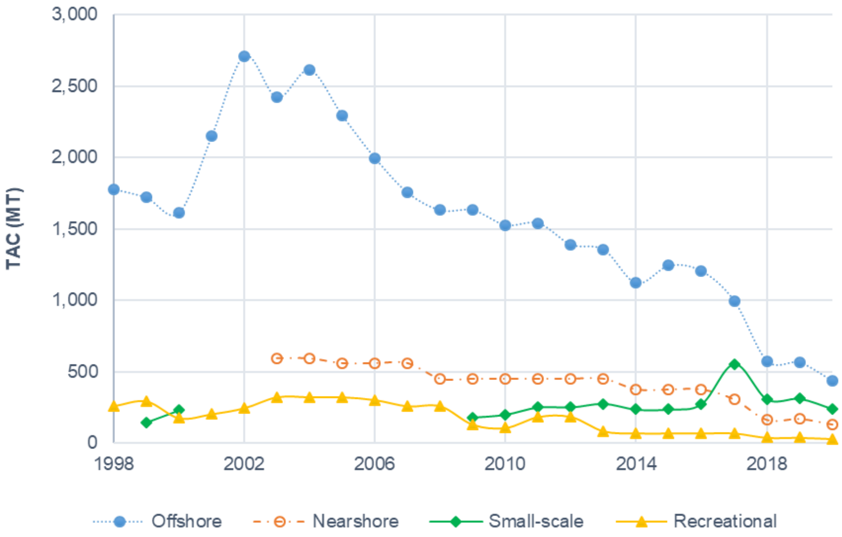


Figure 65: Graph showing the total allowable catch (TAC) of west coast rock lobster.

[3] In 2017, the poached rock lobster was estimated at 2 747 tonnes.

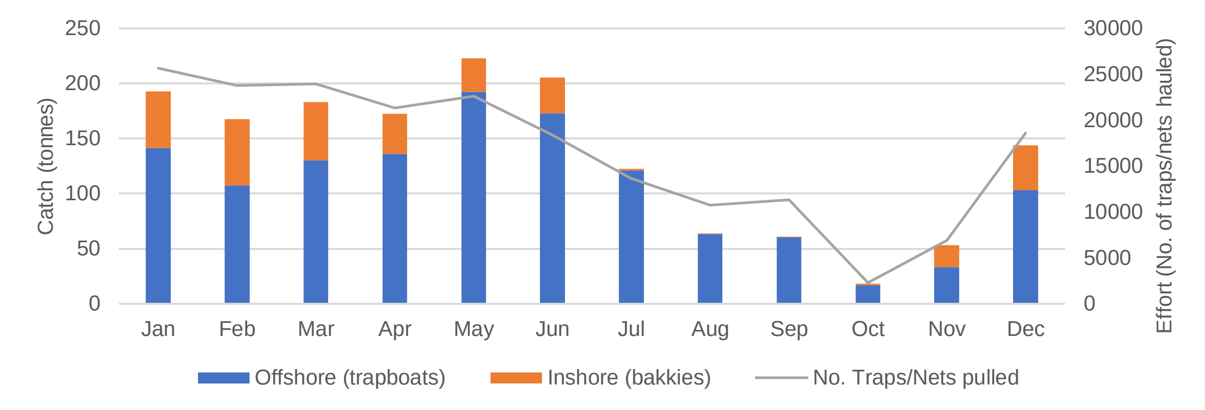


Figure 66: Graph showing the average monthly catch (tonnes) and effort (number of traps hauled) reported by the offshore (trapboat) and inshore (bakkie) rock lobster sectors over the period 2006 to 2020.

The resource is managed geographically, with TACs set annually for different management areas. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones. The start and end dates for the 2020/21 fishing season per sector and zone are shown in Table 22 below.

Table 22: Start and end dates for the fishing season 2020/21 by management zone (DFFE, 2020).

Area	**Catch period**	
	Commercial nearshore, interim relief, small-scale: nearshore	**Commercial offshore, small-scale: offshore**
Area 1 + 2	15 Oct, Nov, Dec, Jan, 15 Feb	
Area 3 + 4	15 Nov, Dec, Jan, Feb, 15 Mar	15 Nov, Dec, Jan, Feb, 15 Mar
Area 5 + 6	15 Nov, Dec, Jan, Feb, 15 Mar	
Area 7		Dec, Jan, Feb, Mar
Areas 8 and 11	15 Nov, Dec, Jan, Feb, 15 Mar	Jan, Mar, Apr, May
Area 8 (deep water)		Jun, Jul
Areas 12, 13 and 14	15 Nov, Dec, Jan, Feb, 15 Mar	

The commercial offshore sector operates at a depth range of approximately 30 m to 100 m, making use of traps consisting of rectangular metal frames covered by netting. These traps are set at dusk and retrieved during the early morning. Approximately 138 vessels participate in the offshore sector.

The commercial nearshore sector makes use of hoop nets to target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 – 30 m. These are deployed from a fleet of small dinghies/bakkies which operate from the shore and coastal harbours. Approximately 653 boats participate in the sector.

The delineation of management zones is shown in Figure 67 below. The five super-areas are: areas 1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F. A historical time-series of TACs and landings is listed in Table 23 below.

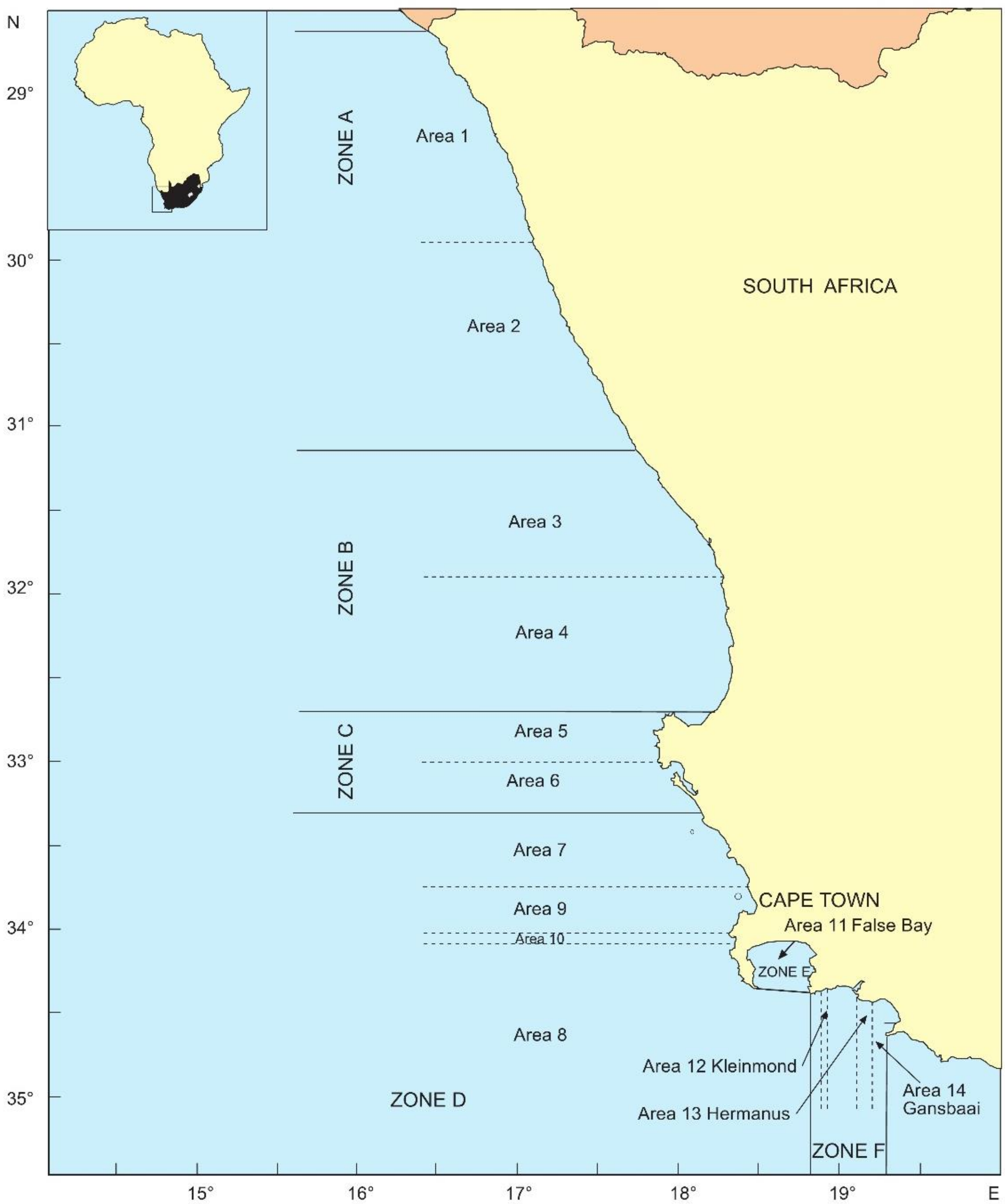


Figure 67: West Coast rock lobster fishing zones and areas. The five super-areas are: areas1–2, corresponding to zone A; areas 3–4, to zone B; areas 5–6, to zone C; area 7, being the northernmost area within zone D; and area 8+, comprising area 8 of zone D as well as zones E and F.

Figure 68 below and Figure 69 below show rock lobster catch by management zone for the commercial offshore and inshore sectors, respectively, in relation to Licence Block 1 and the proposed 3D seismic survey area. The licence block is situated offshore of rock lobster management area 1 (situated in the vicinity of Port Nolloth) and management area 2 (vicinity of Hondeklip Bay). Over the period 2005 to 2020, there was no fishing activity reported by the offshore sector within management areas 1 and 2. Over the same period the inshore sector reported an annual average of 4500 nets set and 11.8 tonnes of lobster caught within management areas 1 and 2. The amount of catch and effort reported within the area amounted to 3.6% and 10.1%, respectively, of the total national landings and overall effort expended by the inshore fleet. A fleet of small dinghies/bakkies operate within the area targeting lobster at discrete suitable reef areas along the shore at a water depth of up to 15 m.

Fishing activity could be expected approximately 17 km shoreward of the seismic acquisition area and fishing grounds do not overlap the proposed seismic acquisition area. Management areas 1 and 2 have a seasonal operational window from 15 October to 15 February.

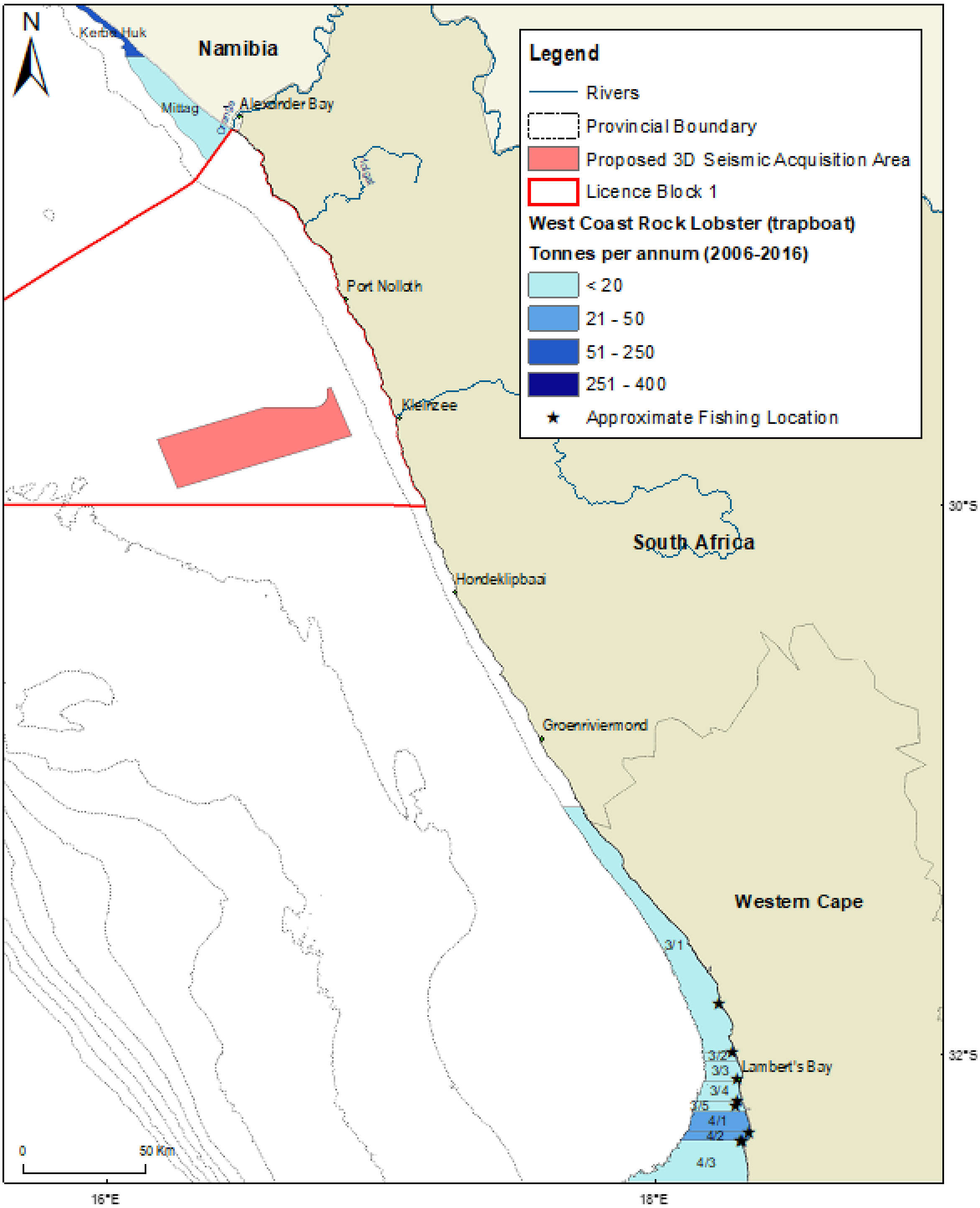


Figure 68: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster offshore (trapboat) sector in relation to Licence Block 1 and the proposed seismic survey acquisition area. Lobster management zones are demarcated and labelled.

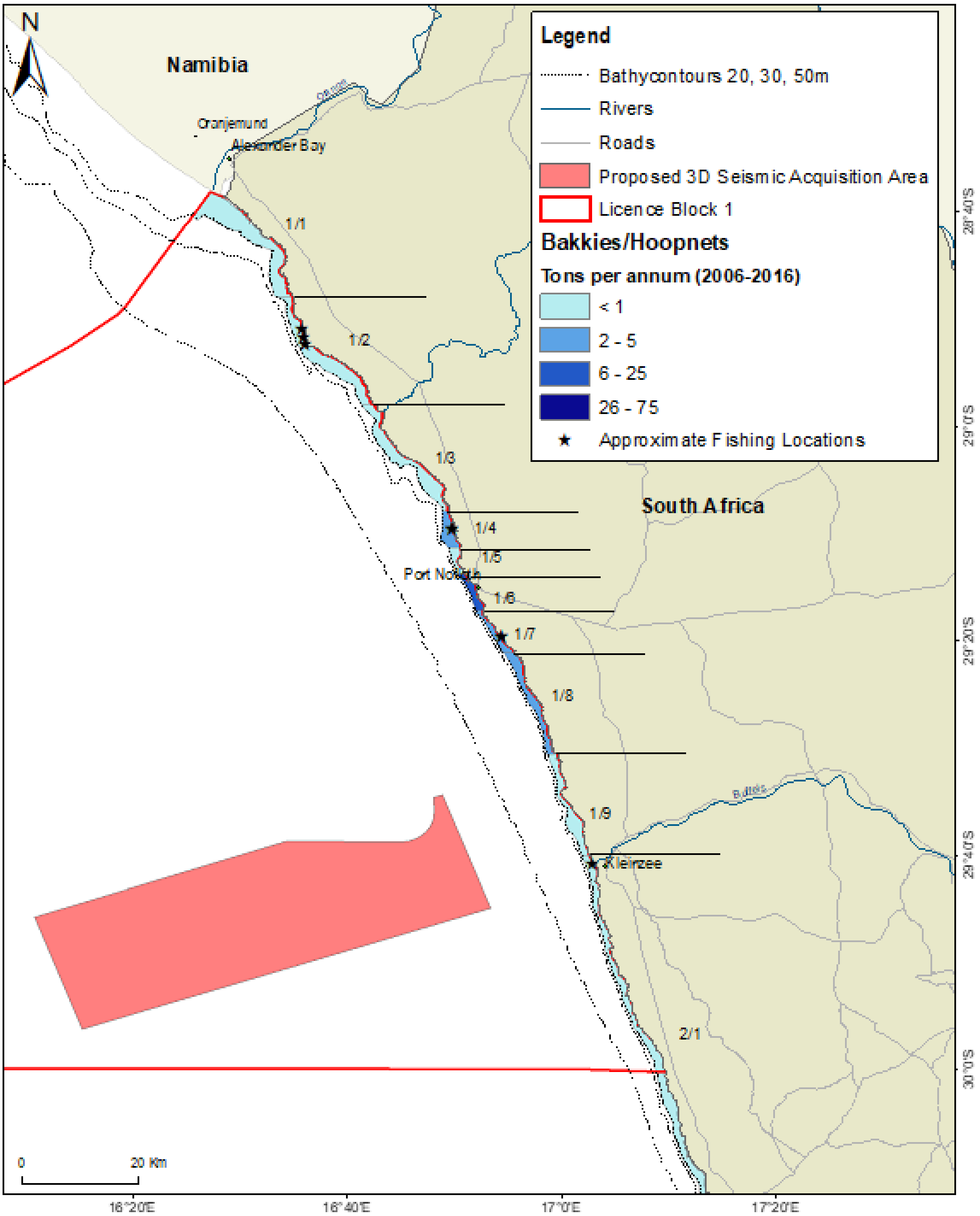


Figure 69: An overview of the spatial distribution of fishing effort expended by the west coast rock lobster inshore (bakkies/hoopnets) sector in relation to Licence Block 1 and the proposed seismic survey acquisition area. Lobster management zones are demarcated and labelled.

Table 23: Total allowable catch, fishing sector landings and total landings for West Coast rock lobster (DEFF, 2020).

Season	Global TAC	Offshore allocation	Nearshore allocation	Interim Relief	Recreational	Total catch[3]
1998/99	2 300	1780			258	2051

Season	Global TAC	Offshore allocation	Nearshore allocation	Interim Relief	Recreational	Total catch[3]
1999/00	2 156	1720		145	291	2152
2000/01	2 018	1614		230	174	2154
2001/02	2 353	2151		[1]	202	2410
2002/03	2 957	2713		[1]	244	2706
2003/04	3 336	2422	594	[1]	320	3258
2004/05	3 527	2614	593	[1]	320	3222
2005/06	3 174	2294	560	[1]	320	2291
2006/07	2 857	1997	560	[2]	300	3366
2007/08	2 571	1754	560	[2]	257	2298
2008/09	2 340	1632	451	[2]	257	2483
2009/10	2 393	1632	451	180	129	2519
2010/11	2 286	1528	451	200	107	2208
2011/12	2 426	1541	451	251	183	2275
2012/13	2 276	1391	451	251	183	2308
2013/14	2 167	1356	451	276	83	1891
2014/15	1 800	1120	376	235	69	1688
2015/16	1 924	1243	376	235	69	1524
2016/17	1 924	1204	376	274[4]	69	1564
2017/18	1 924	994	305	554[5]	69	1355

[1] No Interim Relief allocated

[2] Interim Relief accommodated under Recreational allocation

[3] Total catch by all sectors

[4] Includes 39 t allocated to N Cape small-scale fishers (SSF)

[5] Includes 248.7 t allocated to SSF Offshore and 70.4 t to SSF Nearshore

8.5.3.9 ABALONE RANCHING

The Abalone *Haliotus midae*, is endemic to South Africa and referred to locally as "perlemoen". The natural population extends along 1500 km of coastline east from St Helena Bay in the Western Cape to Port St Johns on the east coast. *H. midae* inhabits intertidal and subtidal rocky reefs, with the highest densities found in kelp forests. Kelp forests are a key habitat for abalone, as they provide a source of food and ideal ecosystem for abalone's life cycle. Light is a limiting factor for kelp beds, which are therefore limited to depths of 10m on the Namaqualand coast. Habitat preferences change as abalone develop. Larvae settle on encrusted coralline substrate and feed on benthic diatoms and bacteria. Juveniles of 3-10 mm are almost entirely dependent on sea urchins for their survival, beneath which they conceal themselves from predators such as the West Coast rock lobster. Juveniles may remain under sea urchins until they reach 21-35 mm in size, after which they move to rocky crevices in the reef. Adult abalone remain concealed in crevices, emerging nocturnally to feed on kelp fronds and red algae. In the wild, abalone may take 30 years to reach full size of 200 mm, but farmed abalone attain 100 mm in only 5 years, which is the maximum harvest size.

The commercial (diver) fishery for abalone started in the late 1940s and catches were initially unregulated, reaching a peak of close to 3 000 tonnes in 1965. By 1970, catches had declined rapidly, although the fishery remained stable, with a total annual catch of around 700 tonnes, until the mid-1990s, after which there were continuous declines in commercial catches. The continued high levels of illegal fishing and declines in the resource led to the introduction of diving prohibitions in selected areas and the closure of the commercial fishery in 2008. The fishery was subsequently reopened in 2010, with TAC allocations of 150 tonnes. Latest published figures of abalone landings are 89.6 tonnes (2016/17). Historically, the resource was most abundant in the region between Cape Columbine and Quoin Point (refer to Figure 70 below). Along the East Coast, the resource was considered to be discontinuous and sparsely distributed and as a result no commercial fishery for abalone was implemented there.

Figure 70: Distribution of abalone (insert) and abalone fishing Zones A–G (Source DAFF, 2016).

South Africa is the largest producer of abalone outside of Asia (Troell et al., 2006). For example, in 2001, 12 abalone farms existed, generating US$12 million at volumes of 500-800 tonnes per annum (Sales & Britz, 2001). By 2006, this number had almost doubled, with 22 permits granted and 5 more being scheduled for development (Troell et al., 2006). Until recently, abalone cultivation has been primarily onshore, but abalone ranching provides more cost effective opportunities for production. Abalone ranching is "where hatchery-produced seed are stocked into kelp beds outside the natural distribution" (Troell et al., 2006).

Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat specifically for seeding of abalone in designated areas (ranching) (Anchor

Environmental, 2012). The potential to increase this to seeded area to 175 km has been made possible through the issuing of "Abalone Ranching Rights" (Government Gazette, 20 August 2010 No. 729) in four concession zones for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016).

Abalone ranching was pioneered by Port Nolloth Sea Farms who were experimentally seeding kelp beds in Port Nolloth by 2000. Abalone ranching expanded in the area in 2013 when DAFF issued rights for each of four Concession Area Zones (refer to Figure 70 above).

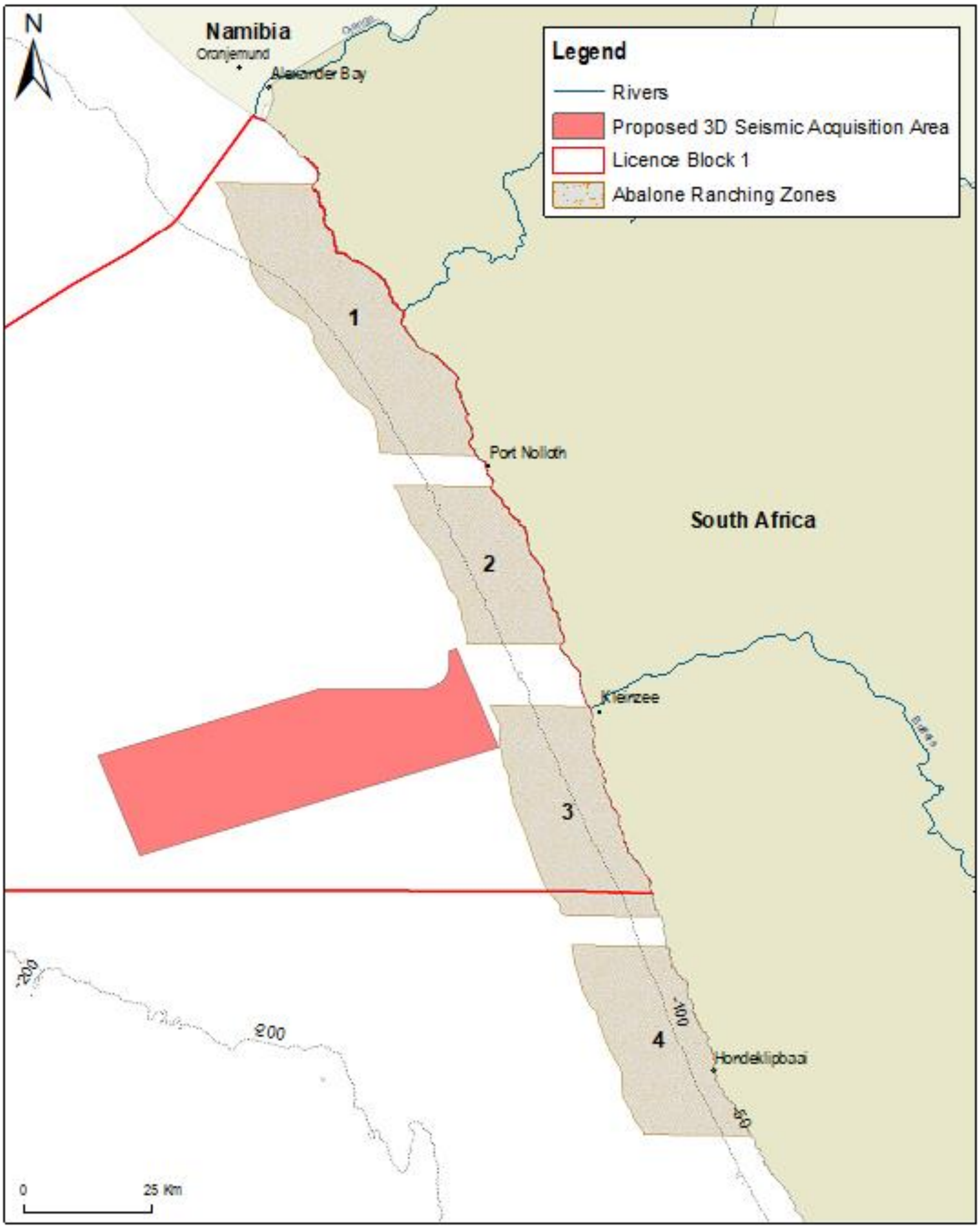


Figure 71: An overview of the spatial distribution of abalone ranching concession areas in relation to Licence Block 1 and the proposed seismic acquisition area.

Abalone ranching includes the spawning, larval development, seeding and harvest. An onshore hatchery supports the ranching in the adjacent sea. Two hatcheries exist in Port Nolloth producing up to 250 000 spat. To date, there has been no seeding in Zones 1 or 2. Seeding has taken place in Zones 3 and 4. Zones 1, 2 and 3 are situated within Licence Block 1 and Zone 3 is located inshore of the proposed seismic acquisition area (refer to

Figure 71 above). As the maximum depth of seeding is considered to be approximately 10 m, the proposed seismic acquisition area would not coincide with seeding areas within Zone 3.

8.5.3.10 SMALL-SCALE FISHERIES

The term small-scale is usually used to distinguish between capital intensive commercial fisheries and low technology, labour intensive fishing activities. Small-scale fishers fish to meet food and basic livelihood needs, and may also directly be involved in fishing for commercial purposes. These fishers traditionally operate on nearshore fishing grounds, using traditional, low technology or passive fishing gear to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing/harvesting techniques are labour intensive[4].

Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities. In the Eastern Cape, KwaZulu-Natal and the Northern Cape, small scale fishers live predominantly in rural areas while those in the Western Cape live mainly in urban areas. Small scale fisheries resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner in line with the ecosystems approach.

South Africa is implementing a Small-Scale Fisheries policy (SSF) – this is in process and was gazetted in May 2019 under the MLRA. A small-scale fishing right is the right to catch different species of fish in the near shore. These rights are allocated to communities and not to individuals in terms of the SSF. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations, including the catching, processing or marketing of fish for a cumulative period of at least 10 years. They also need to show a historical dependence on deriving the major part of their livelihood from traditional fishing operations. More than 270 communities have registered an Expressions of Interest (EOI) with the Department. The location of these coastal communities and the number of fishers per community are shown in Figure 72 below.

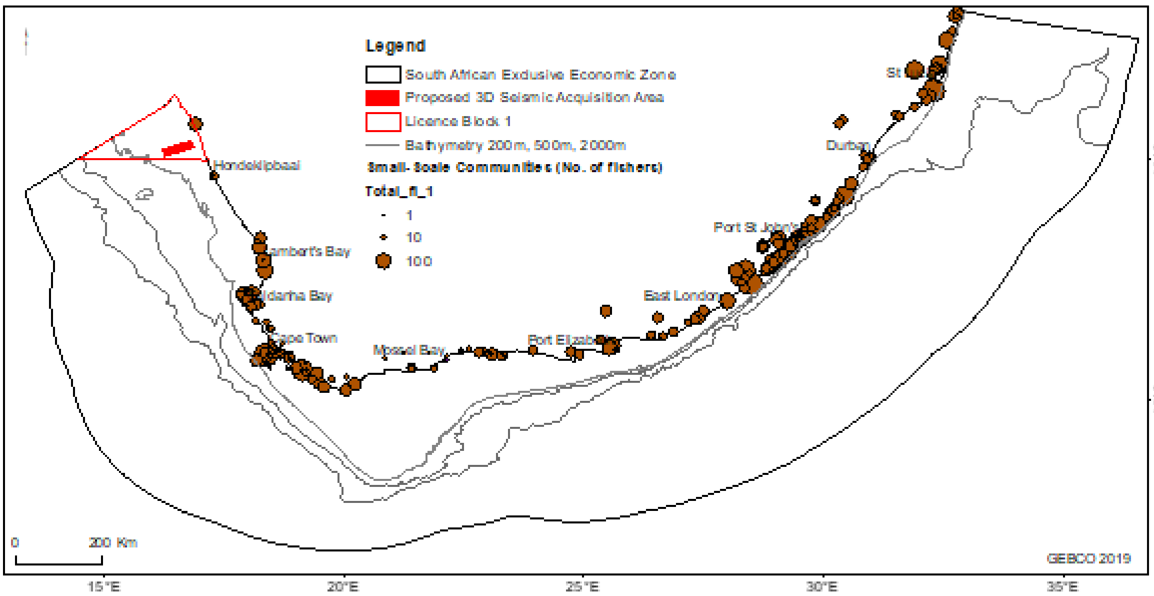


Figure 72: Overview of spatial distribution of small-scale fishing communities and number of participants per community along the South African coastline and in relation to Licence Block 1 and the proposed 3D seismic survey acquisition area.

[4] The equipment used by small scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps.

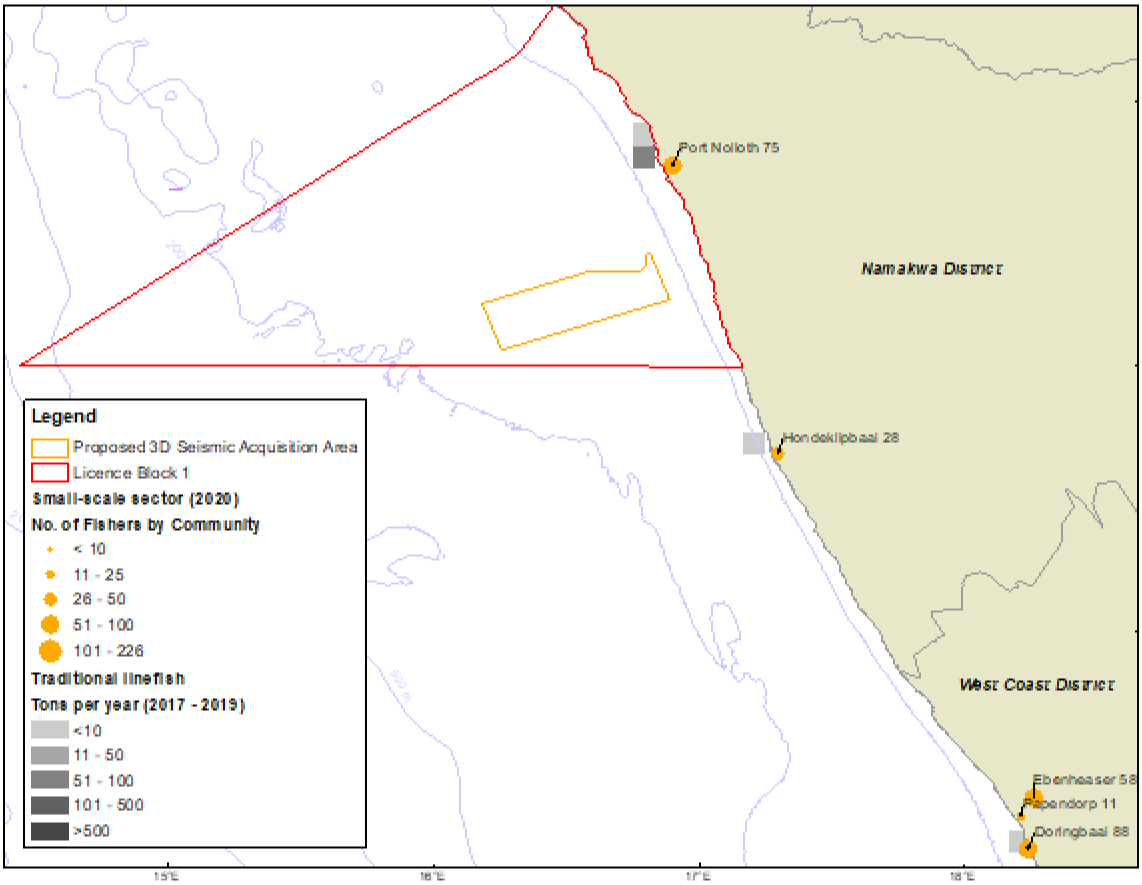


Figure 73: Location of small-scale fishing communities and number of participants per community in the Namakwa municipal district, adjacent to Licence Block 1 and the proposed 3D seismic survey acquisition area.

The small-scale fisheries policy proposes that certain areas on the coast be prioritized and demarcated as small-scale fishing areas. In some areas access rights could be reserved exclusively for use by small-scale fishers. The community, once they are registered as a community-based legal entity, could apply for the demarcation of these areas. The policy also requires a multi-species approach to allocating rights, which will entail allocation of rights for a basket of species that may be harvested or caught within particular designated areas. DFFE recommends five basket areas: 1. Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources 2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources 3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources 4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources 5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

The fishing sectors that could be directly affected are: 1) traditional line fish; 2) squid; 3) white mussel and oysters and 4) hake handline. While most of these sectors are nearshore (within 3 nm of the coast), the fisheries that operate further offshore may be affected by this ongoing process. These include hake handline and squid, which will be subjected to the ongoing Fishery Rights Allocation Process (referred to as "FRAP").

The SSF is to be implemented along the coast in series of community "co-operatives". DFFE has split SFF by communities into district municipalities and local municipalities.

- In the Northern Cape, communities are grouped into the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities and there are 103 registered fishers between Port Nolloth and Hondeklipbaai (see Figure 73 above).
- Western Cape districts include 1) West Coast (Berg River, Saldanha Bay, Cederberg, Matzikama and Swartland local municipalities; 2) Cape Metro; 3) Overberg (Overstrand and Cape Agulhas); and 4) Eden (Knysna, Bitou and Hessequa). In total there are 2 748 fishers registered in the province.

- In the Eastern Cape, the districts are 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. There are 5 154 fishers registered in the province.
- KwaZulu-Natal has 2 008 registered small-scale fishers divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude.

Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, West Coast rock lobster and abalone fisheries, whereas communities on the South Coast would be involved in traditional line, squid jig and oyster harvesting. The above-mentioned fisheries off the West Coast are unlikely to range beyond 3 nm (5.6 km) from the coastline; thus, inshore of the proposed survey area.

8.5.3.11 BEACH-SEINE AND GILLNET FISHERIES (NETFISH)

There are a number of active beach-seine and gillnet operators throughout South Africa (collectively referred to as the “netfish” sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South coasts. These fishermen utilize 1 373 registered and 458 illegal nets and report an average catch of about 1 600 tons annually, constituting 60% harders (also known as mullet, *Liza richardsonii*), 10% St Joseph shark (*Callorhinchus capensis*) and 30% "bycatch" species such as galjoen (*Dichistius capensis*), yellowtail (*Seriola lalandii*) and white steenbras (*Lithognathus lithognathus*). Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and gill-net fisheries respectively off the West Coast to 48 and 5 kg·net-day^{-1} off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast (Lamberth *et al*. 1997).

The fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas (see Table 24 below for the number of rights issued and Figure 74 below for the fishing areas). The number of Rights Holders for 2014 was listed as 28 for beach-seine and 162 for gill-net (DAFF, 2014a). Permits are issued solely for the capture of harders, St Joseph and species that appear on the ‘bait list’. The exception is False Bay, where Right Holders are allowed to target linefish species that they traditionally exploited.

The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth (Lamberth 2006) with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Fréon *et al*. 2010). Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and length of the haul. Nets range in length from 120 m to 275 m. Fishing effort is coastal and net depth may not exceed 10 m (DAFF 2014b). There are currently three rights issued for Area A (Port Nolloth) and no rights issued for Area B (Hondeklipbaai).

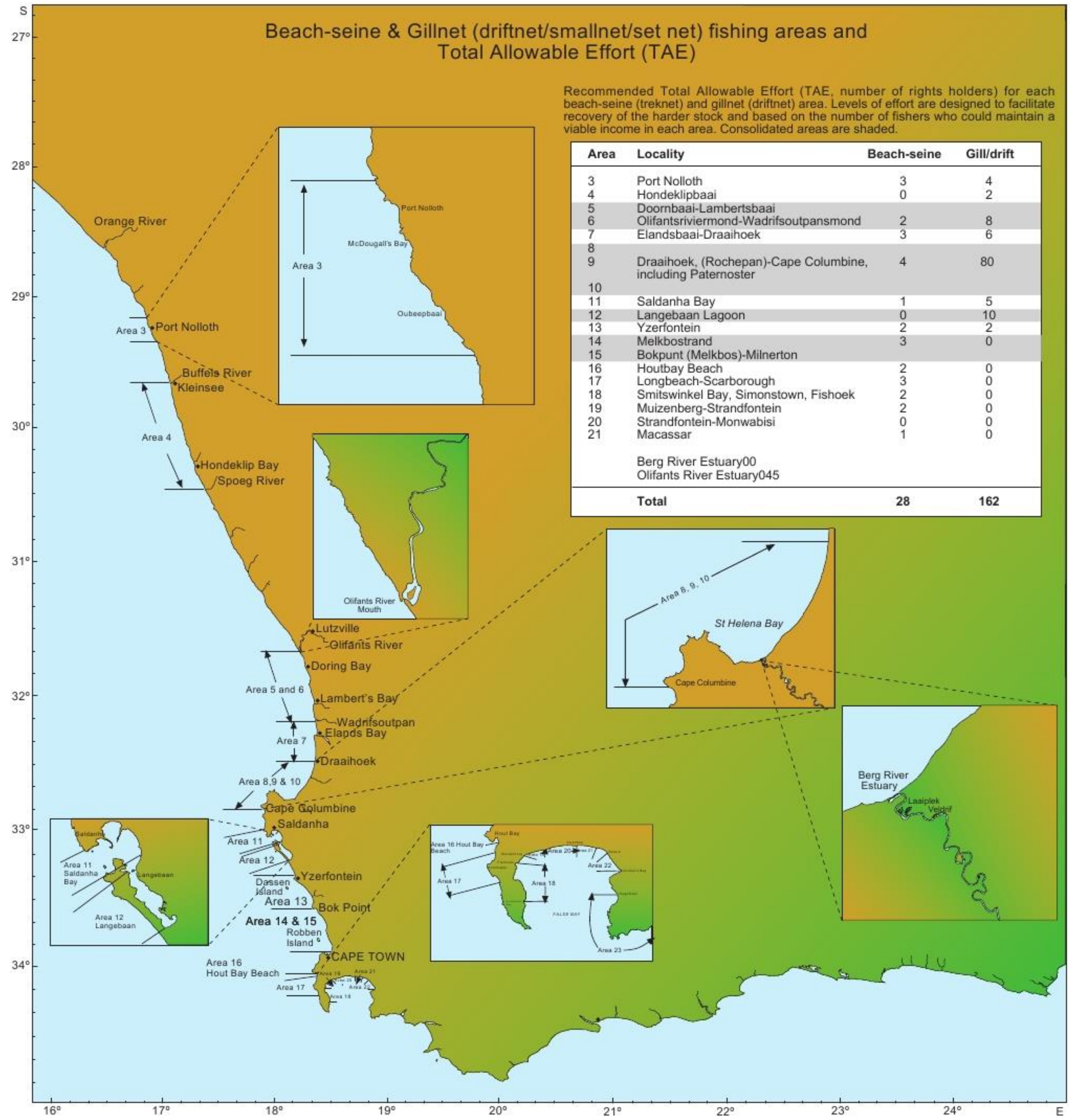
The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m (da Silva *et al*. 2015) and are set in waters shallower than 50 m. The spatial distribution of effort is represented as the annual number of nets per kilometre of coastline and ranges up to a maximum of 15 off St Helena Bay. Of a total of 162 right holders, four operate within Area A (Port Nolloth) and two operate within Area B (Hondeklipbaai).

Table 24: Recommended Total Allowable Effort (TAE, number of rights and exemption holders) and rights allocated in 2016-17 for each netfish area. Levels of effort are based on the number of fishers who could maintain a viable income in each area (DAFF 2017).

Area	Locality	Beach-seine	Gill/drift	Total	Rights allocated
A	**Port Nolloth**	**3**	**4**	**7**	**4**
B	**Hondeklipbaai**	**0**	**2**	**2**	**0**
C	Olifantsriviermond-Wadrifsoutpansmond	2	8	10	4

Area	Locality	Beach-seine	Gill/drift	Total	Rights allocated
D	Wadrifsoutpansmond-Elandsbaai-Draaihoek	3	6	9	6
E	Draaihoek, (Rochepan)-Cape Columbine, including Paternoster	4	80	84	84
F	Saldhana Bay	1	5	6	5
G	Langebaan Lagoon	0	10	10	10
H	Yzerfontein	2	2	4	1
I	Bokpunt (Melkbos)-Milnerton	3	0	3	1
J	Houtbay beach	2	0	2	0
K	Longbeach-Scarborough	3	0	3	1
L	Smitswinkel Bay, Simonstown, Fishoek	2	0	2	2
M	Muizenberg-Strandfontein	2	0	2	2
N	Macassar*	0	0	0	(1)
OE	Olifants River Estuary	0	45	45	45

Licence Block 1 is situated offshore of management area B, however the range of gillnets (50 m) and that of beach-seine activity (20 m) is not likely to directly overlap with the seismic acquisition area which is situated in waters deeper than 100 m. Figure 75 shows the expected range of gillnet fishing activity in relation to the seismic acquisition area.



Area	Locality	Beach-seine	Gill/drift
3	Port Nolloth	3	4
4	Hondeklipbaai	0	2
5	Doornbaai-Lambertsbaai		
6	Olifantsriviermond-Wadrifsoutpansmond	2	8
7	Elandsbaai-Draaihoek	3	6
8			
9	Draaihoek, (Rochepan)-Cape Columbine, including Paternoster	4	80
10			
11	Saldanha Bay	1	5
12	Langebaan Lagoon	0	10
13	Yzerfontein	2	2
14	Melkbostrand	3	0
15	Bokpunt (Melkbos)-Milnerton		
16	Houtbay Beach	2	0
17	Longbeach-Scarborough	3	0
18	Smitswinkel Bay, Simonstown, Fishoek	2	0
19	Muizenberg-Strandfontein	2	0
20	Strandfontein-Monwabisi	0	0
21	Macassar	1	0
	Berg River Estuary00		
	Olifants River Estuary045		
	Total	**28**	**162**

Figure 74: Beach-seine and gillnet fishing areas and TAE (DAFF, 2014)

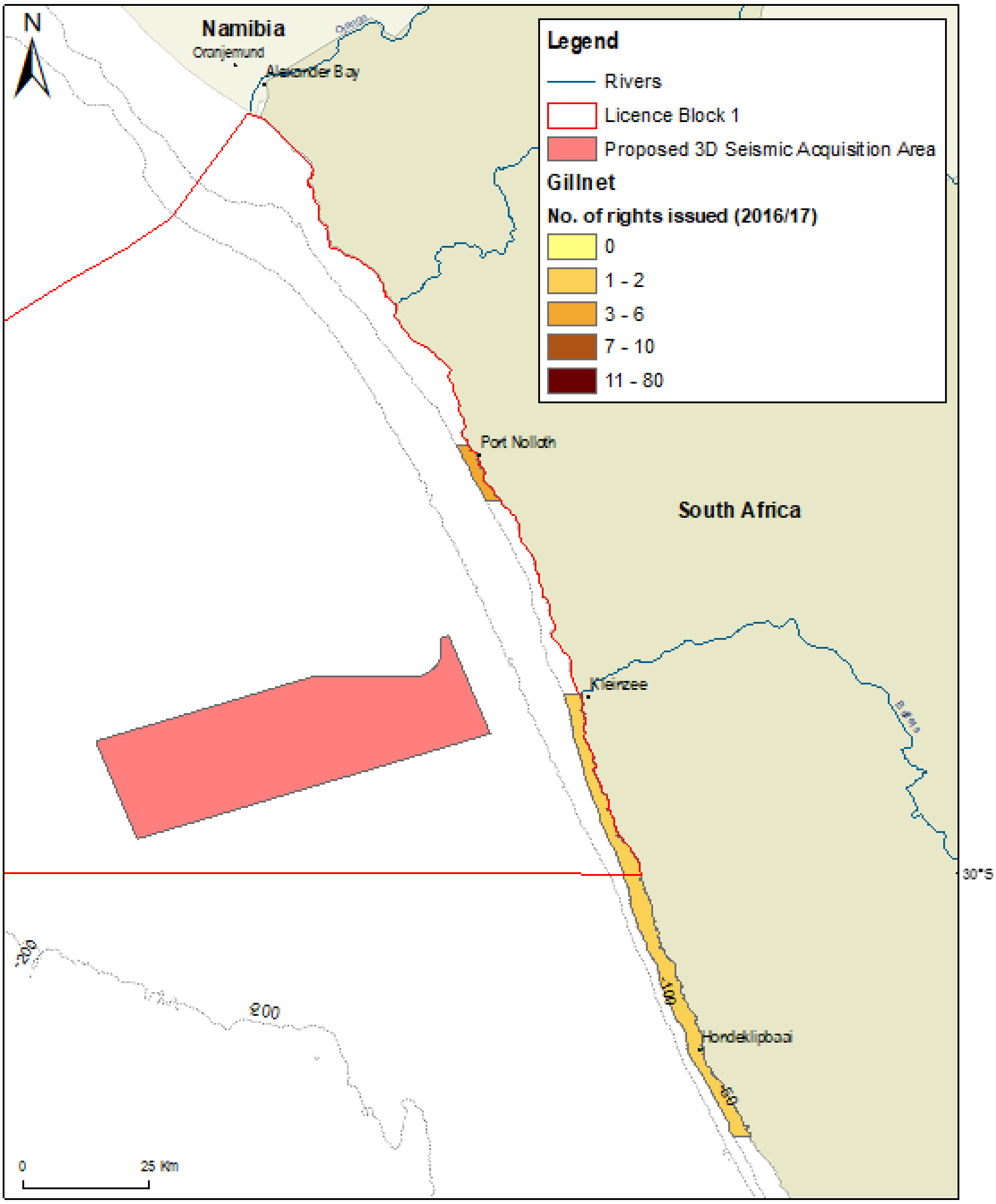


Figure 75: Number of rights issued for gillnet fishing areas A (Port Nolloth) and B (Hondeklipbaai) to a maximum fishing depth of 50 m (DAFF, 2016/17) in relation to Licence Block 1 and the proposed seismic acquisition area.

8.5.3.12 SEAWEED

The South African seaweed industry is based on the commercial collection of kelps (*Ecklonia maxima* and *Laminaria pallida*) and red seaweed (*Gelidium* spp.) as well as small quantities of several other species. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast red seaweeds were collected in Saldanha Bay and St Helena Bay, but there has been no commercial activity there since 2007. *Gelidium* species are harvested in the Eastern Cape (DAFF, 2014a).

The seaweed sector employs approximately 1 700 people, 92% of whom are historically disadvantaged persons. Much of the harvest is sun-dried, milled and exported for the extraction of alginate. Fresh kelp is also harvested in large quantities in the Western Cape as feed for farmed abalone. This resource, with a market value of about R6 million is critically important to local abalone farmers. Fresh kelp is also harvested for high-value plant-growth stimulants that are marketed locally and internationally.

Harvesting rights are issued by management area. Whilst the Minister annually sets both a TAC and TAE for the sector, the principle management tool is effort control and the number of right holders in each seaweed harvesting area is restricted. Fourteen commercial seaweed harvesting rights are currently allocated and each concession area is limited to one right-holder for each functional group of seaweed (e.g. kelps, *Gelidium* spp. and Gracilarioids). In certain areas there are also limitations placed on the amounts that may be harvested. The South African coastline is divided between Port Nolloth and Port St Johns into 23 harvesting areas. Figure 76 below shows licence block 1 in relation to management areas 15 and 16, which are situated offshore of Port Nolloth and Hondeklipbaai.

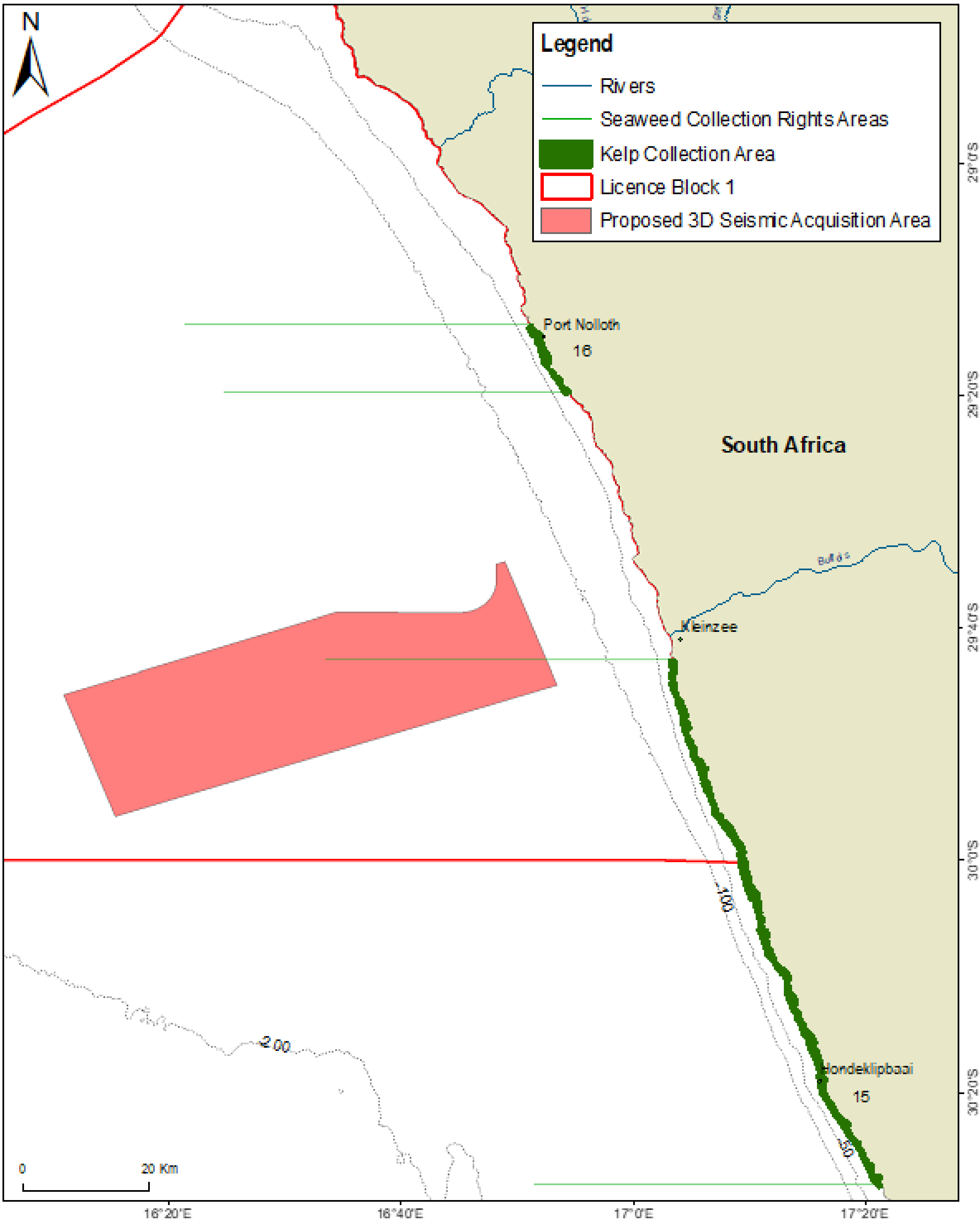


Figure 76: Location of seaweed rights areas in relation to licence block 1 and the proposed seismic survey acquisition area.

Permit conditions stipulate that within these areas kelp may be harvested using a diver deployed from a boat or the shore. The acquisition area is not expected to coincide with the depth range at which divers could harvest kelp. No kelp plants with a stipe less than 50 cm long may be cut or harmed. Beach cast plants may be collected by hand. Over the period 2000 to 2017, an average of 40.33 tonnes per annum of dry harvested kelp (beach cast) and 34.67 tons per annum of wet harvested kelp were reported within collection area 15. An average of 37 tonnes per annum of dry harvested kelp and 37.33 tonnes of wet harvested kelp were reported within collection area 16. Amounts harvested within these collection areas amounts to approximately 16.3% of the total kelp harvests, nationally.

8.5.3.13 FISHERIES RESEARCH

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January. The survey of the Southeast coast (20°E – 27°E longitude) takes place in April/May. Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. On occasion, trawls are targeted in waters deeper than 1 000 m. Figure 77 below shows the distribution of research trawls undertaken in relation to the proposed 3D seismic survey acquisition area.

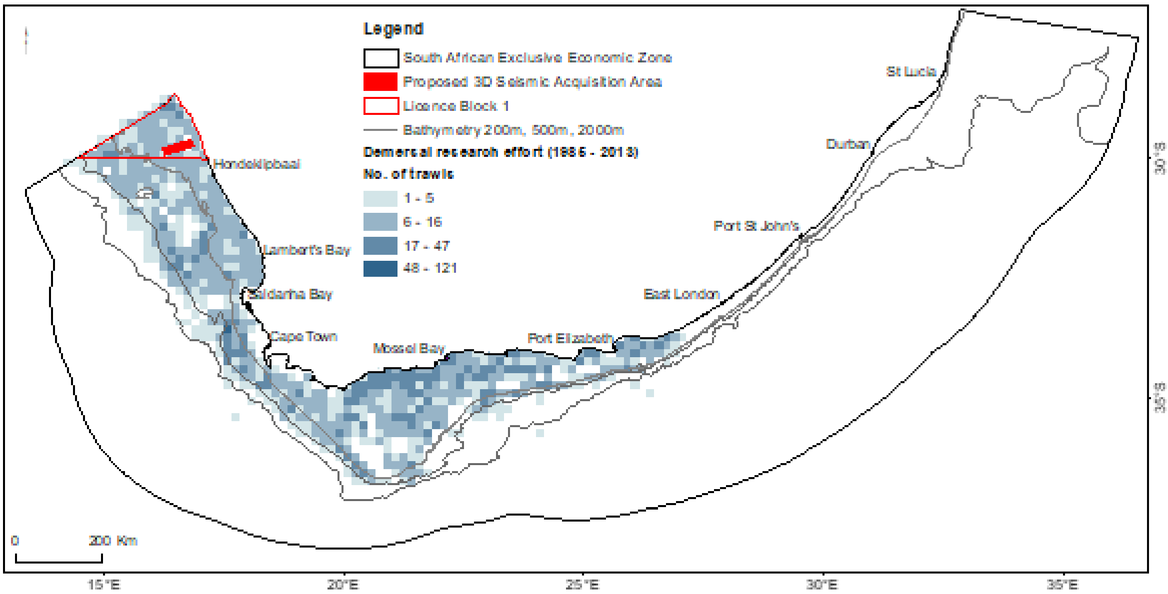


Figure 77: Spatial distribution of trawling effort expended during research surveys undertaken by DFFE to ascertain biomass of demersal fish species.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DFFE survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east. Figure 78 below shows the research effort undertaken between 1988 and 2013 in respect to Licence Block 1 and the proposed 3D survey acquisition area. Figure 79 shows the transects completed during the November 2020 and May 2021 research surveys for the recruitment and spawner biomass of small pelagic species. Two survey transects were undertaken across the proposed seismic survey acquisition area and nine transects across the extent of the licence block.

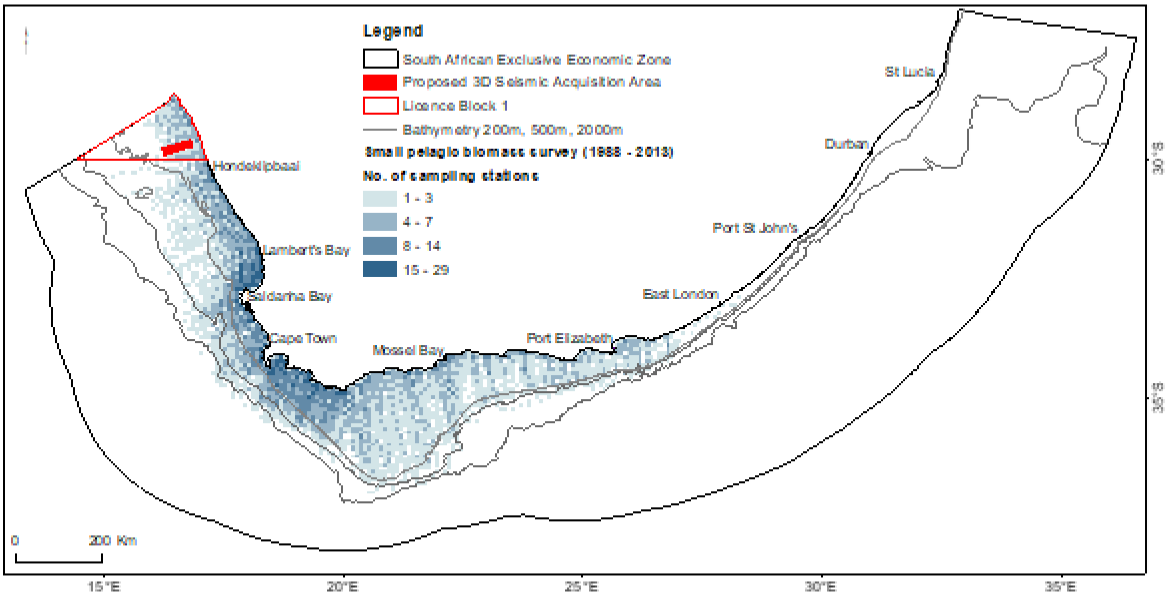


Figure 78: Spatial distribution sampling stations for acoustic surveys of the biomass of small pelagic species (1988 – 2013).

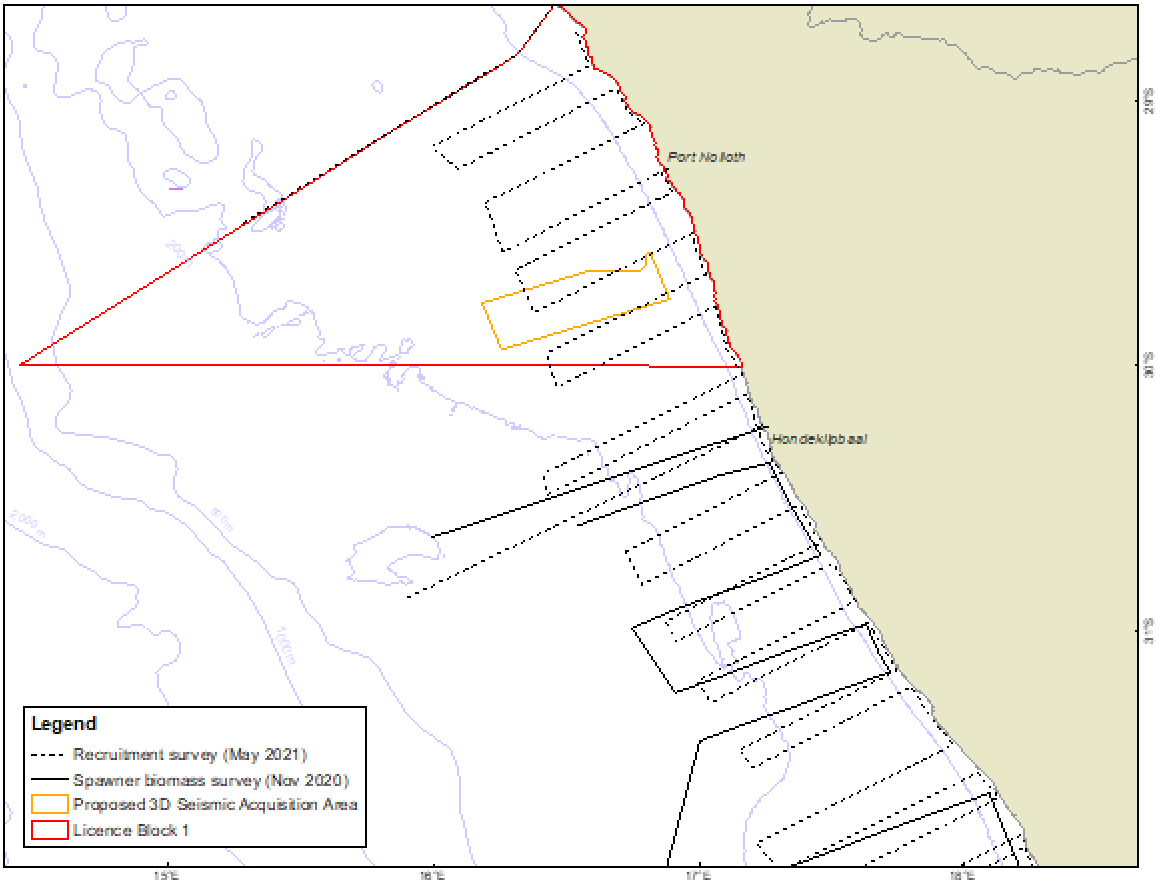


Figure 79: Spatial distribution of survey transects completed during the DFFE research surveys for small pelagic species (May 2021 and November 2020) in relation to Licence Block 1 and the proposed 3D seismic survey area.

8.5.4 SUMMARY TABLE OF SEASONALITY OF CATCHES FOR COMMERCIAL FISHING SECTORS

The seasonality of each of the main commercial fishing sectors that operate within the South Africa EEZ is indicated in Table 25 below– also presented is the relative intensity of fishing effort on a month-by-month basis.

Table 25: Summary table showing seasonal variation in fishing effort expended by each of the main commercial fisheries sectors operating in West Coast South African waters.

Sector	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	H	H	H	H	H	H	H	H	H	H	H	H
Midwater Trawl	H	H	H	H	H	H	H	H	H	H	H	H
Demersal Longline	M	H	H	H	H	H	H	H	H	H	H	H
Small Pelagic Purse-Seine	M	H	H	H	H	H	H	H	H	H	H	M
Large Pelagic Longline	M	M	M	M	H	H	H	H	H	H	H	M
Tuna Pole-Line	H	H	H	H	H	M	M	M	M	M	H	H
Traditional Linefish	H	M	M	M	M	M	M	M	M	M	M	H
West Coast Rock Lobster	H	H	H	H*	H*	H#	M#	N	N	M	M	H
Small-scale (linefish & rock lobster sectors)	M	M	M	H	H	H	M	M	M	M	M	M
Research survey (trawl)	M	M	M	N	N	N	N	N	N	N	N	N
Research survey (acoustic)	N	N	N	N	M	M	N	N	N	M	M	M

Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)

*Areas 8 and 11 only; # Area 8 only

8.6 OTHER USES OF THE AREA

This section provides a description of the other characteristics of the application area. The information has been sourced from the Marine Ecological Study undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix C.

8.6.1 DIAMOND MINING

The coastal area onshore of Block 1 falls within the Alexkor and West Coast Resources coastal diamond mining areas and as public access is restricted, recreational activities along the coastline between Hondeklipbaai and Alexander Bay is limited to the area around Port Nolloth.

The marine diamond mining concession areas are split into four or five zones (Surf zone and (a) to (c) or (d)-concessions), which together extend from the high water mark out to approximately 500 m depth (Figure 80). Off Namaqualand, marine diamond mining activity is primarily restricted to the surf-zone and (a)-concessions. Nearshore shallow-water mining is conducted by divers using small-scale suction hoses operating either directly from the shore in small bays or from converted fishing vessels out to ~30 m depth. However, over the past few years there has been a substantial decline in small-scale diamond mining operations due to the global recession and depressed diamond prices, although some vessels do still operate out of Alexander Bay and Port Nolloth.

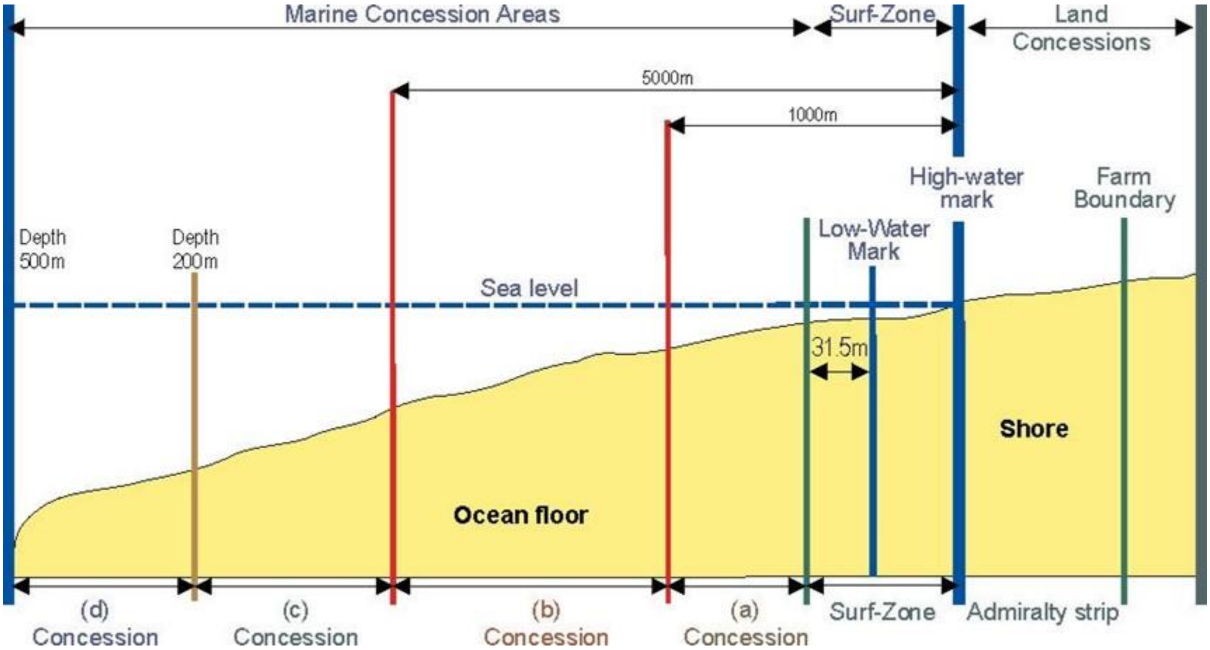


Figure 80: Diagram of the onshore and offshore boundaries of the South African (a) to (d) marine diamond mining concession areas.

Block 1 overlaps with a number of marine diamond mining concession areas (Figure 82). Deep-water diamond mining and exploration is, however, currently limited to operations by Belton Park Trading 127 (Pty) Ltd in concession 2C for mining and 3C -5C for exploration. De Beers Consolidated Mines (Pty) Ltd hold prospecting rights for diamonds, gold platinum group elements and other specific minerals in Concessions 6C – 10C and for gold and other specific minerals in Concessions 2C – 5C. There are also a number of proposed prospecting areas for glauconite and phosphorite/phosphate, all of which are located south of Block 1. In Namibia, deep-water diamond mining by De Beers Marine Namibia is currently operational in the Atlantic 1 Mining Licence Area.

Other industrial uses of the marine environment include the intake of feed-water for mariculture, or diamond-gravel treatment. None of these activities should in any way be affected by exploration drilling activities offshore.

Figure 81: Typical crawler-vessel (left) and drillship (right) operating in the Atlantic 1 Mining Licence Area.

These mining operations are typically conducted to depths of 150 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. The vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread (Figure 81 above). Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

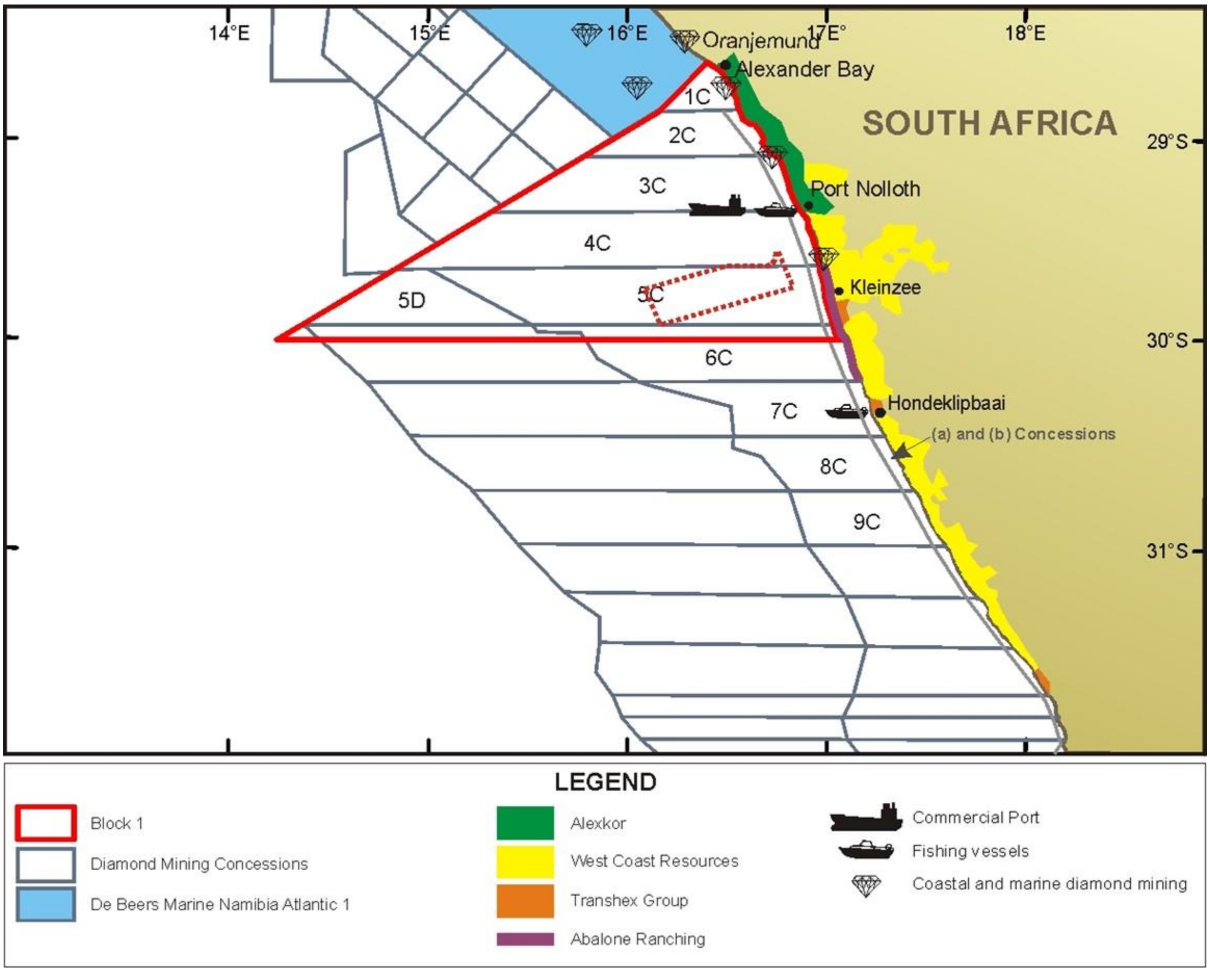


Figure 82: Project - environment interaction points on the West Coast, illustrating the location of Block 1 and the proposed 3D survey area in relation to marine diamond mining concessions and ports for commercial and fishing vessels.

8.6.2 DEVELOPMENT POTENTIAL OF THE MARINE ENVIRONMENT IN THE PROJECT AREA

The economy of the Namaqualand region is dominated by mining. However, with the decline in the mining industry and the closure of many of the coastal mines, the economy of the region is declining and jobs are being lost with potential devastating socio-economic impacts on the region. The Northern Cape provincial government has recognized the need to investigate alternative economic activities to reduce the impact of minerals downscaling and has commissioned a series of baseline studies of the regional economy. These assessments concluded that fishing and specifically mariculture offer a significant opportunity for long term (10+ years) sustainable economic development along the Namaqualand coast. The major opportunities cited in these studies include hake and lobster fishing (although the current trend in quota reduction is likely to limit development potentials), seaweed harvesting and aquaculture of abalone, seaweeds, oysters and finfish. The Northern Cape provincial government is facilitating the development of the fishing and mariculture sectors by means of a holistic sector planning approach and has in partnership with a representative community and industry based Fishing and Mariculture Development Association (FAMDA), developed the Northern Cape Province Fishing and Mariculture Sector Plan. This plan forms part of the 'Northern Cape - Fishing and Mariculture Sector Development Strategy' whereby implementation of the plan will be coordinated and driven by FAMDA.

Abalone ranching (i.e. the release of abalone seeds into the wild for harvesting purposes after a growth period) has been identified as one of the key opportunities to develop in the short- to medium-term and consequently the creation of abalone ranching enterprises around Hondeklip Bay and Port Nolloth forms part of the sector plan's development targets. In the past, experimental abalone ranching concessions have been granted to Port Nolloth Sea Farms (PNSF) in Sea Concession areas 5 and 6, effectively a 60 km strip of coastline (see Figure 82), and to Ritztrade in the Port Nolloth area. These experimental operations have shown that although abalone survival is highly variable depending on the site characteristics and sea conditions, abalone ranching on the Namaqualand coast has the potential for a lucrative commercial business venture. As a result, the government publication ‘Guidelines and potential areas for marine ranching and stock enhancement of abalone *Haliotis midae* in South Africa’ (GG No. 33470, Schedule 2, April 2010) identified broad areas along the South African coastline that might be suitable for abalone ranching. Along the Northern Cape coast, four specific zones were marked, separated by 6-13 km wide buffer zones. Currently, applications for abalone ranching projects have been submitted and permits for pilot projects for some of the zones have been granted.

Besides abalone sea-ranching, several other potential projects were identified in the sector plan. Most of these are land-based aquaculture projects (e.g. abalone and oyster hatcheries in Port Nolloth and abalone grow-out facility in Hondeklip Bay), but included was a pilot project to harvest natural populations of mussels and limpets in the intertidal coastal zone along the entire Northern Cape coast. The objective of the project was to determine the stock levels and to ascertain what percentage of the biomass of each species can be sustainably harvested, as well as the economic viability of harvesting the resource.

Other industrial uses of the marine environment include the intake of feed-water for mariculture, or diamond-gravel treatment. None of these activities should in any way be affected by offshore exploration activities.

8.6.3 CONSERVATION AREAS AND MARINE PROTECTED AREAS

8.6.3.1 CONSERVATION AREAS

Numerous conservation areas and a MPA exist along the coastline of the Western Cape. The only conservation area in the vicinity of the project area in which restrictions apply is the McDougall’s Bay rock lobster sanctuary near Port Nolloth, which is closed to commercial exploitation of rock lobsters.

The Orange River Mouth wetland located at the northern corner of Block 1 provides an important habitat for large numbers of a great diversity of wetland birds and is listed as a Global Important Bird Area (IBA) (ZA023/NA 019). The area was designated a Ramsar site in June 1991, and processes are underway to declare a jointly-managed transboundary Ramsar reserve.

Various marine IBAs have also been proposed in South African and Namibian territorial waters, with a candidate trans-boundary marine IBA suggested off the Orange River mouth (Figure 83 below). Block 1 lies south of the Atlantic Southeast 21 marine IBA and overlaps with the candidate Orange River Mouth Wetland IBA.

8.6.3.2 MARINE PROTECTED AREAS

‘No-take’ MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) were absent northwards from Cape Columbine. This resulted in substantial portions of the coastal and shelf-edge marine biodiversity in the area being assigned a threat status of ‘Critically endangered’, ‘Endangered’ or ‘Vulnerable’ in the 2011 NBA. Using biodiversity data mapped for the 2004 and 2011 NBAs a systematic biodiversity plan was developed for the West Coast with the objective of identifying both coastal and offshore priority areas for MPA expansion. Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. To this end, nine focus areas were identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border.

These focus areas were carried forward during Operation Phakisa, which identified potential offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African EEZ to 5%. The approved MPAs within the broad project area are shown in Figure 84. Block 1 overlap with the Orange Shelf Edge and Namaqua Fossil Forest MPA (Figure 84). The Namaqua Fossil Forest MPA provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an EBSA. The 1 200 km^2 MPA protects the unique fossil forests and the surrounding seabed ecosystems and including a new species of sponge previously unknown to science.

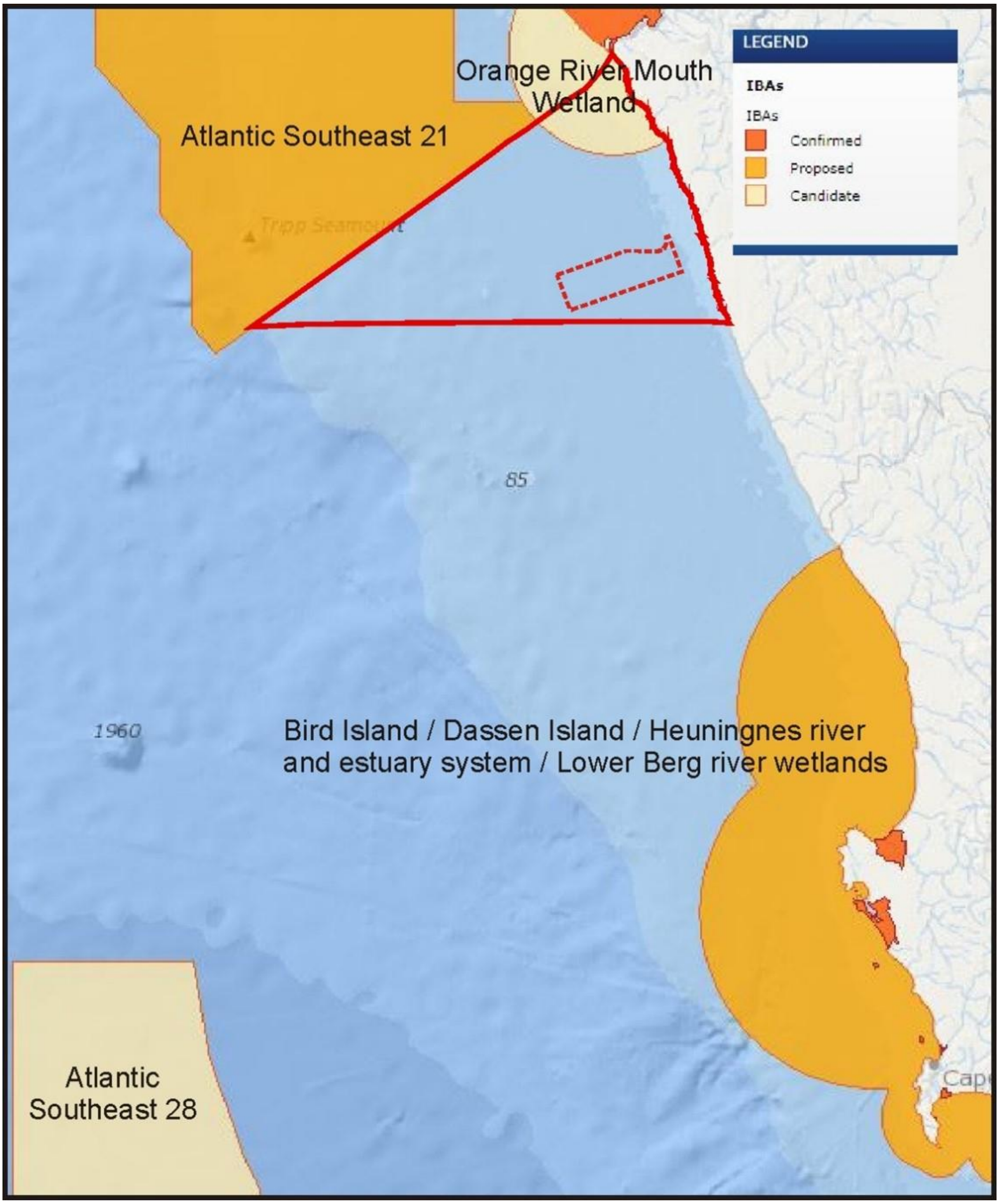


Figure 83: Block 1 in relation to coastal and marine IBAs in Namibia.

Other MPAs in the area are described briefly below (www.marineprotectedareas.org.za/offshore-mpas):

The **Orange Shelf Edge MPA** covers depths of between 250 m and 1,500 m and is unique as it has to date never been trawled. Proclaimed in 2019, this MPA provides a glimpse into what a healthy seabed should look like, what animals live there and how the complex relationships between them support important commercial fish species such as hake, thereby contributing fundamentally towards sustainable fisheries development. This MPA covers an area of importance for migratory species and protects the pelagic habitats that are home to predators such as blue sharks, as well as surface waters where thousands of seabirds such as Atlantic yellow-nosed albatrosses feed.

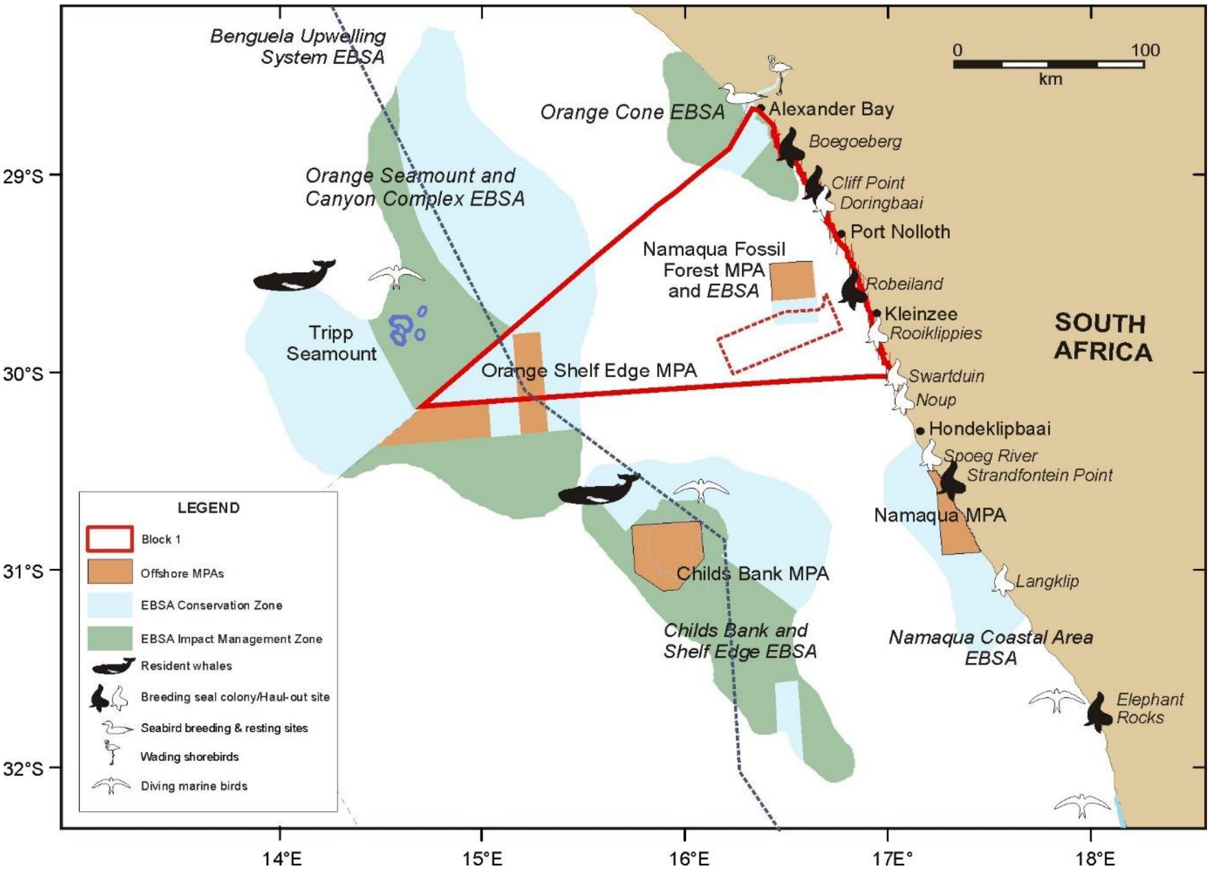


Figure 84: Block 1 (red polygon) and the proposed 3D survey area (dotted line) in relation to project - environment interaction points on the West Coast, illustrating the location of seabird and seal colonies and resident whale populations, Marine Protected Areas, and Ecologically and Biologically Significant Areas (EBSAs) and the marine spatial planning zones within these.

The 1 335 km^2 **Child's Bank MPA**, located to the south of Block 1, supports seabed habitats inhabited by a diversity of starfish, brittle stars and basket stars, many of which feed in the currents passing the bank's steep walls. Although trawling has damaged coral in the area, some pristine coral gardens remain on the steepest slopes. The Child's Bank area was first proposed for protection in 2004 but was only proclaimed in 2019, after reducing its size to avoid petroleum wellheads and mining areas. The MPA provides critical protection to these deep sea habitats (180 - 450 m) as they allow for the recovery of important nursery areas for young fish.

The **Namaqua National Park MPA** provides the first protection to habitats in the Namaqua bioregion, including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape hakes, and the coastal areas support kelp forests and deep mussel beds, which serve as important habitats for the West Coast rock lobster. This 500 km^2 MPA was proclaimed in 2019, both to boost tourism to this remote area and to provide an important baseline from which to understand ecological changes (e.g. introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.

8.6.3.3 SENSITIVE AREAS

Despite the development of the offshore MPA network a number of 'Endangered' and 'Vulnerable' ecosystem types (i.e. Orange Cone Inner Shelf Mud Reef Mosaic, Orange Cone Muddy mid Shelf, Namaqua Muddy Sands, Southern Benguela Outer Shelf Mosaic, Southern Benguela Shelf Edge Mosaic and Southeast Atlantic Lower Slope) are currently 'not well protected' and further effort is needed to improve protection of these threatened ecosystem types (Figure 85 below). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the Southern Benguela Sandy Shelf Edge and Southeast Atlantic Upper- and Mid-Slope are poorly protected receiving only 0.2-10% protection, whereas the Southeast Atlantic Lower Slope receives no protection at all. Expanding the size of the Orange Shelf Edge MPA to form a single MPA along the South African Border could improve protection of these threatened habitats. Most of the ecosystem types in Sea Concessions 4C and 5C are either poorly protected or not protected.

8.6.3.4 ECOLOGICALLY OR BIOLOGICALLY SIGNIFICANT AREAS

As part of a regional Marine Spatial Management and Governance Programme (MARISMA 2014-2020) the Benguela Current Commission (BCC) and its member states have identified a number of Ecologically or Biologically Significant Areas (EBSAs) both spanning the border between Namibia and South Africa and along the South African West, South and East Coasts, with the intention of implementing improved conservation and protection measures within these sites. South Africa currently has 11 EBSAs solely within its national jurisdiction with a further four having recently been proposed. It also shares five trans-boundary EBSAs with Namibia (3) and Mozambique (2). The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. They currently carry no legal status.

Although no specific management actions have as yet been formulated for the EBSAs, two biodiversity zones have recently been defined within each EBSA as part of the marine spatial planning process. The management objective in the zones marked for 'Conservation' is "strict place-based biodiversity protection aimed at securing key biodiversity features in a natural or semi-natural state, or as near to this state as possible". The management objective in the zones marked for 'Impact Management' is "management of impacts on key biodiversity features in a mixed-use area to keep key biodiversity features in at least a functional state". Activities within these two zones can be placed into one of four different Marine Spatial Planning (MSP) categories depending on their compatibility with the EBSA features and management objective of that zone.

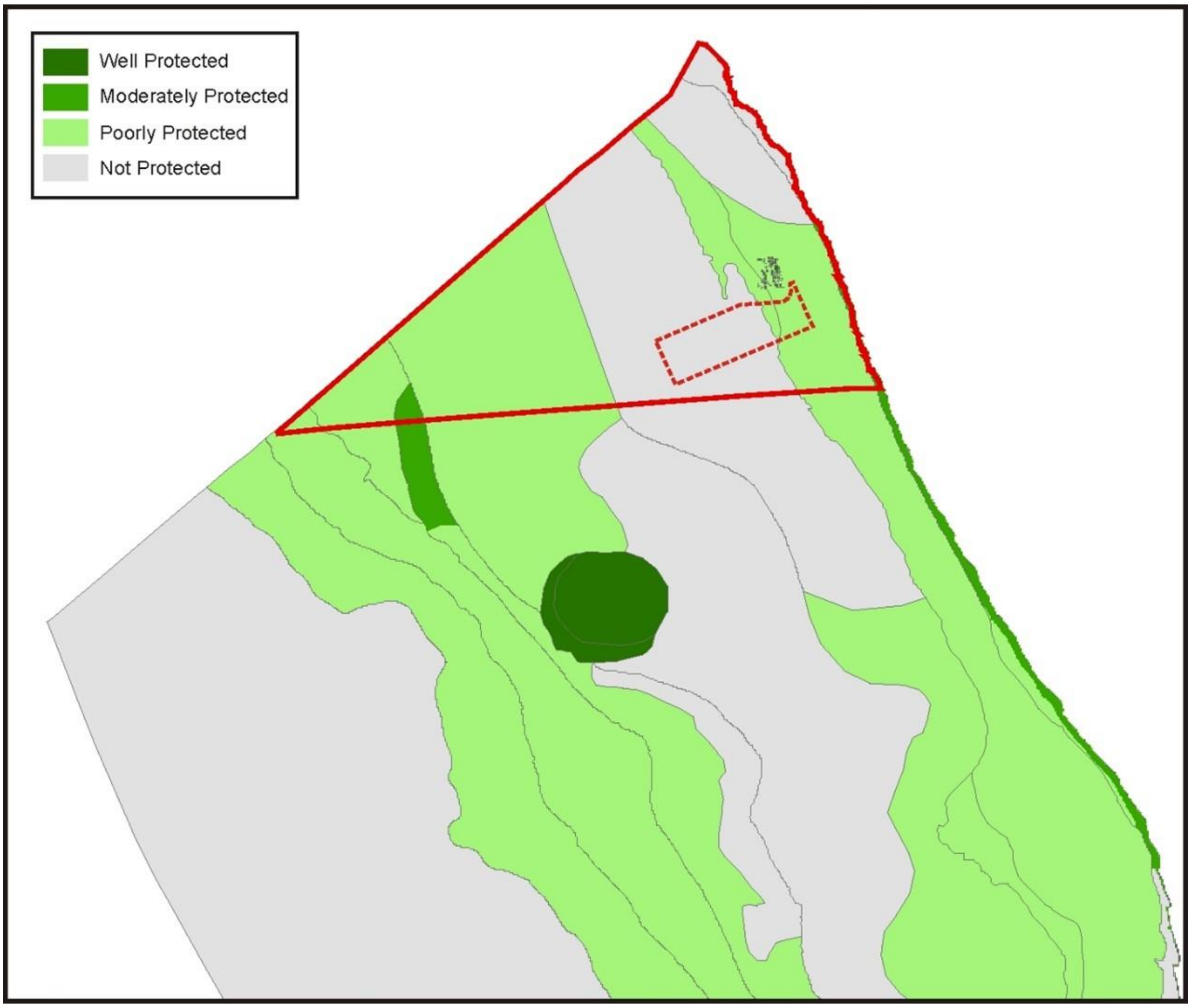


Figure 85: Protection levels of 150 marine ecosystem types as assessed by Sink et al. (2019) in relation to Block 1 (red polygon) and the proposed 3D survey area (dotted line).

Primary An activity that supports the maintenance of biodiversity features. This activity should be encouraged in this zone, and should be prioritized when spatial management decisions are being made. These activities are still likely to be subject to reasonable controls and management measures.

General An activity that is allowed and regulated by current general rules and legislation.

Consent An activity which can continue in this zone subject to specific regulation and control. Careful controls are likely to be put in place to avoid unacceptable impacts on biodiversity features, or ideally to avoid intensification or expansion of impact footprints of uses that are already occuring and where there are no realistic prospects of excluding these activities.

Prohibited An activity which is not allowed or should not be allowed because it is incompatible with maintaining the biodiversity objectives of the zone.

Future activities that may be prohibited in the conservation zone of these EBSAs includes mining construction and operations, although non-destructive or highly localised prospecting activities may be consented in the impact management zone. Block 1 and the proposed 3D survey area overlaps with the southern portion of the Namaqua Fossil Forest EBSA biodiversity conservation zone in which non-destructive exploration and destructive localised impacts such as exploration wells will be conditionally permitted, but petroleum production is considered incompatible. It must be noted, however, that the EBSA Zone boundaries are subject to ongoing revision based on discussions with the National EBSA Working Group. These zones have been incorporated into the most recent iteration of the national Coastal and Marine Critical Biodiversity Area (CBA) Map (v1.0 (Beta 2) released 26th February 2021) (Figure 86). This indicates that CBA1 and CBA2 regions extend south and offshore of the Namaqua Fossil Forest MPA and across the proposed 3D survey area. CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 indicates optimal sites that generally can be adjusted to meet targets in other areas. Ecological Support Areas (ESAs) represent EBSAs outside of MPAs and not already selected as CBAs. Sea-use within the CBAs and ESAs reflect those specified by the EBSA biodiversity conservation and management zones described above.

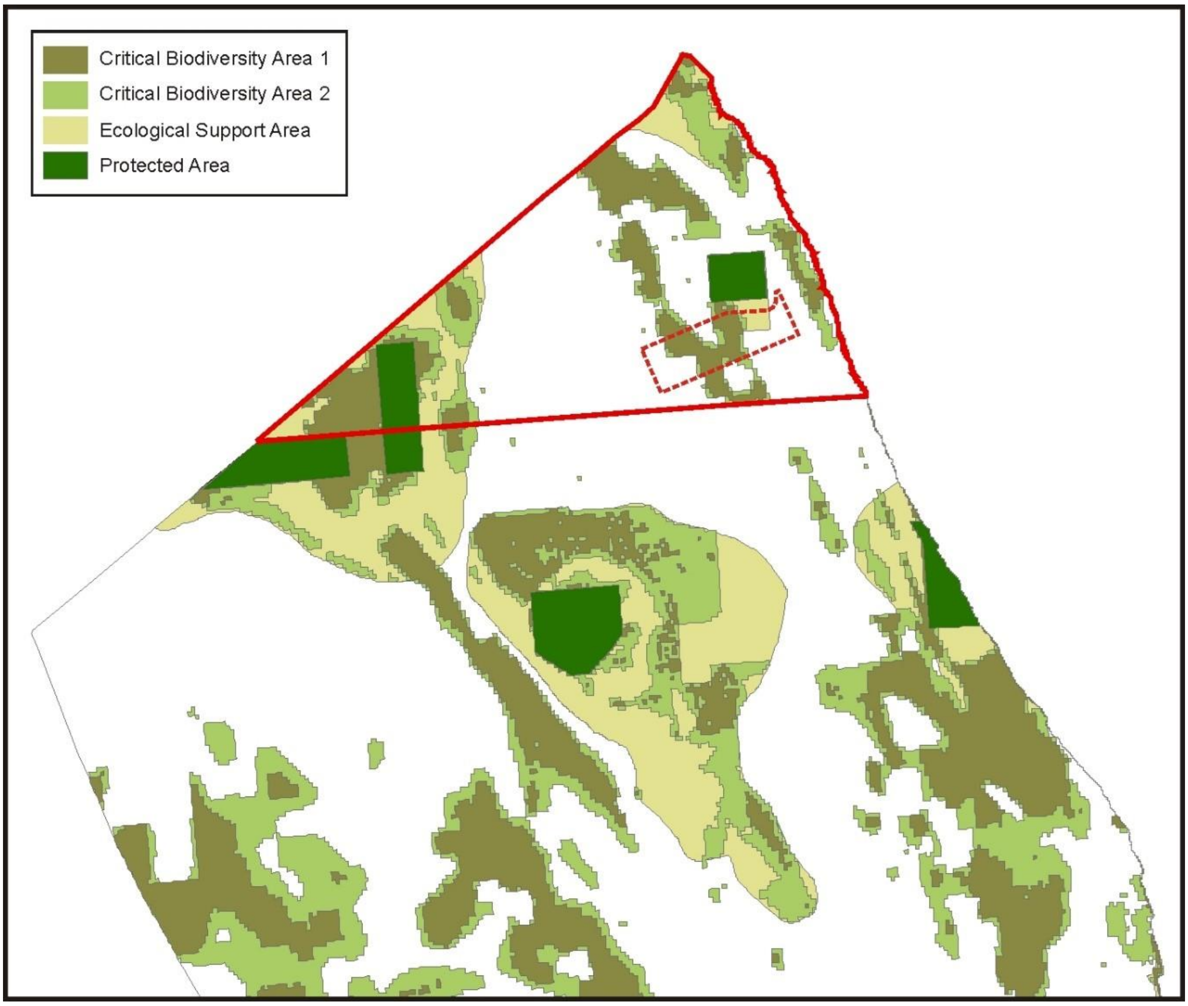


Figure 86: Block 1 (red polygon) and the proposed 3D survey area (dotted line) in relation to the National Coastal and Marine Critical Biodiversity Areas.

The following summaries of the EBSAs in the general area of Block 1 are adapted from http://cmr.mandela.ac.za/EBSA-Portal/South-Africa/.

The **Namaqua Fossil Forest EBSA**, which lies within Block 1, is a small seabed outcrop composed of fossilized yellowwood trees at 136-140 m depth, approximately 30 km offshore on the west coast of South Africa. A portion of the EBSA comprised the Namaqua Fossil Forest MPA. The fossilized tree trunks form outcrops of laterally extensive slabs of rock have been colonized by fragile, habitat-forming scleractinian corals and a newly described habitat-forming sponge species. The EBSA thus encompasses a unique feature with substantial structural complexity that is highly vulnerable to benthic impacts.

The **Orange Seamount and Canyon Complex**, occurs at the western continental margin of southern Africa, spanning the border between South Africa and Namibia. On the Namibian side, it includes Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and shelf-edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are 'Threatened', one is 'Critically endangered' and one 'Endangered'. The Orange Shelf Edge EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures (SST mean = 18.3°C) and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf.

The **Orange Cone transboundary EBSA** lies in the northern corner of Block 1 and spans the mouth of the Orange River. The estuary is biodiversity-rich but modified, and the coastal area includes many 'Critically endangered', 'Endangered' and 'Vulnerable' habitat types (with the area being particularly important for the 'Critically Endangered' Namaqua Sandy Inshore, Namaqua Inshore Reef and Hard Grounds and Namaqua Intermediate and Reflective Sandy Beach habitat types). The marine environment experiences slow, but variable currents and weaker winds, making it potentially favourable for reproduction of pelagic species. An ecological dependence for of river outflow for fish recruitment on the inshore Orange Cone is also likely. The Orange River Mouth is a transboundary Ramsar site and falls within the Tsau//Khaeb (Sperrgebiet) National Park. It is also under consideration as a protected area by South Africa, and is an Important Bird and Biodiversity Area.

The **Childs Bank and Shelf Edge EBSA**, which lies to the south of Block 1, is a unique submarine bank feature rising from 400 m to -180 m on the western continental margin on South Africa. This area includes five benthic habitat types, including the bank itself, the outer shelf and the shelf edge, supporting hard and unconsolidated habitat types. Childs Bank and associated habitats are known to support structurally complex cold-water corals, hydrocorals, gorgonians and glass sponges; species that are particularly fragile, sensitive and vulnerable to disturbance, and recover slowly.

The **Namaqua Coastal Area EBSA**, which lies to the south of Block 1 and encompasses the Namaqua Coastal Area MPA, is characterized by high productivity and community biomass along its shores. The area is important for several threatened ecosystem types represented there, including two 'Endangered' and four 'Vulnerable' ecosystem types, and is important for conservation of estuarine areas and coastal fish species.

The **Benguela Upwelling System** is a transboundary EBSA is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems, and is characterized by very high primary production (>1 000 mg $C.m^{-2}.day^{-1}$). It includes important spawning and nursery areas for fish as well as foraging areas for threatened vertebrates, such as sea- and shorebirds, turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the Northern Benguela, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria.

8.7 SOCIO-ECONOMIC

This section provides and overview of the socio-economic environment for the study area from publicly available sources (e.g. the Namakwa District Municipality (NDM) Integrated Development Plan (IDP) 2020-21).

The NDM is situated in the north-western corner of South Africa and borders the Atlantic Ocean to the west and Namibia to the north. It is also bordered by the ZF Mgcawu and Pixley ka Seme Districts of the Northern Cape Province to the North-East and East, respectively. It is borders by the Western Cape Province to the South (the West Coast, Cape Winelands and Central Karoo District Municipalities). The district is one of five districts in the

Northern Cape Province and situated in the western part of the province. The Namakwa District is the largest district geographically in South Africa (NDM, 2021).

The Local Municipalities Table 26 below are located adjacent to the application area (Figure 88):

Table 26: NDM IDP 2021 Local Municipality Descriptions.

Municipality	Description
Richtersveld Municipality (NC061)	Richtersveld Municipality is one of six Category B Local Municipalities. The municipality is named after Reverend W Richter, a Dutch missionary of the 20th century who opened a mission station in Kuboes. The Richtersveld is a unique landscape surrounded by a variety of contrasts. In Port Nolloth is the ocean, at Alexander Bay there is the Orange River, and at Lekkersing and Eksteensfontein there is underground water that is a little brackish. The Richtersveld Municipal Area are earmarked for a massive harbour development to be located at Boegoebaai on the arid Namakwa coastline. This project is currently in its initial phase and it is envisage that this development will serves as an enabler of further development in the Northern Cape.
Nama Khoi Municipality (NC062)	The Nama Khoi Municipal area is situated in the north-western part of the Northern Cape Province. It forms part of the Namakwa District Municipality with the town of Springbok as the administrative centre. This region is known as the land of the Nama people, the domain of the indigenous Khoi-San. The mighty Orange River provides, not only solace to the soul of the avid nature-lover, but also watersports such as river rafting for the more adventurous. Tourism has become an economic pillar, relieving hardships and serving as a reminder of the rich cultural heritage buried in the plains of Namakwa. Currently Kangnas Wind Farm Project is located 46 km outside of Springbok in the Nama Khoi Municipality. The Wind Farm project started construction during June 2018. Kangnas Wind Farm will generate clean renewable energy, once operational and is an indication of the huge renewable energy potential of the District.
Kamiesberg Municipality (NC064)	The Kamiesberg Municipality serves a geographical area of 11 742 km² and is divided into four municipal wards. Its total population is estimated at just above 10 000, the majority of whom are not economically active. The nearest business centre is Springbok, about 120 km away. The municipality provides electricity to 86 farms within its area. Hondeklipbaai is a seaside town and has a harbour, which serves fishing and diamond-mining boats. It is also a mariculture (i.e. crayfish) and tourist centre (i.e. scenic drives and 4 x 4 routes). Garies and Kamieskroon situated along the N7 Highway are known for their abundance of spring wildflowers. Koiingnaas is a mining town for alluvial diamonds. Several mining activities are presently in different phases in this area.

8.7.1 DEMOGRAPHIC PROFILE

The Namakwa District is the District in the Northern Cape Province with the lowest population in 2016 namely 115488. This is a slight decline from the 2011 census figure of 115 842 and is the least populated district in the Province (and Country, although geographically the largest) with a population comprising 10% of the Provincial total population.

Between 2008 and 2018 the population growth averaged 0.93% per annum which is about half than the growth rate of South Africa as a whole (1.57%). Compared to Northern Cape's average annual growth rate (1.66%), the growth rate in Namakwa's population at 0.93% was about half than that of the province.

Based on the present age-gender structure and the present fertility, mortality and migration rates, Namakwa's population is projected to grow at an average annual rate of 1.1% from 132 000 in 2018 to 139 000 in 2023.

The population pyramid reflects a projected change in the structure of the population from 2018 and 2023. The differences can be explained as follows:

- In 2018, there is a significantly larger share of young working age people between 20 and 34 (23.1%), compared to what is estimated in 2023 (21.7%). This age category of young working age population will decrease over time.
- The fertility rate in 2023 is estimated to be very similar compared to that experienced in 2018.
- The share of children between the ages of 0 to 14 years is projected to be significant smaller (19.4%) in 2023 when compared to 2018 (20.6%).

- In 2018, the female population for the 20 to 34 years age group amounts to 11.7% of the total female population while the male population group for the same age amounts to 11.4% of the total male population. In 2023, the male working age population at 10.8% does not exceed that of the female population working age population at 11.0%, although both are at a lower level compared to 2018.

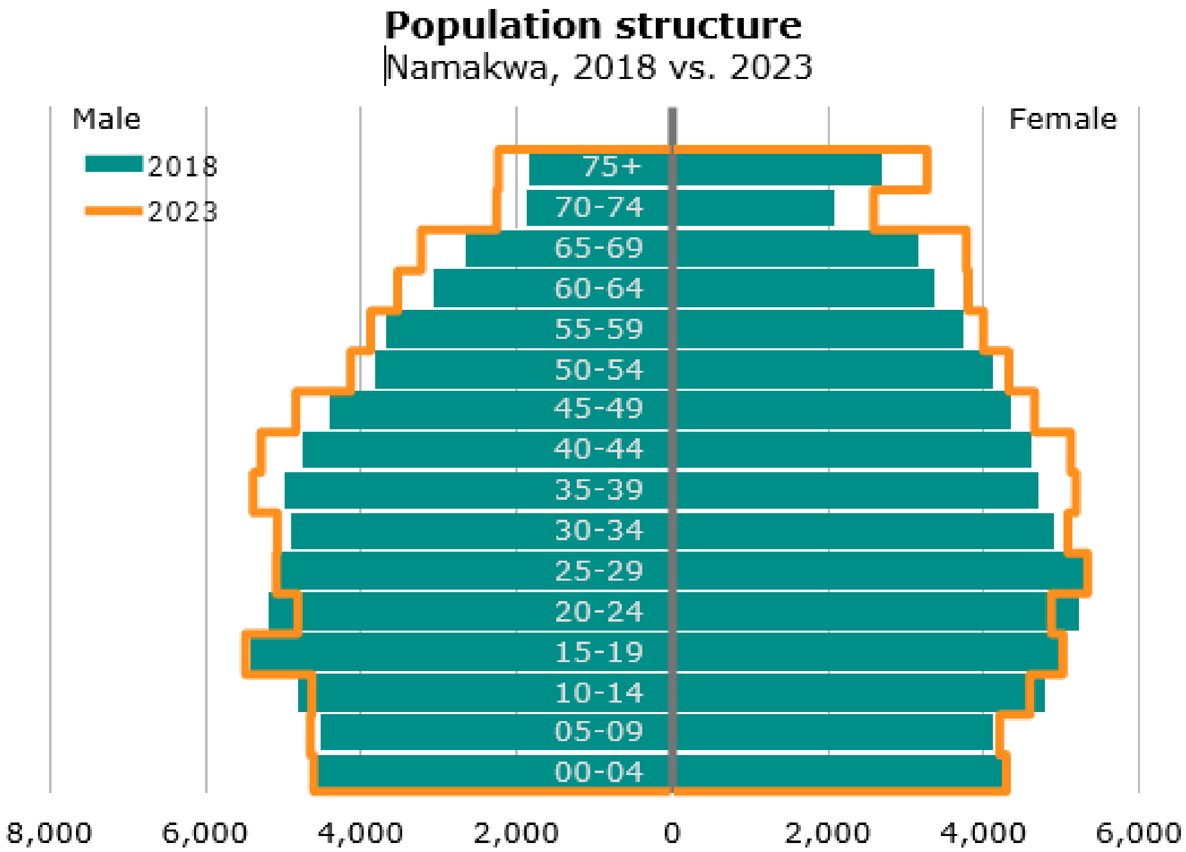


Figure 87: Population pyramid - Namakwa District Municipality, 2018 vs. 2023 (IDP, 2021).

Namakwa District Municipality's male/female split in population was 98.6 males per 100 females in 2018. The Namakwa District Municipality appears to be a fairly stable population with the share of female population (50.36%) being very similar to the national average of (51.04%). In total there were 66 500 (50.36%) females and 65 600 (49.64%) males.

In 2018, the Namakwa District Municipality comprised of 39 400 households. This equates to an average annual growth rate of 1.17% in the number of households from 2008 to 2018. With an average annual growth rate of 0.93% in the total population, the average household size in the Namakwa District Municipality is by implication decreasing. This is confirmed by the data where the average household size in 2008 decreased from approximately 3.4 individuals per household to 3.3 persons per household in 2018.

8.7.2 EMPLOYMENT

The working age population in Namakwa in 2018 was 90 600, increasing at an average annual rate of 1.23% since 2008. For the same period the working age population for Northern Cape Province increased at 1.68% annually, while that of South Africa increased at 1.50% annually. The economically active population (EAP) is a good indicator of how many of the total working age population are in reality participating in the labour market of a region Namakwa District Municipality's EAP was 48 000 in 2018, which is 36.33% of its total population of 132 000, and roughly 10.65% of the total EAP of the Northern Cape Province. From 2008 to 2018, the average annual increase in the EAP in the Namakwa District Municipality was 0.72%, which is 0.785 percentage points lower than the growth in the EAP of Northern Cape's for the same period.

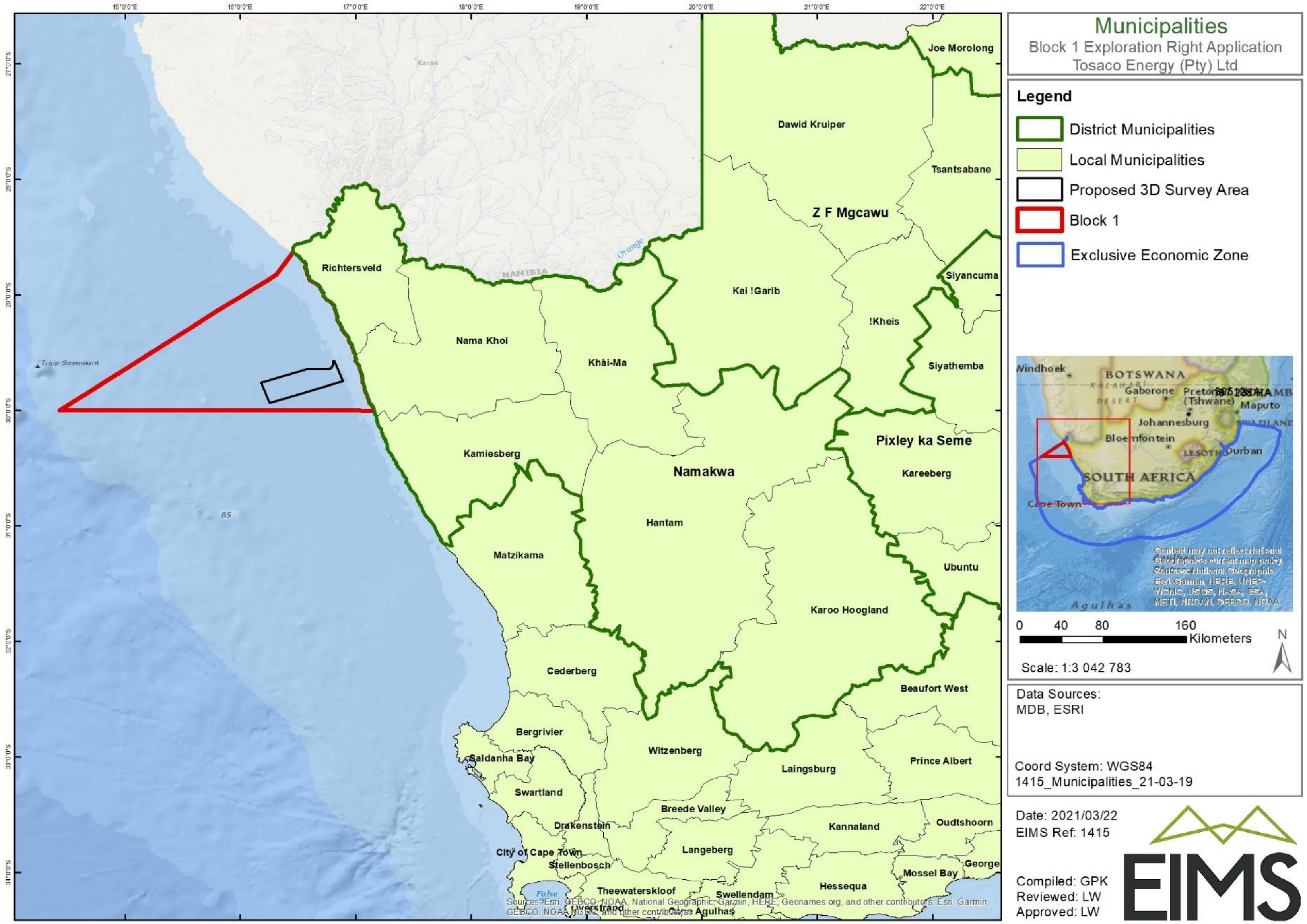


Figure 88: District and Local Municipalities applicable to the study area.

The labour force participation rate (LFPR) is the EAP expressed as a percentage of the total working age population. The following is the labour participation rate of the Namakwa, Northern Cape and National Total as a whole. The Namakwa District Municipality's labour force participation rate decreased from 55.68% to 52.98% which is a decrease of -2.7 percentage points.

Employment data is a key element in the estimation of unemployment. In addition, trends in employment within different sectors and industries normally indicate significant structural changes in the economy. Employment data is also used in the calculation of productivity, earnings per worker, and other economic indicators. Total employment consists of two parts: employment in the formal sector, and employment in the informal sector. In 2018, Namakwa employed 36 200 people which is 11.15% of the total employment in Northern Cape Province (325 000), 0.23% of total employment in South Africa (16.1 million). Employment within Namakwa increased annually at an average rate of 0.39% from 2008 to 2018.

In Namakwa District Municipality the economic sectors that recorded the largest number of employment in 2018 were the community services sector with a total of 9 780 employed people or 27.0% of total employment in the district municipality. The trade sector with a total of 6 200 (17.1%) employs the second highest number of people relative to the rest of the sectors. The electricity sector with 472 (1.3%) is the sector that employs the least number of people in Namakwa District Municipality, followed by the transport sector with 1 360 (3.7%) people employed.

Total employment can be broken down into formal and informal sector employment. Formal sector employment is measured from the formal business side, and the informal employment is measured from the household side where formal businesses have not been established. The number of formally employed people in Namakwa District Municipality counted 31 400 in 2018, which is about 86.74% of total employment, while the number of people employed in the informal sector counted 4 800 or 13.26% of the total employment. Informal employment in Namakwa increased from 3 420 in 2008 to an estimated 4 800 in 2018.

Mining industry, due to well-regulated mining safety policies, and the strict registration of a mine, has little or no informal employment. The Electricity sector is also well regulated, making it difficult to get information on informal employment. Domestic Workers and employment in the Agriculture sector is typically counted under a separate heading. In 2018 the Trade sector recorded the highest number of informally employed, with a total of 1 740 employees or 36.23% of the total informal employment. This can be expected as the barriers to enter the Trade sector in terms of capital and skills required is less than with most of the other sectors. The Transport sector has the lowest informal employment with 235 and only contributes 4.90% to total informal employment.

Table 27: Formal and informal employment by broad economic sector - Namakwa District Municipality, 2018

Sector	Formal employment	Informal employment
Agriculture	5,600	N/A
Mining	3,380	N/A
Manufacturing	1,030	368
Electricity	472	N/A
Construction	2,450	675
Trade	4,460	1,740
Transport	1,120	235
Finance	1,890	573
Community services	8,570	1,210
Households	2,450	N/A

In 2018, there were a total number of 12 000 people unemployed in Namakwa, which is an increase of 1 760 from 10 200 in 2008. The total number of unemployed people within Namakwa constitutes 9.36% of the total number of unemployed people in Northern Cape Province. The Namakwa District Municipality experienced an average annual increase of 1.60% in the number of unemployed people, which is better than that of the Northern Cape Province which had an average annual increase in unemployment of 2.14%.

In 2018, there were 51 100 people living in poverty, using the upper poverty line definition, across Namakwa District Municipality - this is 13.13% lower than the 58 800 in 2008. The percentage of people living in poverty has decreased from 49.05% in 2008 to 39.26% in 2018, which indicates a decrease of 9.79 percentage points.

8.7.3 EDUCATION

Within Namakwa District Municipality, the number of people without any schooling decreased from 2008 to 2018 with an average annual rate of -2.09%, while the number of people within the 'matric only' category, increased from 14,400 to 19,800. The number of people with 'matric and a certificate/diploma' increased with an average annual rate of 2.78%, with the number of people with a 'matric and a Bachelor's' degree increasing with an average annual rate of 3.55%. Overall improvement in the level of education is visible with an increase in the number of people with 'matric' or higher education.

8.8 CULTURAL AND HERITAGE RESOURCES

The Namaqua Fossil Forest Marine Protected Area in the Northern Cape is an offshore Marine Protected Area in the 120 m to 150 m depth range lying approximately 15 nautical miles offshore of the coastal area between Port Nolloth and Kleinsee. The Namaqua Fossil Forest MPA provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The fossilized trees are not known to be found anywhere else in our oceans and are valuable for research into past climates. In 2014 this area was recognised as globally important and declared as an EBSA. The 1 200 km^2 MPA protects the unique fossil forests and the surrounding seabed ecosystems and including a new species of sponge previously unknown to science.

8.9 SHIPPING DENSITY

A large number of vessels navigate the major shipping lanes along the South African Coastline. Approximately 96% of the country's exports are conveyed by sea through eight commercial ports. These ports are the conduits for trade between South Africa and its southern African partners as well as hubs for traffic to and from Europe, Asia, the Americas and the east and west coasts of Africa. Figure 89 provides an indication of the shipping density along the South African Coast. It can be observed that the shipping density is generally very low over the majority of the proposed 3D survey area.

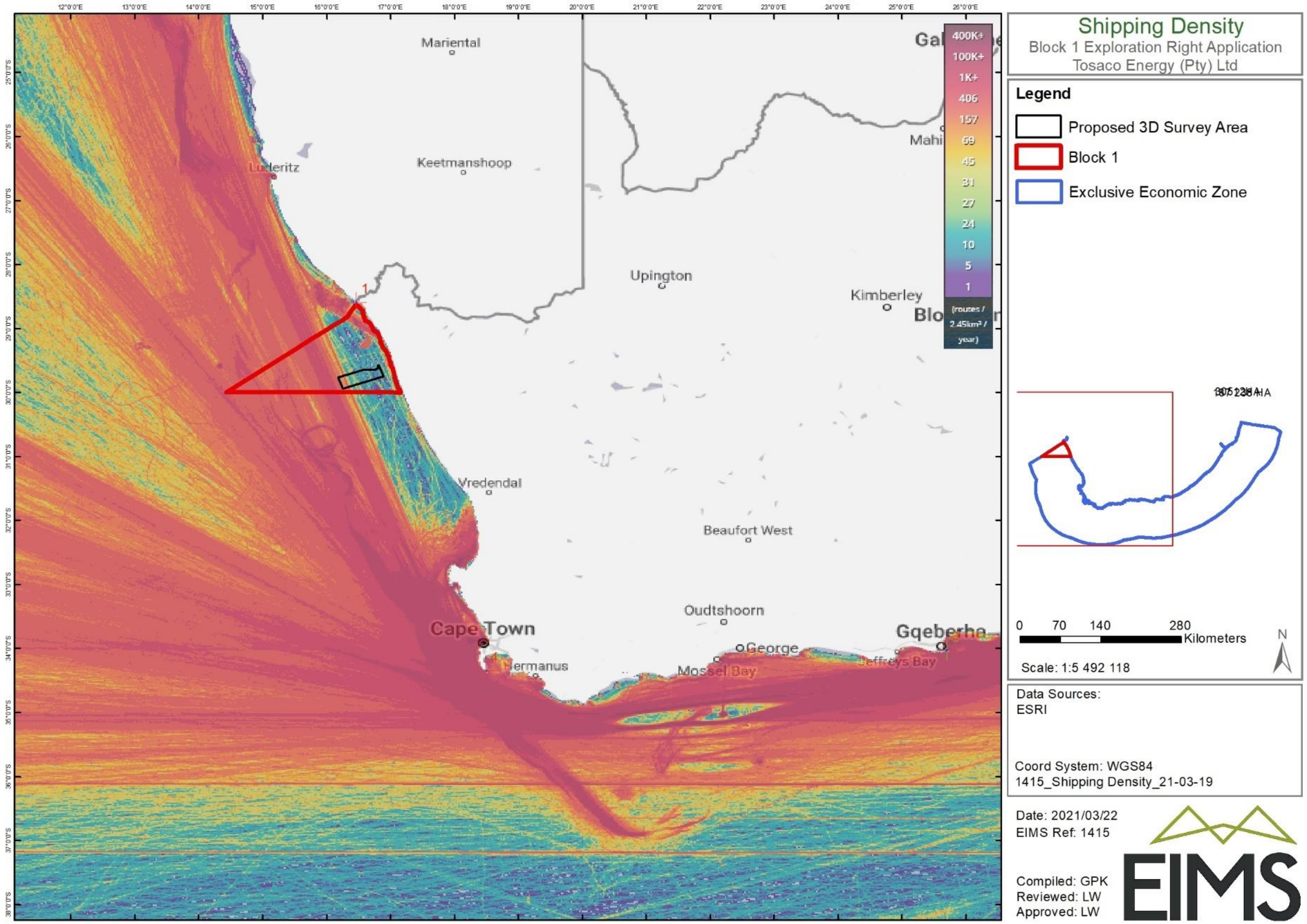


Figure 89: Shipping density along the South African Coast.

9 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

9.1.1 DETERMINATION OF ENVIRONMENTAL RISK

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C} = \frac{(\boldsymbol{E} + \boldsymbol{D} + \boldsymbol{M} + \boldsymbol{R}) * \boldsymbol{N}}{\boldsymbol{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 28 below.

Table 28: Criteria for Determining Impact Consequence.

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).

Aspect	Score	Definition
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per Table 29.

Table 29: Probability Scoring.

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 30: Determination of Environmental Risk.

Consequen	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15

	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 31.

Table 31: Significance Classes.

Risk Score	Description
< 10	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥ 10; < 20	Medium (i.e. where the impact could have a significant environmental risk),
≥ 20	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

9.1.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 32: Criteria for Determining Prioritisation.

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.

Irreplaceable Loss of Resources (LR)	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 32. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (Refer to Table 33).

Table 33: Determination of Prioritisation Factor.

Priority	Ranking	Prioritisation Factor
2	Low	**1**
3	Medium	**1.125**
4	Medium	**1.25**
5	Medium	**1.375**
6	High	**1.5**

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 34: Environmental Significance Rating

Value	Description
< -9	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ -9 < -17	Medium negative (i.e. where the impact could influence the decision to develop in the area).
≥ -17	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
0	No impact

< 9	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ 9 < 17	Medium positive (i.e. where the impact could influence the decision to develop in the area).
≥ 17	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

9.2 IMPACTS IDENTIFIED

This Section presents the impacts that have been assessed during the EIA Phase. Potential environmental impacts were identified during the scoping process. These impacts were identified by the EAP, the appointed specialists, as well as the preliminary input from the public. The impacts identified during the Scoping Phase to be assessed further during the EIA Phase included in Table 35 below. It should be noted that this report will be made available to I&AP's for review and comment and their comments and concerns will be addressed in the final EIA Report submitted to the PASA/DMRE for adjudication.

The impacts were assessed in terms of nature, significance, consequence, extent, duration and probability in line with the methodology described in Section 9.1 above. The impact assessment matrix (including pre- and post-mitigation assessment) is included in Appendix D. Without proper mitigation measures and continual environmental management, most of the identified impacts may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts have been identified, evaluated, and mitigation measures suggested and have been updated during the detailed EIA level investigation.

When considering cumulative impacts, it is important to bear in mind the scale at which different impacts occur. There is potential for a cumulative effect at a broad scale, such as regional deterioration of air quality, as well as finer scale effects occurring in the area surrounding the activity. The main impacts which have a cumulative effect on a regional scale are related to the transportation vectors that they act upon. For example, air movement patterns result in localised air quality impacts having a cumulative effect on air quality in the region. Similarly, water acts as a vector for distribution of impacts such as contamination across a much wider area than the localised extent of the impacts source. At a finer scale, there are also impacts that have the potential to result in a cumulative effect, although due to the smaller scale at which these operate, the significance of the cumulative impact is lower in the broader context.

Table 35: Impacts Identified and Assessed during the EIA Phase

#	Impact	Phase
1	**Noise impact on Plankton**	Operation
2	**Noise Impacts on Marine Invertebrates - physiological Injury**	Operation
3	**Noise Impacts on Marine Invertebrates - behavioural avoidance**	Operation

#	Impact	Phase
4	**Noise impacts on fish - physiological injury**	Operation
5	**Noise impacts on fish - behavioural avoidance**	Operation
6	**Noise impacts on fish - reproductive success**	Operation
7	**Noise impacts on fish - masking of sounds**	Operation
8	**Noise impacts on fish - food sources**	Operation
9	**Noise impacts on Birds - physiological injury**	Operation
10	**Noise impacts on Birds - behavioural avoidance**	Operation
11	**Noise impacts on Birds - food sources**	Operation
12	**Noise impact on turtles - physiological injury**	Operation
13	**Noise impact on turtles - behavioural disturbance**	Operation
14	**Noise impact on turtles - masking of sounds**	Operation
15	**Noise impact on turtles - food sources**	Operation
16	**Noise impact on seals - physiological injury**	Operation
17	**Noise impact on seals - behavioural disturbance**	Operation
18	**Noise impact on seals - masking of sounds**	Operation
19	**Noise impact on seals - food sources**	Operation
20	**Noise impact on mysticetes - physiological injury**	Operation
21	**Noise impact on mysticetes - behavioural disturbance**	Operation
22	**Noise impact on mysticetes - masking of sounds**	Operation
23	**Noise impact on mysticetes - food sources**	Operation
24	**Noise impact on odontocetes - physiological injury**	Operation
25	**Noise impact on odontocetes - behavioural disturbance**	Operation
26	**Noise impact on odontocetes - masking of sounds**	Operation
27	**Noise impact on odontocetes - food sources**	Operation
28	**Impacts of non-seismic noise**	Operation
29	**Impact of vessel lighting**	Operation
30	**Ballast water discharges**	Operation
31	**Routine vessel discharges**	Operation

#	Impact	Phase
32	**Vessel strikes and entanglement**	Operation
33	**Loss of Equipment**	Operation
34	**Release of diesel**	Operation
36	**Noise Nuisance from Vessel and Helicopter Operations**	Planning
		Operation
38	**Interference with Existing Uses**	Planning
		Operation
39	**Tuna Pole Fishery, Netfish, Demersal Longline and Fisheries Research**	Operation
40	**Fisheries Noise Emissions During Survey**	Operation
41	**Exclusion from Fishing Ground Due to Temporary Safety Zone around Survey Vessel**	Operation

9.3 DESCRIPTION AND ASSESSMENT OF IMPACTS

The following potential impacts were identified during the EIA phase assessment based on the methodology described above. The impact assessment matrix is included in Appendix D and the below subsections describe each impact in more detail.

9.3.1 IMPACTS ON MARINE ECOLOGY

This section provides a description of the Marine Ecological Impacts identified by in the Marine Ecological Study. For a more detailed description of the impacts, please refer to the Marine Ecological Assessment undertaken by Pisces Environmental Services (Pty) Ltd included in Appendix C.

9.3.1.1 ACOUSTIC IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994).

Acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC 2003). Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate hundreds of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock et al. 2003). Typical natural ambient noise levels in the study area are estimated to have overall root-mean-square sound pressure levels (RMS SPLs) in the range of 80 – 120 dB re 1 µPa, for the frequency range 10 – 10k Hz with a median level around 100 dB re 1µPa upon calm to strong sea state conditions (Croft & Li 2017; Li & Lewis 2020). A comparison of the various noise sources in the ocean is shown in Figure 90 below.

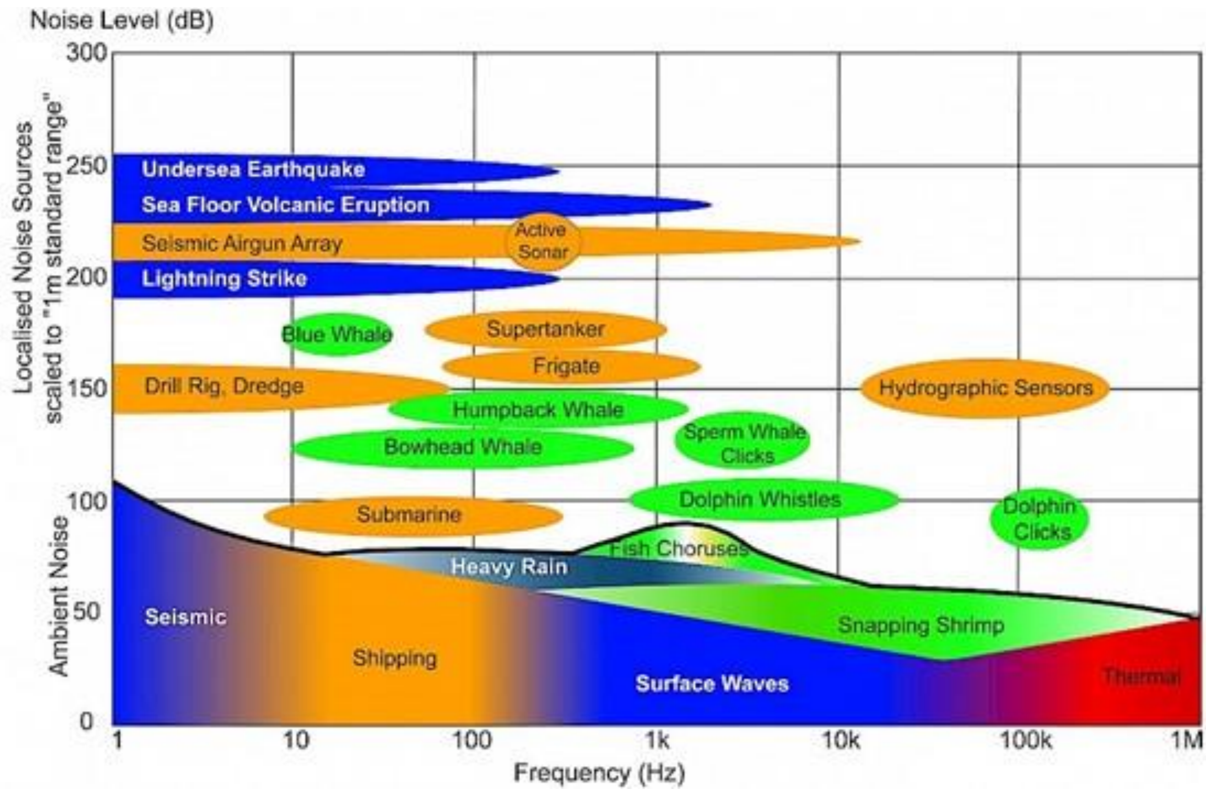


Figure 90: Comparison of noise sources in the ocean (Goold & Coates 2001).

The airguns used in modern seismic surveys produce some of the most intense non-explosive sound sources used by humans in the marine environment (Gordon et al. 2004). However, the transmission and attenuation of seismic sound is probably of equal or greater importance in the assessment of environmental impacts than the produced source levels themselves, as transmission losses and attenuation are very site specific, and are affected by propagation conditions, distance or range, water and receiver depth and bathymetrical aspect with respect to the source array. In water depths of 25 - 50 m airgun arrays are often audible above ambient noise levels to ranges of 50 - 75 km, and with efficient propagation conditions such as experienced on the continental shelf or in deep oceanic water, detection ranges can exceed 100 km and 1,000 km[5], respectively (Bowles et al. 1991; Richardson et al. 1995; see also references in McCauley 1994). The signal character of seismic shots also changes considerably with propagation effects. Reflective boundaries include the sea surface, the sea floor and boundaries between water masses of different temperatures or salinities, with each of these preferentially scattering or absorbing different frequencies of the source signal. This results in the received signal having a different spectral makeup from the initial source signal. In shallow water (<50 m) at ranges exceeding 4 km from the source, signals tend to increase in length from <30 milliseconds, with a frequency peak between 10-100 Hz and a short rise time, to a longer signal of 0.25-0.75 seconds, with a downward frequency sweep of between 200 - 500 Hz and a longer rise time (McCauley 1994; McCauley et al. 2000).

In contrast, in deep water received levels vary widely with range and depth of the exposed animals, and exposure levels cannot be adequately estimated using simple geometric spreading laws (Madsen et al. 2006). These authors found that the received levels fell to a minimum between 5 - 9 km from the source and then started increasing again at ranges between 9 – 13 km, so that absolute received levels were as high at 12 km as they were at 2 km, with the complex sound reception fields arising from multi-path sound transmission.

Acoustic pressure variation is usually considered the major physical stimulus in animal hearing, but certain taxa are capable of detecting either or both the pressure and particle velocity components of a sound (Turl 1993). An important component of hearing is the ability to detect sounds over and above the ambient background noise. Auditory masking of a sound occurs when its' received level is at a similar level to background noise within the

[5] Audibility above ambient, however, does not imply impacts resulting in PTS, TTS or behavioural changes.

same frequencies. The signal to noise ratio required to detect a pure tone signal in the presence of background noise is referred to as the critical ratio.

The auditory thresholds of many species are affected by the ratio of the sound stimulus duration to the total time (duty cycle) of impulsive sounds of <200 millisecond duration. The lower the duty cycle the higher the hearing threshold usually is. Although seismic sound impulses are extremely short and have a low duty cycle at the source, received levels may be longer due to the transmission and attenuation of the sound (as discussed above).

The sounds generated by the airgun arrays used during 3D surveys are no different to those produced during a 2D survey, the only difference being the number or airgun arrays and the size of the towed streamer array. However, as 3D seismic surveys are conducted on a very tight survey grid, typically over a smaller area within which promising petroleum prospects are suspected, the acoustic impact within the localised area persists for longer relative to that experienced within a particular location during a widely spaced 2D survey. Although the overall duration of a 3D survey is not necessarily longer than for a 2D survey, the impact of seismic noise will be locally somewhat higher for a 3D survey compared to a 2D survey. 2D surveys in contrast tend to be conducted over a larger area, and the spatial extent of the impact may thus be higher for 2D surveys.

Below follows a brief review of the impacts of seismic surveys on marine faunal communities. While the effects on pelagic and benthic invertebrates, fish, turtles and seabirds are covered briefly, the discussion and assessments focus primarily on marine mammals.

9.3.1.1.1 NOISE IMPACT ON PLANKTON

As the movement of phytoplankton and zooplankton is largely limited by currents, they are not able to actively avoid the seismic vessel and thus are likely to come into close contact with the sound sources, potentially experiencing multiple exposures during shooting of adjacent lines. Potential impacts of seismic pulses on plankton would include physiological injury or mortality in the immediate vicinity of the airgun sound source.

As the 3D survey would most likely be scheduled for the summer survey window (start December to end May) over a four-month period, there will be some temporal overlap with the spawning periods of commercially important species. However, as plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, and the proposed survey area is located offshore of the West Coast spawning areas, any impacts on the plankton stocks would be of LOW intensity. Although the impact is restricted to within a few hundred metres of the airguns, it would extend over the entire survey area (SITE). Should impacts occur, they would persist over the immediate-term (days) only due to the rapid natural turn-over rate of plankton communities. The environmental risk would therefore be (VERY) LOW.

This potential impact cannot be eliminated due to the nature of the seismic sound source required during surveying. Considering the very low sensitivity and (very) low environmental risk, the impact is thus deemed to have a (VERY) LOW Significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impact on Plankton	Operation	-3.00	-3.00	-3.00
Mitigation Measures				
• No direct mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.				

9.3.1.1.2 NOISE IMPACTS ON MARINE INVERTEBRATES

Many marine invertebrates have tactile organs or hairs (termed mechanoreceptors), which are sensitive to hydro-acoustic near-field disturbances, and some have highly sophisticated statocysts, which have some resemblance to the ears of fishes (Offutt 1970; Hawkins & Myrberg 1983; Budelmann 1988, 1992; Packard et al.

1990; Popper et al. 2001) and are thought to be sensitive to the particle acceleration component of a sound wave in the far-field. Potential impacts of seismic pulses on invertebrates would include physiological injury or mortality in the immediate vicinity of the airgun sound source, and behavioural avoidance. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely and are thus not discussed further here.

As the proposed 3D survey area within Block 1 is located in waters in excess of 100 m depth, the received noise by benthic invertebrates at the seabed would be within the far-field range, and outside of distances at which physiological injury would be expected. The impact is therefore deemed of MINOR intensity across the survey area (SITE) for benthic invertebrates for the four-month survey duration (IMMEDIATE) and is therefore considered to be of (VERY) LOW environmental risk, both without and with mitigation.

The potential impact of seismic noise on physiological injury or mortality and behavioural avoidance of pelagic cephalopods could potentially be of high intensity to individuals, but as distribution of mobile neritic and pelagic squid is naturally spatially highly variable and the numbers of giant squid likely to be encountered is low, the intensity would be considered LOW across the Licence Area (SITE) and for the survey duration (4 months) resulting in a (VERY) LOW environmental risk, both without and with mitigation.

With the implementation of the typical 'soft-starts', the residual impact of 2D and 3D seismic noise on benthic, and neritic and pelagic invertebrates, and on potential behavioural avoidance by cephalopods, is thus deemed to have a (VERY) LOW significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Noise Impacts on Marine Invertebrates - physiological Injury	Operation	-3.00	-2.50	-2.50
Noise Impacts on Marine Invertebrates - behavioural avoidance	Operation	-3.00	-2.50	-2.50
Mitigation Measures				
• All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing neritic and pelagic cephalopods to move out of the survey area.				

9.3.1.1.3 NOISE IMPACTS ON FISH

Fish hearing has been reviewed by numerous authors including Popper and Fay (1973), Hawkins (1973), Tavolga et al. (1981), Lewis (1983), Atema et al. (1988), and Fay (1988) (amongst others). Fish have two different systems to detect sounds namely 1) the ear (and the otolith organ of their inner ear) that is sensitive to sound pressure and 2) the lateral line organ that is sensitive to particle motion. Certain species utilise separate inner ear and lateral line mechanisms for detecting sound; each system having its own hearing threshold (Tavolga & Wodinsky 1963), and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases (Cahn et al. 1970, in Turl 1993).

In fish, the proximity of the swim-bladder to the inner ear is an important component in the hearing as it acts as the pressure receiver and vibrates in phase with the sound wave. Vibrations of the otoliths, however, result from both the particle velocity component of the sound as well as stimulus from the swim-bladder. The resonant frequency of the swim-bladder is important in the assessment of impacts of sounds as species with swim-bladders of a resonant frequency similar to the sound frequency would be expected to be most susceptible to injury. Although the higher frequency energy of received seismic impulses needs to be taken into consideration, the low frequency sounds of seismic surveys would be most damaging to swim-bladders of larger fish. The lateral line is sensitive to low frequency (between 20 and 500 Hz) stimuli through the particle velocity component of sound and would thus be sensitive to the low frequencies of airguns, which most energy at 20-150 Hz.

The sound waves produced during seismic surveys are low frequency, with most energy at 20-150 Hz (although significant contributions may extend up to 500 Hz) (Hirst & Rodhouse 2000), and overlap with the range at which fish hear well (Dalen & Mæsted 2008). A review of the available literature suggests that potential impacts of seismic pulses to fish (including sharks) species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, reduced reproductive success and spawning, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

The likelihood of encountering feeding aggregations of large pelagic species is dependent on the locality of oceanic fronts and is considered to be low. Should an encounter occur, the potential physiological impact on individual migratory pelagic fish, would be of high intensity, but as the likelihood of encountering feeding aggregations of large pelagic species is low and dependent on the locality of oceanic fronts, the intensity is considered MODERATE. Furthermore, the duration of the impact on the population would be limited to the IMMEDIATE (4 months) and be restricted to the survey area (SITE). The impact is therefore considered to be of LOW environmental risk.

Behavioural responses such as deflection from migration paths or 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 μPa. Behavioural effects are generally immediate, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact on individual fish behaviour could therefore be of moderate to high intensity (particularly in the near-field of the airgun array) for individuals but of MODERATE intensity for the population due to the low likelihood of encounters in the offshore environment. Impacts to behavioural responses would be limited to the survey duration (IMMEDIATE), and the survey area (SITE). Consequently it is considered to be of LOW environmental risk.

If behavioural responses result in deflection from coastal migration routes or disturbance of spawning, further impacts may occur that may affect recruitment to fish stocks. The intensity of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection, but can be considered of MINOR intensity overall. Considering the wide range over which the potentially affected species occur, the relatively short duration of the proposed survey (IMMEDIATE), the location of the 3D survey areas being offshore of the main migration routes of West Coast fish species and that the migration routes do not constitute narrow restricted paths, the impact is considered to be of (VERY) LOW environmental risk.

While some nearshore reef species are known to produce isolated sounds or to call in choruses, communication and the use of environmental sounds by fish off the South African West Coast are unknown.. Demersal species on the continental shelf habitats or associated with Child's Bank or Tripp Seamount would receive the seismic noise in the far field and vocalisation, should it occur, is unlikely to be masked. Impacts arising from masking of sounds are thus expected to be of MINOR 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 (SITE) and for the duration of the survey (4 months). The impact is thus considered to be of (VERY) LOW environmental risk.

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, tunas or diving seabirds to pelagic shoaling 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. Little information is available on the feeding success of large migratory fish species in association with seismic survey noise. The pelagic shoaling species that that constitute the main prey item of migratory pelagic species typically occur inshore of the 200 m depth contour. Although large pelagic species are known to aggregate around seamounts to feed, considering the extensive range over which large pelagic fish species can potentially feed in relation to the survey area, and the likely low abundance of pelagic shoaling species that constitute their main prey, the intensity of the impact would be MINOR, restricted to the survey area (SITE) and persisting over the IMMEDIATE-term only (4 months). The impact would thus be of (VERY) LOW environmental risk.

The potential impacts cannot be eliminated due to the nature of the seismic sound source required during surveying. With the implementation of the mitigation measures, the intensity of the impact for the impacts relating to physiological injury / mortality and behavioural avoidance would reduce from low to minor, the residual impacts will remain of very low environmental risk and of (VERY) LOW significance

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impacts on fish - physiological injury	Operation	-3.50	-1.50	-1.50
Noise impacts on fish - behavioural avoidance	Operation	-5.25	-3.00	-3.00
Noise impacts on fish - reproductive success	Operation	-1.50	-1.25	-1.25
Noise impacts on fish - masking of sounds	Operation	-1.25	-1.25	-1.25
Noise impacts on fish - food sources	Operation	-1.50	-1.25	-1.25

Mitigation Measures

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing fish to move out of the survey area and thus avoid potential physiological injury or behavioural avoidance as a result of seismic noise.
- All breaks in airgun firing of longer than 5 minutes but less than 20 minutes should be followed by a "soft-start" of similar duration. All breaks in firing of 20 minutes or longer must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing.
- Any attraction of predatory fish (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 onboard Independent Observer or Marine Mammal Observer (MMO).
- Airgun firing should be terminated if, in the unlikely event, mass mortality of fish is observed as a direct result of shooting.

9.3.1.1.4 NOISE IMPACTS ON BIRDS

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, being above the water and thus not coming in direct contact with the seismic pulses, is considered NEGLIGIBLE and will not be discussed further here.

Should an encounter with diving pelagic seabirds occur, the potential physiological impact on individual pelagic birds, would be of high intensity, but as the likelihood of encountering large numbers of pelagic seabirds is low, due to their extensive distributions and feeding ranges the intensity is considered LOW. Furthermore, the duration of the impact on the population would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE). The potential for physiological injury is therefore considered to be of LOW environmental risk.

For coastal diving seabirds such as African Penguins and Gannets the environmental risk is considered NEGLIGIBLE as they are highly unlikely to be encountered in the survey area.

Due to the unlikely probability of encountering African Penguins or Cape Gannets in the survey area, and the extensive distribution and feeding ranges of pelagic seabirds, the impact for pelagic seabirds would thus be of LOW intensity within the survey area (SITE) over the duration of the survey period (4 months). The behavioural avoidance of feeding areas by diving seabirds is thus considered to be of (VERY) LOW environmental risk.

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. With few exceptions, most plunge-diving birds forage on small shoaling fish prey species that typically occur relatively close to the shore (<200 m depth) or associated with oceanic features such as the Child's Bank or Tripp Seamount. No information is available on the feeding success of seabirds in association with seismic survey noise. Although seismic surveys have been reported to affect fish catches up to 30 km from the sound source, with effects persisting for a duration of up to 10 days, for the current project relatively low behavioural risks are expected for fish species at far-field distances (1,000s of metres) (see for example Li & Lewis 2020b). This could have implications for plunge-diving seabirds such as African Penguins that forage in restricted areas within a given radius of their breeding sites. Similarly, pelagic seabirds that feed around seamounts may also be affected. The impact on potential food sources for pelagic seabirds would thus be of MINOR intensity within the survey area (SITE) over the duration of the survey period (4 months). 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 suggest that indirect impacts would be of (VERY) LOW environmental risk.

With the implementation of the mitigation measures above, the magnitude of the impacts for physiological injury and behavioural avoidance will reduce to MINOR. Considering their medium sensitivity and very low environmental risk, the residual impacts of seismic sounds on diving seabirds is thus deemed to be of (VERY) LOW significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impacts on Birds - physiological injury	Operation	-3.50	-2.50	-2.50
Noise impacts on Birds - behavioural avoidance	Operation	-3.00	-2.50	-2.50
Noise impacts on Birds - food sources	Operation	-1.25	-1.25	-1.25

Mitigation Measures

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing pelagic seabirds to move out of the survey area and thus avoid potential physiological injury or behavioural avoidance as a result of seismic noise.
- An area of radius of 500 m from the centre of the airgun array be scanned (visually during the day) by an independent observer for the presence of diving seabirds (and in particular feeding aggregations of diving seabirds) prior to the commencement of "soft starts" and that these be delayed until such time as this area is clear of seabirds.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance

- Seabird incidence and behaviour should be recorded by an onboard Independent Observer.
  - 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 as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an onboard Independent Observer.
- All breaks in airgun firing of longer than 5 minutes but less than 20 minutes should be followed by a "soft-start" of similar duration. All breaks in firing of 20 minutes or longer must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing.
- Any attraction of predatory fish (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 onboard Independent Observer.
- Airgun firing should be terminated if, in the unlikely event, mass mortality of seabirds is observed as a direct result of shooting.

9.3.1.1.5 NOISE IMPACTS ON TURTLES

The potential effects of seismic surveys on turtles include:

- Physiological injury (including disorientation) or mortality from seismic noise;
- Behavioural avoidance of seismic survey areas;
- Masking of environmental sounds and communication; and
- Indirect impacts due to effects on predators or prey.

As the breeding areas for Leatherback turtles occur over 1,000 km to north of the survey area in Gabon, and on the northeast coast of South Africa, turtles encountered during the survey(s) are likely to be migrating vagrants. Due to their extensive distributions and feeding ranges, the number of turtles encountered in the survey area is expected to be low and consequently the intensity of potential physiological injury would be rated as LOW. Furthermore, the duration of the impact on the population would be limited to the immediate-term (4 months) and be restricted to the survey area (LOCAL). The potential physiological injury or mortality of turtles is considered to be of LOW environmental risk.

The sound transmission loss modelling undertaken for a licence block on the Agulhas Bank, where the shallowest point modelled was at similar depth to that of the proposed 3D survey area in Block 1 (Li & Lewis 2020a) identified that the zones of behavioural disturbance for turtles caused by the immediate exposure to individual pulses was predicted to be within 3.5 km from the array source. Turtles can therefore hear seismic sounds at a considerable distance and may respond by altering their swimming/basking behaviour or alter their migration route. However, as the number of turtles encountered during the proposed 3D surveys is expected to be low, the impact of seismic sounds on turtle behaviour would be of LOW intensity, and would persist only for the duration of the survey (4 months), and be restricted to the survey area (SITE). The impact of seismic noise on turtle behaviour is thus deemed to be of LOW environmental risk.

Although three species of turtles occur along the West Coast, it is only the Leatherback turtle that is likely to be encountered in deeper waters. As the breeding areas for Leatherback turtles occur over 1,000 km to north of the survey area in Gabon, and on the northeast coast of South Africa, abundances of turtles encountered in the Licence Block during the survey are likely to be low, comprising occasional migrating vagrants. Effects on recruitment success would thus be both indirect, through entanglement and mortality of adults, as well as direct through seismic impacts to hatchlings. As hatchlings from Gabon would be dispersed eastwards in the South Equatorial Current, no hatchlings would be expected in the Benguela Current. The effect of seismic surveys on recruitment success will be of MINOR intensity and the consequently the impact of seismic noise on hatchling survival would be of NEGLIGIBLE environmental risk, and will not be assessed further.

As the breeding areas for Leatherback turtles occur over 1,000 km to north of the survey area in Gabon, turtles encountered during the survey are likely to be migrating vagrants. Their low abundance in the survey area would suggest that the impact (should it occur) would be of MINOR intensity. As the impact would persist only for the duration of the survey (4 months), and be restricted to the survey area (SITE), the impact is deemed to be of (VERY) LOW environmental risk.

As with other vertebrates, the assessment of indirect effects of seismic surveys on turtles is limited by the complexity of trophic pathways in the marine environment. The leatherback turtles eat pelagic prey, primarily jellyfish. The low numbers and the broad ranges of potential prey species and extensive ranges over which most turtles feed suggest that indirect impacts would be of MINOR intensity, persisting only for the duration of the survey (4 months), and restricted to the survey area (SITE). The impact would therefore be of (VERY) LOW environmental risk.

With the implementation of the mitigation measures above, the magnitude of the impacts for physiological injury and behavioural avoidance will reduce. Considering their medium sensitivity and very low environmental risk, the residual impacts of seismic sounds on turtles is thus deemed to be of (VERY) LOW significance.

Impact	**Phase**	**Pre-mitigation ER**	**Post-mitigation ER**	**Final** Significance
Noise impact on turtles - physiological injury	Operation	-5.25	-3.00	-3.00
Noise impact on turtles - behavioural disturbance	Operation	-3.00	-1.25	-1.25
Noise impact on turtles - masking of sounds	Operation	-1.25	-1.25	-1.25
Noise impact on turtles - food sources	Operation	-1.25	-1.25	-1.25

Mitigation Measures

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing turtles to move out of the survey area and thus avoid potential physiological injury or behavioural avoidance as a result of seismic noise.
- An area of radius of 500 m from the centre of the airgun array be scanned (visually during the day) by an independent observer 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.
- Turtle incidence and behaviour should be recorded by an onboard Independent Observer.
  - Any negative changes to turtle behaviour observed from the survey vessel must be recorded, or if animals are observed within the immediate vicinity (within 500 m) of operating airguns or appear to be approaching firing airguns.
  - Any obvious mortality or injuries to turtles as a direct result of the survey should result in temporary termination of operations until the mortality can be investigated and the MMO provides the approval for the resumption of the activities.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
• All breaks in airgun firing of longer than 5 minutes but less than 20 minutes should be followed by a "soft-start" of similar duration. All breaks in firing of 20 minutes or longer must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing.				

9.3.1.1.6 NOISE IMPACT ON SEALS

The potential impact of seismic survey noise on seals could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey. The Cape fur seal that occurs off the West Coast forages over the continental shelf to depths of over 200 m and is thus highly likely to be encountered in the proposed 3D survey area.

The potential impact of physiological injury to seals as a result of seismic noise is deemed to be of medium intensity and would be limited to the survey area (LOCAL). As seals are known to forage up to 120 nautical miles (~220 km) offshore, the proposed 3D survey area falls within the foraging range of seals from the Buchu Twins, Cliff Point and Kleinzee colonies. The intensity of the impact is considered to be MINOR. Furthermore, as the duration of the impact would be limited to the IMMEDIATE-term (4 months) (although injury could extend beyond the survey duration) and be restricted to the survey area (SITE), the potential physiological injury is therefore considered to be of (VERY) LOW environmental risk.

Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seals species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly reverted back to normal behaviour. The potential impact of seal foraging behaviour changing in response to seismic surveys is thus considered to be of MINOR intensity as they are known to show a tolerance to loud noises. Furthermore, as the duration of the impact would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE), the potential for behavioural avoidance of seals is considered to be of (VERY) LOW environmental risk.

The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (18.75 m interval between consecutive shot-points). The potential impact of masking of sounds and communication in seals due to seismic surveys is considered to be of MINOR intensity as they are known to show a tolerance to loud noises. As the duration of the impact would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE), the potential for masking of sounds is considered to be of (VERY) LOW environmental risk.

As with other vertebrates, the assessment of indirect effects of seismic surveys on Cape fur seals 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 species (and the flexibility of the diet), and the effect of seismic surveys on the diet species. Seals typically forage on small pelagic shoaling fish prey species that occur inshore of the 200 m depth contour or associated with oceanic features such as Child's Bank. Furthermore, the broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be of MINOR intensity, would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE). The potential for effects of seismic surveys on prey species is thus considered to be of (VERY) LOW environmental risk.

With the implementation of the typical 'soft-start' procedures, the residual impacts would all remain of very low environmental risk and (VERY) LOW significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impact on seals - physiological injury	Operation	-1.25	-1.25	-1.25
Noise impact on seals - behavioural disturbance	Operation	-1.25	-1.25	-1.25
Noise impact on seals - masking of sounds	Operation	-1.25	-1.25	-1.25
Noise impact on seals - food sources	Operation	-1.25	-1.25	-1.25

Mitigation Measures

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration, allowing seals to move out of the survey area and thus avoid potential physiological injury or behavioural avoidance as a result of seismic noise.
- An area of radius of 500 m from the centre of the airgun array be scanned (visually during the day) by an independent observer for the presence of seals prior to the commencement of "soft starts" and that these be delayed until such time as this area is clear of seals for a period of 10 minutes. If after a period of 10 minutes seals are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least a 20-minutes duration. Their activity should be carefully monitored during "soft-starts" to determine if they display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of the seismic activities.
- Seal incidence and behaviour should be recorded by an onboard Independent Observer.
  - Seismic shooting should be terminated when obvious negative changes to seal behaviour is observed from the survey vessel.
  - Any obvious mortality or injuries to seals as a direct result of the survey should result in temporary termination of operations.
- All breaks in airgun firing of longer than 5 minutes but less than 20 minutes should be followed by a "soft-start" of similar duration. All breaks in firing of 20 minutes or longer must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing.

9.3.1.1.7 NOISE IMPACT ON WHALES AND DOLPHINS

The potential impact of seismic survey noise on whales and dolphins could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey.

Assuming the survey is scheduled so as to avoid the key migration period (early June to late November), there would be a low likelihood of encountering migrating humpback and southern right whales, but a moderate likelihood of encountering Bryde's whales. The impact of potential physiological injury to mysticete cetaceans as a result of seismic sounds is thus deemed to be of HIGH intensity, while the intensity of the impact on odontocetes is considered to be of MODERATE intensity. Furthermore, as the duration of the impact would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE) for mysticetes and LOCALLY for odontocetes due to their better hearing abilities at the frequencies concerned, the potential for physiological injury is therefore considered to be of MEDIUM environmental risk for resident odontocetes, and MEDIUM environmental risk for mysticetes.

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 Licence Area, but several species are considered to be year-round residents. Furthermore, a number of 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. The impact of seismic survey noise on the behaviour of toothed whales is considered to be of MODERATE intensity, audible to odontocetes well beyond the Licence Area (REGIONAL) and for the duration of the survey (4 months). The overall environmental risk will, however, not vary between species, and will be MEDIUM.

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- and high frequency range (up to and exceeding 15 kHz) can travel far (at least 8 km), masking of communication sounds produced by whistling dolphins and blackfish[6] is likely (Madsen et al. 2006). In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in November/December when accompanied by calves. Although most mother-calf pairs tend to follow a coastal route southwards, there is no clear migration corridor and humpbacks can be spread out widely across the shelf and into deeper pelagic waters. Vocalisation of southward migrating whales may thus potentially be regionally comparatively high on commencement of operations in December, reducing thereafter. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses. Assuming the survey is scheduled to avoid the key migration and breeding period, there would be a low likelihood of encountering migrating humpback whales (including possible mother-calf pairs), the intensity of impacts on baleen whales is likely to be HIGH (mother-calf pairs) over the survey area (LOCAL) and duration (4 months), and of MODERATE intensity (species specific) in the case of toothed whales beyond the survey area (REGIONAL) and duration (4 months). The environmental risk for mysticetes will therefore be MEDIUM and for odontocets be LOW.

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. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species. Although the majority of baleen whales will undertake little feeding within breeding-ground waters along the southern African west coast and rely on blubber reserves during their migrations there is increasing evidence that some species (fin whales, southern rights and humpbacks) are using upwelling areas off the South African West Coast as summer feeding grounds. Although the upwelling zone off Cape Columbine has become an important summer feeding area, baleen whales have not been reported to feed while in the location of Block 1. Any indirect effects on their food source would thus be of MINOR intensity over the survey area (SITE) and duration (4 months) and therefore of (VERY) LOW environmental risk. In the case of odontocetes, 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 LOW intensity over the survey area (SITE) and duration (4 months) and therefore of LOW environmental risk.

With the implementation of the mitigation measures outlined in Section 6.3, the magnitude of the impacts in most cases will be reduced resulting in the residual impacts all being of LOW or VERY LOW environmental risk and of LOW or VERY LOW significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impact on mysticetes - physiological injury	Operation	-10.00	-3.00	-3.75

[6] The term blackfish refers to the delphinids: melon-headed whale, killer whale, pygmy killer whale, false killer whale, long-finned pilot whale, short-finned pilot whale

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Noise impact on mysticetes - behavioural disturbance	Operation	-11.00	-5.25	-5.91
Noise impact on mysticetes - masking of sounds	Operation	-9.00	-6.00	-6.75
Noise impact on mysticetes - food sources	Operation	-1.25	-1.25	-1.25
Noise impact on odontocetes - physiological injury	Operation	-10.00	-6.00	-7.50
Noise impact on odontocetes - behavioural disturbance	Operation	-11.00	-6.75	-7.59
Noise impact on odontocetes - masking of sounds	Operation	-8.00	-5.25	-5.91
Noise impact on odontocetes - food sources	Operation	-3.00	-1.25	-1.25
Mitigation Measures				
• Please refer to Section 11.4.1 below for detailed mitigation measures for cetaceans.				

9.3.1.2 **OTHER IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA**

9.3.1.2.1 IMPACTS OF NON-SEISMIC NOISE

The project activities (per phase) that will result in an increase in noise impacts on marine fauna are listed below.

Mobilisation Transit of vessels to survey area

Operation Operation of survey vessels and helicopters

Demobilisation Survey vessels leave survey area and transit to port or next destination

The presence and operation of the seismic vessel and support vessels during transit to the survey area, during the proposed survey and during demobilisation will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area. Crew transfers by helicopter from Saldanha Bay/Port Nolloth or a suitable location nearby to the survey vessel, if required (prefer alterative is via the support vessel) will generate noise in the atmosphere that may disturb coastal species such as seabirds and seals. Noise source levels from helicopters are expected to be around 109 dB re 1µPa at worst (SLR Consulting Australia 2019).

Elevated underwater and aerial noise can affect marine fauna, including cetaceans, by:

- causing direct physical injury to hearing;
- masking or interfering with other biologically important sounds (e.g. communication, echolocation, signals and sounds produced by predators or prey);
- causing disturbance to the receptor resulting in behavioural changes or displacement from important feeding or breeding areas.

Although the proposed 3D survey area in Block 1 is located inshore of the main offshore shipping routes that pass around southern Africa, local fishing and mining vessels would contribute to the shipping noise component of the ambient noise environment within and around the licence block. Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90 - 130 dB re 1 µPa for the frequency range 10 Hz – 10 kHz (SLR Consulting Australia 2019). The noise generated by the survey vessel, thus falls within the hearing range of most fish and marine mammals, and would be audible for considerable ranges before attenuating to below threshold levels. However, unlike the noise generated by airguns, underwater noise from vessels is not considered to be of sufficient amplitude to cause direct harm to marine life, even at close range (SLR Consulting Australia 2019). Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed 3D survey is expected to be low and consequently the intensity of potential physiological injury or behavioural disturbance as a result of vessel noise would be rated as MINOR. Furthermore, the duration of the impact on the populations would be limited to the IMMEDIATE-term (4 months) and extend along the vessel route at any one time (although extending PROVINCIALLY between the survey area and the logistics base in Saldanha Bay). The potential physiological injury or behavioural disturbance as a result of vessel noise would thus be of (VERY) LOW environmental risk.

Noise generated by helicopters undertaking crew transfers between Saldanha Bay and the survey vessel could affect seabirds and seals in breeding colonies and roosts on the mainland coast. The nearest seabird colonies to Saldanha airport are on the Saldanha Bay Islands and on the emergent reefs off Cape Columbine. These colonies would fall within the potential flight path between the Saldanha Bay airport and the centre of the proposed 3D survey area. The seal colonies falling within the potential flight paths would similarly be at Cape Columbine. Indiscriminate low altitude flights over whales, seals, seabird colonies and turtles by helicopters used to support the seismic vessel could thus have an impact on behaviour and breeding success. The intensity 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 and could range from low to high intensity for individuals but of MINOR intensity for the populations as a whole. As such impacts would be limited to the area along the flight path and IMMEDIATE term (4 months), impacts would be of (VERY) LOW environmental risk.

The generation of noise from helicopters cannot be eliminated if helicopters are required for crew changes. Similarly, the generation of vessel noise cannot be eliminated. With the implementation of the mitigation measures above, the residual impact would be of (very) low environmental risk and (VERY) LOW significance considering their medium sensitivity of the pelagic and coastal species potentially impacted.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Impacts of non-seismic noise on marine fauna	Operation	-2.00	-2.00	-2.00
Mitigation Measures				
• Pre-plan flight paths to ensure that no flying occurs over seal colonies and bird breeding area. • Avoid extensive low-altitude coastal flights (<2,500 ft and within 1 nautical mile of the shore). • The flight path between the onshore logistics base and seismic vessel should be perpendicular to the coast. • A flight altitude >1 000 m to be maintained at all times, except when taking off and landing or in a medical emergency. • Maintain an altitude of at least 2 500 ft above the highest point of a Special Nature Reserve, National Park or World Heritage Site. • Contractors should comply fully with aviation and authority guidelines and rules. • Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.				

9.3.1.2.2 IMPACT OF VESSEL LIGHTING ON PELAGIC FAUNA

The project activities (per phase) that will result in an increase in vessel lighting impacts on marine fauna are listed below.

Mobilisation	Transit of vessels to survey area
Operation	Operation of survey vessels and support vessel
Demobilisation	Survey vessels leave survey area and transit to port or next destination

Transit and operation of the survey vessel and support vessels. The operational lighting of survey/support vessels during transit and seismic acquisition can be a significant source of artificial light in the offshore environment increasing the ambient lighting in offshore areas.

The survey activities would be undertaken in the offshore marine environment, more than 25 km offshore, far removed from any sensitive coastal receptors (e.g. bird or seal colonies), but could still directly affect migratory pelagic species (pelagic seabirds, turtles, marine mammals and fish) transiting through the licence area. The strong operational lighting used to illuminate the survey vessel at night may disturb and disorientate pelagic seabirds, seals and small odontocetes feeding in the area. Operational lights may also result in physiological and behavioural effects of fish and cephalopods as these may be drawn to the lights at night where they may be more easily preyed upon by other fish, seabirds and dolphins.

Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed 3D survey is expected to be low. Due to anticipated numbers and the proximity of survey area to the local traffic routes, the increase in ambient lighting in the offshore environment would be of LOW intensity and limited to the area in the immediate vicinity of the vessel (ACTIVITY) within the survey area (SITE) over the IMMEDIATE-term (4 months). For support vessels travelling from Port Nolloth increase in ambient lighting would likewise be restricted to the immediate vicinity of the vessel over the IMMEDIATE-term. The potential for behavioural disturbance as a result of vessel lighting would thus be of VERY LOW magnitude.

With the implementation of the mitigation measures above, the potential for behavioural disturbance by vessel lighting is deemed to be of (VERY) LOW significance, due to the medium sensitivity of the receptors and the very low environmental risk.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Impact of vessel lighting	Operation	-1.25	-1.25	-1.25
Mitigation Measures				
• 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 minimised. • Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).				

9.3.1.2.3 BALLAST WATER DISCHARGES

The project activities (per phase) that will result in the discharge of ballast water and potential introduction of alien invasive species are listed below.

Mobilisation	Transit of vessels to survey area
	Discharge of ballast water by seismic vessel and/or support vessels

Artificial structures deployed at sea serve as a substrate for a wide variety of larvae, cysts, eggs and adult marine organisms. The transportation of equipment from one part of the ocean to another would therefore also facilitate the transfer of the associated marine organisms. Survey vessels, seismic equipment and support vessels are used and relocated all around the world. Similarly, the ballasting and de-ballasting of these vessels may lead to the introduction of exotic species and harmful aquatic pathogens to the marine ecosystems (Bax et al. 2003).

The marine invertebrates that colonize the surface of vessels can easily be introduced to a new region, where they may become invasive by outcompeting and displacing native species. Marine invasive species are considered primary drivers of ecological change in that they create and modify habitat, consume and outcompete native fauna, act as disease agents or vectors, and threaten biodiversity. Once established, an invasive species is likely to remain in perpetuity (Bax et al. 2003).

In terms of hull fouling, the survey area is located on the southern boundary of the main traffic routes (further inshore) that pass around southern Africa. Thus, the introduction of invasive species into South African waters due to hull fouling of project vessels is unlikely to add to the current risk that exists due to the numerous vessels that operate in or pass through South African coastal waters, inshore of the survey area, on a daily basis. Considering the remote location of the survey area and compliance with the IMO guidelines for ballast water, the impact related to the introduction of alien invasive marine species is considered to be of MODERATE intensity potentially enduring PERMANENTLY if the species becomes established and potentially of REGIONAL extent. Thus, the environmental risk is considered to be MEDIUM.

With the implementation of the mitigation measures, the potential for introductions of non-native marine species through hull fouling or ballast water discharge is deemed to be (VERY) LOW, due to the very low sensitivity of the offshore receptors and the very low environmental risk.

Impact	**Phase**	**Pre-mitigation ER**	**Post-mitigation ER**	**Final** Significance
Ballast water discharges	Operation	-12.75	-1.25	-1.72
Mitigation 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.				

9.3.1.2.4 ROUTINE VESSEL DISCHARGES

The project activities that will result in a reduction of water quality from routine discharges to the sea from vessels are listed below.

Mobilisation Transit of vessels to survey area

Operation Operation of survey vessels and transit of support vessels between the survey area and Port Nolloth

Demobilisation Survey vessels leave survey area and transit to port or next destination

These activities and their associated aspects are described further below:

Deck drainage: all deck drainage from work spaces is collected and piped into a sump tank on board the seismic vessel to ensure MARPOL compliance (15 ppm oil in water). The fluid would be analysed and any hydrocarbons skimmed off the top prior to discharge. The oily substances would be added to the waste (oil) lubricants and disposed of at a suitable facility onshore.

Grey Water and Sewage: sewage discharges will be comminuted and disinfected. In accordance with MARPOL Annex IV, the effluent must not produce visible floating solids in, nor causes discolouration of, the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination before the treated effluent can be discharged into the sea. The treated sanitary effluents discharged into the sea are estimated at around 16 000 litres per day for the duration of the seismic study based on 200 litres per 80 persons. The discharge depth is variable, depending upon the draught of the seismic vessel / support vessel at the time, but would be in accordance with MARPOL Annex IV.

Vessel machinery spaces, mud pit wash residue and ballast water: the concentration of oil in discharge water from vessel machinery space or ballast tanks may not exceed 15 ppm oil in water (MARPOL Annex I). If the vessel intends to discharge bilge or ballast water at sea, this is achieved through use of an oily-water separation system. Oily waste substances must be shipped to land for treatment and disposal.

Food (galley) wastes: food wastes may be discharged after they have been passed through a comminuter or grinder, and when the seismic vessel is located more than 3 nautical miles from land. Discharge of food wastes not comminuted is permitted beyond 12 nautical miles. The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a standard seismic vessel is expected to be <0.2 m^3.

Cooling water and drinking water surplus: The cooling water and surplus generated by the drinking water supply system are likely to contain a residual concentration of chlorine (generally less than 0.5 mg/l for drinking water supply systems. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines.

The discharge of wastes to sea could create local reductions in water quality, both during transit to and within the survey area. Deck and machinery space drainage may result in small volumes of oils, detergents, lubricants and grease, the toxicity of which varies depending on their composition, being introduced into the marine environment. Sewage and gallery waste will place a small organic and bacterial loading on the marine environment, resulting in an increased biological oxygen demand.

These discharges will result in a local reduction in water quality, which could impact marine fauna in a number of different ways:

- Physiological effects: Ingestion of hydrocarbons, detergents and other waste could have adverse effects on marine fauna, which could ultimately result in mortality.
- Increased food source: The discharge of galley waste and sewage will result in an additional food source for opportunistic feeders, speciality pelagic fish species.
- Increased predator - prey interactions: Predatory species, such as sharks and pelagic seabirds, may be attracted to the aggregation of pelagic fish attracted by the increased food source.

The contracted survey / support vessels will have the necessary sewage treatment systems in place, and the vessel will have oil/water separators and food waste macerators to ensure compliance with MARPOL 73/78 standards. MARPOL compliant discharges would therefore introduce relatively small amounts of nutrients and organic material to oxygenated surface waters, which will result in a minor contribution to local marine productivity and possibly of attracting opportunistic feeders. The intermittent discharge of sewage is likely to contain a low level of residual chlorine following treatment, but given the relatively low total discharge and rapid dilution in surface waters this is expected to have a minimal effect on seawater quality.

Furthermore, the survey area is suitably far removed from sensitive coastal receptors and the dominant wind and current direction will ensure that any discharges are rapidly dispersed south-westwards and away from the coast. There is no potential for accumulation of wastes leading to any detectable long-term impact.

Due to the distance offshore, it is only pelagic fish, birds, turtles and cetaceans that may be affected by the discharges, and these are unlikely to respond to the minor changes in water quality resulting from vessel discharges. The most likely animal to be attracted to the survey vessels will be large pelagic fish species, as well as sharks and odontocetes (toothed whales). Pelagic seabirds that feed primarily by scavenging would also be attracted.

Other types of wastes generated during the exploration activities will be segregated, duly identified transported to shore for ultimate valorisation and/or disposal at a licensed waste management facility. The disposal of all waste onshore will be fully traceable.

Based on the relatively small discharge volumes and compliance with MARPOL 73/78 standards, offshore location and high energy sea conditions, the potential impact of normal discharges from the survey / support vessels will be of LOW intensity, IMMEDIATE duration and mainly limited to the immediate area around the survey vessel (ACTIVITY). The environmental risk is therefore considered (VERY) LOW before mitigation and NEGLIGIBLE with mitigation.

This potential impact cannot be eliminated because the seismic / support vessels are needed to undertake the survey and will generate routine discharges during operations. With the implementation of the project controls and mitigation measures, and considering the medium sensitivity of the offshore receptors and the very low environmental risk the residual impact will be of NEGLIGIBLE significance.

Impact	**Phase**	**Pre-mitigation ER**	**Post-mitigation ER**	**Final** Significance
Routine vessel discharges	Operation	-2.50	-1.00	-1.00

Mitigation Measures

- Implement a waste management system that addresses all wastes generated at the various sites, shore-based and marine. This should include:
  - Separation of wastes at source;
  - Recycling and re-use of wastes where possible; and
  - Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation).
- Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.
- Use a low-toxicity biodegradable detergent for the cleaning of all deck spillages.
- **No discharge of waste into the ocean while doing seismic surveys.**

9.3.1.3 **UNPLANNED EVENTS**

9.3.1.3.1 VESSEL STRIKES AND ENTANGLEMENT

The project activities (and phases) that will result in potential collision impacts with marine fauna are listed below.

Mobilisation Ship strikes during transit of vessels to survey area

Operation Ship strikes during Operation of survey vessels

Strikes and entanglement of marine fauna during seismic and/or acquisition

Demobilisation Ship strikes during transit to port or next destination

These activities and their associated aspects are described below:

- Passage of the seismic vessel and chase vessels - Ship strikes.

- Towing of seismic equipment - Collision with or entanglement in towed seismic apparatus.

The potential effects of vessel presence and towed equipment on turtles and cetaceans include physiological injury or mortality.

The potential for collision between adult turtles and the seismic vessel, or entanglement of turtles in the towed seismic equipment and surface floats, is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, and the extended distance from their nesting sites, the number of turtles encountered during the proposed 3D survey is expected to be low. Should collisions or entanglements occur, the impacts would be of high intensity for individuals but of LOW intensity for the population as a whole. Furthermore, as the duration of the impact would be limited to the IMMEDIATE-term (4 months) and be restricted to the survey area (SITE), the potential for collision and entanglement in seismic equipment is therefore considered to be of (VERY) LOW environmental risk.

The potential for strikes and entanglement of cetaceans in the towed seismic equipment, is similarly highly dependent on the abundance and behaviour of cetaceans in the survey area at the time of the survey. Due to their extensive distributions and feeding ranges, the number of cetaceans encountered during the proposed 3D survey is expected to be low. Should entanglements occur, the impacts would be of high intensity for individuals but of LOW intensity for the population as a whole. Furthermore, as the duration of the impact would be limited to the short-term (4 months) and be restricted to the survey area (SITE), the potential for entanglement in seismic equipment is therefore considered to be of VERY LOW environmental risk.

With the implementation of the mitigation measures, the residual impact would be of (VERY) LOW significance due to the medium sensitivity of the receptors and the very low environmental risk.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Vessel strikes and entanglement	Operation	-1.75	-1.25	-1.25
Mitigation Measures				
• The vessel operators and MMO should keep a constant watch for marine mammals and turtles in the path of the vessel. • Ensure vessel transit speed between the survey area and port is a maximum of 12 knots (22 km/hr), except in MPAs where it is reduced further to 10 knots (18 km/hr). • Keep watch for marine mammals behind the vessel when tension is lost on the towed equipment and either retrieve or regain tension on towed gear as rapidly as possible. • 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'.				

9.3.1.3.2 LOSS OF EQUIPMENT

The project activities (per phase) that will result in the accidental loss of equipment are listed below.

Operation Accidental loss of equipment to the water column or seabed during operation

These activities and their associated aspects are described further below:

- Irretrievable loss of equipment to the seabed during seismic acquisition
- Accidental loss of paravanes, streamers, arrays and tail buoys during seismic acquisition

During seismic acquisition, the survey vessel tows a substantial amount of equipment; the deflectors or paravanes, which keep the streamers equally spread are towed by heavy-duty rope, and the streamers themselves are towed by lead-in cables. Each streamer is fitted with a dilt float at the head of the streamer, numerous streamer mounts (birds and fins) to control streamer depth and lateral positioning, and a tail buoy to mark the end of the streamer. Streamers are neutrally buoyant at the required depth (5-10 m) but have buoyancy bags embedded within them that inflate at a depth of 40 m. If streamers are accidentally lost they would therefore float in the water column for some time before sinking. Dilt floats and tail buoys would ultimately be dragged down under the weight of the streamer.

Airguns are suspended under floats by a network of ropes, cables and chains, with each float configuration towed by an umbilical. Should both the float and umbilical fail, the airguns would sink to the seabed. In the unlikely event of complete failure of buoyancy and tow systems, the seismic equipment and the attached ropes, cables and chains could pose an entanglement hazard to turtles and marine mammals. If equipment falls to the seabed, it would crush benthic fauna in its footprint, but ultimately provide a hard surface for colonisation.

The potential impacts associated with lost equipment include:

- Potential disturbance and damage to seabed habitats and crushing of epifauna and infauna within the equipment footprint;
- Potential physiological injury or mortality to pelagic and neritic marine fauna due to entanglement in streamers, arrays and tail buoys drifting on the surface or in the water column.

The accidental loss of equipment onto the seafloor would provide a localised area of hard substrate in an area of otherwise unconsolidated sediments. The availability of hard substrata on the seabed provides opportunity for colonisation by sessile benthic organisms and could provide shelter for demersal fish and mobile invertebrates thereby potentially increasing the benthic biodiversity and biomass in the continental slope and abyssal regions. The benthic fauna inhabiting islands of hard substrata in otherwise unconsolidated sediments of the continental shelf are, however, poorly known but would likely be different from those of the surrounding unconsolidated sediments. In the unlikely event of equipment loss, associated impacts would be of LOW intensity and be highly localised and limited to the ACTIVITY over the short-term (any lost object, depending on its size, will likely sink into the sediments and be buried over time). The environmental risk for equipment lost to the seabed is therefore considered (VERY) LOW.

The loss of streamers and floats would result in entanglement hazards in the water column before the streamers sink under their own weight. In the unlikely event of streamer loss, associated impacts would similarly be of LOW intensity and be highly localised and limited to the ACTIVITY (although would potentially float around the SITE) over the IMMEDIATE term. The impact magnitude for equipment lost to the water column is therefore considered (VERY) LOW.

With the implementation of the project controls and mitigation measures, the residual impact associated with the accidental loss of equipment will be of (VERY) LOW significance due to the medium sensitivity of the offshore receptors and the very low environmental risk.

Impact	**Phase**	**Pre-mitigation ER**	**Post-mitigation ER**	**Final** Significance
Release of diesel	Operation	-2.00	-1.50	-1.50
Mitigation Measures				
• In the event that equipment is lost during the operational stage, assess safety and metocean conditions before performing any retrieval operations. Establishing a hazards database listing the type of gear left on the seabed and/or in the licence area with the dates of abandonment/loss and locations, and where applicable, the dates of retrieval. • Notify Department of Transport (Directorate of Maritime Affairs) and the SAN Hydrographer 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.				

9.3.1.3.3 RELEASE OF DIESEL

The project activities that will result in the accidental release of diesel / oil are listed below.

Mobilisation	Loss of fuel from vessel accident
Operation	Loss of fuel from vessel accident
	Bunkering of fuel
Demobilisation	Loss of fuel from vessel accident

These activities and their associated aspects are described further below:

- Instantaneous spills of marine diesel at the surface of the sea can potentially occur during operation, and Such spills are usually of a low volume.
- Larger volume spills of marine diesel would occur in the event of a vessel collision or vessel accident.

Marine diesel spilled in the marine environment would have an immediate detrimental effect on water quality, with the toxic effects potentially resulting in mortality (e.g. suffocation and poisoning) of marine fauna or affecting faunal health (e.g. respiratory damage). If the spill reaches the coast, it can result in the smothering of sensitive coastal habitats.

In the unlikely event of an operational spill or vessel collision, the magnitude of the impact would depend on whether the spill occurred in offshore waters where encounters with pelagic seabirds, turtles and marine mammals would be low due to their extensive distribution ranges, or whether the spill occurred closer to the shore where encounters with sensitive receptors will be higher. Based on the results of the oil spill modelling undertaken in Block 1 (PRDW 2014) a diesel slick released 32 km offshore would be blown as a narrow plume extending in a northerly direction. The diesel would most likely remain at the surface for <36 hours with no probability of reaching sensitive coastal habitats, but potentially crossing the Namaqua Fossil Forest MPA. In offshore environments, impacts associated with a spill or vessel collision would thus be of LOW intensity, LOCALISED over the IMMEDIATE term (5 days). The environmental risk for a marine diesel spill is therefore considered (VERY) LOW.

However, in the case of a spill or collision en route to the survey area, the spill may extend into coastal MPAs or EBSAs and reach the shore affecting intertidal and shallow subtidal benthos and sensitive coastal bird species, in which case the intensity would be considered MEDIUM, but still remaining LOCAL over the IMMEDIATE-term. The environmental risk would however remain (VERY) LOW.

With the implementation of the project controls and mitigation measures, the significance of the residual impact will be (VERY) LOW significance due to the medium sensitivity of the receptors and the very low environmental risk. It must be pointed out that the probability of a spill or collision is unlikely.

<table>
<tr><th>Impact</th><th>Phase</th><th>Pre-mitigation ER</th><th>Post-mitigation ER</th><th>Final Significance</th></tr>
<tr><td>Release of diesel</td><td>Operation</td><td>-2.00</td><td>-1.50</td><td>-1.50</td></tr>
<tr><td colspan="5">Mitigation Measures</td></tr>
<tr><td colspan="5">• Prepare and implement a Shipboard Oil Pollution Emergency Plan and an Oil Spill Contingency Plan. In doing so take cognisance of the South African Marine Pollution Contingency Plan, which sets out national policies, principles and arrangements for the management of emergencies including oil pollution in the marine environment.
• Use low toxicity dispersants cautiously and only with the permission of DFFE.
• As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill</td></tr>
</table>

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance

- Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.
- Ensure offshore bunkering is not undertake in the following circumstances:
  - Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale;
  - During any workboat or mobilisation boat operations;
  - During helicopter operations;
  - During the transfer of in-sea equipment; and
  - At night or times of low visibility.

9.3.1.4 CONFOUNDING EFFECTS AND CUMULATIVE IMPACTS

The assessments of impacts of seismic sounds provided in the scientific literature usually consider short-term responses at the level of individual animals only, as our understanding of how such short-term effects relate to adverse residual effects at the population level are limited. Data on behavioural reactions to seismic noise acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term, i.e. what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population, particularly when combined with other stressors (e.g. temperature, competition for food, shipping noise) (Przeslawski et al. 2015). Confounding effects are, however, difficult to separate from those due to seismic surveys.

Similarly, potential cumulative impacts on individuals and populations as a result of other seismic surveys undertaken either previously, concurrently or subsequently are difficult to assess. A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. Historic survey data for the West Coast is illustrated in Figure 91, which shows the 2D survey lines shot between 2001 and 2018, and indicates 3D survey areas on the West Coast. Despite the density of seismic survey coverage over the past 17 years, the southern right whale population is reported to be increasing by 6.5% per year (Brandaõ et al. 2018), and the humpback whale by at least 5% per annum (IWC 2012) over a time when seismic surveying frequency has increased, suggesting that, for these population at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities.

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day (Wartzok et al. 2004; Southall et al. 2007). If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the population as a whole (NRC 2005). However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant. The increasing numbers of southern right and humpback whales around the Southern African coast, and their lingering on West Coast feeding grounds long into the summer, suggest that those surveys conducted over the past 17 years have not negatively influenced the distribution patterns of these two migratory species at least. Information on the population trends of resident species of baleen and toothed whales is unfortunately lacking, and the potential effects of seismic surveys on such populations remains unknown.

Consequently, suitable mitigation measures must be implemented during seismic data acquisition to ensure the least possible disturbance of marine fauna in an environment where the cumulative impact of increased background anthropogenic noise levels has been recognised as an ongoing and widespread issue of concern (Koper & Plön 2012). If the survey is undertaken by two vessels working concurrently as proposed, cumulative impacts can be expected.

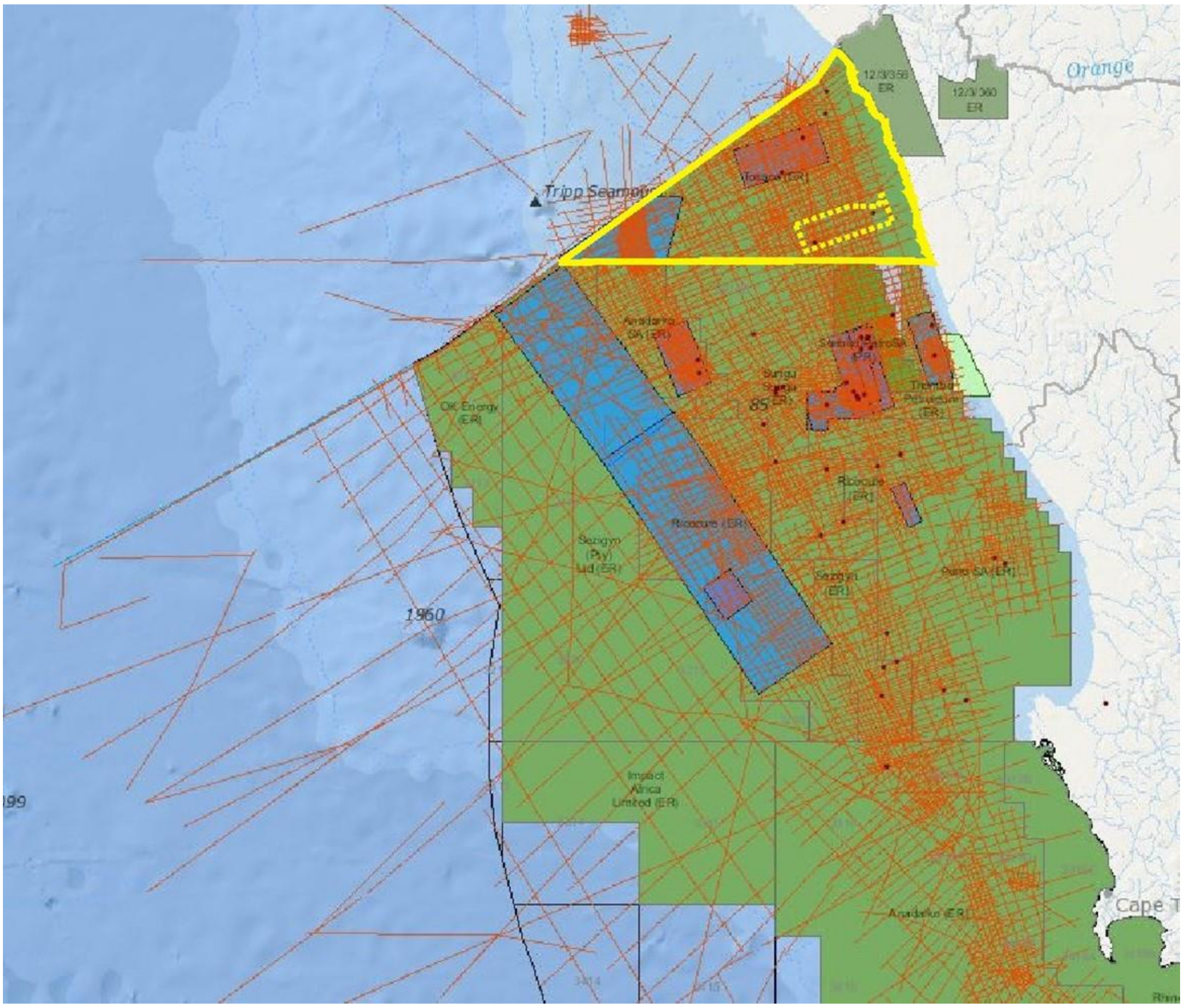


Figure 91: Block 1 (yellow polygon) and the proposed 3D survey area (dotted line) in relation to historical 2D (red lines) and 3D (blue and purple polygons) surveys conducted on the West Coast between 2001 and 2018 (Source: PASA).

9.3.2 IMPACTS ON FISHERIES

This section provides a description of the Fisheries Impacts identified by in the Fisheries Study. For a more detailed description of the impacts, please refer to the Fisheries Study undertaken by Capricorn Marine Environmental (Pty) Ltd included in Appendix C.

9.3.2.1 EXCLUSION FROM FISHING GROUND DUE TO TEMPORARY SAFETY ZONE AROUND SURVEY VESSEL

For most fisheries sectors, the effects of acoustic disturbance on catch rates would be considered to be of overall negligible significance. However, in the case of the Demersal Longline, Tuna Pole-Line, Traditional Linefish, Small Scale Fisheries and Fisheries Research sectors, the spread of sound into fishing grounds may affect catch rates and therefore the overall significance of the survey impact on these sectors has been assessed to be low.

9.3.2.1.1 DEMERSAL LONGLINE

Demersal longline vessels operate within the licence block between the 200 m and 500 m bathymetric contours. Over the period 2000 to 2017, 0.35% of the overall effort and 0.27% of the overall catch were reported within the licence block. Incidental fishing activity has been reported within 5 km of the seismic survey acquisition area, but the probability of fishing activity taking place within the survey area itself is considered to be unlikely. The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be improbable (<25%). Based on the above ratings, the overall significance of the impact is assessed to be low negative.

9.3.2.1.2 TUNA POLE-LINE

Vessels registered under the pole-and-line sector target either albacore in favoured areas off the shelf break, or they target snoek and yellowtail in coastal waters. Fishing records received from DFFE for the reporting period 2007 to 2019 indicate that tuna-directed fishing does not take place within the licence block; however, a significant amount of snoek-directed activity occurs inshore of the 100 m depth contour. Approximately 2.5% of the overall effort expended by the sector and 27% of the snoek catch landed by the sector was reported within the licence block. Fishing activity within the block is seasonal with all fishing reported within the period March to July inclusive. Vessels could be expected to operate in close proximity to the proposed seismic acquisition area, within 6 km of the inshore extent of the seismic acquisition area. Vessels may therefore be affected by the navigational safety zone around the survey vessel, especially if the survey design requires the survey vessel to conduct line changes (vessel turns) into shallow waters. The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be medium (>50% and <75%). Based on the above ratings, the overall significance of the impact is assessed to be low negative.

9.3.2.1.3 TRADITIONAL LINEFISH

Within Licence Block 1, linefish vessels operate in coastal waters (water depths shallower than 100 m) and in close proximity to Port Nolloth and Hondeklipbaai (generally within 15 km of the vessel launch site). Fishing activity in this area is seasonal (March to September) and predominantly snoek-directed. Over the period 2017 to 2019, 3.32% of the total snoek landings reported by the sector were caught within the licence block. There was no fishing effort reported within the proposed seismic survey acquisition area itself[7]. However, due to the potential inaccuracies of reported fishing positions by this sector, the current assessment assumes that the proposed survey area is within the maximum range (75 km) of vessels launching from Port Nolloth and Hondeklipbaai. Therefore there is a low probability (<25%) that vessels would operate in the vicinity of the inshore section of the proposed survey area. Vessels may therefore be affected by the navigational safety zone around the survey vessel, especially if the survey design requires the survey vessel to conduct line changes (vessel turns) into shallow waters. The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be low to moderate (where normal operations will need to be modified). The impact of temporary exclusion of fishing operations is assessed to be of LOW NEGATIVE significance.

9.3.2.1.4 SMALL-SCALE FISHERIES

Certain areas on the coast are prioritized and demarcated by DFFE as small-scale fishing areas. Small-scale fishermen along the Northern Cape coast are typically involved in the traditional line and west coast rock lobster fisheries. Approximately 10 000 small-scale fishers have been identified around the South African coastline, 103 of which are registered at the Port Nolloth and Hondeklipbaai fishing communities. The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). These in reality are unlikely to extend beyond 3 nm from the coast. However, based on a precautionary approach, the current assessment assumes that linefish operations could be within range of the nearshore extent of the proposed seismic survey area. The impact of temporary exclusion to small scale fishing operations is expected to be of overall LOW NEGATIVE significance.

[7] Most activity would be expected within 15 km of the launch sites at Port Nolloth and Hondeklipbaai.

9.3.2.1.5 FISHERIES RESEARCH

Research trawls are undertaken by DFFE to establish the stock status of key commercial species. These research cruised are undertaken on a bi-annual basis across stratified depth ranges from the coastline up to approximately the 1000 m bathymetric contour. As such, they cover the entire extent of the licence block and the proposed seismic acquisition area. Approximately 8.5% and 0.31% of the total number of demersal research trawls were reported within the licence block and seismic acquisition area, respectively. The demersal research survey would be expected to take place within this area over the period January/February whereas the acoustic survey for small pelagic species would be expected to operate within the area during November and again during May/June (a pre-recruitment biomass survey for small pelagic species). The impact is considered to be local in extent (i.e. the area within 5 km of the survey acquisition area) and immediate in duration (limited to the duration of the survey i.e. 4 months). The magnitude (or intensity) of the impact on the sector is expected to be moderate (where normal operations will need to be modified). This rating is based on the proportion of fishing effort and catch within the affected area relative to total effort and catch reported by the sector. The probability of the impact materialising is considered to be medium (>50% and <75%). Based on the above ratings, the overall significance of the impact is assessed to be low negative.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
Fisheries Exclusion: Tuna pole-line sector	Operation	-6.00	-6.00	-6.00
Fisheries Exclusion: Traditional linefish sector	Operation	-3.50	-3.50	-3.50
Fisheries Exclusion: Small-scale sector	Operation	-3.50	-3.50	-3.50
Fisheries Exclusion: Demersal longline sector	Operation	-1.50	-1.50	-1.50
Mitigation Measures				

- At least three weeks prior to the commencement of survey activities the following key stakeholders should be consulted and informed of the proposed survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the survey vessels):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), SA Commercial Linefish Association and West Coast Rock Lobster Association.
  - Other key stakeholders: SANHO, South African Maritime Safety Association, Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town.
- These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the activity.
- An experienced Fisheries Liaison Officer (FLO) should be placed on board the survey or guard vessel to facilitate communications with fishing vessels in the vicinity of the survey areas.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance

- Timing: The tuna pole-and-line sector targets snoek seasonally in the vicinity of the proposed seismic survey acquisition area. If possible, time the survey to avoid peak fishing activity during March to July.
- Demersal research surveys are undertaken within the licence area and proposed seismic survey area over the period January/February. An acoustic survey for small pelagic species is carried out in the area during November and again during May/June by DFFE.
- As far as possible, avoid vessel turns in shallow waters east of the proposed seismic acquisition area.
- The lighting on the survey and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.
- Notify any fishing vessels at a radar range of 12 nm from the vessel via radio regarding the safety requirements around the survey vessel.
- Implement a grievance mechanism in case of disruption to fishing or navigation.

9.3.2.2 FISHERIES NOISE EMISSIONS DURING SURVEY

As a general guideline, the sound ranges of 161 to 166 dB re 1 µPa rms may be used as a suitable indicator sound pressure level at which behavioural modifications of fish start to take place (McCauley et al., 2000). Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array. The current assessment is based on an assumption that the maximum potential zone of acoustic disturbance could extend to a distance of up to 1.5 km from the seismic acquisition area. This is based on an assumption that sound pressure levels generated during the survey would attenuate to the minimum threshold level at which behavioural disturbance on fish could be expected.

The spatial extent of the impact of airgun noise emissions on catch rates is expected to be localised. The effects are considered to be of immediate duration (for duration of survey ~4 months) and of low to moderate magnitude (intensity). The impact is considered to be highly reversible – any disturbance of behaviour that may occur as a result of survey noise would be temporary. The impact of sound produced during the proposed survey is assessed to be of LOW NEGATIVE significance to the demersal longline, tuna pole-line, traditional linefish and small-scale sectors. There is no impact expected on the demersal trawl, midwater trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone, netfish and seaweed sectors.

Potential impacts of seismic pulses on plankton and fish eggs and larvae would include mortality or physiological injury in the immediate vicinity of the airgun sound source, and potentially within a maximum range of 1.2 km of the airgun passage (Pulfrich, 2020). Impacts will thus be of high intensity at close range. The impact of seismic airgun operations on the recruitment of fish stocks is assessed to be of overall low negative significance.

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.

Two species that migrate along the West Coast following the shoals of small pelagic species are snoek and chub mackerel. 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). 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.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Fisheries Noise: Tuna pole-line sector	Operation	-6.00	-6.00	-6.00
Fisheries Noise: Traditional linefish sector	Operation	-3.50	-3.50	-3.50
Fisheries Noise: Small-scale sector	Operation	-3.50	-3.50	-3.50
Fisheries Noise: Demersal longline sector	Operation	-1.50	-1.50	-1.50
Fisheries Noise Research: DFFE	Operation	-5.25	-5.25	-5.25

Mitigation Measures

- At least three weeks prior to the commencement of survey activities the following key stakeholders should be consulted and informed of the proposed survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the survey vessels):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), SA Commercial Linefish Association and West Coast Rock Lobster Association.
  - Other key stakeholders: SANHO, South African Maritime Safety Association, Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town.
- These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the activity.
- An experienced Fisheries Liaison Officer (FLO) should be placed on board the survey or guard vessel to facilitate communications with fishing vessels in the vicinity of the survey areas.
- Timing: The tuna pole-and-line sector targets snoek seasonally in the vicinity of the proposed seismic survey acquisition area. If possible, time the survey to avoid peak fishing activity during March to July.
- Demersal research surveys are undertaken within the licence area and proposed seismic survey area over the period January/February. An acoustic survey for small pelagic species is carried out in the area during November and again during May/June by DFFE.
- As far as possible, avoid vessel turns in shallow waters east of the proposed seismic acquisition area.
- The lighting on the survey and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.
- Notify any fishing vessels at a radar range of 12 nm from the vessel via radio regarding the safety requirements around the survey vessel.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
• Implement a grievance mechanism in case of disruption to fishing or navigation.				

9.3.3 INTERFERENCE WITH EXISTING USES

Surveys can result in localised interference with existing uses. The extent of the disturbance depends on the timing and duration of the survey and the number of vehicles involved in the survey. This impact will have a low overall significance as long as the mitigation measures are implemented.

The survey activities have the potential to affect marine transport routes and other mining, exploration and production activities. Due to the distance from the coast and the fact that there are few other mineral right areas in the vicinity of the survey area that may be affected, this impact has a low final significance. With the implementation of the project controls and mitigation measures, the significance of the residual impact will be (VERY) LOW significance.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	Final Significance
Interference with Existing Uses	Planning	-1.00	-1.00	-1.00
Interference with Existing Uses	Operation	-6.75	-4.00	-4.00
Mitigation Measures				

- At least three weeks prior to the commencement of survey activities, the following key stakeholders should be consulted and informed of the proposed survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the survey vessels):
  - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), SA Commercial Linefish Association and West Coast Rock Lobster Association.
  - Other key stakeholders: SANHO, South African Maritime Safety Association, Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town.
- These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- The lighting on the survey and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to other vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.
- Notify other vessels at a radar range of 12 nm from the vessel via radio regarding the safety requirements around the survey vessel.
- Implement a grievance mechanism in case of disruption to fishing or navigation.
- Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the activity.
- Distribute a Notice to Mariners prior to the commencement of the survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
around the survey vessel, and (4) provide details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.				

9.3.4 NO-GO ALTERNATIVE

The no go alternative would imply that no exploration activities are undertaken and, as such, the negative impacts as stated above, would not materialise. However, conversely, this will negate the potential positive impacts associated with the proposed exploration activities, including:

- The opportunity to identify potential oil and gas resources within the Block 1 and proposed 3D survey area; and
- Provision of job opportunities (limited during the exploration phase).

Since there are no mitigation measures, the impact significance will be LOW pre- and post-mitigation and final significance will be the same.

Impact	Phase	Pre-mitigation ER	Post-mitigation ER	**Final** Significance
No-Go Alternative	Operation	-3.00	-3.00	-3.00
Mitigation Measures				
• N/A				

10 CLOSURE AND REHABILITATION

It is anticipated that the activities will have a limited impact on the receiving environment. The impacts will be limited to the planning and operational phases and it is not anticipated that there will be any need for closure or rehabilitation once the 3D surveys have been concluded. As such, closure of the project will be limited to the conclusion of the physical 3D surveys to be undertaken in the target area. This will mainly relate to

- Waste generation and disposal; and
- Water contamination and pollution.

Residual impacts post completion of the seismic activities are limited (if any) and therefore there will be no requirements for closure, decommissioning and rehabilitation actions. The overall closure objective will be to ensure that the post closure environment aligns with the pre-development. Therefore, no financial provisions apply to this application. Please refer to Appendix F: Final Rehabilitation, Decommissioning and Closure Plan for further details.

11 CONCLUSIONS AND RECOMMENDATIONS

The Scoping Phase of the EIA process identified potential issues and impacts associated with the proposed project and defined the extent of the studies required within the EIA Phase. The EIA Phase addressed those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with applicable phases of the project and recommends appropriate mitigation measures for potentially significant environmental impacts. The EIA report provides sufficient information regarding the potential impacts and the acceptability of these impacts in order for the Competent Authority to make an informed decision regarding the proposed project. The release of a draft EIA Report provides stakeholders with an opportunity to verify that the issues they have raised through the EIA process had been captured and adequately considered.

The EIA Phase aimed to achieve the following:

- Provide an overall assessment of the social and biophysical environments affected by the proposed project.
- Assess potentially significant impacts (direct, indirect and cumulative, where required) associated with the proposed project.
- Identify and recommend appropriate mitigation measures for potentially significant environmental impacts; and
- Undertake a fully inclusive public involvement process to ensure that I&APs are afforded the opportunity to participate, and that their issues and concerns are recorded.

11.1 CONCLUSIONS FROM SPECIALIST STUDIES

The conclusions and recommendations of this EIA are the result of the assessment of identified impacts by specialists, and the parallel process of public participation. The public consultation process has been extensive, and every effort has been made to include representatives of all stakeholders in the study area. The main conclusions from each of the specialist studies are presented below.

11.1.1 MARINE ECOLOGY

The proposed exploration activities to be undertaken by Tosaco are expected to result in impacts on marine invertebrate fauna in Block 1, ranging from negligible to very low significance. Only in the case of potential impacts to marine mammals are impacts of low significance expected.

If all environmental guidelines, and appropriate mitigation measures recommended in this report are implemented, there is no reason why the proposed seismic survey programme should not proceed. It should also be kept in mind that some of the migratory species are now present year-round off the West Coast, and that certain baleen and toothed whales are resident and/or show seasonality opposite to the majority of the baleen whales. Data collected by independent onboard observers should form part of a survey close–out report to be forwarded to the necessary authorities, and any incidence data and seismic source output data arising from surveys should be made available for analyses of survey impacts in Southern African waters.

11.1.2 FISHERIES ASSESSMENT

The sources of potential impacts on the fishing industry were identified as 1) noise emissions generated during survey activities and 2) temporary exclusion during survey activities.

Sound generated during the proposed seismic survey is expected to be in the order of 220 dB re 1 µPa at 1 m at an operating frequency range of 5 – 300 Hz. This falls within the hearing range of most fish species. The potential impacts on fish of sound produced by seismic airguns may include, amongst other effects, physiological injury/mortality, behavioural avoidance and reduced reproductive success. These impacts were assessed to be of overall very low significance, after mitigation, for pelagic and demersal fish species and of overall insignificance for cephalopods and crustaceans. These results were used to inform the assessment of potential effects of reduced catch rates as a result of behavioural avoidance of fish in response to elevated sound levels. The effects on catch rates vary by species and gear-type, as well as the oceanographic variables that affect the attenuation of noise from the sound source. Based on the current project description, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array. The current assessment is based on an assumption that the maximum potential zone of acoustic disturbance could extend to a distance of up to 1.5 km from the seismic acquisition area. This is based on an assumption that sound pressure levels generated during the survey would attenuate to the minimum threshold level at which behavioural disturbance on fish could be expected. For the demersal trawl, midwater trawl, small pelagic purse-seine, west coast rock lobster and netfish sectors, there is no impact expected. However, in the case of the demersal longline, tuna pole-and-line, traditional linefish and fisheries research sectors, the spread of sound into fishing grounds may affect catch rates and the impact on these sectors has been assessed to be of low negative significance.

During the seismic survey, fishing vessels would be required to maintain a safe operational distance of up to 9 Nautical miles from the survey vessel. The impact of potential exclusion was assessed for each commercial sector based on the affected area of fishing ground and the relative quantities of catch reported within the proposed survey acquisition area. The impact of potential exclusion from fishing grounds was assessed to be of low negative significance to the demersal longline, tuna pole-line, traditional linefish and small-scale sectors, which show relatively low levels of fishing activity in the vicinity of the proposed seismic survey acquisition area. It is recommended that the seismic survey be timed to avoid the seasonal activity of snoek-directed coastal fishing over the period March to July. There is no impact of exclusion expected on the remaining commercial fisheries sectors viz, demeral trawl, mid-water trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone ranching, netfish (beach-seine and gillnet) and the harvesting of seaweed.

Stock biomass estimate surveys by DFFE would be expected within the seismic acquisition area over the period January/February (demersal trawl), November (acoustic survey for small pelagic species) and again during May/June (a pre-recruitment biomass survey for small pelagic species). Seismic survey operations that coincide with scheduled fisheries research surveys could result in a negative impact, local in extent and of moderate magnitude. The impact on fisheries research surveys was assessed to be of overall low negative significance (i.e. where this impact would not have a direct influence on the decision to proceed with the seismic survey).

11.2 PREFERRED ALTERNATIVES

The preferred alternatives are discussed in the sections below. The final Sensitivity Map is provided in

11.2.1 LAYOUT ALTERNATIVES

A number of MPAs are located within the Block 1 offshore area. For oil and gas exploration activities, although vessels are permitted to sail through these areas, no invasive exploration activities are permitted in any proclaimed MPA. Should an exploration right be issued, no exploration activities may be undertaken in any proclaimed MPAs. As will be discussed Section 8 above, it should be noted that the proposed 3D Seismic Survey area is intersected by the Namaqua Fossil Forest MPA (Figure 14 above). As such, it has been recommended that the area falling within the MPA, as well as the recommended 5 km buffer required by the NEMPAA, be excluded from the 3D Seismic area. Apart from the exclusion of the NEMPAA, no other layout alternative is considered feasible.

11.2.2 TECHNOLOGY ALTERNATIVES

The activities proposed in this application require specialised technology and skills. The available technology alternatives are limited by most suitable technology for conducting seismic surveys.

To this end, it was concluded by Weilgart (2010) that airgun design can be optimized to reduce unwanted energy. Imaging deep geological targets requires an acoustic source outputting relatively low frequency content (200Hz) and in directions (both inline and horizontal to the plane of interest) that are not of use. During collection of seismic data for deep imaging purposes one should strive to reduce unnecessary acoustic energy (noise) through array, source, and receiver design optimization. Weilgart (2010) further concluded that that regardless of the imaging target, anyone collecting seismic data should strive to reduce unwanted energy or noise. It should be noted that even if unwanted frequencies (> 200 Hz) are removed, there will still be frequency overlap with several marine animals (including most baleen whales) that can and should be minimized. It was further concluded that, lower source levels could be achieved through better system optimization, i.e. a better pairing of source and receiver characteristics, and better system gain(s). For example, new receiver technologies, such as fibre optic receivers, may allow the use of lower amplitude sources through a higher receiver density and/or a lower system noise floor. Some evidence exists which indicates that re-engineered air guns with "mufflers" can be used to attenuate unwanted high frequency energy without affecting frequencies of interest.

The above optimisation techniques should be implemented including better airgun design and system optimisation with the selected survey contractor. In addition, kerosene free hydro-streamers should be used.

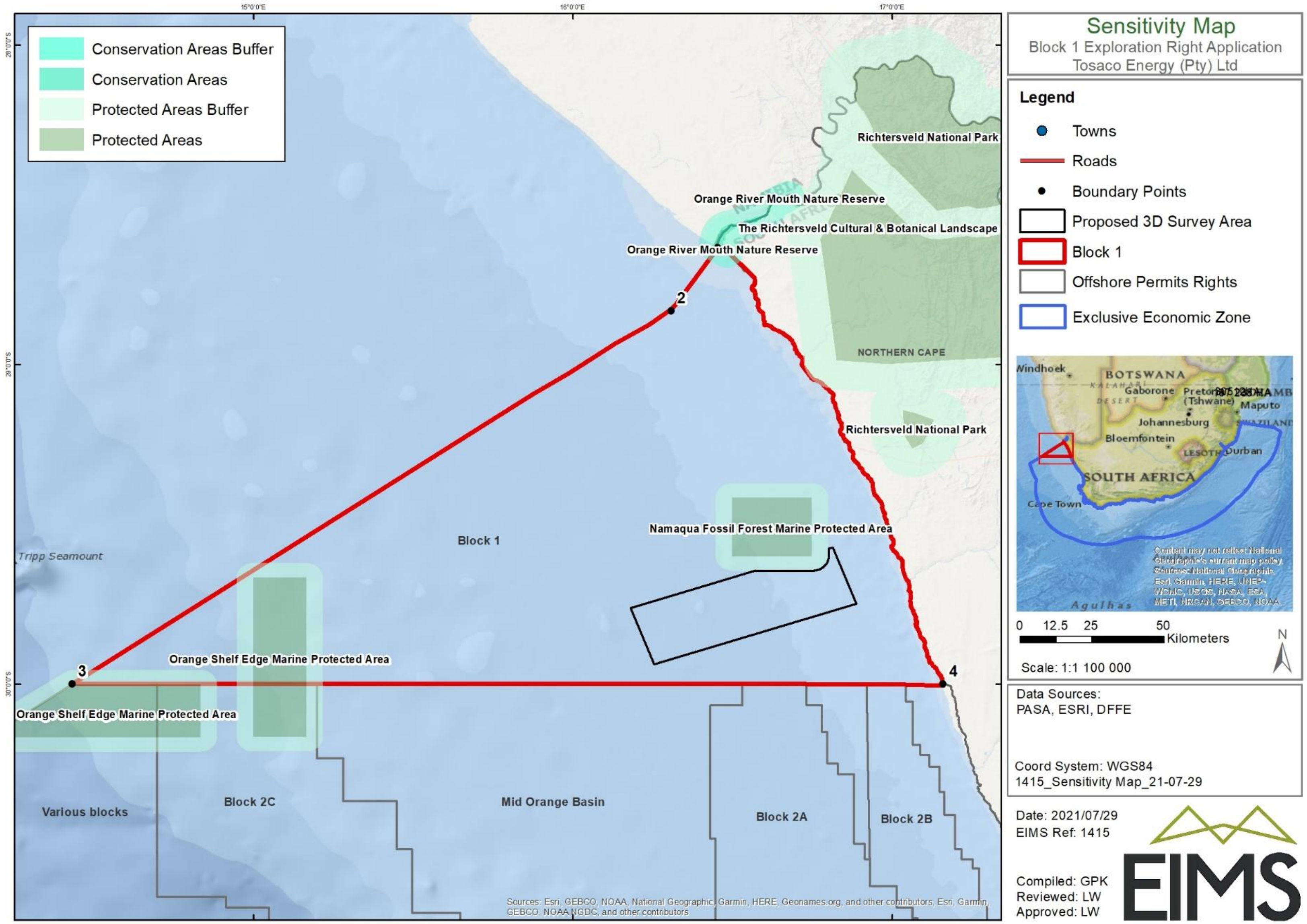


Figure 92: Final Sensitivity Map

11.3 ENVIRONMENTAL IMPACT STATEMENT

The findings of the specialist studies conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding, provided that the recommended mitigation and management measures are implemented. Based on the nature and extent of the proposed project, the local level of disturbance predicted as a result of the exploration activities, the findings of the specialist studies, and the understanding of the significance level of potential environmental impacts, it is the opinion of the EIA project team and the EAP that the significance levels of the majority of identified negative impacts can generally be reduced to an acceptable level by implementing the recommended mitigation measures and the project should be authorized.

11.4 RECOMMENDATIONS FOR INCLUSION IN ENVIRONMENTAL AUTHORIZATION

11.4.1 MARINE ECOLOGY

11.4.1.1 APPLICATION OF THE MITIGATION HIERARCHY

A key component of this EIA process is to explore practical ways of avoiding and where not possible to reducing potentially significant impacts of the proposed seismic acquisition activities. The mitigation measures put forward are aimed at preventing, minimising or managing significant negative impacts to as low as reasonably practicable (ALARP). The mitigation measures are established through the consideration of legal requirements, project standards, best practice industry standards and specialist inputs.

The mitigation hierarchy, as specified in International Finance Corporation (IFC) Performance Standard 1, is based on a hierarchy of decisions and measures aimed at ensuring that wherever possible potential impacts are mitigated at source rather than mitigated through restoration after the impact has occurred. Any remaining significant residual impacts are then highlighted and additional actions are proposed. With few exceptions, however, identified impacts were of low significance with very low or zero potential for further mitigation. In such cases the appropriate project Standards will be used and additional best management practices are proposed.

The operator will ensure that the proposed seismic survey is undertaken in a manner consistent with good international industry practice and Best Available Techniques (BAT), and in compliance with the applicable requirements in the MPRDA regulations.

The operator will ensure that the proposed seismic survey is undertaken in a manner consistent with good international industry practice and in compliance with the applicable requirements in MARPOL 73/78, as summarised below.

- The discharge of biodegradable wastes from vessels is regulated by MARPOL 73/78 Annex V, which stipulates that:
    - No disposal to occur within 3 nautical miles (± 5.5 km) of the coast.
    - Disposal between 3 nautical miles (± 5.5 km) and 12 nautical miles (± 22 km) needs to be comminuted to particle sizes smaller than 25 mm.
    - Disposal overboard without macerating can occur greater than 12 nautical miles from the coast when the vessel is sailing.
- Discharges of oily water (deck drainage, bilge and mud pit wash residue) to the marine environment are regulated by MARPOL 73/78 Annex I, which stipulates that vessels must have:
    - A Shipboard Oil Pollution Emergency Plan (SOPEP).
    - A valid International Oil Pollution Prevention Certificate, as required by vessel class.
    - Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks, e.g. oil separating/filtering equipment and oil content meter. Oil in water concentration must be less than 15 ppm prior to discharge overboard.

- Oil residue holding tanks.
- Oil discharge monitoring and control system.

- Sewage and grey water discharges from vessels are regulated by MARPOL 73/78 Annex IV, which specifies the following:
  - Vessels must have a valid International Sewage Pollution Prevention Certificate.
  - Vessels must have an onboard sewage treatment plant providing primary settling, chlorination and dechlorination before discharge of treated effluent.
  - The discharge depth is variable, depending upon the draught of the seismic vessel / support vessel at the time, but will be in accordance with MARPOL 73/78 Annex IV.
  - Discharge of sewage beyond 12 nm requires no treatment. However, sewage effluent must not produce visible floating solids in, nor cause the discolouration of, the surrounding water.
  - Sewage must be comminuted and disinfected for discharges between 3 nautical miles (± 6 km) and 12 nautical miles (± 22 km) from the coast. This will require an onboard sewage treatment plant or a sewage comminuting and disinfecting system.
  - Disposal of sewage originating from holding tanks must be discharged at a moderate rate while the ship is proceeding on route at a speed not less than 4 knots.
- Sewage will be treated using a marine sanitation device to produce an effluent with:
  - A biological oxygen demand (BOD) of <25 mg/l (if the treatment plant was installed after 1/1/2010) or <50 mg/l (if installed before this date).
  - Minimal residual chlorine concentration of 1.0 mg/l.
  - No visible floating solids or oil and grease.

The project will also comply with industry best practices with regard to waste management, including:

- Waste management will follow key principles: Avoidance of Waste Generation, adopting the Waste Management Hierarchy (reduce, reuse, recycle, recover, residue disposal), and use of Best Available Technology (BAT).
- An inventory will be established of all the potential waste generated, clarifying its classification (hazardous, non-hazardous or inert) and quantity, as well as identifying the adequate treatment and disposal methods.
- Waste collection and temporary storage shall be designed to minimise the risk of escape to the environment (for example by particulates, infiltration, runoff or odours).
- On-site waste storage should be limited in time and volume.
- Dedicated, clearly labelled, containers (bins, skips, etc.) will be provided in quantities adapted to anticipated waste streams and removal frequency.

Detailed mitigation measures for seismic surveys in other parts of the world are provided by Weir et al. (2006), Compton et al. (2007) and US Department of Interior (2007). Many of the international guidelines presented in these documents are extremely conservative as they are designed for areas experiencing repeated, high intensity surveys and harbouring particularly sensitive species, or species with high conservation status. A number of countries have more recently updated their guidelines, most of which are based on the JNCC (2010, 2017) recommendations but adapted for specific areas of operation. A review and comparison of these is provided in MaMa CoCo SEA (2015). The guidelines currently applied to seismic surveying in South African waters are those proposed in the Generic EMPR (CCA & CMS 2001). These have been updated as necessary to include salient points from recognised international guidelines, particularly the JNCC (2010, 2017) Guidelines and the 2013 New Zealand Code of Conduct for seismic operations.

The mitigation measures proposed for seismic surveys are as provided below for each phase of a seismic survey operation:

11.4.1.2 **MOBILISATION PHASE**

11.4.1.2.1 PRE-SURVEY PLANNING

- Plan seismic surveys to avoid the periods of movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (June to November inclusive), and ensure that migration paths are not blocked by seismic operations. In addition, avoid surveying during December when humpback whales may still be moving through the area on their return migrations.
- Plan survey, as far as possible, so that the first commencement of airgun firing in a new area (including gun tests) are undertaken during daylight hours.
- Although a seismic vessel and its gear may pass through a declared Marine Protected Area, acoustic sources (airguns) must not be operational during this transit.
- A buffer of at least 5 km is recommended around MPAs.

11.4.1.2.2 KEY EQUIPMENT

- All seismic vessels must be fitted with Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations.
- The use of PAM 24-h a day must be implemented to detect deep diving species.
- 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
- Define and enforce the use of the lowest practicable airgun volume for production.
- Ensure the ramp-up noise volumes do not exceed the production volume.
- Prohibit airgun use (including airgun tests) outside of the area of operation (which includes line turns undertaken outside the licence area).
- The operator must provide a display screen for the acoustic source operations. All information relating to the activation of the acoustic source and the power output levels must be readily available to support the observers in real time via the display screen and to ensure that operational capacity is not exceeded.
- 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'.
- Ensure that solid streamers rather than fluid-filled streamers are used to avoid leaks.

11.4.1.2.3 MMO AND PAM DUTIES

- Two qualified, independent MMOs are required on board at all times; as a minimum one must be on watch during daylight hours while the acoustic source is in the water in the operational area.
- The duties of the MMO would be to:
    - o Give effective briefings to crew members, and establish clear lines of communication and procedures for onboard operations;
    - o Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes;
    - o Observe and record responses of marine fauna to seismic shooting from optimum vantage points, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance/bearing 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 seismic activities. Both the identification and the behaviour of the animals must be recorded accurately along with current seismic sound levels. Any attraction of predatory seabirds, large pelagic fish or cetaceans (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should also be recorded;

  - Sightings of any injured or dead protected species (marine mammals, seabirds and sea turtles) should be recorded, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (latitude/longitude) of the strike, and the species identification or a description of the animal should be recorded;
  - Record meteorological conditions at the beginning and end of the observation period, and whenever the weather conditions change significantly;
  - Request the delay of start-up or temporary termination of the seismic survey or adjusting of seismic shooting, as appropriate. It is important that MMO decisions on the termination of firing are made confidently and expediently, and following dialogue between the observers on duty at the time. A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports);
  - Use the JNCC (2017) recording spreadsheet in order to record all the above observations and decisions; and
  - Prepare daily reports of all observations, to be forwarded to the necessary authorities on a daily or weekly basis to ensure compliance with the mitigation measures.
- At least two qualified, independent PAM operators are required on board at all times, as a minimum one must be on watch while the acoustic source is in the water in the operational area. If PAM is to be operational 24/7 then 3 PAM operators are required.
- The duties of the PAM operator would be to:
  - Give effective 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 1 000 m (very high frequency cetaceans) or 500 m (low and high frequency cetaceans) of the airgun 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 airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and
  - Request the delay of start-up and temporary termination of the seismic survey, as appropriate.
- Ensure MMOs and PAM operators are briefed on the area-specific sensitivities and on the seismic survey planning (including roles and responsibilities, and lines of communication).
- Seabird, turtle and marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, DFFE, and the Petroleum Agency South Africa for analyses of survey impacts in local waters.

11.4.1.3 OPERATIONAL PHASE

11.4.1.3.1 AIRGUN TESTING

- For airgun testing the following should apply:

- If testing a single lowest power airgun a “soft-start” is not required;
- If testing multiple higher powered airguns a “soft-start” is required. The “soft-start” should be carried out over a time period proportional to the number of guns being tested and not exceed 20 minutes; airguns should be tested in order of increasing volume;
- If testing all airguns at the same time a 20 minute “soft-start” is required;
- A pre-shoot watch must be maintained before any instances of airgun testing;
- No airgun testing may be undertaken outside of the 3D survey area identified in Figure 14.

11.4.1.3.2 PRE-START OBSERVATIONS

- Soft starts should be scheduled so as to minimise, as far as possible, the interval between reaching full power operation and commencing a survey line.
- The implementation of “soft-start” procedures of a minimum of 20 minutes’ duration on initiation of seismic surveying is required.
- The “soft-start” cannot commence during daylight hours unless:
    - An area of 500 m radius from the centre of the airgun array (exclusion zone) has been scanned for the presence of diving seabirds (including penguins) and in particular feeding aggregations of diving seabirds, turtles, seals and cetaceans. As the survey will primarily be conducted in water depths of more than 200 m, there should be a dedicated pre-shoot watch of at least 60 minutes for deep-diving species. “Soft-starts” should be delayed until such time as this area is clear of individuals or aggregations of diving seabirds, turtles and cetaceans. A “soft-start” should not begin until 60 minutes after the animals depart the exclusion zone or 60 minutes after they are last seen or acoustically detected by PAM in the exclusion zone. In the case of fur seals, which may occur commonly around the vessel, the presence of seals (including number and position / distance from the vessel) and their behaviour should be recorded prior to “soft-start” procedures. “Soft-starts” should only commence once it has been confirmed that no seal activity has been observed within 500 m of the airguns for at least 10 minutes. However, if after a period of 10 minutes they are still within 500 m of the airguns, the normal “soft-start” procedure should be allowed to commence for at least a 20-minute duration. Their activity should be carefully monitored during “soft-starts” to determine if they display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of the seismic activities.
    - Passive Acoustic Monitoring for the presence of marine mammals has been carried out for at least 60 minutes before activation of “soft-starts” and no vocalising cetaceans have been detected in the mitigation zone.
    - If PAM has malfunctioned then revert to requirements under Section 11.4.1.3.5.
- “Soft-start” procedures cannot commence during times of poor visibility or darkness unless:
    - Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a PAM operator for at least 60 minutes before activation and no vocalising cetaceans have been detected in the mitigation zone.
- When arriving at a new location in the survey programme for the first time, the initial acoustic source activation must not be undertaken at night or during poor sighting conditions unless either:
    - MMOs have undertaken observations within 20 nautical miles of the planned start up position for at least the previous two hours of good sighting conditions preceding proposed operations, and no marine mammals have been detected; or
    - Where there have been less than two hours of good sighting conditions preceding proposed operations (within 20 nautical miles of the planned start up position), the source may be activated if:
        - PAM monitoring has been conducted for 2 hours immediately preceding proposed operations and no marine mammals have been acoustically detected;

- MMOs have conducted visual monitoring for 2 hours immediately preceding proposed operations and no marine mammals have been visually detected; and
- No fur seals have been sighted in the mitigation zone during visual monitoring in the 10 minutes immediately preceding proposed operations.

11.4.1.3.3 LINE TURNS AND BREAKS IN FIRING

- When surveying in deeper waters (>200 m) and for surveys which have relatively fast line turn times, the searches for marine mammals can commence before the end of the survey line if line changes take less time than a pre-shoot search and soft-start combined (i.e. 80 minutes). If marine mammals are detected when the airguns have ceased firing, the commencement of the “soft-start” for any subsequent survey lines should be preceded by the usual 60 minute pre-watch period.
- If line changes are expected to take longer than 40 minutes, firing must be terminated at the end of the survey line and the usual pre-shoot search undertaken during the line change, followed by a “soft-start”;
- If during unplanned breaks airguns can be restarted within 5 minutes, no soft-start is required and firing can recommence at the same power **level provided no marine mammals have been detected in the mitigation zone during the break-down period**.
- All breaks in airgun firing of longer than 5 minutes but less than 20 minutes should be followed by a “soft-start” of similar duration. All breaks in firing of 20 minutes or longer must be followed by a “soft-start” procedure of at least 20 minutes prior to the survey operation continuing.
- For planned breaks longer than 40 minutes normal start-up procedures apply. For planned breaks less than 10 minutes, monitoring must commence 20 minutes prior to the break and continue for the duration of the break. In this regard, good communication between the seismic contractor and MMOs and PAM operators is key in order to ensure that all parties are aware of planned breaks and early commencement of pre-watch periods.

11.4.1.3.4 SHUT-DOWNS

- Seismic shooting should be terminated on observation of diving seabirds (including penguins) and in particular feeding aggregations of diving seabirds, turtles, seals and cetaceans within the 500 m mitigation zone. If PAM detects the presence of very high frequency cetaceans (Heaviside’s dolphins, pygmy sperm whale and dwarf sperm whale) within 1 000 m of the sound source, seismic shooting should be terminated.
- Seismic shooting should be terminated on observation of any obvious mortality or injuries to cetaceans, turtles, seals or large mortalities of invertebrate and fish species as a direct result of the survey. Such mortalities would be of particular concern where a) commercially important species are involved, or b) mortality events attract higher order predator and scavenger species into the seismic area during the survey, thus subjecting them to acoustic impulses.
- Seismic shooting should also be terminated when obvious changes to turtle, seal or cetacean behaviours are observed from the survey vessel, or turtles and cetaceans (not seals) are observed within 500 m of operating airguns or appear to be approaching firing airguns (particularly if the MMO has lost sight of the approaching animal prior to it entering the mitigation zone). The rationale for this is that animals at close distances (i.e. where physiological injury may occur) may be suffering from reduced hearing as a result of seismic sounds, that frequencies of seismic sound energy lies below best hearing frequencies (certain toothed cetaceans and seals), or that animals have become trapped within the area filled with sound through diving behaviour.
- Although a seismic vessel and its gear may pass through a declared Marine Protected Area, acoustic sources (airguns) must not be operational during this transit.

11.4.1.3.5 PAM MALFUNCTIONS

- If the PAM system malfunctions or becomes damaged during night-time operations or periods of low visibility, surveying must be discontinued until such time as the functional PAM system can be redeployed.

- If the PAM system breaks down during daylight hours operations may continue for 20 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may continue for an additional 2 hours without PAM monitoring as long as:
    - No marine mammals were detected solely by PAM in the mitigation zones in the previous 2 hours;
    - Two MMOs maintain watch at all times during operations when PAM is not operational;
    - The time and location in which operations began without an active PAM system is recorded.
- Sufficient time should be provided to the PAM operator to redeploy fixed or replacement PAM equipment prior to survey activities (with appropriate pre-watch and "soft-start" operations) recommencing.

11.4.1.4 VESSEL AND AIRCRAFT OPERATIONS

- Pre-plan flight paths to ensure that no flying occurs over the Mossel Bay and Robber Peninsula seal colonies;
- Avoid extensive low-altitude coastal flights (<2,500 ft and within 1 nautical mile of the shore);
- The flight path between the onshore logistics base and seismic vessel should be perpendicular to the coast;
- A flight altitude >1 000 ft be maintained at all times, except for when the aircraft lands on or takes off from the seismic vessel and logistics base;
- Maintain an altitude of at least 2 500 ft over of a Special Nature Reserve, National Park or World Heritage Site;
- Contractors should comply fully with aviation and authority guidelines and rules;
- Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.
- The lighting on the seismic vessel 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 minimised.
- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring.
- Develop a ballast water management plan that considers all IMO requirements.
- Ensure all infrastructure (e.g. arrays, streamers, tail buoys etc.) that has been used in other regions is thoroughly cleaned prior to deployment.
- Implement a waste management system that addresses all wastes generated at the various sites, shore-based and marine. This should include:
    - Separation of wastes at source;
    - Recycling and re-use of wastes where possible;
- Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation).
- Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.
- Use a low-toxicity biodegradable detergent for the cleaning of all deck spillages.
- In the event that equipment is lost during the operational stage, assess safety and metocean conditions before performing any retrieval operations.

- Establishing a hazards database listing the type of gear left on the seabed and/or in the licence area with the dates of abandonment/loss and locations, and where applicable, the dates of retrieval.
- Prepare and implement a Shipboard Oil Pollution Emergency Plan and an Oil Spill Contingency Plan. In doing so take cognisance of the South African Marine Pollution Contingency Plan, which sets out national policies, principles and arrangements for the management of emergencies including oil pollution in the marine environment.
- As far as possible, and whenever the sea state permits, attempt to control and contain the spill at sea with suitable recovery techniques to reduce the spatial and temporal impact of the spill.
- Ensure offshore bunkering is not undertake in the following circumstances:
    - Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale;
    - During any workboat or mobilisation boat operations;
    - During helicopter operations;
    - During the transfer of in-sea equipment; and
    - At night or times of low visibility.

11.4.2 FISHERIES

- At least three weeks prior to the commencement of survey activities the following key stakeholders should be consulted and informed of the proposed survey programme (including navigational co-ordinates of location, timing and duration of proposed activities) and the likely implications thereof (specifically the exclusion and safety zone around the survey vessels):
    - Fishing industry associations: SA Tuna Association; SA Tuna Longline Association, Fresh Tuna Exporters Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), SA Commercial Linefish Association and West Coast Rock Lobster Association.
    - Other key stakeholders: SANHO, South African Maritime Safety Association, Ports Authority and the Department of Agriculture, Forestry and Fisheries Vessel Monitoring, Control and Surveillance Unit in Cape Town.
- These stakeholders should again be notified at the completion of the project when the survey and support vessels are off location.
- Request, in writing, the SANHO to broadcast a navigational warning via Navigational Telex (Navtext) and Cape Town radio for the duration of the activity.
- Distribute a Notice to Mariners prior to the commencement of the survey operations. The Notice to Mariners should give notice of (1) the co-ordinates of the survey area, (2) an indication of the proposed survey timeframes, (3) the dimensions of the towed gear array and dimensions of the safety zone around the survey vessel, and (4) provide details on the movements of support vessels servicing the project. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.
- An experienced Fisheries Liaison Officer (FLO) should be placed on board the survey or guard vessel to facilitate communications with fishing vessels in the vicinity of the survey areas.
- Timing: The tuna pole-and-line sector targets snoek seasonally in the vicinity of the proposed seismic survey acquisition area. If possible, time the survey to avoid peak fishing activity during March to July.
- Demersal research surveys are undertaken within the licence area and proposed seismic survey area over the period January/February. An acoustic survey for small pelagic species is carried out in the area during November and again during May/June by DFFE.
- As far as possible, avoid vessel turns in shallow waters east of the proposed seismic acquisition area.

- The lighting on the survey and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.
- Notify any fishing vessels at a radar range of 12 nm from the vessel via radio regarding the safety requirements around the survey vessel.
- Implement a grievance mechanism in case of disruption to fishing or navigation.

12 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations relating to this EIA phase assessment should be noted:

12.1 GENERAL

- In determining the significance of impacts, with mitigation, it is assumed that mitigation measures proposed in the report are correctly and effectively implemented and managed throughout the life of the project.

12.2 MARINE ECOLOGY

- The study is based on the project description made available to the specialists at the time of the commencement of the study.
- Information gaps include:
  - o details of the benthic macrofaunal communities and potentially vulnerable species on deep water reef habitats; and
  - o current information on the distribution, population sizes and trends of most pelagic seabird, turtle and cetacean species occurring in South African waters and the project area in particular.

12.3 FISHERIES

- The official governmental record of fisheries data was used to display fishing catch and effort relative to the proposed project area. These data are derived from logbooks that are completed by skippers, and it is assumed that there will be a proportion of erroneous data due to mistakes in the capturing of these data into electronic format. The proportion of erroneous data is estimated to be up to 10% of the total dataset and would be primarily related to the accurate recording or transcription of the fishing position (latitude and longitude). Where obvious s in the reporting of fishing positions were identified these were excluded from the analysis.
- In assessing the impact of the proposed exclusion zone on fishing operations, calculations of potential loss of catch were based on the assumption that fisheries would be excluded from the entire target survey area (inclusive of the additional exclusion area surrounding the survey vessel where this extends beyond the boundary of the target survey area) for the entire duration of the survey. In practice, the exclusion area would be a moving footprint of approximately 500 km^2 extending around the vessel. The approach is likely to be an overestimate of the potential impact on fishing operations which in reality could continue within certain portions of the Licence Block.
- The acoustic impact has been considered to affect the entire survey acquisition area (inclusive of a buffer of 1.5 km of acoustic disturbance around the acquisition area) at all times. The study has not factored in the transitory nature of the acoustic impact i.e. that the sound source moves in space and time as the survey progresses within the target area. The calculations of potential reduction of catch are therefore likely to be overestimates.
- The effects of seismic sound on the CPUE of fish and invertebrates have been drawn from the findings of international studies. To date there have been no studies focused directly on the species found locally. Although the results from international studies are likely also to be representative for local species, current gaps in knowledge on the topic lead to uncertainty when attempting to accurately quantify the potential loss of catch for each type of fishery. Research into the effects of seismic sound on marine fauna is ongoing.

13 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I **Gideon Kriel** herewith undertake that the information provided in the foregoing report is correct to the best of my knowledge, and that the comments and inputs from stakeholders and Interested and Affected Parties has been correctly recorded in the report where applicable.

____

Signature of the EAP

Date: 2021/07/30

14 UNDERTAKING REGARDING LEVEL OF AGREEMENT

I **Gideon Kriel** herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with Interested and Affected Parties and stakeholders has been correctly recorded and reported herein.

____

Signature of the EAP

Date: 2021/07/30

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16 APPENDICES

Appendix A: EAP CV

Appendix B: Public Participation

Appendix C: Specialist Reports

Appendix D: Impact Assessment Matrix

Appendix E: Environmental Management Programme

Appendix F: Final Rehabilitation, Decommissioning and Closure Plan