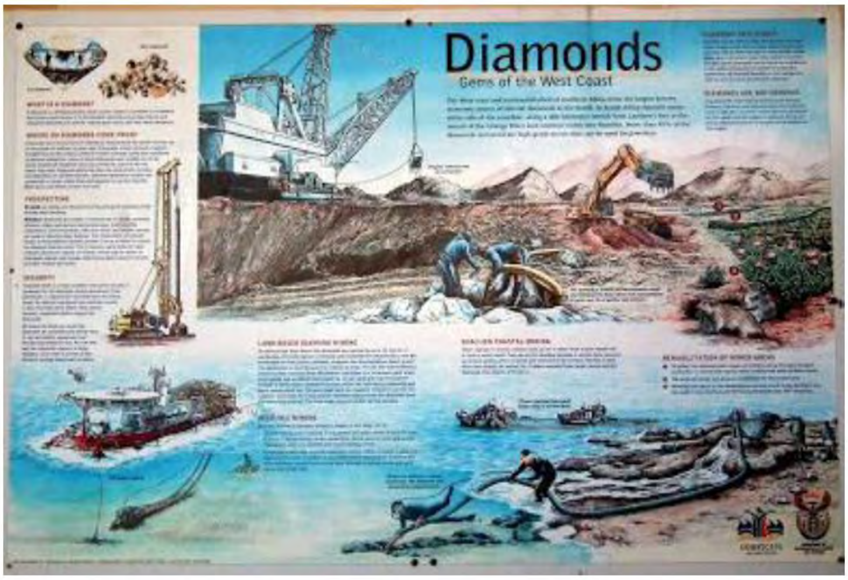



Draft Basic Assessment Report

Proposed Prospecting Right over Sea Concession 12C, Western Cape

Reference Number: WC 30/5/1/1/2/10425 PR

October 2022

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Proposed Prospecting Right over Sea Concession 12C, Western Cape

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CARRIED OUT BY:

GroenbergEnviro (Pty) Ltd

COMMISSIONED BY:

Aqua Marine Diamonds 12 (Pty) Ltd

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SYNOPSIS:

See Below.

PREPARED BY:

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mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT
And
ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: Aqua Marine Diamonds 12 (Pty) Ltd

TEL NO: 027 851 7776

FAX NO: 086 666 5915

POSTAL ADDRESS: P.O. Box 127, Port Nolloth, 8280

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FILE REFERENCE NUMBER SAMRAD: (WC) 30/5/1/1/3/2/1/10425PR

FILE REFERENCE NUMBER SAMRAD: (WC) 30/5/1/1/3/2/1/10425PR

1. IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining “will not result in unacceptable pollution, ecological degradation or damage to the environment”.

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2. Objective of the basic assessment process

The objective of the basic assessment process is to, through a consultative process─

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

(b) identify the alternatives considered, including the activity, location, and technology alternatives;

(c) describe the need and desirability of the proposed alternatives,

(d) through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage , and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on the these aspects to determine:

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

(ii) the degree to which these impacts—

(aa) can be reversed;

(bb) may cause irreplaceable loss of resources; and

(cc) can be managed, avoided or mitigated;

(e) through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to—

(i) identify and motivate a preferred site, activity and technology alternative;

(ii) identify suitable measures to manage, avoid or mitigate identified impacts; and

(iii) identify residual risks that need to be managed and monitored.

PART A: SCOPE OF ASSESSMENT AND BASIC ASSESSMENT REPORT

1 Contact Person and correspondence address

1.1 Details of

1.1.1 Details of the EAP

Name of The Practitioner: Helene Botha (GroenbergEnviro (Pty) Ltd)

Tel No.: 079 509 0785
Fax No. : 086 476 7139

e-mail address: helene@groenbergenviro.co.za

1.1.1.1 Expertise of the EAP.

(1) The qualifications of the EAP

(with evidence).

NAME	Helene Botha	Pieter Badenhorst
QUALIFICATIONS	B. Sc. (Zoology & Genetics) B. SC. Hons. (Animal Behaviour) M. Env. Man (Masters' Degree in Environmental Management)	B. SC. B. Eng. (Civil) M. Eng. (Irrigation) B. Hons. (B&A) MBA
PROFESSIONAL REGISTRATION	Registration with Environmental Assessment Practitioners'' Association of South Africa (EAPASA): Reg. No.: 2019/558.- in progress	Professional Engineer, member of the Engineering Council of South Africa Member of the South African Institute of Civil Engineers Member of the International Association of Impact Assessment (South Africa) Registration with Environmental Assessment Practitioners' Association of South Africa (EAPASA): Reg. No.: 2019/1108

(2) Summary of the EAP's past experience.

(In carrying out the Environmental Impact Assessment Procedure)

Refer to Appendix A: Attachments as per DMR Template

Appendix 1&2: CV , page 187 for CV of EAP.

1.1.2 Location of the overall Activity.

Farm Name:	Sea Concession 12C
Application area (Ha)	±221 254Ha
Magisterial district:	Vanrhynsdorp
Distance and direction from nearest town	Sea Concession 12C is situated ap-proximately 300 km north of Cape Town, with the inshore boundary lo-cated 5km seaward of the coast be-tween Strandfontein in the south and Namakwa Sands Wet Separation Plant in the north. The offshore boundary is located approximately 95 km offshore

21 digit Surveyor General Code for each farm portion	The concession area is located offshore and described as Sea Concession 12C.

1.1.3 Locality map

(show nearest town, scale not smaller than 1:250000).

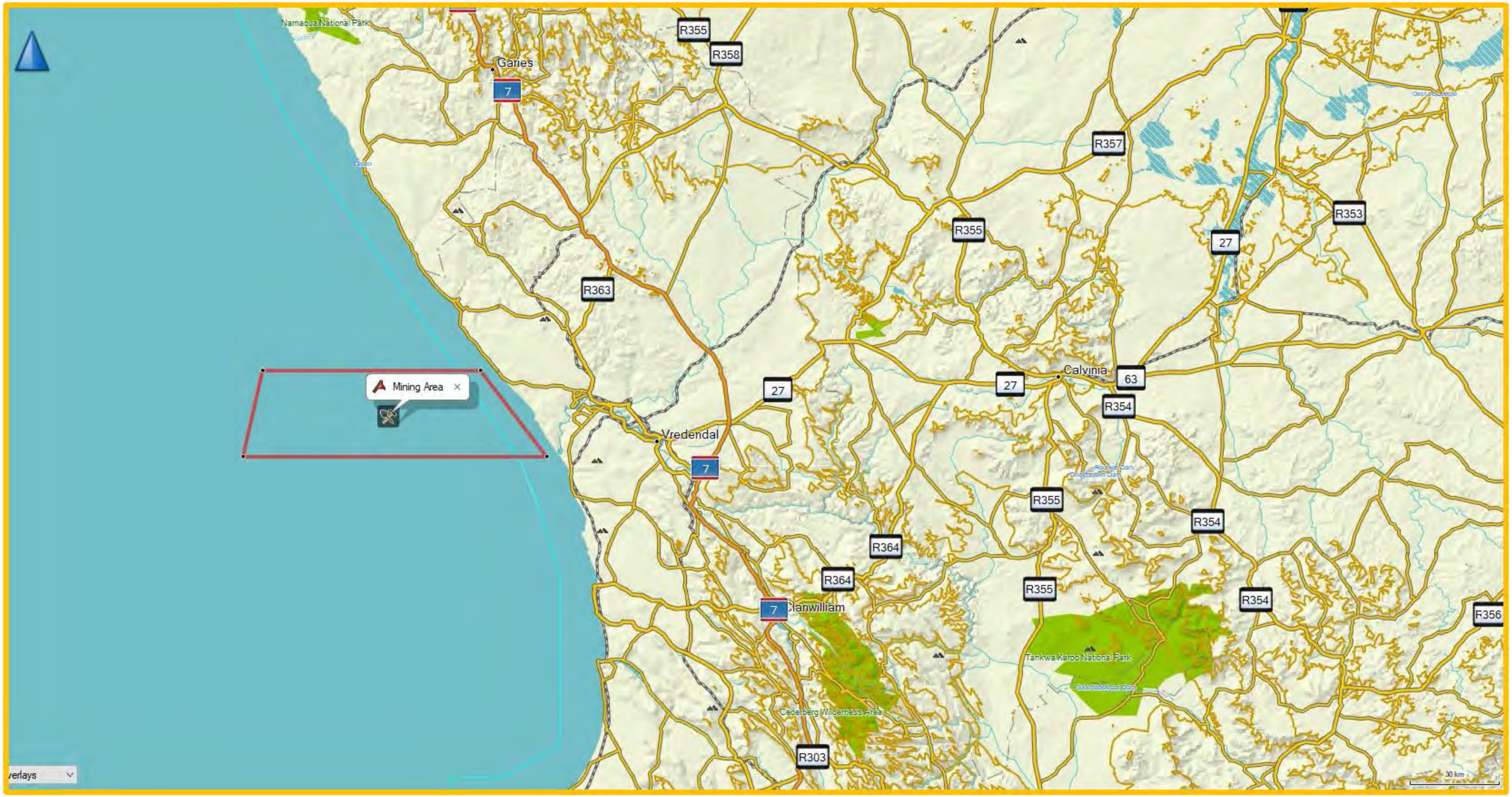

Figure 1: Locality plan with major Towns and Routes

1.1.4 Description of the scope of the proposed overall activity.

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site

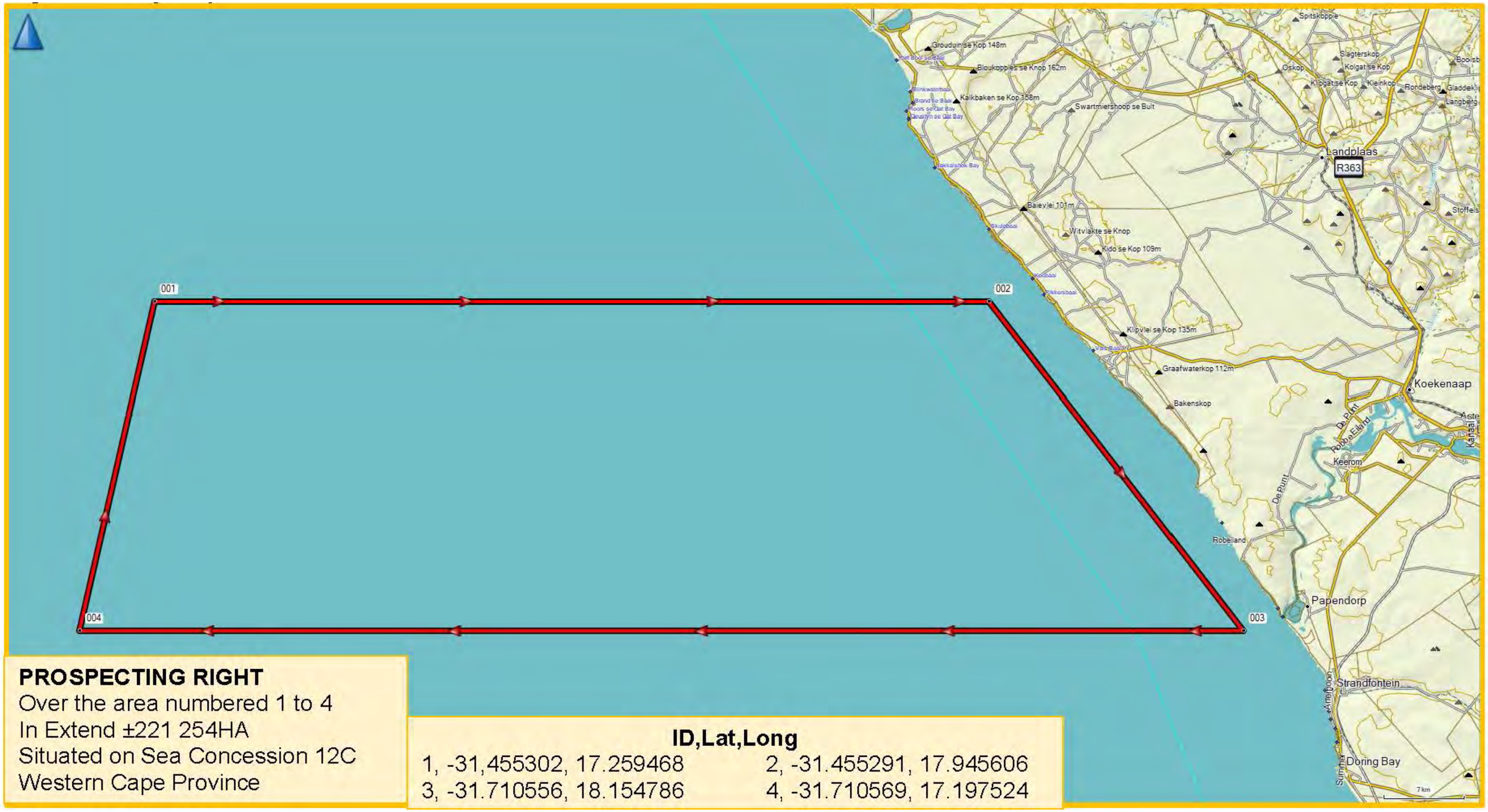

Figure 2: Layout plan Sea Concession 12C

1.1.4.1 Listed and specified activities

Table 1: Listed activities applied for

NAME OF ACTIVITY **(E.g. For prospecting - drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc…etc…etc**	**Aerial extent of the Activity** **Ha or m²**	**LISTED ACTIVITY** **Mark with an X where applicable or affected.**	**APPLICABLE LISTING NOTICE** **(GNR 544, GNR 545 or GNR 546)**
The operation directly relates to prospecting of an offshore mineral resource (diamonds) and requires a prospecting right in terms of section 16 of the MPRDA. Prospecting is planned within Sea Concession area 12C using both non-invasive and invasive sampling activities, none of which require infrastructure. Sampling will be conducted in three phases to detect the presence of paleo-beach deposits, which are known from other concessions to contain diamondiferous gravels. Prospecting operations are expected to occur sporadically within the concession area. • Geophysical Surveys (Phase 1 Non-Invasive) including Swath bathymetry and sub-bottom profiling • Corel Sampling (Phase 2a Invasive) • Grab Sampling (Phase 2a Invasive) • Large Diameter Drilling (Phase 2b Invasive)	Total Area ±221 254Ha Core samples footprint ±1.57m², & volume ±4.71m³. Grab samples footprint ±5m² & volume ±1.5m³ LDD footprint ± 2.4ha	X	GNR 983 Listing Notice 1 of 2014 (dated 8 December 2014), as amended by GN 517 GG 44701 (dated 11 June 2021): Activity 20: Any activity including the operation of that activity which requires a prospecting right in terms of section 16 of the MPRDA, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the prospecting right.”;

1.2 Description of the activities to be undertaken

(Describe Methodology or technology to be employed, including the type of commodity to be prospected/mined and for a linear activity, a description of the route of the activity)

The following was taken from the *Prospecting Works Programme (2022)*:

1.2.1 Project description

The company is proposing to prospect within Sea Concession area 12C using both non-invasive and invasive sampling activities, none of which require infrastructure. For the purpose of this study, non-invasive means not physically destructive and invasive means physical sampling that is destructive. As the activity is located offshore and comprises prospecting only, no land-based infrastructure will be required.

Prospecting will be vessel-based and will take place during spring and/or summer and when weather conditions are suitable, and seas are calm. It is anticipated to be completed within five (5) years. Sampling will be conducted in three phases and include a combination of non-invasive and invasive activities to detect the presence of paleo-beach deposits, which are known from other concessions to contain diamondiferous gravels. Prospecting operations are expected to occur sporadically within the concession area.

The non-invasive activities will include geophysical exploration (acoustic survey), data acquisition and analysis, while the invasive activities will include physical sampling (collection of core, drill and grab samples). The principal objective of the proposed prospecting activities is to discover and estimate the potential mineral resources for possible future mining.

Prospecting will be conducted by a group owned custom fit survey vessel normally with an overall length of 45.15m and a gross tonnage of 498t. This will be a multipurpose customised survey vessel capable of High-Resolution geophysical surveys (Phase 1) and small-scale boat sampling programs such as Coring and Van Veen Grab Sampling (Phase 2). Refer ***Figure 3*** *of the sampling techniques possible with a single custom fit exploration and mining vessel.*

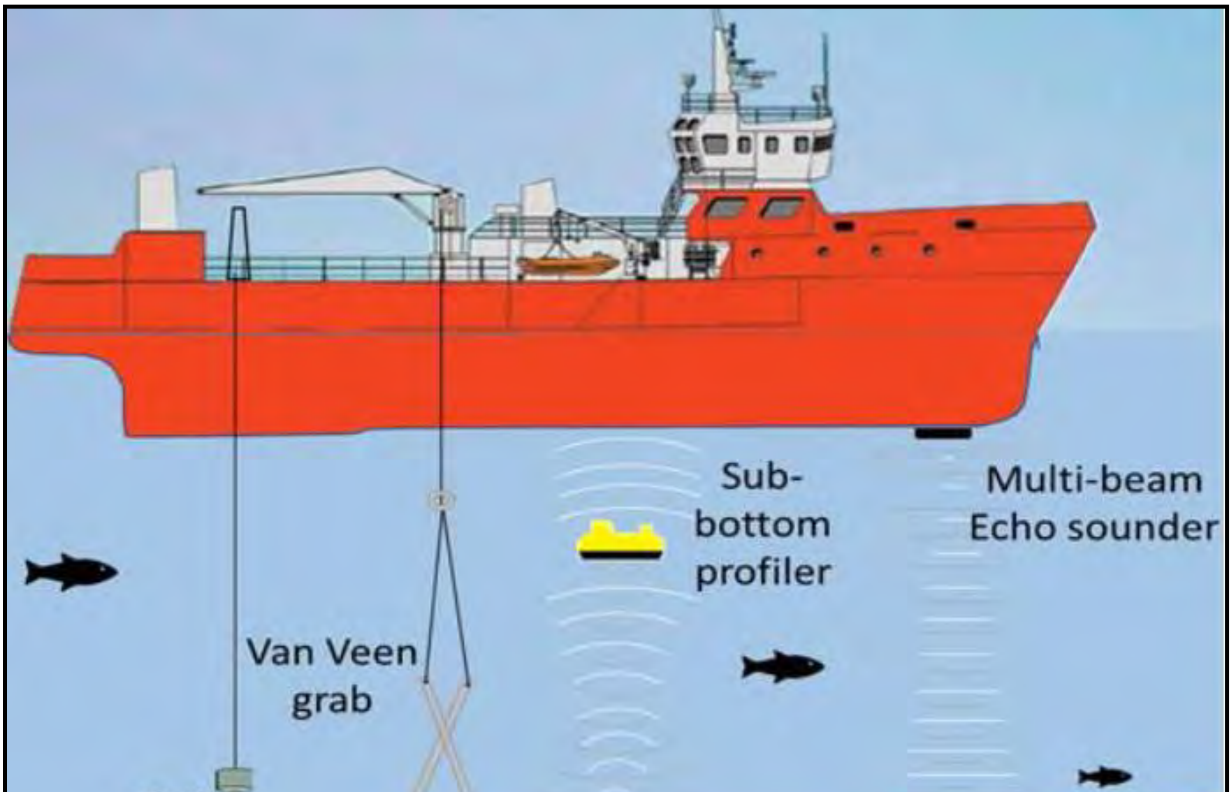

Figure 3: Illustration of sampling techniques possible in shallow water with a single custom fit exploration and mining vessel

Figure 4: An example of a sub-bottom profiler. Source: Seatronics

Figure 5: Left Example of a corer and right a Van Veen grab that works like a claw to grab sediment from the seafloor

Figure 6: Example of a dedicated drill sampling vessel

Figure 7: Example of the 2.5 m diameter drill bit within the drill frame structure

*During Phase 2 a dedicated large diameter drill sampling vessel, normally with an overall length of 114.4m, and gross tonnage of 4677t (**Figure 4**) may also be deployed. Such a vessel is equipped with a subsea sampling tool, which can be operated in water depths up to 200m. The sampling tool comprises a 2.5m diameter drill bit operated from a drill frame structure (**Figure 5**).*

1.2.1.1 Geophysical Surveys Phase 1

Swath bathymetry and sub-bottom profiling will be the geophysical survey techniques employed during the proposed prospecting operations making use of:

*• a multibeam echosounder designed to produce high resolution digital terrain models of the seafloor (**Figure 8**) by transmitting a 30 kHz sounding in a wide swath below the vessel; and*

*• a parametric sub-bottom profiler (Topas system), which uses shallow (35 to 45 kHz) and medium penetration (1 to 10 kHz) "Chirp" seismic pulses to generate profiles up to 60 m beneath the seafloor (**Figure 8**), thereby giving a cross section view of the sediment layers.*

Sound levels from the acoustic equipment would range between 190 to 220dB re 1µPa at 1m. The proposed surveys would be undertaken in specific priority areas in the concessions, at water depths of between approximately 15 - 75m. The surveys would have a line spacing of between 100 to 1 000m apart. The total line kilometres to be surveyed is estimated at 600km. The planned duration for the proposed geo-physical surveys would be a total of 20 days per year over a four-year period.

In general terms, sound sources that have high sound pressure and low frequency will travel the greatest distances in the marine environment. Conversely, sources that have high frequency will tend to have greater attenuation over distance due to interference and scattering effects (Anon 2007). It is for this reason that the acoustic footprint of the above-mentioned sonar survey tools is considered to be much lower than that of deeper penetration low frequency seismic surveys and in addition have lower sound pressure levels. It should be noted that a decibel is a logarithmic scale of pressure where each unit of increase represents a tenfold increase in the quantity being measured.

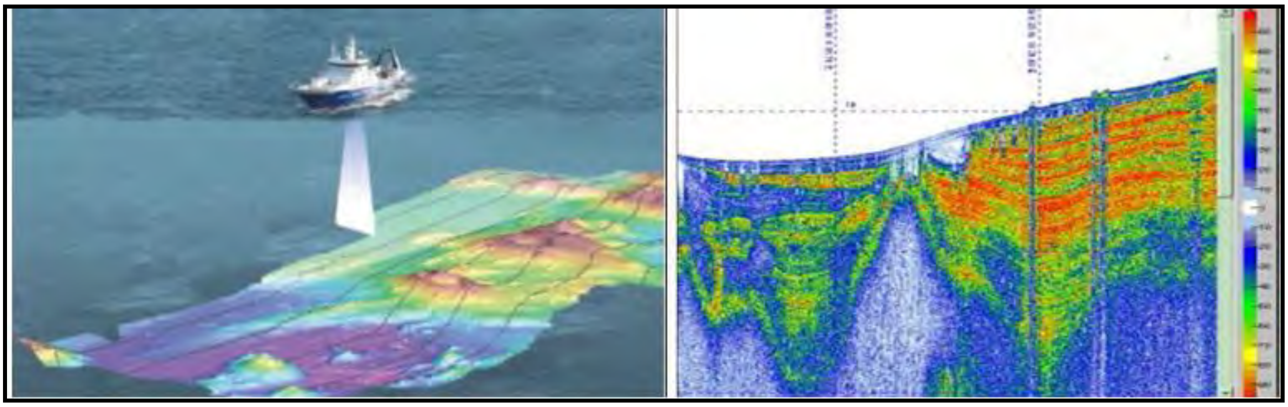

Figure 8: Swath bathymetry (left) and Sub-bottom profiling (right)

1.2.1.2 Drill Sampling Phase 2

High-power vibrocorer system that can collect cores up to 3m long and a diameter of 96mm will be deployed for water depths up to 100 meters.

A vibrocorer consists of a core barrel in a landing frame with a vibrating motor on top.

The vibrocorer is landed on the seafloor, the motor turned on and the barrel penetrates the unconsolidated sediment. Once the core stops penetrating, the motor is turned off and the vibrocorer is raised back up to the deck. A PVC pipe is placed inside the core barrel prior to coring and the core sample is collected in this pipe.

Core samples will be collected at 100-200 sites. A corer penetrates the seafloor to collect sediment samples used to determine the structure of the seafloor, sediment layers and types of sediment (i.e., sand, gravel and/ or rock and the hardness of the rock). This information is then used to engineer the drilling tool if required. Geotechnical sampling is also used to determine whether there are materials that can be mined in the area and whether it will be economically viable. The core samples will disturb a total surface area of 1.57m² and collect a total volume of 4.71m³.

Van Veen Grab sampling may also be used to supplement the vibrocoring: A Van Veen grab (clamshell bucket) collects sediment samples that are analysed to identify sediment types. Sampling will be done at

20-50 sites, disturb a total surface area of 5 square meters (m²) and a total volume of 1.5 cubic meters (m³).

For deeper water drill sampling activities would be undertaken using a dedicated drilling vessel to be sub-contracted. Such a vessel is equipped with a subsea sampling tool that comprises a 2.5m diameter drill bit operated from a drill frame structure, which is launched through the moon pool of the support vessel and positioned on the seabed.

The drill frame structure has a base of 6.5 x 6.5m, stands 23m high and weighs 147tons. The drill bit can penetrate sediments up to 12m depth above the bedrock. The sediments are fluidised with strong water jets and airlifted to the support vessel where they are treated in the onboard mineral recovery plant. All oversized and undersized tailings are discharged back to the sea on site.

A sample spacing of as little as 20m can be achieved by the dynamically positioned vessel. Depending on sea and the sub-seabed geotechnical conditions, up to 60 samples can be successfully taken per day. The samples would be undertaken at intervals of 50 to 500m. The total number of drill samples would be up to a maximum of 4 800. With the drill footprint of 5m², a total area of 2.4ha would be sampled.

1.2.1.3 Pre-/feasibility studies Phase 3

The project manager monitors the programme, consolidates and processes the data and amends the programme depending on the results. This is a continuous process throughout the programme and continues even when no prospecting is done on the ground.

Each physical phase of prospecting is followed by desktop studies involving interpretation and modelling of all data gathered. These studies will determine the manner in which the work programme is to proceed in terms of activity, quantity, resources, expenditure and duration.

1.2.1.4 Prospecting Works Programme

The different phases that will be exercised during the prospecting works are indicated above in 1.2. Refer to Table 2 below, which provides an indication of the typical programme followed in prospecting.

1.2.1.5 Vessel Emissions and Discharges

This section provides a brief description of the types of emissions and discharges that are expected from the proposed prospecting operations during normal operations. These would include:

- *Discharges such as deck drainage, machinery space wastewater, sewage, etc.;*
- *Disposal of solid waste such as food waste; and*
- *Vessel machinery emissions.*

These are discussed in more detail below.

1.2.1.5.1 Discharges to Sea

Vessel machinery spaces (bilges), ballast water and deck drainage

The concentration of oil in discharge water from any vessel (bilge and ballast) would comply with the MARPOL Regulation 21 standard of less than 15ppm oil in water. Any oily water would be processed through a suitable separation and treatment system to meet the MARPOL Annex I standard before discharge overboard. Drainage from marine (weather) deck spaces would wash directly overboard.

Sewage

South Africa is a signatory to MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships and contracted vessels would be required to comply with the legislated requirements of this Annex.

Food (galley) wastes

The disposal into the sea of food waste is permitted in terms of MARPOL Annex V when it has been comminuted or ground and the vessel is located more than 3 nautical miles (approximately 5.5km) from land. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25mm. Disposal overboard without macerating can occur greater than 12 nautical miles (approximately 22km) from the coast. The daily discharge from a vessel is typically about 0.15m³.

Detergents

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

Other

Vessels used during prospecting activities would have a certified antifouling coating system that is tin free.

1.2.1.5.2 Waste disposal to land

A number of other types of waste generated during the bulk sampling activities would not be discharged at sea but would be transported onshore for ultimate disposal. Waste transported to land would be disposed at a licensed municipal landfill facility or at an alternative approved site. Operators would co-operate with local authorities to ensure that waste disposal is carried out in an environmentally acceptable manner. A summary of these waste types generated by a vessel used during typical prospecting operations is given below.

General waste

This includes waste, paper, plastics, wood, glass, etc. Waste would be disposed of at an onshore landfill site in accordance with legal requirements.

Scrap Metal

Scrap metal would be stored and recycled / disposed of on land in accordance with legal requirements.

Drums and Containers

Empty drums containing residues, which may have adverse environmental effects (solvents, lubricating/gear oil, etc.), would be recycled / disposed of in a licensed landfill site in accordance with legal requirements.

Used Oil

This includes used lubricating and gear oil, solvents, hydrocarbon-based detergents and machine oil. Toxicity varies depending on oil type. All non-recycled waste oils would be securely stored, transported to shore and disposed of at a licensed landfill site, acceptable to the relevant authorities.

Chemicals and hazardous wastes

Disposal of any unexpected chemical and hazardous substance (e.g., fluorescent tubes, toner cartridges, batteries, etc.) would be undertaken on a case-by-case basis and in a manner acceptable to appropriate regulatory authorities.

Infectious wastes

Infectious wastes include bandages, dressings, surgical waste, tissues, medical laboratory wastes, needles, and food wastes from persons with infectious diseases. Only minor quantities of medical waste are expected.

Prevention of exposure to contaminated materials is essential, requiring co-operation with local medical facilities to ensure proper disposal. All such waste will be incinerated onboard or stored and brought onshore for disposal via a registered medical waste company.

Filters and filter media

This includes air, oil and water filters from machinery. Oily residue and used media in oil filters that may contain metal (e.g., copper) fragments, etc. are possibly toxic. Filters and media would be transported onshore and disposed of at a licensed landfill facility.

1.2.1.5.3 Discharges to air

Compliance with the requirements of Marpol Annex VI - Prevention of Air Pollution from Ships will be required for all vessel engines and where vessels are fitted with rubbish incinerators.

Table 2: Prospecting Program as per Project Works Programme (2022)

Phase	Activity	Skill(s) required	Timeframe	Outcome	Timeframe for out-come	What technical expert will sign off on the out-come?
1 Non – invasive	Regional scale, High-Resolution geophysical surveys	Geologist Project Manager	20 days per year for 4 years	Maps, plan & report on previous work. Delineation of potential gravel resource.	Year 4	Geologist
2a Invasive	Shallow water Collection of core and grab samples	Geologist Project Manager	8 days per year for 4 years	Diamond Ore Characterization (DOC) study for metallurgical purposes	Year 4	Geologist
2b Invasive	Deep water Large diameter drill sampling					
3 Feasibility study	Final analysis, quality control, database update and resource statement Application for mining right or final decommissioning and closure	Geologist Economist	Month 49-60	Feasibility study and decision making if results prove negative then decommissioning and final closure if results prove positive then continue with mining Mining right or Closure certificate	Year 5	Project Manager

2 Policy and Legislative Context

Table 3: Applicable Legislation and Guidelines

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT	REFERENCE WHERE APPLIED	HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE LEGISLATION AND POLICY CONTEXT
Constitution of South Africa, specifically everyone has a right; a. to an environment that is not harmful to their health or wellbeing; and b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: i. prevents 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.	Prospecting Right activities	The prospecting right activities shall be conducted in such a manner that significant environmental impacts are avoided, where significant impacts cannot all together be avoided, it will be minimised and mitigated in order to protect the environmental right of South Africans.
Minerals and Petroleum Resources Development Act (No 28 of 2002) [MPRDA] Section 24 (as amended) MPRDA Regulations as amended by GNR349 of 18 April 2011.	Application to the DMR for a prospecting right in terms of Sections 16.	The conditions and requirements attached to the granting of the Prospecting Right will apply to the prospecting activities. DMR is the Competent Authority (CA) for this NEMA application.
National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA]	Application to the DMR for Environmental Authorisation in terms of the 2014 EIA Regulations as amended by the 2021 EIA Regulations. Refer to Table 1 for list of activities.	An Application for Environmental Authorisation must be submitted to DMR for an Environmental Authorisation (EA). The listed activities in **Table 1** that are triggered determine the Environmental Authorisation (EA) application process to be followed, which is an EIA for this Prospecting Right. The appropriate EA must be obtained before proceeding with any prospecting activities in terms of the prospecting right application. The compilation of this Scoping Report and the Public Participation Process is required in terms of NEMA.
National Environmental Management Act, 1998 (Act No. 107 of 1998): Financial Provisions Regulations in GNR 1147 (dated 20/11/2015), as amended by GNR 991 (dated 21/09/2018)	The Final Rehabilitation, Decommissioning and Mine Closure Plan is included in Appendix F: Final Rehabilitation, Decommissioning and Mine Closure Plan, page 532.	The purpose of these Regulations is to regulate the determination and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation, and remediation of environmental impacts from prospecting, exploration, mining, or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future. The Final Rehabilitation, Decommissioning and Mine Closure Plan is included in Appendix F: Final Rehabilitation, Decommissioning and Mine Closure Plan, page 532..

"Procedures for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes in terms of Section 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" ("the Protocols"), in GG 43110 (dated 20 March 2020 came into effect on 15 May 2020), and GN 320. Themes included in this GN are agriculture; aquatic biodiversity terrestrial biodiversity; radioactivity; nois. Protocols in GG 43855 of GN No. 1150 dated 30 October 2020 provide for Terrestrial and Animal Plant Species.	Screening Tool Report, and Site Sensitivity Verification Report is attached at Appendix C: Screening Tool Reports And Site Sensitivity Verification Report, Page 216.	Refer to Section 6.1. Appendix C: Screening Tool Reports And Site Sensitivity Verification Report, Page 216. **Section 6.1.6** details the specialist compliance statements required to inform the BAR Phase, as per the requirements of the Protocols.
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) [NEMBA] National list of ecosystems that are threatened and in need of protection, 2011 (in GN 1002 dated 2 December 2011)	Section 6.2.6.1.	There is no overlap with sanctuaries and Marine Protected areas. Concession 12C falls within the transboundary Benguela Upwelling System EBSA and lies immediately south of the southern portion of the Namaqua Coastal Area EBSA. Concession 12C overlaps with areas mapped as Critical Biodiversity Area 1 (CBA 1), Critical Biodiversity Area 2 (CBA 2), and Ecological Support Area (ESA). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there are often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and/or will be larger areas. Overlap with CBA 1: Natural and CBA 2: Natural accounts for 27.9% and 10.0% of the concession area, respectively (Figure 72), whereas overlap with CBA 1: Restore and CBA 2: Restore accounts for 3.4% and 5.0%, respectively.
National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)	Section 6.1.5	In terms of Section 36 of the Act, the metropolitan and district municipalities are charged with implementing the AEL system. However, as the offshore area of activity and the Exclusive Economic Zone (EEZ) do not fall within the borders of any municipality or province of South Africa as set out in the Constitution, there is no formal means in terms of NEM: AQA by which application can be made for incineration from vessels in the offshore. Furthermore, the on-board incineration of waste is permitted in terms of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL), to which South Africa is a signatory. Thus, there is uncertainty of the applicability of NEM: AQA to offshore operations, given that MARPOL, an international convention,

		allows for the on-board incineration of waste and there is no formal implementing authority for AEL applications associated with offshore operations.
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	Section 6.1.2 & 6.1.3	A Marine Heritage Impact Assessment and a Palaeontological Report was prepared for inclusion in the BA Phase. These will be submitted to SAHRA for comment
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	Section 2.1	MARPOL, an international convention, allows for the on-board incineration of waste and offshore waste management activities, such as those related to sewage.
Hazardous Substances Act (Act No. 15 of 1973)	Storage and control of hazardous substances to be included in EMPr.	The objective of the Act is to provide for the control of substances which may cause injury or ill health to or death of human beings due to their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure. In terms of the Act, substances are divided into schedules, based on their relative degree of toxicity and the Act provides for the control of importation, manufacture, sale, use, operation, application, modification, disposal and dumping of substances in each schedule. The reagent chemicals to be used in the mineral processing plant, as well as chemicals typically found in petroleum products (for example) benzene, are regulated in terms of this Act. The processing plant, chemical storage area, fuel storage facility and refueling bay, with all appropriate controls in place, will not conflict with the Act. The EMPr will provide details in this regard.
Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA)	Safety precautions to be taken into account by the Project Team in the prospecting planning.	The objective of the Act is to cover all aspects relating to health and safety of employees and other persons on the mine property. The Act places the responsibility on the mine owner for ensuring that the mine is designed, constructed and equipped in a manner which allows for a safe and healthy working environment.
Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) [PAJA]	Decision by the Competent Authority	Gives effect to section 33 of the Constitution that requires that "*Everyone has the right to administrative action that is lawful, reasonable and procedurally fair*". All administrative actions must be based on the relevant considerations.
Marine Living Resources Act 18 of 1998 (MLRA)	Section 2	Although there are a number of declared MPAs off the West Coast, the Applicant does not intend prospecting in these areas and consequently there will be no impact on these MPAs.
National Environmental Management: Integrated Coastal Management Act 24 of 2008	Section 2	NEM: ICMA provides for the integrated management of the coastal zone, including the promotion of social equity

		and best economic use, while protecting the coastal environment. Chapter 8 of the Act establishes an integrated system for regulating the disposal of effluent and waste into the sea. Section 70 prohibits incineration at sea and restricts dumping at sea unless done so in terms of a permit and in accordance with South Africa's obligations under international law. As the Applicant does not intend on disposing effluent and waste into the sea, no authorisations are required in terms of NEM: ICMA.
Municipal Plans and Policies		
The sea concession area does not fall within the jurisdiction of any municipality.		
Standards, Guidelines and Spatial Tools		
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	Section 6	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	Section 4	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	Section Draft environmental management programme., 160	This guideline was consulted to inform the EMPr.
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	Section 7	This guideline was consulted to inform the impact assessment.
Mining and Biodiversity Guideline: 2013 Mainstreaming biodiversity into the mining sector. Pretoria.	Section 3.2	The mitigation measures to address and mitigate the potential impacts of the prospecting will be included in the EMPr.
DEA Guideline on Need & Desirability (2017)	Section 3.4	Refer to Section 3
DEA Guideline on PPP DMR Guideline on Consultation with Communities and I&APs (undated)	Sections 5 & Appendix B: , Page 191	Sections 5 & Appendix B: , Page 191
DEAT Integrated Environmental Management Information Series 5: Impact Significance (2002)	Section 7	This guideline was consulted to inform the impact assessment.
DEAT Integrated Environmental Management Information Series 7: Cumulative Effects Assessment (2004)	Section 7	This guideline was consulted to inform the impact assessment.
SANBI BGIS databases (www.bgis.sanbi.org)	Baseline environmental descriptions in Section 6.1	Used during desktop research to identify sensitive environments within the prospecting right area.

In addition to the foregoing, the Applicant must also comply with the provisions of other relevant conventions and legislation, which includes, amongst others, the following:

2.1 International Marine Pollution Conventions

- International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
- Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978
- (MARPOL) (Bulletin 567 – 2/08);
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC
- Convention);
- United Nations Convention on Law of the Sea, 1982 (UNCLOS);

- 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); and
- Convention on Biological Diversity (1992).

2.2 Other South African Legislation

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

3 Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

3.1 Overarching Needs & Desirability Motivation

South African possesses some of the world's richest resources and contributes substantially to South Africa's GDP (gross domestic product). Diamonds are an important commodity in the global economy that has grown from approximately 1 million carats in the late 1800's to 176.7 million carats in 2005 (Janse 2007) and is now considered a billion-dollar industry. According to the Minerals and Mining Policy for South Africa, 1998, the national mining industry is said to be one of the few "world-class industries" in the country with the potential to create broad scale employment opportunities and wealth. Further, South Africa has unprecedented amounts of minerals (and several other commodities) with the potential to supply the international markets with more than it can consume. (Minerals and Mining Policy for South Africa, 1998).

While the majority of diamond production in South Africa is attributed to large-scale land-based mining operations, marine and coastal diamond mining operations are rapidly increasing. In 2005, six of the 14 Southern African Development Community (SADC) member states (Angola, Botswana, Democratic Republic of Congo, Namibia, South Africa and Tanzania) together produced 87.8 million carats of diamonds (US$7.5 billion) which is equivalent to 53% of world production (DME, 2006; Penney et al. 2007). Diamond mining production in South Africa alone, however, has decreased slightly from around 15 million carats in 2007 to around 9.9 million carats to in 2017 (DMR 2017). Although the overall South African Mining Industry production decreased by 4.0% in 2016, which was regarded as the largest annual fall since the global recession of 2009, diamond production still grew in that year (1%), and was recognized as the most successful mineral for the year in 2016. Furthermore, the latter commodity escalated further reaching 17% production growth in 2017 (STATS SA 2018).

While the most important source of diamonds is kimberlite pipes, the second major source is alluvial diamonds, which are formed through the erosion of the kimberlite pipes, resulting in the release of diamonds into rivers and ultimately, the sea. Today, these deposits extend from the coast down to 150m depth (approximately 50 – 60 km offshore) where they are found in gullies and potholes which have been covered with sediment over time. It is this marine diamondiferous gravel that is of interest to the modern marine diamond mining industry (Penney et al. 2007). Diamond mining in the Benguela region (off the west coasts of southern Africa) has been shown to be economically important (DME 2006; Penney et al. 2007) and therefore the proposed prospecting activities are ideally placed in concession area 12C offshore of the Western Cape Coast of South Africa.

Mineral prospecting also aligns itself with two national policies: The National Development Plan 2030 (NDP) and Operation Phakisa. The main objective of the NDP is to alleviate poverty and inequality amongst South Africans through faster and inclusive growth development. A manner of achieving this is to focus on South Africa's already unprecedented amounts of natural resources and creating opportunities that will advance the NDP strategy. Mining is identified in the NDP as an industry that has large potential for growth and employment opportunities and for it to continue to contribute largely to the South African economy, new mineral resources need to be identified through prospecting.

Operation Phakisa was established to facilitate and boost the growth of the economy to help achieve the objectives of the NDP, and to operate across industries. Mining Phakisa is a programme established under this operation whose objective is to warrant the economic sustainability of the South African mining industry and to promote the growth and contribution thereof at a national level. Both of these frameworks promote the sustainable use of the country's natural resources as well as the conservation, preservation and restoration of the environment.

In terms of the above, it is evident that mining-related activities are deemed to be a key component of the current national and provincial economies and future mining projects are a means to assist Government in meeting broader societal needs.

3.2 Mining and Biodiversity Guidelines (2013)

The Mining and Biodiversity Guidelines (2013)[1] state that: "*Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act) and is fundamental to the notion of sustainable development. International guidelines*

[1] Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute. 2013. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria.

and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa."

The Department of Mineral Resources (DMR), as custodian of South Africa's mineral resources, is tasked with enabling the sustainable development of these resources. This includes giving effect to the constitutional requirement to "*prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*"[2].

The primary environmental objective of the MPRDA is to give effect to the "*environmental right*"[3] contained in the South African Constitution. The MPRDA further requires the Minister to ensure the sustainable development of South Africa's mineral resources, within the framework of national environmental policies, norms, and standards, while promoting economic and social development.

The Mining and Biodiversity Guidelines (2013) document identifies four categories of biodiversity priority areas in relation to their biodiversity importance and implications for mining & prospecting. The categories are: Category A: Biodiversity priority area which are legally protected and mining is prohibited; Category B: Highest Biodiversity importance – highest risk for mining; Category C: High Biodiversity Importance – high risk to mining; and "Category D: Moderate Biodiversity Importance" – moderate risk for mining. Category B and Category C require an environmental impact assessment process to address the issues of sustainability.

Refer to **Figure 9**, which shows the prospecting right area in relation the Mining and Biodiversity Guidelines database (SANBI BGIS). A small section of the Sea Concession 12C is situated in an area classified as highly sensitive for mining.

3.3 Diamond Resources Supply and Employment Benefits

The full labour force is unknown at present but will include unskilled, semi-skilled, and skilled. Some services that will be outsourced and that will provide job security, will be environmental monitoring services and compliance officer, training, mining engineer, surveyor, consultant geologist, and main workshop.

Minerals and Mining Policies and Plans in South Africa

In order for mining to continue to be a core contributor to the South African economy and in the pursuance of the sustainable development of the nation's mineral resources, it is necessary to identify new resources through prospecting activities, such as bulk sampling in the case of this application. A key intent of the Minerals and Mining Policy of South Africa states that Government will: "*promote exploration and investment leading to increased mining output and employment*" (Minerals and Mining Policy of South Africa, 1998). The Policy states further that:

- "The South African mining industry, one of the country's few world-class industries, has the capacity to continue to generate wealth and employment opportunities on a large scale;
- Mining is an international business and South Africa has to compete against developed and developing countries to attract both foreign and local investment. Many mining projects in South Africa have tended to be unusually large and long term, requiring massive capital and entailing a high degree of risk; and
- South Africa has an exceptional minerals endowment, and in several major commodities has the potential to supply far more than the world markets can consume."

In the more recently published Department of Minerals Resources and Energy (then Department of Mineral Resources) Strategic Plan 2014 – 2019, the foreword by the Minister of Mineral Resources and Energy notes that the Department "*will continue to promote mineral value addition to strengthen the interface between extractive industries and national socio-economic developmental objectives*" and "*contribute towards decent employment, inclusive growth and industrialisation of South Africa*".

The West Coast District Municipality's (WCDM) Integrated Development Plan 2017 – 2022 (2019) notes that it has "*a vast number of mineral resources, of which some are currently not being exploited*" and deems that "*mining could potentially make an increased economic contribution to the WCDM economy when these unexploited resources are utilised in future*".

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[2] Constitution of the Republic of South Africa (No. 108 of 1996).

[3] Section 24 of the Constitution states 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: prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

In terms of the above, it is evident that the proposed prospecting activities are deemed to be important to the current national and provincial economies as future mining projects are a means to assist Government in meeting broader societal needs.

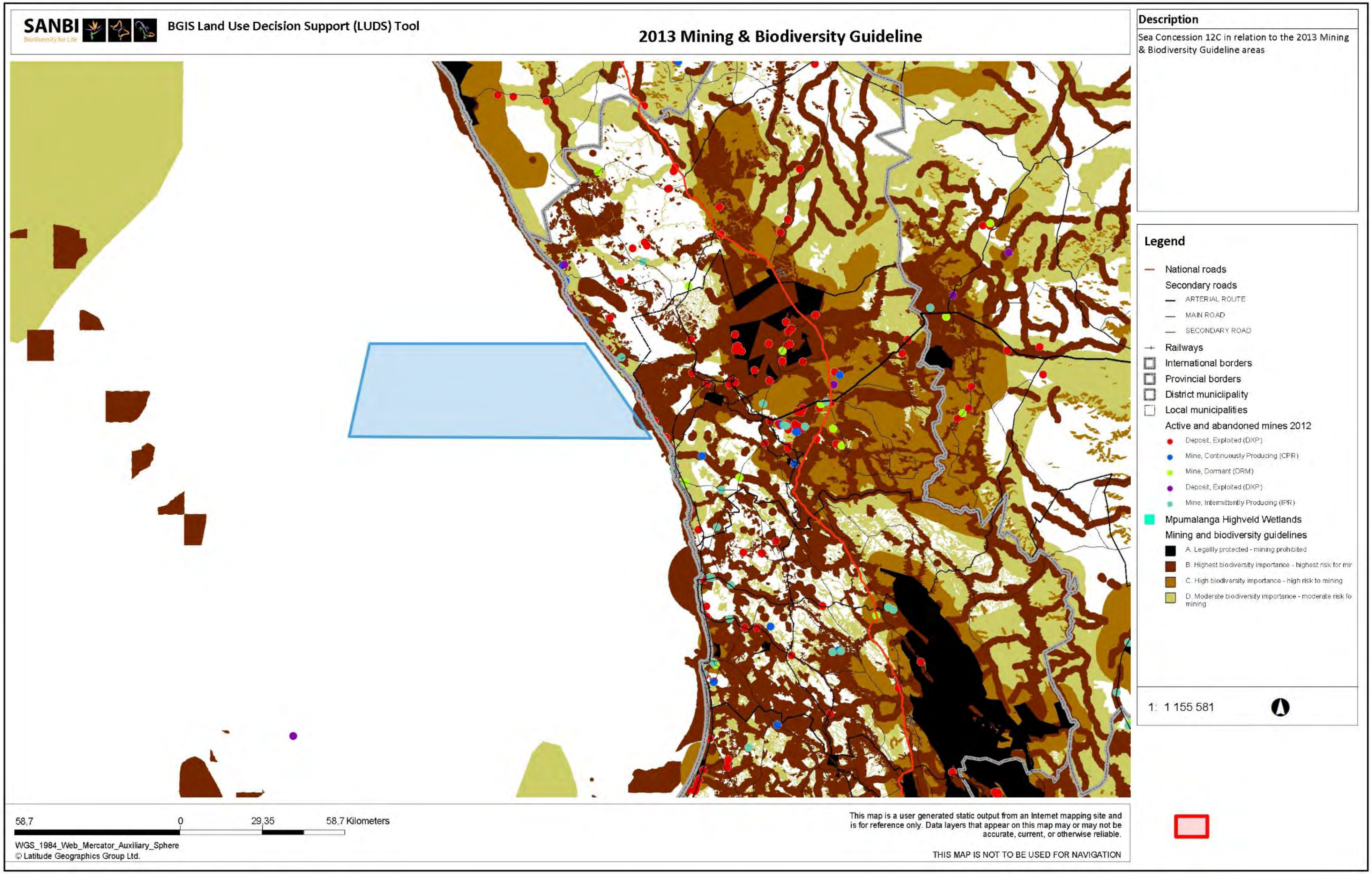


Figure 9: Sea Concession 12C in relation to the 2013 Mining & Biodiversity Guideline areas

3.4 DEA Guideline on Need and Desirability (2017)

As referenced in the DEA Guideline on Need and Desirability (2017), NEMA defines "*evaluation*" as "*the process of ascertaining the relative importance or significance of information, in the light of people's values, preferences and judgements, in order to make a decision*." In evaluating each impact (negative and positive) in terms of each of the aspects of the environment, "*need and desirability*" must specifically be considered in the analysis of each impact of the proposed activity. However, to determine if the proposed activity is the best option when considering "*need and desirability*," it must also be informed by the sum of all the impacts considered holistically. In this regard "*need and desirability*" also becomes the impact summary with regard to the proposed activity. The impact summary will be included in the fBAR.

These Guidelines state that: "*In considering the impact summary it must be remembered that ultimately the aim of EIA is to identify, predict and evaluate the actual and potential risks for and impacts on the geographical, physical, biological, social, economic and cultural aspects of the environment, in order to find the alternatives and options that best avoid negative impacts altogether, or where negative impacts cannot be avoided, to minimise and manage negative impacts to acceptable levels, while optimising positive impacts, to ensure that ecological sustainable development and justifiable social and economic development outcomes are achieved*".

The principles of *Integrated Environmental Management* (IEM) as set out in Section 23 of NEMA have been considered in this scoping environmental assessment and will be applied in the BAR, EMPr and Closure Report, as explained below.

- **Environmental management placing people and their needs at forefront of its concern, and serve their physical, physiological, developmental, cultural and social interests equitably** – This process will be undertaken in a transparent manner and all effort will be made to involve all the relevant stakeholders and Interested and Affected Parties. I.e., Public participation will be undertaken to obtain the issues / concerns / comments of the affected people for input into the process.
- **Socially, environmentally, and economically sustainable development** – All aspects of the receiving environment and how this will be impacted has been considered and investigated to ensure a minimum detrimental impact to the environment. Where the impact could not be avoided, suitable and effective mitigation measures were proposed to ensure that the impact is mitigated. i.e., this report along with the EMPr (to be included in the EIA Phase) proposes mitigation measures which will minimise the negative impacts of the proposal on the environment.
- **Consideration for ecosystem disturbance and loss of biodiversity** – the prospecting site is located in a marine area, in close proximity to the Olifants River in an area earmarked for mining. Ecosystem disturbance and loss of biodiversity will be considered in the impact assessment. Rehabilitation, where applicable back to the natural state is a key component and will be undertaken in a phased manner as the prospecting activities progress. This report together with the EMPr and Closure Plan proposes mitigation measures which will minimise the impacts of the proposal on the environment.
- **Pollution and environmental degradation** – The implementation of recommendations made and proposed mitigations to be detailed in the BAR and Environmental Management Programme Report (EMPr), and Closure Plan will ensure minimum environmental degradation. Erosion and dust have been identified and detailed mitigation measures will be included in the EMPr in the EIA phase to minimise the impacts.
- **Landscape disturbance** – All aspects of the receiving environment and how this will be impacted has been considered and investigated at a scoping level to ensure a minimum detrimental impact to the environment. Where the impact could not be avoided, suitable and effective mitigation measures will be detailed in the BAR, EMPr and Closure Plan to ensure that the impact is mitigated.
- **Waste avoidance, minimisation, and recycling** – These aspects were considered and incorporated into the operational component of the project, and mitigation measures included in the EMPr.
- **Responsible and equitable use of non-renewable resources** – These aspects have been considered and there is not much scope to reduce the use of non-renewable resources, such as transport or the use of diesel and fuel for marine vessels.
- **Avoidance, minimisation and remedying of environmental impacts** - All aspects of the receiving environment and how this will be impacted have been considered and investigated to ensure a minimum detrimental impact to the environment. Where the impact could not be avoided, suitable and effective mitigation measures will be proposed to ensure that the impact is mitigated. A number of mitigation measures will be detailed to minimise the impact of the proposal on the environment.
- **Interests, needs and values of Interested and Affected Parties** – This process has been undertaken in a transparent manner and all effort has been made to involve all the relevant stakeholders and Interested and Affected Parties (I&APs). The BAR will be made available to all identified I&APs to obtain comments on the proposed development.

- **Access of information** – Potential Interested and Affected Parties will be notified of the proposal and the availability of the Draft BAR (DBAR). They were also notified of having the opportunity to register as an I&AP. Organs of state will be kept informed during the course of the process.
- **Promotion of community well-being and empowerment** – This process is being undertaken in a transparent manner and all effort is being made to involve all the relevant stakeholders and I&APs.

Potential impacts on the biophysical environment and socio-economic conditions have been assessed, and steps have been taken to mitigate negative impacts, and enhance positive impacts. Any mitigation measures from SAHRA will be included in the FBAR. Adequate and appropriate opportunity will be provided for public participation. Environmental attributes have been considered based on the available information, and environmental management practices have been identified and established to ensure that the proposed activities will proceed in accordance with the principles of IEM.

4 Alternative Development

4.1 Motivation for the overall preferred site, activities and technology alternative.

Kimberlite pipes are believed to have formed by high-pressure and deep-rooted volcanic eruptions. They are igneous intrusions or "*pipes*" projecting through the Earth's crust and a major source of diamonds and other minerals such as rutile, zircon, garnets, ilmenite and magnetite. These pipes transport the diamonds and minerals from the upper mantle to the surface of the Earth. These deposits were then further transported by means of erosion, wind, rain and rivers and deposited primarily in the sea in gravel terraces along riverbanks and on the coast. The Orange and Olifants rivers are believed to be the major westward transport mechanisms responsible for the deposition of diamondiferous sediments along west coast of South Africa and southern Namibia. With the influence of currents, swell and tidal action, diamonds gradually accumulated on gravel beaches along the coast. Today, these deposits extend from the coast down to 150 m depth (approximately 50–60km offshore) where they are found in gullies and potholes which have been covered with sediment over time. It is this marine diamondiferous gravel which is of interest to the modern marine diamond mining industry.

With the Benguela region being rich in diamond, mineral and other deposits, the former Department of Minerals and Energy (now the Department of Mineral Resources and Energy — DMRE) established designated mineral sea concession areas in 1994, extending from Saldanha Bay to the Orange River mouth on the west coast of South Africa. Prospecting and mining activities are only permitted by individuals that are in possession of a mining or prospecting right, and only within specially designated areas that allow the industry, the trade of commodities, the associated activities and potential impacts, environmental management and the responsible extraction of minerals, to be monitored. Companies can apply for prospecting and/ or mining rights within concession areas for which rights are available. As this is a competitive industry, few concession areas are available at any given time. Although several alternative concession areas were considered by the applicant, the prospecting and mining rights for many of these were already held by other companies.

As the intention of the proposed prospecting activity is to search for diamondiferous, gemstone, mineral and metal deposits, and to ensure the economic feasibility of mining within a certain concession area, an area known to contain these resources needs to be selected. As such, few location alternatives exist. Diamonds and other commodities have been discovered in neighbouring "C" concession areas (i.e., areas extending from the westernmost boundary of concession area B to the 200 m isobath) during mining operations. In addition, the preferred site contains palaeo-beach deposits which are known from prospecting and mining in other concession areas, to contain diamondiferous gravels.

The preferred activities, i.e., geophysical surveys and drilling are the primary methods used for mineral prospecting and will facilitate the discovery and estimation of mineral resources within the concession area. These activities will include invasive and non-invasive methods such as geophysical surveys, drilling and baseline biological sampling outlined in section 1.2.1 above. These methods have been developed through many years of research and development by the mining industry and are the preferred methods for resource estimation and cannot easily be replaced by any other methods.

4.2 Full description of the process followed to reach the proposed preferred alternatives within the site.

NB!! – This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

The National Web based Environmental Screening Tool was used to identify any terrestrial areas of conservation that would need to be avoided (see Appendix 3). The SANBI BGIS database was consulted to review the Ecosystem Threat Status and to identify Marine protected Areas and Ecologically and Biologically Significant Areas in the area. GIS layers were extracted and overlaid on a map of Concession 12C in Google Earth. This enabled the identification of areas of conservation concern that needs to be avoided.

In addition, Geophysical surveying will be undertaken along survey lines spaced 1000m to 100m apart throughout the concession area. This will be conducted over a two-month period of suitable, calm sea and weather conditions (the survey speed of the DP Star is typically 100 km/day). As no geophysical sampling has been conducted in this area to date, the exact position of reefs and other areas that need to be avoided have not yet been identified. These areas will be identified only after the non-invasive seismic surveys have been completed.

Furthermore, findings and recommendations from the appointed specialists were used to fine tune the alternatives and the layout.

Consultation with stakeholders during the Public Participation Process will further elucidate areas that need to be avoided. The preferred alternative within the site is thus subject to change pending results from the geophysical survey and consultation with stakeholders. No infrastructure will be placed on shore or in the sea.

4.2.1 Details of the development footprint alternatives considered.

With reference to the site plan provided as **Appendix 4: Site Plan & Coordinates, Page 190** and the location of the individual activities on site, provide details of the alternatives considered with respect to:

(a) the property on which or location where it is proposed to undertake the activity;

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

(d) the technology to be used in the activity;

(e) the operational aspects of the activity; and

(f) the option of not implementing the activity.

Appendix 1 Section 2 (h)(i) of the EIA Regulations, 2014, requires that all BAR processes must identify and describe feasible and reasonable alternatives. Alternatives considered during the screening phases of the project are described below.

Alternatives, in relation to a proposed activity, are different ways of meeting the general purposes and requirements of the proposed activity, which may include alternatives to:

- the location where it is proposed to undertake the activity; and
- the technology to be used in the activity or operations alternative.
- No-Go alternative

4.2.1.1 Location or Site Alternatives

As the intention of the proposed prospecting operations is to determine the presence of economically viable diamond deposits that occur within Sea Concessions 12C, no further location alternatives are considered in this BAR.

The different prospecting activities being considered in the Basic Assessment process are described in detail in Section 4.2.1.3 below.

4.2.1.2 Type of Activity

The Applicant is not the landowner, and therefore it would not be realistic for this company to propose another type of activity as their core business is prospecting or mining. This area has been earmarked as a sea concession area for prospecting/mining. Although the proposed prospecting activity takes place over an extended time period, the best post-mining land use alternative is to return the site to its natural state, where possible. The holder of a prospecting right is required to rehabilitate the environment affected by prospecting to its natural state or to another predetermined land use. Other activity alternatives have therefore not been considered as the purpose of the proposed project is to prospect for diamonds within the Sea Concession 12C application area as shown in Figure 2.

The application is for prospecting rights and no alternatives were considered.

4.2.1.3 Technology & Operations Alternatives

The applicant is proposing to prospect within Sea Concession area 12C using both non-invasive and invasive sampling activities, none of which require infrastructure. For the purpose of this study, non-invasive means not physically destructive and invasive means physical sampling that is destructive. As the activity is located offshore and comprises prospecting only, no land-based infrastructure will be required.

Prospecting will be vessel-based and will take place during spring and/or summer and when weather conditions are suitable, and seas are calm. It is anticipated to be completed within five (5) years. Sampling will be conducted in three phases and include a combination of non-invasive and invasive activities to detect the presence of paleo-beach deposits, which are known from other concessions to contain diamondiferous gravels. Prospecting operations are expected to occur sporadically within the concession area.

The non-invasive activities will include geophysical exploration (acoustic survey), data acquisition and analysis, while the invasive activities will include physical sampling (collection of core, drill and grab samples). The principal objective of the proposed prospecting activities is to discover and estimate the potential mineral resources for possible future mining.

Prospecting will be conducted by a group owned custom fit survey vessel normally with an overall length of 45.15m and a gross tonnage of 498t. This will be a multipurpose customised survey vessel capable of High-Resolution geophysical surveys (Phase 1) and small-scale boat sampling programs such as Coring and Van Veen Grab Sampling (Phase 2). Refer to Figure 14 of the sampling techniques possible with a single custom fit exploration and mining vessel, the vessel can even be modified to handle small scale Remote Dredge Pump Mining (**Figure 10** to **Figure 12**).

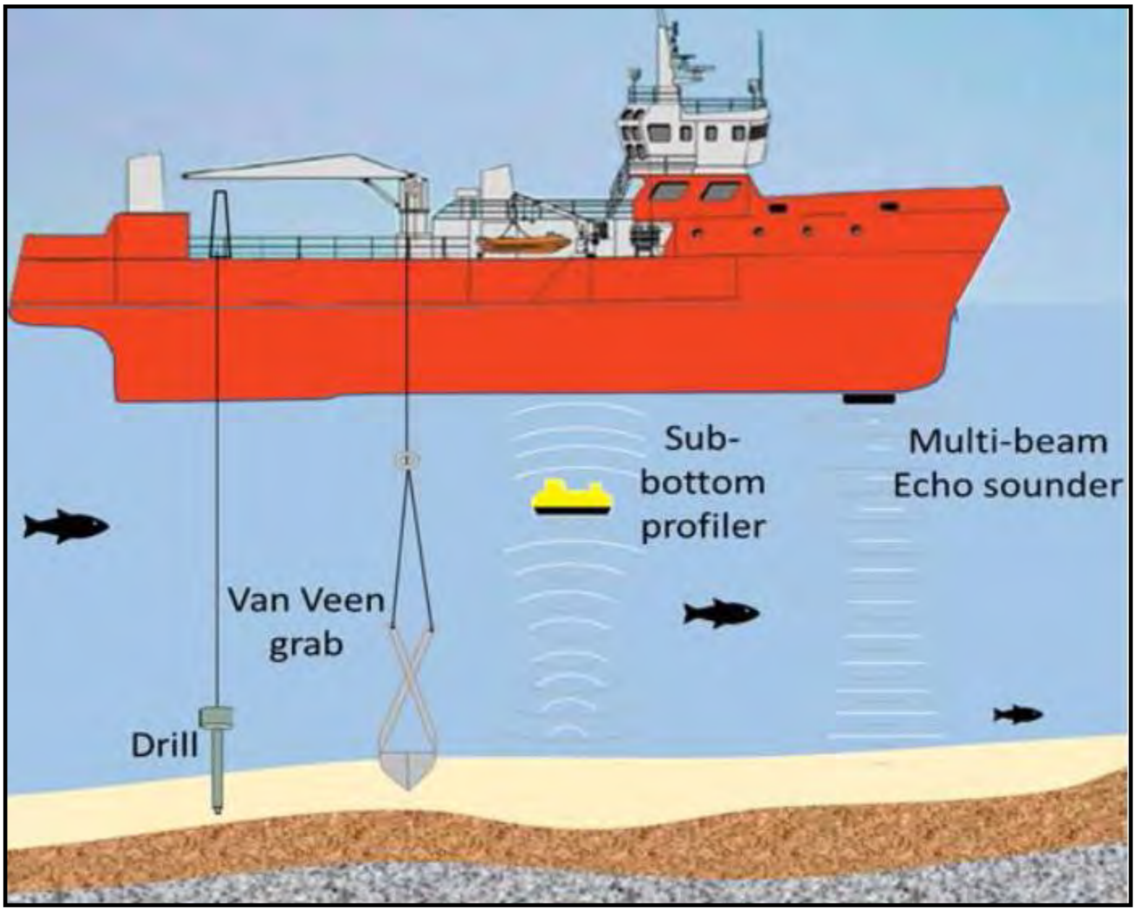


Figure 10: Illustration of sampling techniques possible in shallow water with a single custom fit exploration and mining vessel

Figure 11: An example of a sub-bottom profiler. Source: Seatronics

Figure 12: Left Example of a corer and right a Van Veen grab that works like a claw to grab sediment from the seafloor

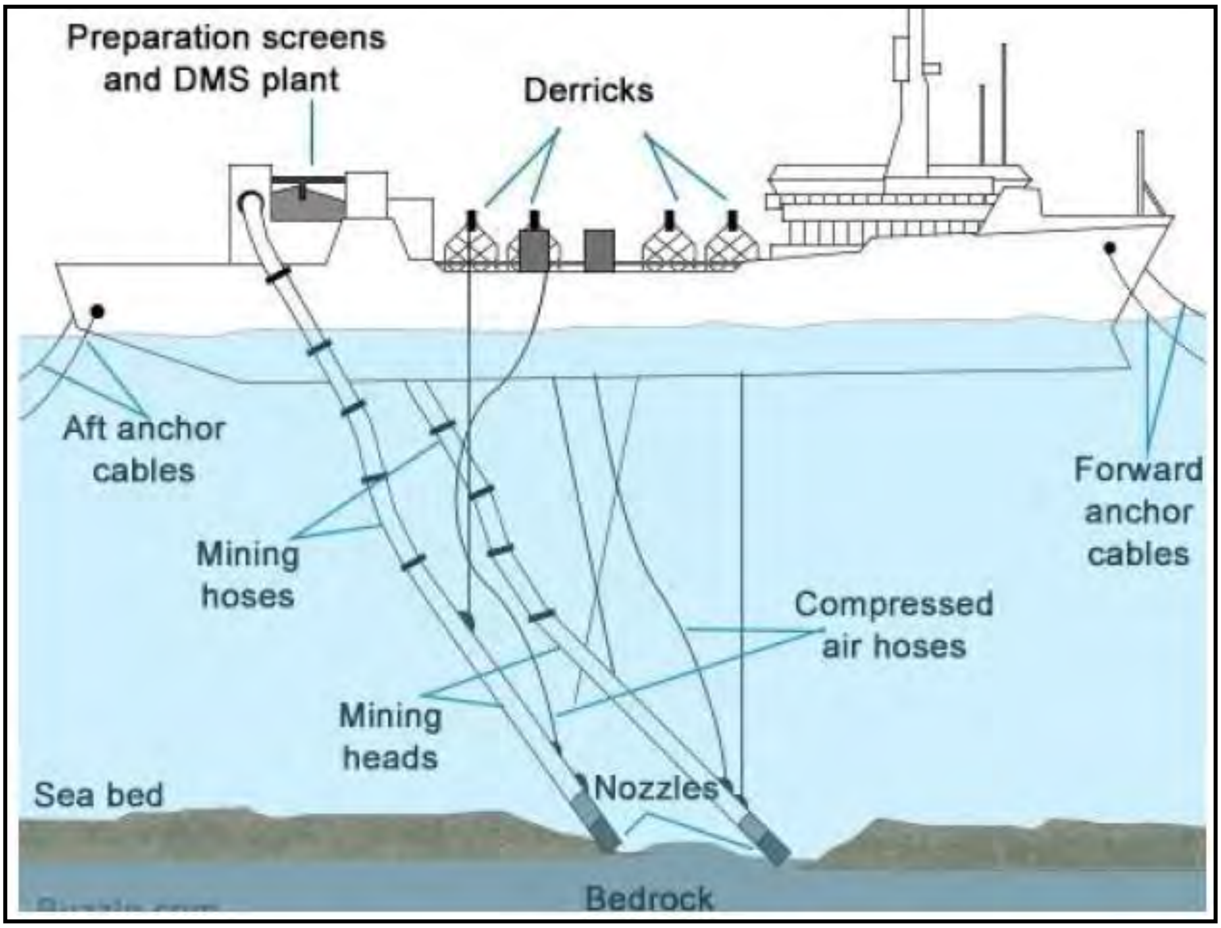


Figure 13: Illustration of remote pump mining (Source: http://globalextractionnetworks.com/about-diamonds/)

During Phase 2 a dedicated large diameter drill sampling vessel, normally with an overall length of 114.4m, and gross tonnage of 4677t (**Figure 13**) may also be deployed. Such a vessel is equipped with a subsea sampling tool, which can be operated in water depths up to 200m. The sampling tool comprises a 2.5m diameter drill bit operated from a drill frame structure (**Figure 14**).

Figure 14: Example of a dedicated drill sampling vessel

Figure 15: Example of the 2.5 m diameter drill bit within the drill frame structure

4.2.1.3.1 Geophysical Surveys Phase 1

Swath bathymetry and sub-bottom profiling will be the geophysical survey techniques employed during the proposed prospecting operations making use of:

- a multibeam echosounder designed to produce high resolution digital terrain models of the seafloor (**Figure 16**) by transmitting a 30kHz sounding in a wide swath below the vessel; and
- a parametric sub-bottom profiler (Topas system), which uses shallow (35 to 45kHz) and medium penetration (1 to 10kHz) "Chirp" seismic pulses to generate profiles up to 60m beneath the seafloor (**Figure 16**), thereby giving a cross section view of the sediment layers.

Sound levels from the acoustic equipment would range between 190 to 220dB re 1µPa at 1m. The proposed surveys would be undertaken in specific priority areas in the concessions, at water depths of between approximately 15 - 75m. The surveys would have a line spacing of between 100 to 1 000m apart. The total line kilometres to be surveyed is estimated at 600km. The planned duration for the proposed geo-physical surveys would be a total of 20 days per year over a four-year period.

In general terms, sound sources that have high sound pressure and low frequency will travel the greatest distances in the marine environment. Conversely, sources that have high frequency will tend to have greater attenuation over distance due to interference and scattering effects. It is for this reason that the acoustic footprint of the above-mentioned sonar survey tools is considered to be much lower than that of deeper penetration low frequency seismic surveys and in addition have lower sound pressure levels. It should be noted that a decibel is a logarithmic scale of pressure where each unit of increase represents a tenfold increase in the quantity being measured.

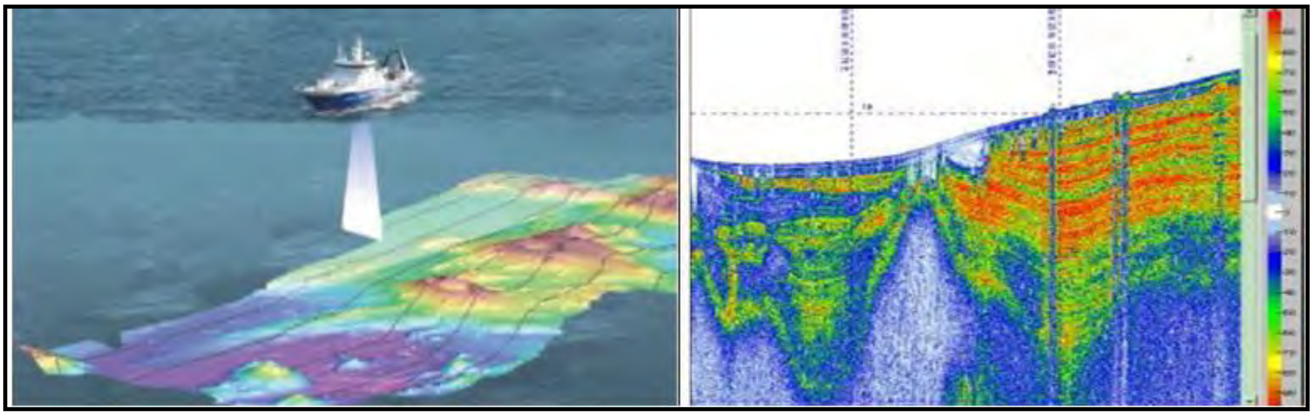


Figure 16: Swath bathymetry (left) and Sub-bottom profiling (right)

4.2.1.3.2 Drill Sampling Phase 2

A vibrocorer consists of a core barrel in a landing frame with a vibrating motor on top.

The vibrocorer is landed on the seafloor, the motor turned on and the barrel penetrates the unconsolidated sediment. Once the core stops penetrating, the motor is turned off and the vibrocorer is raised back up to the deck. A PVC pipe is placed inside the core barrel prior to coring and the core sample is collected in this pipe. Cores can penetrate up to water depths of 50m and core samples up to 3m in length.

Core samples will be collected at 100-200 sites. A corer penetrates the seafloor to collect sediment samples used to determine the structure of the seafloor, sediment layers and types of sediment (i.e., sand, gravel and/ or rock and the hardness of the rock). This information is then used to engineer the drilling tool. Geotechnical sampling is also used to determine whether there are materials that can be mined in the area and whether it will be economically viable. The core samples will disturb a total surface area of 1.57m² and collect a total volume of 4.71m³.

Van Veen Grab sampling may also be used to supplement the vibrocoring: A Van Veen grab (clamshell bucket) collects sediment samples that are analysed to identify sediment types. Sampling will be done at 20-50 sites, disturb a total surface area of 5 square meters (m²) and a total volume of 1.5 cubic meters (m³).

For deeper water drill sampling activities would be undertaken using a dedicated drilling vessel to be sub-contracted. Such a vessel is equipped with a subsea sampling tool that comprises a 2.5m diameter drill bit operated from a drill frame structure, which is launched through the moon pool of the support vessel and positioned on the seabed. The drill frame structure has a base of 6.5 x 6.5m, stands 23m high and weighs 147tons. The drill bit can penetrate sediments up to 12m depth above the bedrock. The sediments are fluidised with strong water jets and airlifted to the support vessel where they are treated in the onboard mineral recovery plant. All oversized and undersized tailings are discharged back to the sea on site.

A sample spacing of as little as 20m can be achieved by the dynamically positioned vessel. Depending on sea and the sub-seabed geotechnical conditions, up to 60 samples can be successfully taken per day. The samples would be undertaken at intervals of 50 to 500m. The total number of drill samples would be up to a maximum of 4 800. With the drill footprint of $5m^2$, a total area of 2.4ha would be sampled.

4.2.1.3.3 Pre-/feasibility studies Phase 3

The project manager monitors the programme, consolidates and processes the data and amends the programme depending on the results. This is a continuous process throughout the programme and continues even when no prospecting is done on the ground.

Each physical phase of prospecting is followed by desktop studies involving interpretation and modelling of all data gathered. These studies will determine the manner in which the work programme is to proceed in terms of activity, quantity, resources, expenditure and duration.

The technology described above is currently used and the most practical option available with good results. There are therefore no other technology or operational alternatives for consideration.

4.2.1.4 The No-go Alternative

The No-Go Alternative will mean that the potential for increasing the supply of diamonds will not be realised. There will be no supply of diamonds to the local and international market, and no generation of much needed employment opportunities. South Africa and the Western Cape has a high unemployment rate, with the decline in mining a decade ago. The ongoing flow of revenue and employment security will continue to have a very positive spin-off locally and regionally.

4.2.1.5 Summary of Alternatives

The assessment of alternatives must at all times include the “no-go” option as a baseline against which all other alternatives must be measured. The “no go” alternative will therefore be further assessed together with the preferred and only alternative in the impact rating component of this Basic Assessment Report.

The project site has been selected based on the fact that the site has been earmarked for prospecting/mining. The technology or operations of the mining and the associated existing infrastructure comprising the logistics, infrastructure and processing plants has been determined by the position of the mineral resource, and will continue to be applicable for Sea Concession 12C, as shown in **Figure 17.** The operational approach is practical and based on best practice to ensure a phased prospecting approach.

In summary therefore:

- The Preferred Alternative is the Prospecting of Diamonds, as per the area depicted by Sea Concession 12C shown in **Figure 17**.
- The preferred and only **location** alternative of the prospecting activity is as per **Figure 17**, which indicates the prospecting areas. No electricity powerline connections are required.
- The preferred **technology and operational** alternative are the use of geophysical surveys, drill sampling, bulk sampling.

The preferred alternatives described above will be rated in the impact assessment component in the BAR, together with the mandatory “no-go” alternative that must be assessed against as the environmental baseline, for comparison purposes in terms of significance through the life of the project.

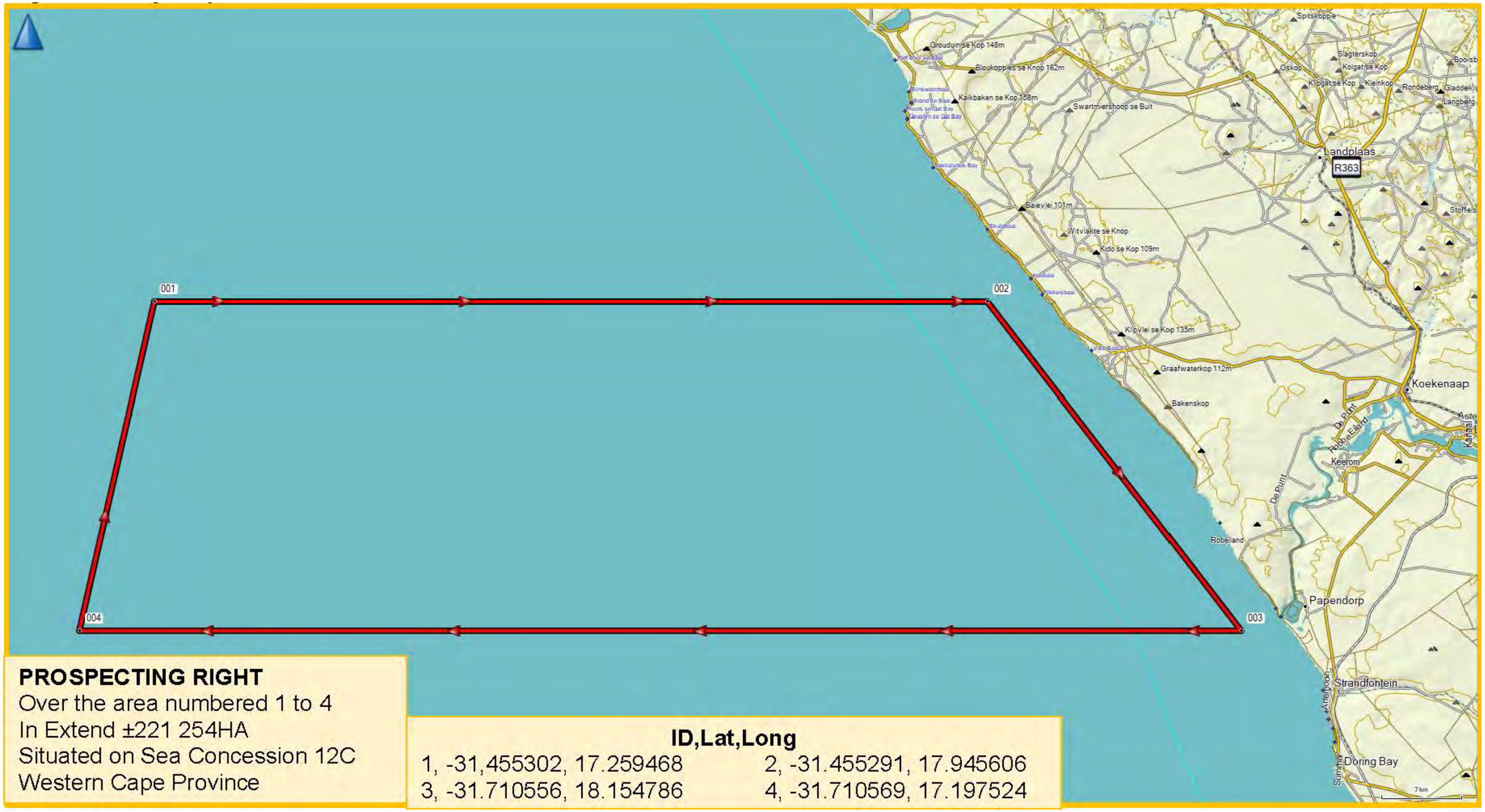


Figure 17: Proposed prospecting area over Sea Concession 12C

5 Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

5.1 Introduction

The public participation process will be conducted according to the requirements as prescribed in Regulations 40 to 44 of the EIA Regulations, 2014 (as amended). Full details of the public participation process conducted including copies of all supporting documents (e.g., the information provided to Interested & Affected Parties (I&APs) and the comments received) are included in **Appendix B: , Page 191** in the draft Basic Assessment Report.

5.1.1 Comment Period on the Draft Basic Assessment Report

The project notification and availability of the draft Basic Assessment Report will be distributed via email to relevant Government Departments, and other Interested and/or Affected Parties (I&APs). Included in the Project Notification Letter will be a Registration and Comment form and POPIA consent form, a copy of which is included in **Appendix B: , Page 191.** Hard copies may be requested where the EAP will then furnish one to the nearest local public library. A link to download the reports will be included with the email notification dated 30 October 2022.

The commenting period of 30 days on this Draft Basic Assessment Report was from 31 October 2022 to 30 November 2022.

All public consultation documents, such as a copy of the advertisement placed in the local newspaper (Ons Kontrei); site notices placed in near towns; project notification; and proof of project notification, will be included in **Appendix B: , Page 191** of the Final Basic Assessment Report. Refer to Table 4 below (**Sections 5.1.2**)

5.1.2 Summary of issues raised by I&Aps

(Complete the table summarising comments and issues raised, and reaction to those responses)

Table 4: Summary of issues raised by I&Aps

Interested and Affected Parties List the names of persons consulted in this column, and Mark with an X where those who must be consulted were in fact consulted.		Date Comments Received	Issues raised	EAPs response to issues as mandated by the applicant	Section and paragraph reference in this report where the issues and or response were incorporated.
AFFECTED PARTIES					
Landowner					
Republic of South Africa	X				
Lawful occupier/s of the land					
N/A					
Landowners or lawful occupiers on adjacent properties					
N/A					
Municipal Councillor					
Municipal Manager: Matzikama Local Municipality	x				
Municipal Manager: West Coast District Municipality	x				
Municipality					
Matzikama Local Municipality	X				
West Coast District Municipality	X				
Organs of state (Responsible for infrastructure that may be affected Roads Department, Eskom, Telkom, DWA)					
N/A	x				
Communities					
N/A					
Dept. Land Affairs	X				
Department of Rural Development and Land Reform					
Traditional Leaders					
N/A					
Dept. Environmental Affairs & Development Planning					
Dept. Environmental Affairs & Development Planning: Directorate: Development Facilitation	x				
Other Competent Authorities affected					
Department of Water and Sanitation (DHSW&S)	X				
SAHRA	X				
Cape Nature	X				

Department of Environment, Forestry and Fisheries	X				
SAHRA	X				
Department Oceans and Coast	X				
DAFF: Marine Resources Management: Offshore and High Seas Fisheries Director: Stakeholder Relations					
DAFF: Marine Resources Management: Offshore and High Seas Fisheries Director: Offshore & High Seas Fisheries					
Department of Environmental Affairs and Development Planning: Directorate: Development Facilitation					
Department of Forestry, Fisheries and the Environment (DFFE): Oceans & Coast					
Department of Forestry, Fisheries and the Environment (DFFE)_National					
Department of Public Works Western Cape					
National Department Of Public Works And Infrastructure: Chief Town Planner Projects And Professional Services ¦					
National Department of Public Works and Infrastructure:					
Department of Rural Development and Land Reform					
South Africa Navy Hydrographic Office					
South African Maritime Safety Authority (SAMSA)					
South African National Biodiversity Institute (SANBI)					
Transnet National Ports Authority					
CapeNature Conservation Operations: Landscape Conservation Intelligence Management Unit					
SAHRA					
Department of Water & Sanitation					
Department of Forestry, Fisheries and the Environment, Branch Fisheries Management, Directorate Sustainable Aquaculture Management					
OTHER AFFECTED PARTIES					
INTERESTED PARTIES					

6 The Environmental attributes associated with the alternatives.

(The environmental attributed described must include socio-economic, social, heritage, cultural, geographical, physical and biological aspects)

6.1 Baseline Environment

6.1.1 Type of environment affected by the proposed activity.

6.1.1.1 Geographical

Sea Concession 12C is situated approximately 300km north of Cape Town, with the inshore boundary located 5km seaward of the coast between Strandfontein to the south and Namakwa Sands Wet Separation Plant to the north.

The offshore boundary is located approximately 95km offshore.

6.1.1.2 Geophysical Characteristics

The following is taken from Marine Biodiversity Assessment, page 252:

6.1.1.2.1.1 Bathymetry

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest (180 km) off the Orange River. The nature of the shelf break varies off the South African West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle and outer shelf normally lacks relief and slopes gently seawards reaching the shelf break at a depth of ~300 m.

Banks on the continental shelf include Child's Bank, situated ~150 km offshore at about 31°S and well to the north of concession 12C. Child's Bank is the only known submarine bank within South Africa's Exclusive Economic Zone (EEZ), rising from a depth of 350 - 400 m water to less than 200 m at its shallowest point. The bank area has been estimated to cover some 1 450 km2 (Sink et al. 2012).

No detailed bathymetry is available for Concession 12C at this stage.

6.1.1.2.1.2 Coastal and Inner-shelf Geology and Seabed Geomorphology

The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Dingle et al. 1987; Birch et al. 1976; Rogers 1977; Rogers & Bremner 1991). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the innershelf between the Orange River and St Helena Bay (Birch et al. 1976). Further offshore, sediment is dominated by muds and sandy muds. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input from the Orange River. This sediment is generally transported northward. Most of the sediment in the concession 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) (Sink et al. 2012). These were refined in the 2018 NBA (Sink et al. 2019) to provide substratum types (Figure 18).

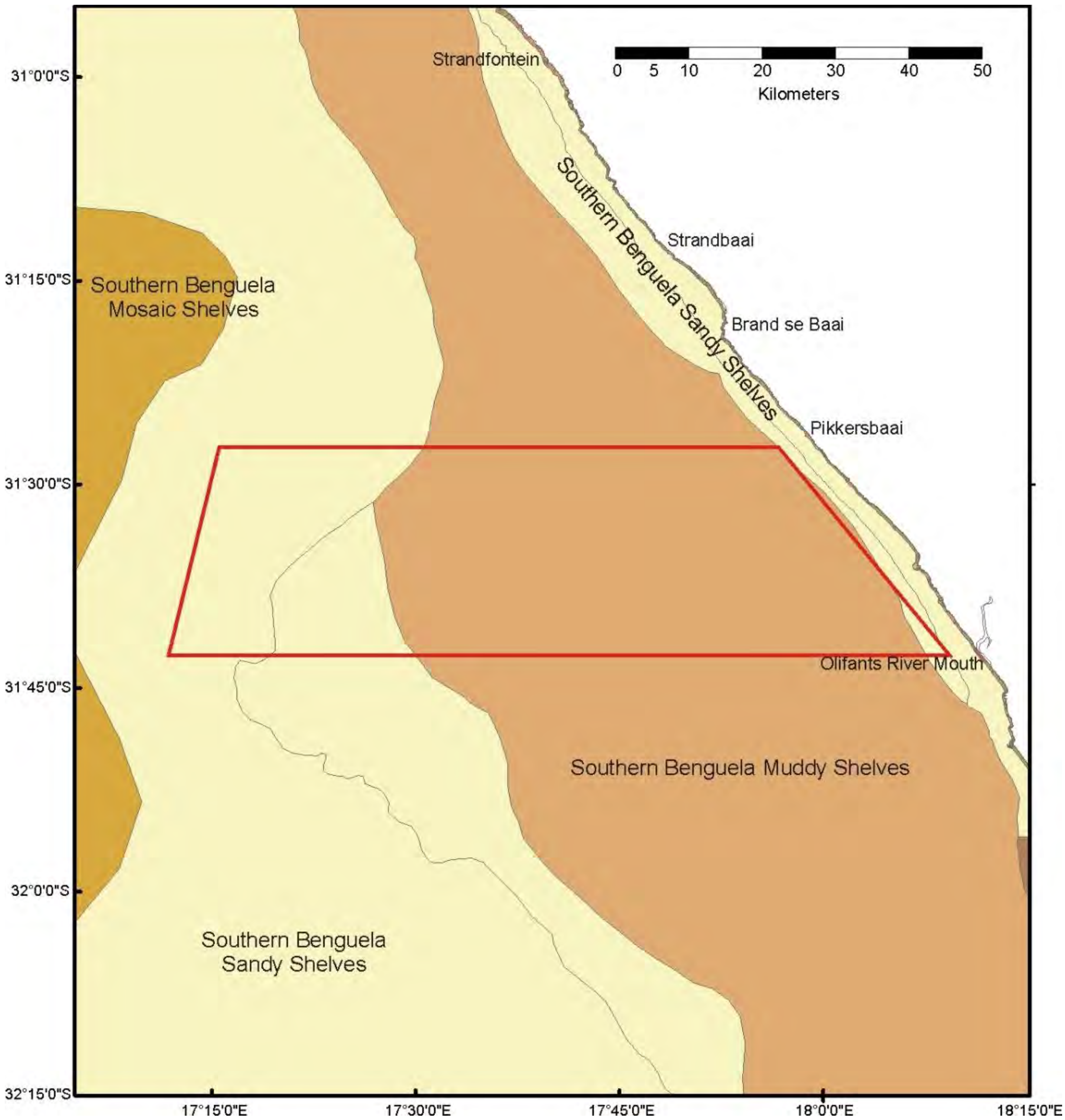


Figure 18: Concession 12C (red polygon) in relation to the distribution of seabed substratum types along the West Coast (adapted from Sink et al. 2019).

6.1.1.3 Biophysical Characteristics

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

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component. This 'reversal' from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 4% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

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

6.1.1.3.2 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 (Boyd & Oberholster 1994), although localised flows in excess of 50 cm/s occur associated with eddies. On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current, resulting in considerable variation in current speed and direction over the domain. In the south, the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The surface flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington et al. 1990; Nelson & Hutchings 1983) (Figure 19). Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Current speeds decrease with depth, while directions rotate from predominantly north-westerly at the surface to south-easterly near the seabed. Near bottom shelf flow is mainly poleward with low velocities of typically <5 cm/s (Nelson 1989; Boyd & Oberholster 1994; Shannon & Nelson 1996). The poleward flow becomes more consistent in the southern Benguela.

The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore (average sea surface temperature 10 - 14°C). Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Cape Point (34°S), Cape Columbine (33°S) and Namaqua (30°S) upwelling cells (Taunton-Clark 1985) (Figure 20; left). The 12C concession fall between the Cape Columbine and Namaqua upwelling cells. 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 20.

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 20, right). These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. The surface water of the Agulhas Current is generally >21°C, and its influence west of Cape Agulhas results in average sea surface temperatures in the southern Benguela of 16 - 20°C (Shannon 1985). During the process of ring formation, intrusions of cold sub-Antarctic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species (Best 2007).

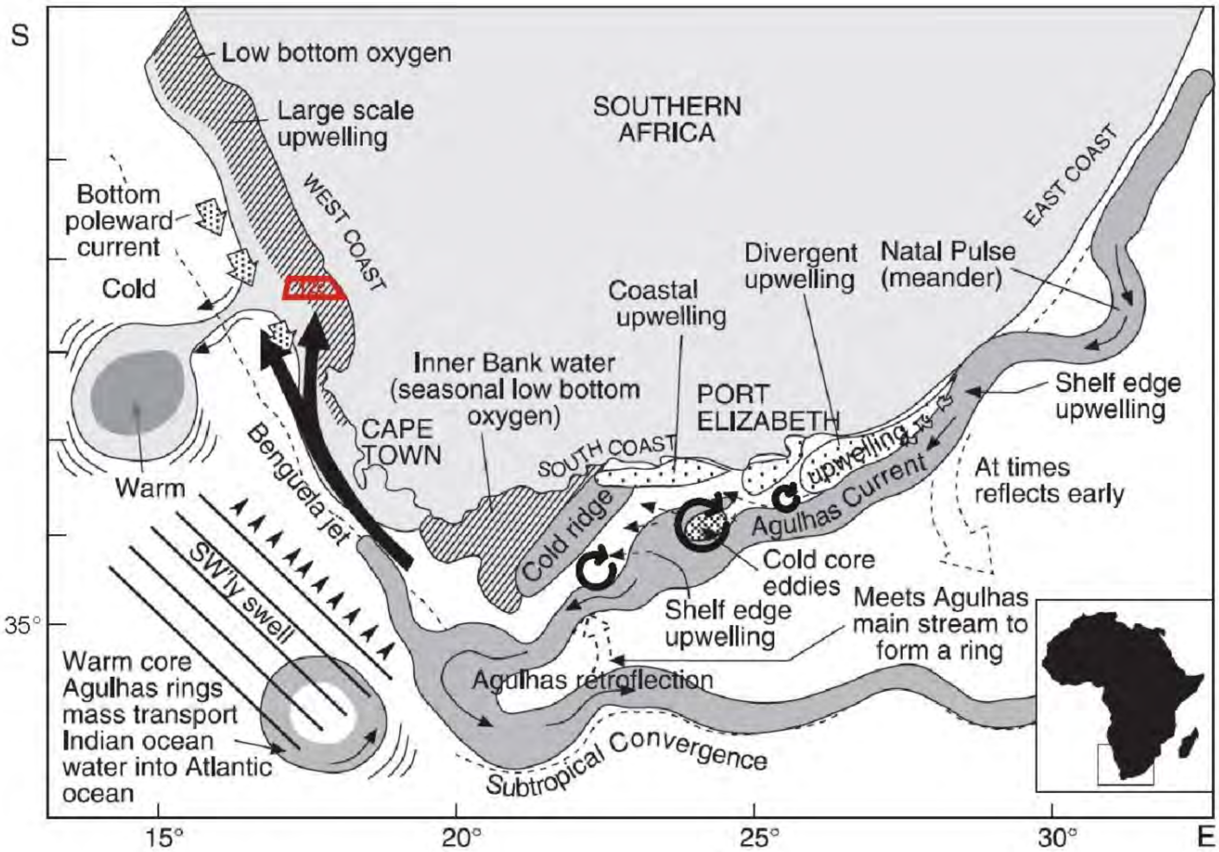


Figure 19: Concession 12C (red polygon) in relation to important physical processes and features associated with the West Coast (adapted from Roberts 2005).

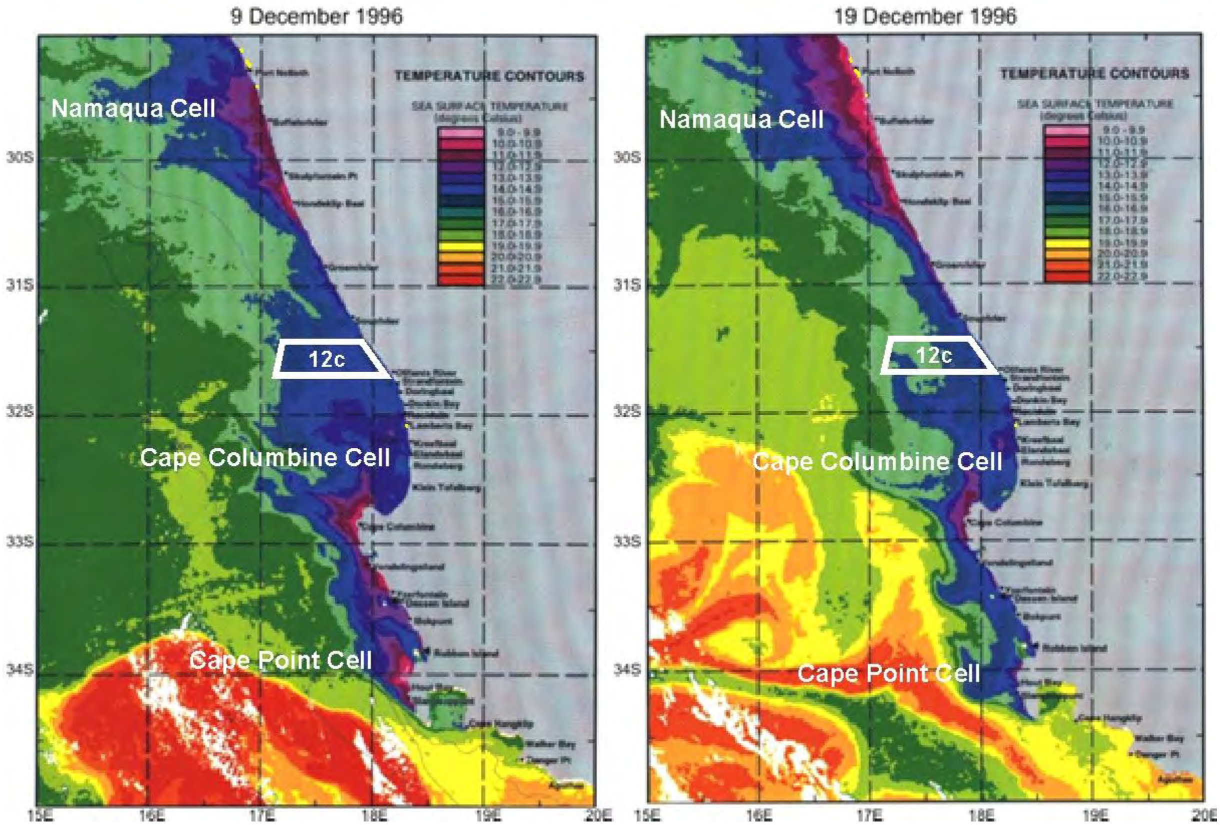


Figure 20: Satellite sea-surface temperature images showing the 12C concession area (white polygons) in relation to upwelling intensity along the South African west coast on two days in December 1996 (from Lane & Carter 1999).

6.1.1.3.3 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. The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

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

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

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

6.1.1.3.4 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 (Nelson & Hutchings 1983). Salinities range between 34.5 ‰ and 35.5 ‰ (Shannon 1985).

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

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

6.1.1.3.5 Upwelling & Plankton Production

During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). Nutrient concentrations of upwelled water of the Benguela system attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey et al. 1985). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays. Biological decay of plankton blooms can in turn lead to "black tide" events, as the available dissolved oxygen is stripped from the water during the decomposition process (see below). Subsequent anoxic decomposition by sulphur reducing bacteria can result in the formation and release of hydrogen sulphide (Pitcher & Calder 2000).

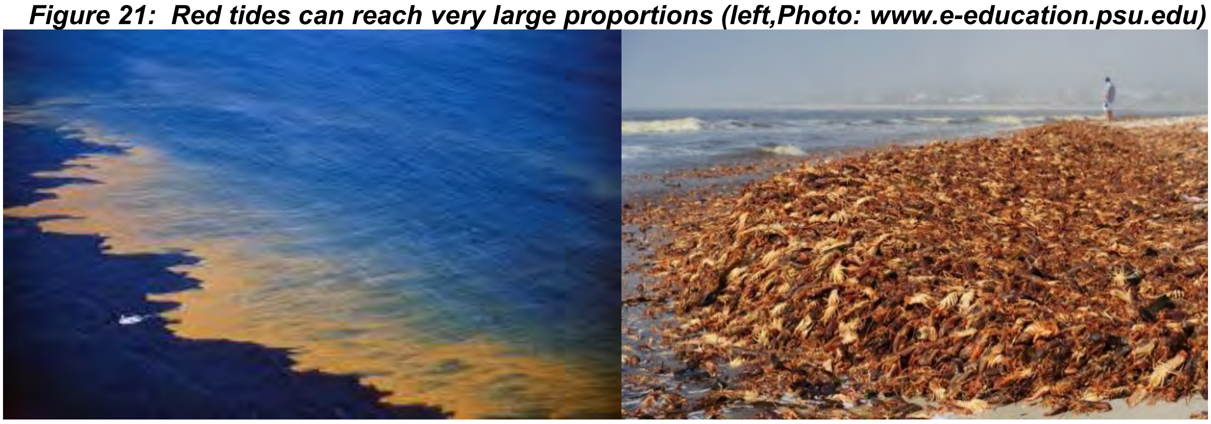
6.1.1.3.6 Organic Inputs

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/km2 of phytoplankton and 31.5 tons/km2 of zooplankton alone (Shannon et al. 2003). 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) (see Shannon & Pillar 1985; Pitcher 1998). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean (Figure 21, 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 21, right).

Figure 21: Red tides can reach very large proportions (left,Photo: www.e-education.psu.edu) and



can lead to mass stranding, or 'walk-out' of rock lobsters, such as occurred at Elands Bay in March 2022 (Photo: www.waterencyclopedia.com).

6.1.1.3.7 Low Oxygen Events

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

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft et al. 2000) (see Figure 21, right). 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 most recent walkout occurred in early March 2022 at Elands Bay, when some 500 tons of rocklobster were reported stranded on the beach. 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.

6.1.1.3.8 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 and Olifants Rivers or from ‘berg’ wind events. Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 - 26 million tons/yr (Rogers 1979). ‘Berg’ wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O’Toole 1998; Lane & Carter 1999). For example, a ‘berg’ wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20,000 km2. Although the Berg River and Olifants River (two of only three permanently open river systems on the West Coast) enter the West Coast, annual sediment yields are low due to thin soils and the resistant nature of Table Mountain Sandstones (Clark & Ractliffe 2007). PIM loading in Concession 12C would therefore typically be negligible.

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/ℓ to several tens of mg/ℓ (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley et al. 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/ℓ, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. During storm events, concentrations near the seabed may even reach up to 10,000 mg/ℓ (Miller & Sternberg 1988). In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/ℓ at Alexander Bay just south of the mouth (Zoutendyk 1995) to peak values of 7 400 mg/ℓ immediately upstream of the river mouth during the 1988 Orange River flood (Bremner et al. 1990).

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorwards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington et al. 1990; Rogers & Bremner 1991).

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

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

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

Although natural turbidity of seawater is a global phenomenon, there has been a worldwide increase of water turbidity and sediment load in coastal areas as a consequence of anthropogenic activities. These include dredging associated with the construction of harbours and coastal installations, beach replenishment, accelerated runoff of eroded soils as a result of deforestation or poor agricultural practices, and discharges from terrestrial, coastal and marine mining operations (Airoldi 2003). Such increase of sediment loads has been recognised as a major threat to marine biodiversity at a global scale (UNEP 1995).

6.1.1.4 The Biological Environment

Biogeographically, the study area falls within the cold temperate Namaqua Bioregion (Emanuel et al. 1992; Lombard et al. 2004) (Figure 22), which in the 2018 NBA (Sink et al. 2019) is referred to as as a subregion of the Southern Benguela Shelf ecoregion. 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. The West Coast is, however, characterized by low marine species richness and low endemicity (Awad et al. 2002).

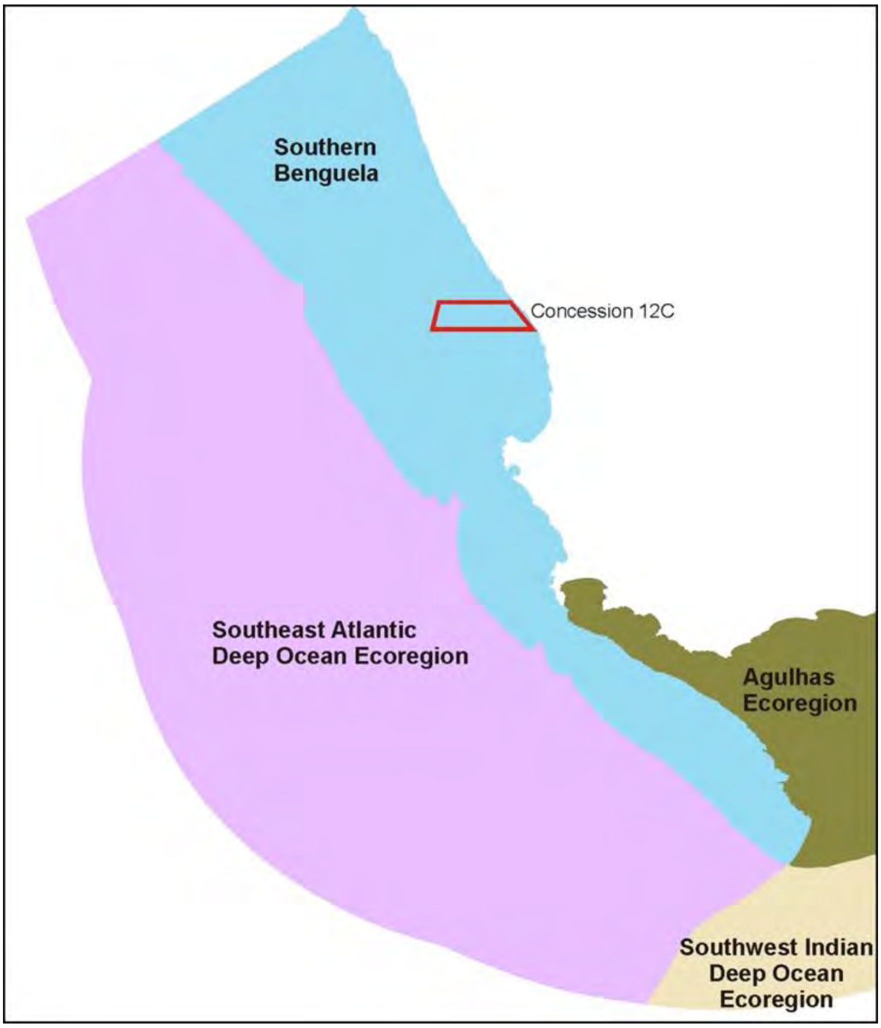


Figure 22: The South African ecoregions in relation to Concession 12C (red polygon) (adapted from Sink et al. 2019).

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). Concession

12C is located beyond the 50 m depth contours and therefore falls into the sub-photic zone in which light no longer penetrates to the seabed. The near- and 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 mining activities.

The biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). No rare or endangered species have been recorded (Awad et al. 2002). 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 prospecting activities. The description of benthic macrofaunal communities was provided by Natasha Karenyi of the South African National Biodiversity Institute (SANBI), and the section on marine mammals was provided by Dr Simon Elwen of the Mammal Research Institute (University of Pretoria) for a similar offshore project off the West Coast.

6.1.1.4.1 Offshore Demersal Communities

6.1.1.4.1.1Benthic Invertebrate Macrofauna

The seabed communities in Concession 12C lie within the Namaqua Bioregion sub-photic biozone, which extend from a depth of -30 m to the shelf break. The benthic habitats of South Africa were mapped as part of the 2018 National Biodiversity Assessment (Sink et al. 2019) to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (Figure 23) and assigned an ecosystem threat status based on their level of protection (Figure 24).

The benthic biota of unconsolidated marine sediments constitutes invertebrates that live on, or burrow within, the sediments, and are generally divided into megafauna (>10 cm), macrofauna (animals >1 mm) and meiofauna (<1 mm). Numerous studies have been conducted on southern African West Coast continental shelf benthos, mostly focused on mining, pollution or demersal trawling impacts (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Environmental Evaluation Unit 1996; Field & Parkins 1997; Parkins & Field 1997; 1998; Pulfrich & Penney 1999; Goosen et al. 2000; Savage et al. 2001; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b; Steffani 2009a, 2009b, 2010a, 2010b, 2010c; Atkinson et al. 2011; Steffani 2012a, 2012b, 2014; Karenyi 2014; Steffani et al. 2015; Biccard & Clark 2016; Biccard et al. 2016; Duna et al. 2016; Karenyi et al. 2016; Biccard et al. 2017, 2018; Gihwala et al. 2018; Biccard et al. 2019; Giwhala et al. 2019; Biccard et al. 2019). The description below is drawn from these.

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth, Karenyi 2014; Karenyi et al. 2016) off the Namaqualand coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile predators (e.g. the gastropod Bullia laevissima and polychaete Nereis sp.), sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by the mud prawns Callianassa sp. and Calocaris barnardi. A second mid-shelf sandy community occurring in sandy sediments, is characterised by various polychaetes including deposit-feeding Spiophanes soederstromi and Paraprionospio pinnata. Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the west coast (Figure 25). The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments (e.g. Kenny et al. 1998; Kendall & Widdicombe 1999; van Dalfsen et al. 2000; Zajac et al. 2000; Parry et al. 2003), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich 2004).

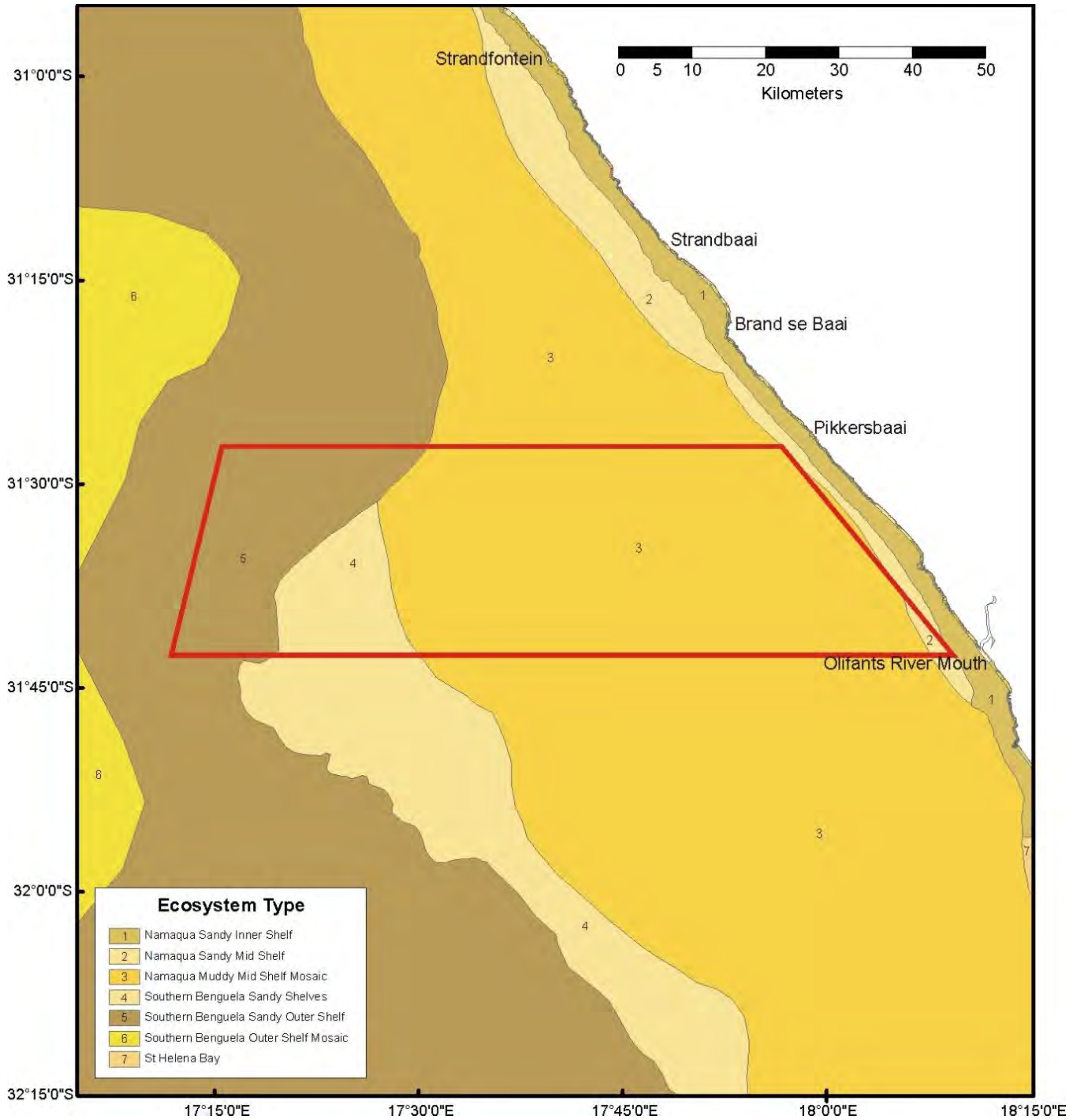


Figure 23: Concession 12C (red polygon) in relation to the marine ecosystem types (adapted from Sink et al. 2019).

Karenyi et al. (2016) found that off Namaqualand, species richness generally increased 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 was highest in the inshore (± 50 g/m2 wet weight) and decreased across the mid-shelf averaging around 30 g/m2 wet weight. This is contrary to Christie (1974, 1976) who found that biomass was greatest in the mudbelt at 80 m depth off Lambert's Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those further offshore or further north.

Given the state of our current knowledge of South African macro-infauna it is not possible to determine the threat status or endemicity of macro-infauna species on the West Coast, although such research is currently underway (pers. comm. N. Karenyi, SANBI and UCT). However, the marine component of the 2018 National Biodiversity Assessment (Sink et al. 2019), rated the inner and mid-shelf areas between Hondeklipbaai and Doringbaai as of 'least concern'.

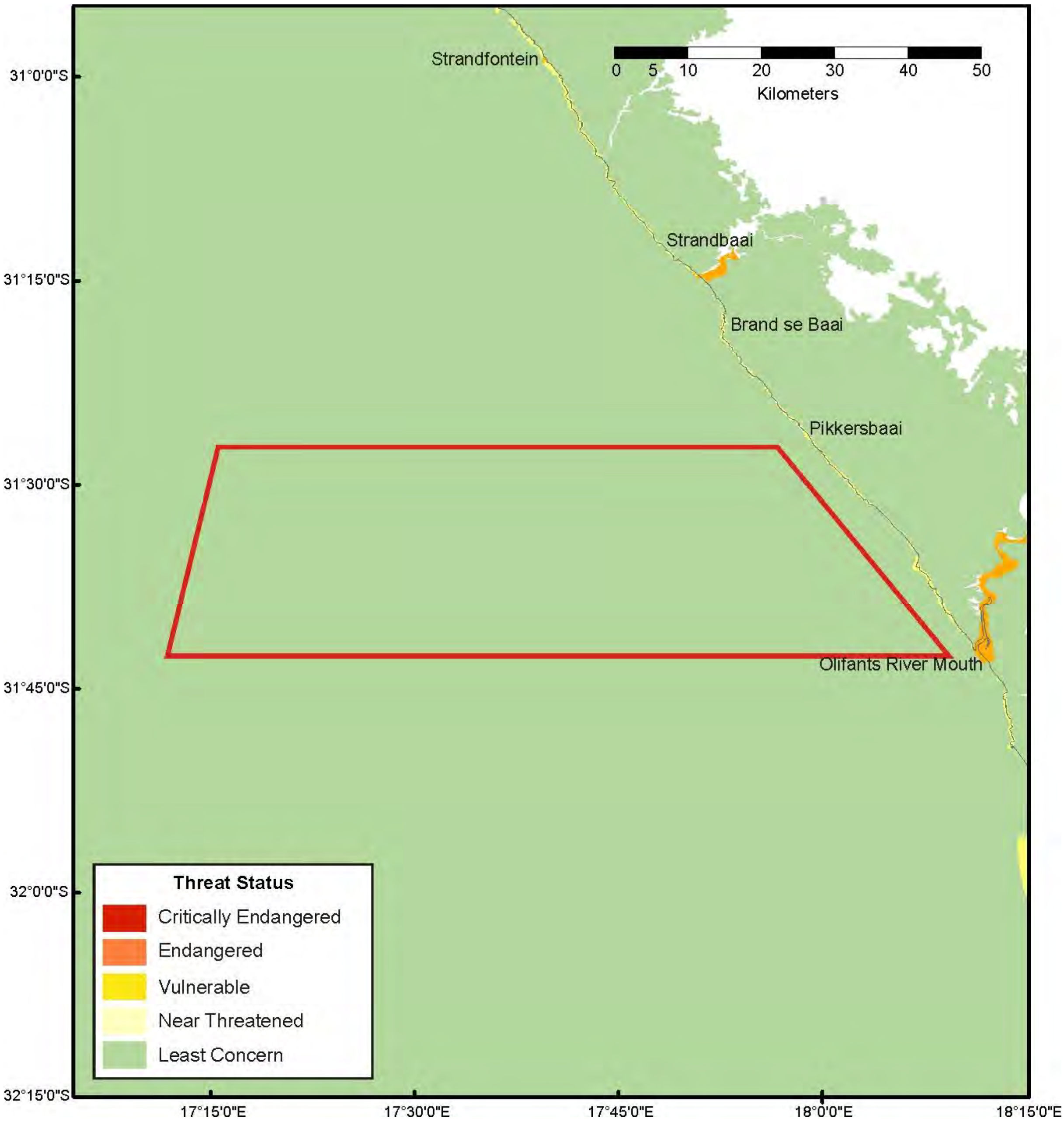


Figure 24: Concession 12C (red polygon) in relation to the ecosystem threat status for coastal and offshore ecosystem types on the South African West Coast (adapted from Sink et al. 2019).

Figure 25: 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.

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African west coast (Christie 1974, 1976; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b) and elsewhere in the world (e.g. Gray 1981; Ellingsen 2002; Bergen et al. 2001; Post et al. 2006). However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration (Post et al. 2006; Currie et al. 2009; Zettler et al. 2009), productivity (Escaravage et al. 2009), organic carbon and seafloor temperature (Day et al. 1971) may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deepwater shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability (Monteiro & van der Plas 2006; Pulfrich et al. 2006). In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure.

The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability) and serve as important food source for commercially valuable fish species and other higher order consumers. As a result of their comparatively limited mobility and permanence over seasons, these animals provide an indication of historical environmental conditions and provide useful indices with which to measure environmental impacts (Gray 1974; Warwick 1993; Salas et al. 2006).

Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. According to Lange (2012) the continental shelf on the West Coast between depths of 100 m and 250 m (and thus beyond the deepest portions of the concession), 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.

6.1.1.4.1.2 Reef Communities

The following general description of the subtidal reef habitats for the West Coast is based on Field et al. (1980), Branch & Branch (1981), Branch & Griffiths (1988) and Field & Griffiths (1991). The biological communities of rocky subtidal reefs are generally ubiquitous throughout the southern African West Coast region, being particular only to wave exposure, turbulence and/or depth zone. Biological communities of the rocky sublittoral can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora, and an offshore zone below 10 m depth dominated by fauna. This shift in communities is not knife-edge, and rather represents a continuum of species distributions, merely with changing abundances.

From the sublittoral fringe to a depth of between 5 and 10 m, the benthos is largely dominated by algae, in particular two species of kelp. The canopy forming kelp Ecklonia maxima extends seawards to a depth of about 10 m. The smaller Laminaria pallida forms a sub-canopy to a height of about 2 m underneath Ecklonia, but continues its seaward extent to about 30 m depth, although further north up the west coast increasing turbidity limits growth to shallower waters (10-20 m) (Velimirov et al. 1977; Jarman & Carter 1981; Branch 2008). Ecklonia maxima is the dominant species in the south forming extensive beds from west of Cape Agulhas to north of Cape Columbine, but decreasing in abundance northwards. Laminaria becomes the dominant kelp north of Cape Columbine and thus in the project area, extending from Danger Point east of Cape Agulhas to Rocky Point in northern Namibia (Stegenga et al. 1997; Rand 2006).

Kelp beds absorb and dissipate much of the typically high wave energy reaching the shore, thereby providing important partially-sheltered habitats for a high diversity of marine flora and fauna, resulting in diverse and typical kelp-forest communities being established (Figure 26). Through a combination of shelter and provision of food, kelp beds support recruitment and complex trophic food webs of numerous species, including commercially important rock lobster stocks (Branch 2008). There is substantial spatial and temporal variability in the density and biomass of kelp beds, as storms can remove large numbers of plants and recruitment appears to be stochastic and unpredictable (Levitt et al. 2002; Rothman et al. 2006). Some kelp beds are dense, whilst others are less so due to differences in seabed topography, and the presence or absence of sand and grazers.

Growing beneath the kelp canopy, and epiphytically on the kelps themselves, are a diversity of understorey algae, which provide both food and shelter for predators, grazers and filter-feeders associated with the kelp bed ecosystem. Representative under-storey algae include Botryocarpa prolifera, Neuroglossum binderianum, Botryoglossum platycarpum, Hymenena venosa and Rhodymenia (=Epymenia) obtusa, various coralline algae, as well as subtidal extensions of some algae occurring primarily in the intertidal zones (Bolton 1986). Epiphytic species include Polysiphonia virgata, Gelidium vittatum (=Suhria vittata) and Carpoblepharis flaccida. In particular, encrusting coralline algae are important in the under-storey flora as they are known as settlement attractors for a diversity of invertebrate species. The presence of coralline crusts is thought to be a key factor in supporting a rich shallow-water community by providing substrate, refuge, and food to a wide variety of infaunal and epifaunal invertebrates (Chenelot et al. 2008).

Figure 26: The canopy-forming kelp Ecklonia maxima provides an important habitat for a diversity of marine biota (Photo: Geoff Spiby).

The sublittoral invertebrate fauna is dominated by suspension and filter-feeders, such as the mussels Aulacomya ater and Choromytilus meriodonalis, and the Cape reef worm Gunnarea capensis, and a variety of sponges and sea cucumbers. Grazers are less common, with most herbivory being restricted to grazing of juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin Parechinus angulosus, with lesser grazing pressure from limpets, the isopod Paridotea reticulata and the amphipod Ampithoe humeralis. The abalone Haliotis midae, an important commercial species present in kelp beds south of Cape Columbine is naturally absent north of Cape Columbine. Key predators in the sub-littoral include the commercially important West Coast rock lobster Jasus lalandii and the octopus Octopus vulgaris. The rock lobster acts as a keystone species as it influences community structure via predation on a wide range of benthic organisms (Mayfield et al. 2000). Relatively abundant rock lobsters can lead to a reduction in density, or even elimination, of black mussel Choromytilus meriodonalis, the preferred prey of the species, and alter the size structure of populations of ribbed mussels Aulacomya ater, reducing the proportion of selected size-classes (Griffiths & Seiderer 1980). Their role as predator can thus reshape benthic communities, resulting in large reductions in taxa such as black mussels, urchins, whelks and barnacles, and in the dominance of algae (Barkai & Branch 1988; Mayfield 1998).

Of lesser importance as predators, although numerically significant, are various starfish, feather and brittle stars, and gastropods, including the whelks Nucella spp. and Burnupena spp. Fish species commonly found in kelp beds off the West Coast include hottentot Pachymetopon blochii, two tone finger fin Chirodactylus brachydactylus, red fingers Cheilodactylus fasciatus, galjoen Dichistius capensis, rock suckers Chorisochismus dentex and the catshark Haploblepharus pictus (Branch et al. 2010).

Further offshore in the sub-photic zone of Concession 12C, the reefs are dominated by a diversity of encrusting and upright sponges, bryozoans, seafans, soft corals, ascidians and hydroids. Community structure is determined by the influence of sand and detritus and the tolerances of the various species to these physical factors. Mobile species include various starfish, urchins, feather and brittle stars, gastropods and crustaceans. Important amongst the crustaceans is the West Coast rock lobster, which although typically associated with shallow-water reefs, has been recorded to depths of 120 m (Branch et al. 2010)

In recent years there has been increasing interest in deep-water corals, bryozoans and sponges because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders, however, generally occur at depths below 150 m with some coral species being recorded from as deep as 3,000 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to *otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze et al. 1997; MacIssac et al. 2001). Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies. In the productive Benguela region, substantial areas on and off the edge of the shelf should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities. Deep water corals are known from the iBhubezi Reef to the east of the Gas Field. 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 27), and in 190-527 m depth on Child's Bank (Sink et al. 2019) suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges and hard-corals do occur on the continental shelf, some of which are thought to be Vulnerable Marine Ecosystem (VME) indicator species.*

The concept of a 'Vulnerable Marine Ecosystem' (VME) centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities (Parker et al. 2009; Auster et al. 2011; Hansen et al. 2013). The distribution of 22 potential VME indicator taxa for the South African EEZ were recently mapped, with those from the West Coast listed in Table 5 (Atkinson & Sink 2018; Sink et al. 2019).

Figure 27: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine).

Table 5: Table of Potential VME species from the the continental shelf and shelf edge on the West Coast (Atkinson & Sink 2018)

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*

The distribution of known and potential VME habitat based on potential VME features, DFFE and SAEON trawl survey data, and many visual surveys indicating the presence of indicator taxa were mapped by Harris et al. 2022 (Figure 28). Some sites need more research to determine their status. Concession 12C overlaps with areas identified as potential VME records, with the shelf between Hondeklipbaai and Lambert's Bay hosting rich sponge fields (Sink et al. 2011).

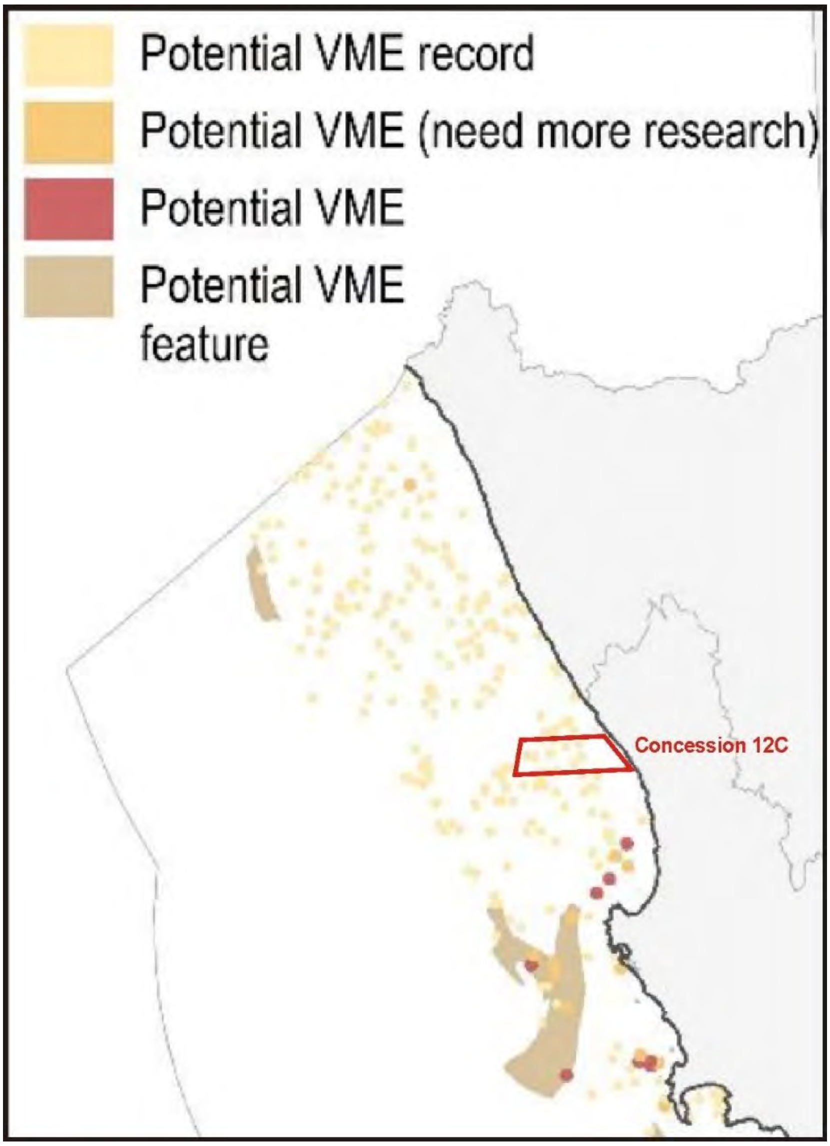


Figure 28: Concession 12C (red polygon) in relation to the distribution of known and potential Vulnerable Marine Ecosystem habitat (adapted from Harris et al. 2022).

6.1.1.4.1.3 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 (Roel 1987). Changes in fish communities occur with increasing depth (Roel 1987; Smale et al. 1993; Macpherson & Gordoa 1992; Bianchi et al. 2001; Atkinson 2009), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake M. capensis, and includes jacopever Helicolenus dactylopterus, Izak catshark Holohalaelurus regain, soupfin shark Galeorhinus galeus and whitespotted houndshark Mustelus palumbes. The more diverse deeper water community is dominated by the deepwater hake Merluccius paradoxus, monkfish Lophius vomerinus, kingklip Genypterus capensis, bronze whiptail Lucigadus ori and hairy conger Bassanago albescens and various squalid shark species. There is some degree of species overlap between the depth zones.

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

The diversity and distribution of demersal cartilagenous fishes occurring on the West Coast is discussed by Compagno et al. (1991). The species that may occur on the continental shelf in the general project area in waters <1,000 m depth are listed in Table 6. The distribution of some of these species is provided in Harris et al. (2022) (Figure 29).

Table 6: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Compagno et al. 1991) and their IUCN conservation status. The National Assessment is provided in parentheses where available.

Common Name	*Scientific name*	*Depth Range (m)*	*IUCN Conservation Status*
Bramble shark	*Echinorhinus brucus*	*55-285*	*EN*
Shortnose spiny dogfish	*Squalus megalops*	*75-460*	*LC*
Sixgill sawshark	*Pliotrema warreni*	*60-500*	*LC*
Tigar catshark	*Halaelurus natalensis*	*50-100*	*VU*
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	*<10-300*	*CR (EN)*
Houndshark	*Mustelus mustelus*	*<100*	*EN (DD)*
Thorny skate	*Raja radiata*	*50-600*	*VU*
Slime skate	*Raja pullopunctatus*	*15-460*	*LC*
Rough-belly skate	*Raja springeri*	*85-500*	*VU*
Yellowspot skate	*Raja wallacei*	*70-500*	*VU*
Biscuit skate	*Raja clavata*	*25-500*	*NT*
Spearnose skate	*Raja alba*	*75-260*	*EN*
St Joseph	*Callorhinchus capensis*	*30-380*	*LC(LC)*

LC – Least Concern *VU – Vulnerable* *NT – Near Threatened*

EN – Endangered *CR – Critically Endangered* *DD – Data Deficient*

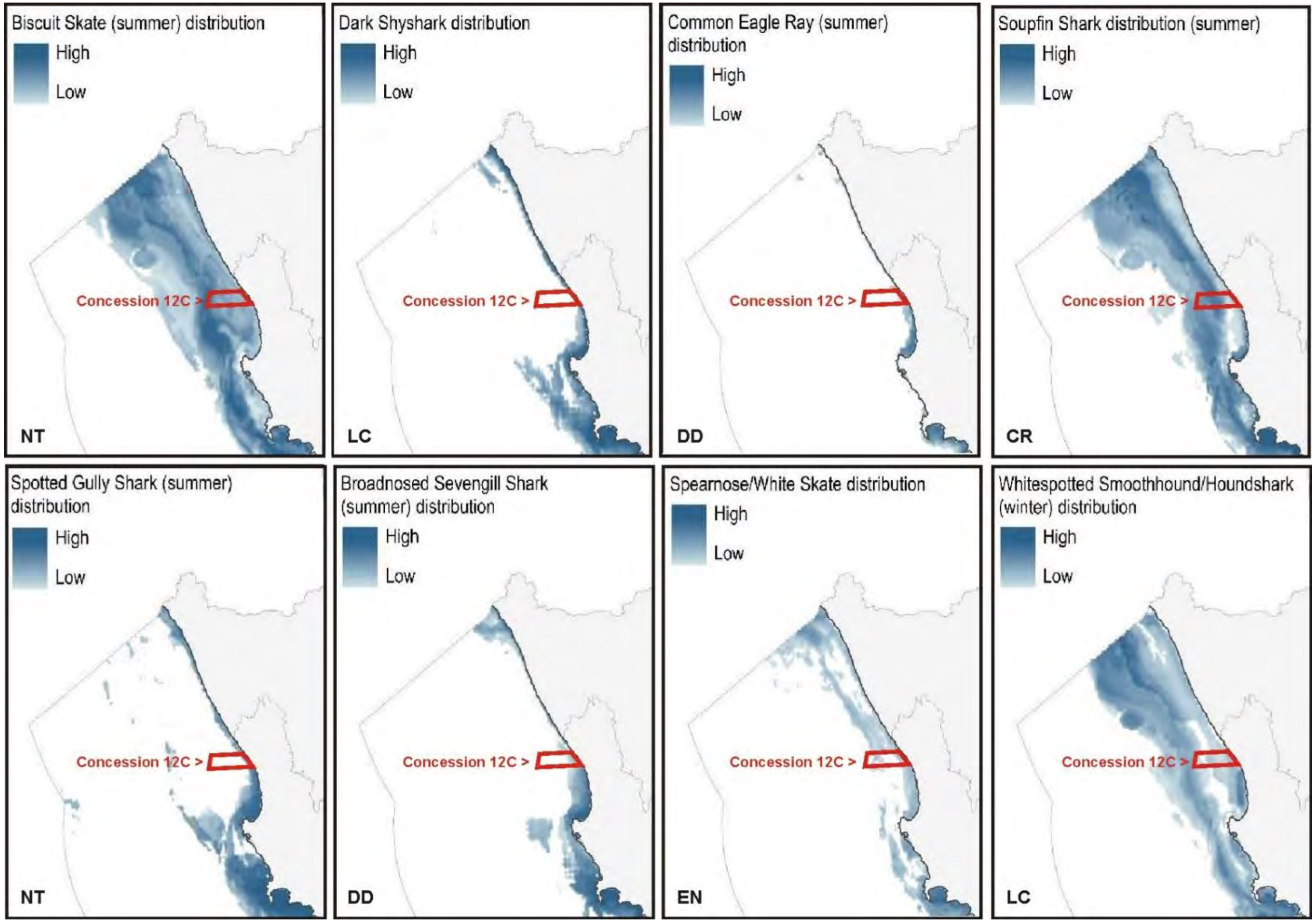


Figure 29: The distribution of various demersal cartilaginous species in relation to Concession 12C (red polygon) (adapted from Harris et al. 2022). The IUCN conservation status is provided.

6.1.1.4.2 Pelagic Communities

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

6.1.1.4.2.1 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 phytoplankton, zooplankton, and ichthyoplankton (Figure 30).

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Brown et al. 1991; Walker & Peterson 1991; Brown 1992). The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are Chaetoceros, Nitschia, Thalassiosira, Skeletonema, Rhizosolenia, Coscinodiscus and Asterionella (Shannon & Pillar 1985). Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. Prorocentrum, Ceratium and Peridinium) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

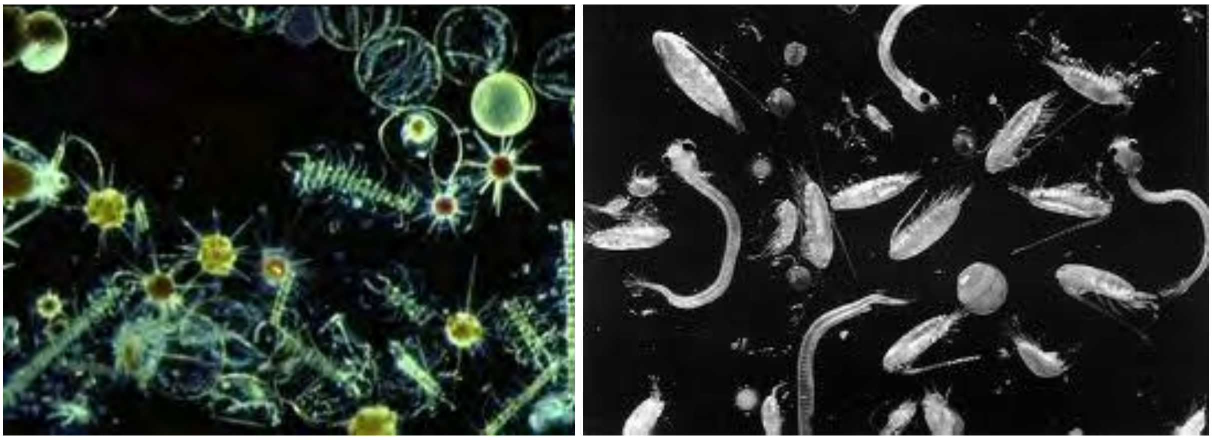


Figure 30: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells.

Red-tides are ubiquitous features of the Benguela system (see Shannon & Pillar 1985). 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 (see Figure 21).

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are Centropages brachiatus, Calanoides carinatus, Metridia lucens, Nannocalanus minor, Clausocalanus arcuicornis, Paracalanus parvus, P. crassirostris and Ctenocalanus vanus. All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, 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 (Pillar et al. 1991).

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 (Pillar 1986). Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplankton (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank and Tripp seamount in response to topographically steered upwelling around such seabed features.

Zooplankton biomass varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford et al. 1987; Hutchings 1994; Hutchings et al. 2002) (Figure 31), and their eggs and larvae form an important contribution to the ichthyoplankton in the region. Spawning of key species is presented below.

- *Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period (Figure 32, left). There is also sardine spawning on the east coast and even off KwaZulu-Natal, where sardine eggs are found during July–November.*
- *Anchovies spawn on the whole Agulhas Bank (Figure 32, right), with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.*

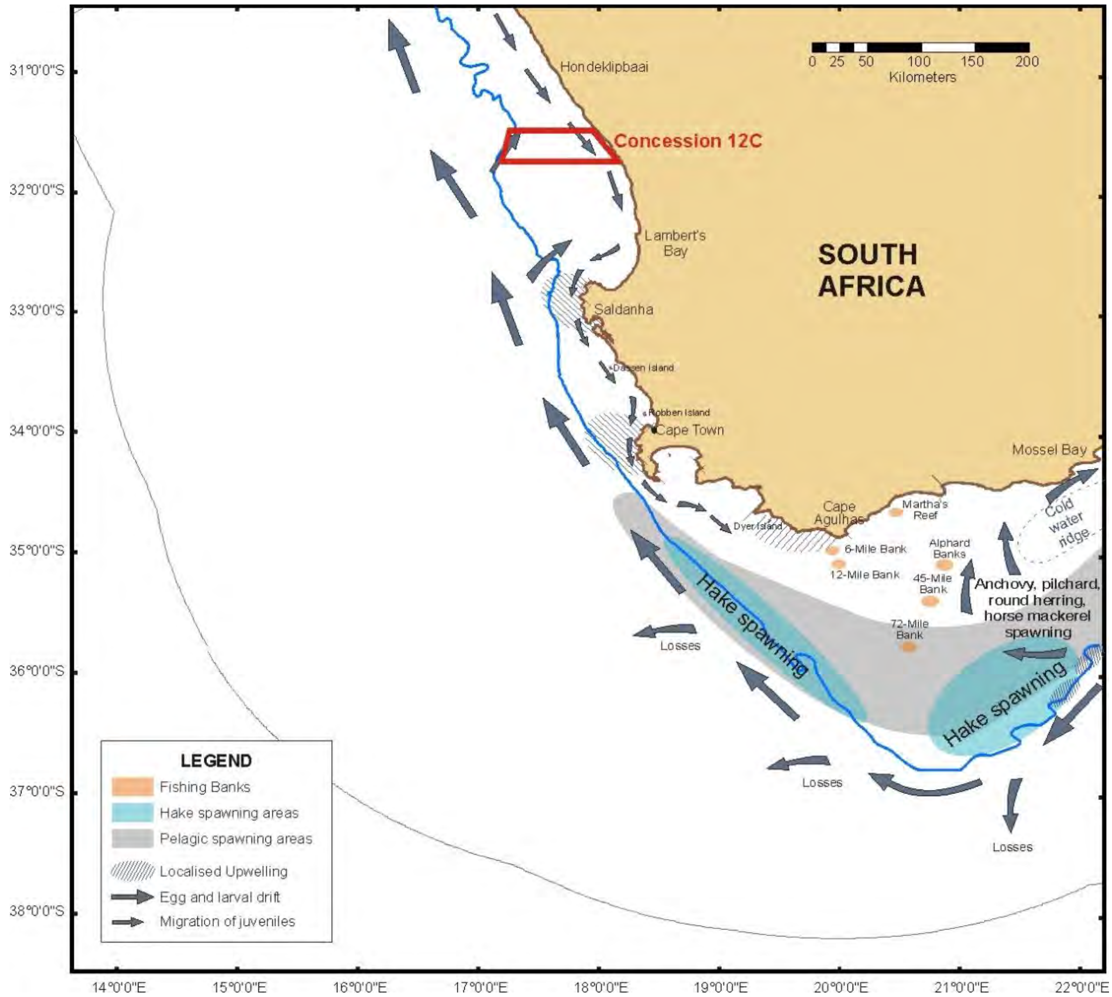


Figure 31: Concession 12C (red polygon) in relation to the major spawning areas in the southern Benguela region (adapted from Cruikshank 1990).

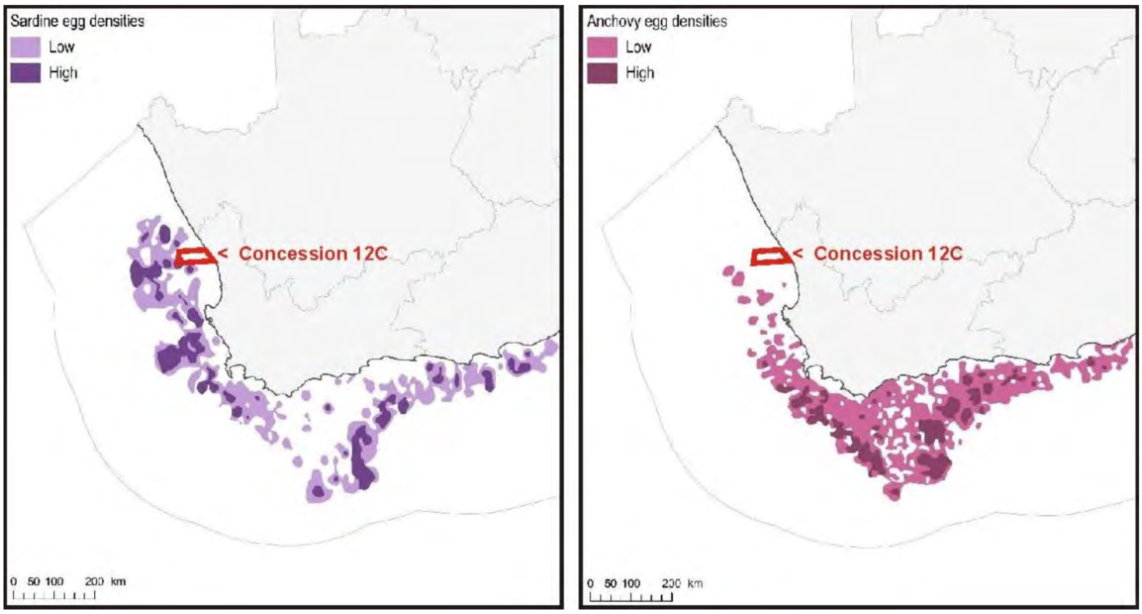


Figure 32: Distribution of sardine (left) and anchovy (right) spawning areas, as measured by egg densities, in relation to Concession 12C (red polygon) (adapted from Harris et al. 2022).

- *Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a* *minimum and their eggs and larvae drift northwards and inshore to the west coast nursery grounds. Figure 33a and 19b highlight the temporal variation in hake eggs and larvae with there being a greater concentration of eggs and larvae between September - October compared to March - April. However, hake are reported to spawn throughout the year (Strømme et al. 2015). Snoek spawn along the shelf break (150-400 m) of the western Agulhas Bank and the West Coast between June and October (Griffiths 2002).*

- *Horse mackerel spawn over the east/central Agulhas Bank during winter months.*

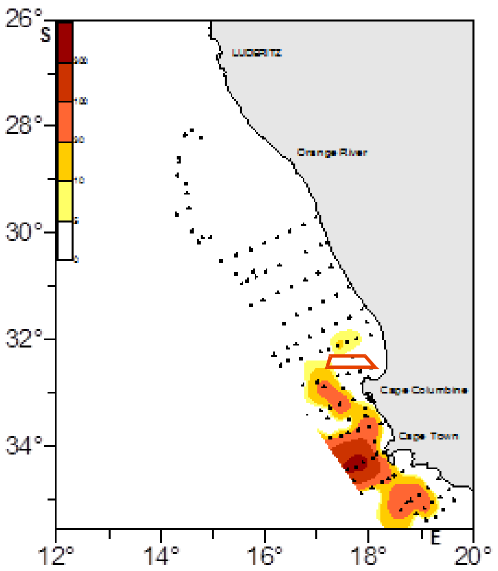


Figure 33a: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005 (adapted from Stenevik et al. 2008)).

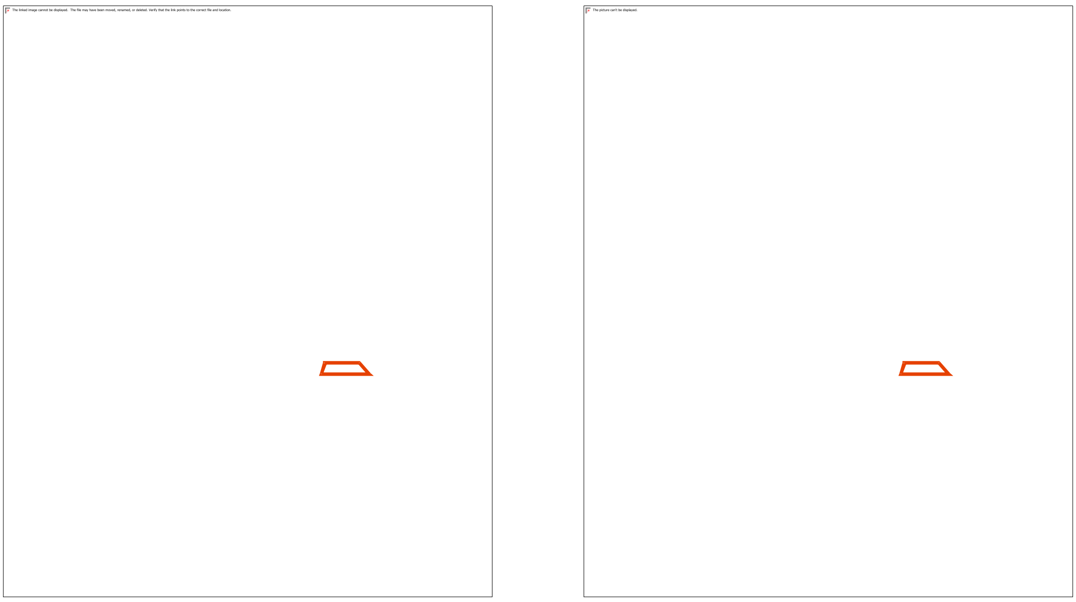


Figure 20b: Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007 (adapted from Stenevik et al. 2008)).

The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is, therefore, some overlap of

Concession 12C with the northward egg and larval drift of commercially important species, and the return migration of recruits (Figure 31). Thus, ichthyoplankton abundance in the concession is likely to be seasonally high.

6.1.1.4.2.2 Cephalopods

Fourteen species of cephalopds have been recorded in the southern Benguela, the majority of which are sepiods/cuttlefish (Lipinski 1992; Augustyn et al. 1995). Most of the cephalopod resource is distributed on the mid-shelf with Sepia australis being most abundant at depths between 60-190 m, whereas S. hieronis densities were higher at depths between 110-250 m. Rossia enigmatica occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter. Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn et al. 1995). They form an important food item for demersal fish.

6.1.1.4.2.3 Pelagic Fish

The structure of the nearshore and surf zone fish community varies greatly with the degree of wave exposure. Species richness and abundance is generally high in sheltered and semi-exposed areas but typically very low off the more exposed beaches (Clark 1997a, 1997b). The surf-zone and outer turbulent zone habitats of sandy beaches are considered to be important nursery habitats for marine fishes (Modde 1980; Lasiak 1981; Kinoshita & Fujita 1988; Clark et al. 1994). However, the composition and abundance of the individual assemblages seems to be heavily dependent on wave exposure (Blaber & Blaber 1980; Potter et al. 1990; Clark 1997a, b). Surf-zone fish communities off the South African West Coast have relatively high biomass, but low species diversity. Typical surf-zone fish include harders (Liza richardsonii), white stumpnose (Rhabdosargus globiceps) (Figure 34), Cape sole (Heteromycteris capensis), Cape gurnard (Chelidonichthys capensis), False Bay klipfish (Clinus latipennis), sandsharks (Rhinobatos annulatus), eagle ray (Myliobatis aquila), and smooth-hound (Mustelus mustelus) (Clark 1997b).

Fish species commonly found in kelp beds off the West Coast include hottentot Pachymetopon blochii (Figure 35, left), twotone fingerfin Chirodactylus brachydactylus (Figure 35, right), red fingers Cheilodactylus fasciatus, galjoen Dichistius capensis, rock suckers Chorisochismus dentex, maned blennies Scartella emarginata and the catshark Haploblepharus pictus (Sauer et al. 1997; Brouwer et al. 1997; Branch et al. 2010).

Figure 34: Common surf-zone fish include the harder (left, photo: aquariophil.org) and the white stumpnose (right, photo: easterncapescubadiving.co.za).

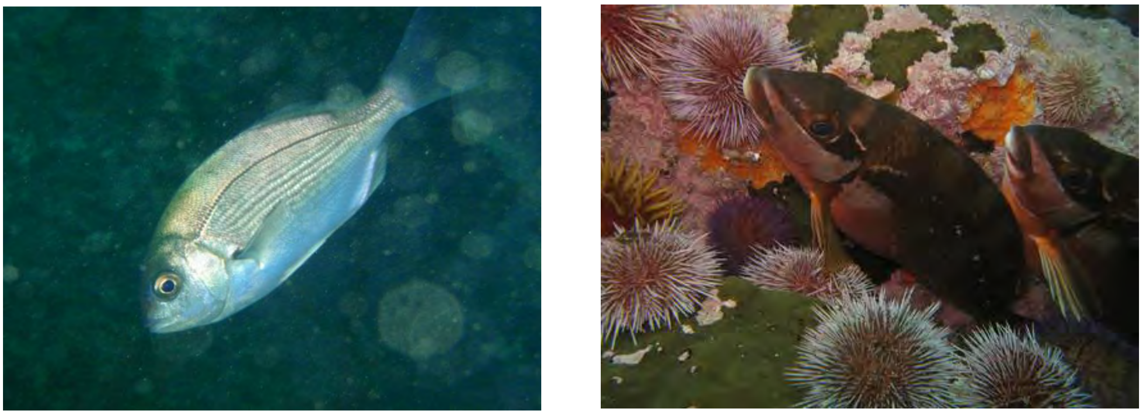


Figure 35: Common fish found in kelp beds include the Hottentot fish (left, photo: commons. wikimedia.org) and the twotone fingerfin (right, photo: www.parrphotographic.com).

Small pelagic species occurring beyond the surf-zone and generally within the 200 m contour include the sardine/pilchard (Sadinops ocellatus) (Figure 36, left), anchovy (Engraulis capensis), chub mackerel (Scomber japonicus), horse mackerel (Trachurus capensis) (Figure 36, right) and round herring (Etrumeus whiteheadi). These species typically occur in mixed shoals of various sizes (Crawford et al. 1987), and exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge (30 – 130 km offshore) extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986). They spawn downstream of major upwelling centres in spring and summer (September to February), 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 on the Agulhas Bank. 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 36: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek Thyrsites atun and chub mackerel Scomber japonicas. Both these species have been rated as 'Least concern' on the national assessment (Sink et al. 2019). While the appearance of chub mackerel along the West and South-West coasts is highly seasonal, adult snoek are found throughout their distribution range and longshore movement are random and without a seasonal basis (Griffiths 2002). Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast (Crawford & De Villiers 1985; Crawford et al. 1987), Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell (Griffiths 2003). On the West Coast, snoek move offshore to spawn and there is some southward dispersion as the spawning season progresses, with females on the West Coast moving inshore to feed between spawning events as spawning progresses. In contrast, those found further south along the western Agulhas Bank remain on the spawning grounds throughout the spawning season (Griffiths 2002) (Figure 37). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989).

The fish most likely to be encountered on the shelf, beyond the shelf break and offshore of the concession area 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 4). 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.

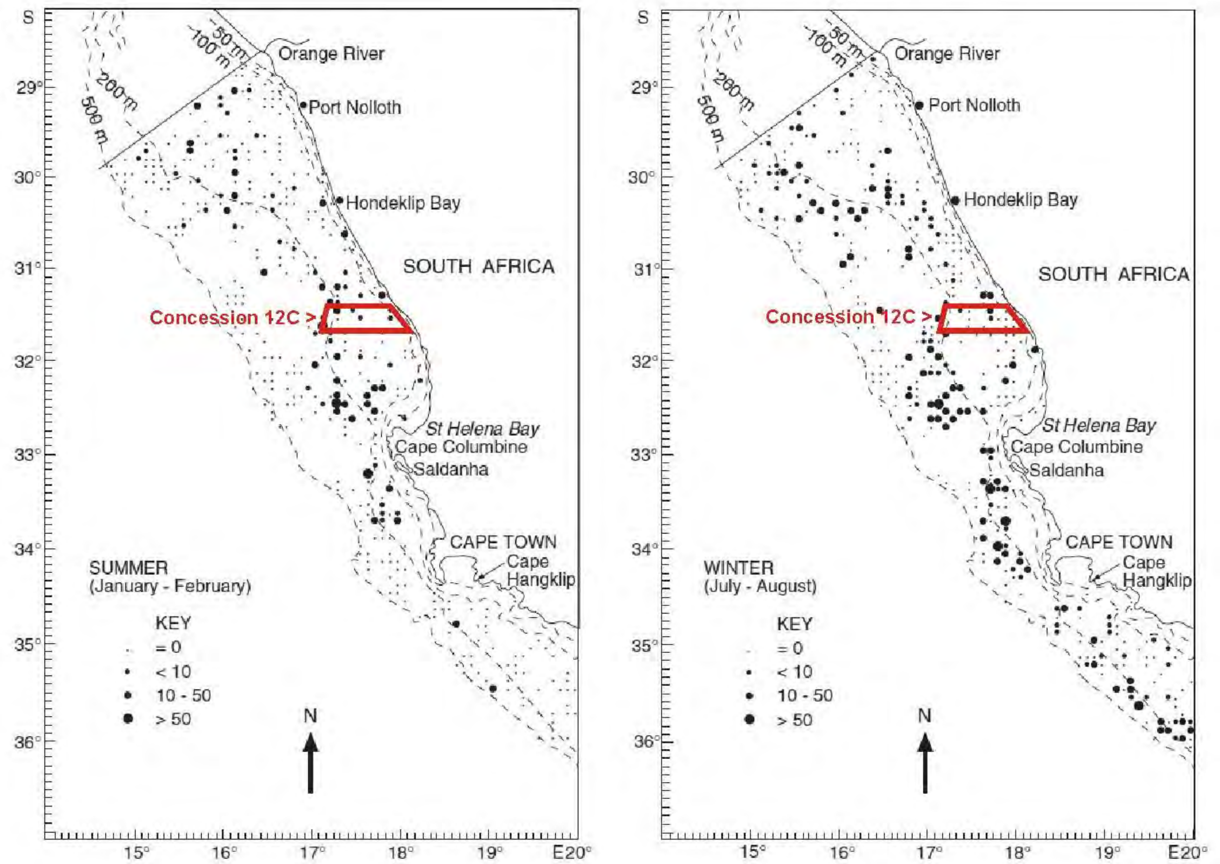


Figure 37: Mean number of snoek per demersal trawl per grid block (5 × 5 Nm) by season for (A) the west coast (July 1985–Jan 1991) and (B) the south coast in relation to Concession 12C (red polygon) (adapted from Griffiths 2002).

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Species occurring off western southern Africa include the albacore/longfin tuna Thunnus alalunga, yellowfin T. albacares, bigeye T. obesus, and skipjack Katsuwonus pelamis tunas, as well as the Atlantic blue marlin Makaira nigricans, the white marlin Tetrapturus albidus and the broadbill swordfish Xiphias gladius (Payne & Crawford 1989). The 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 (Shannon et al. 1989; Penney et al. 1992). Seasonal association with Child's Bank (off Namaqualand) and Tripp Seamount (off southern Namibia) occurs *between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/ NAM/body.htm; see CapMarine 2018 – Fisheries Specialist Study).*

Table 7: 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*	*Not Assessed*	*Endangered**
Bigeye Tuna	*Thunnus obesus*	*Vulnerable*	*Vulnerable*
Longfin Tuna/Albacore	*Thunnus alalunga*	*Near Threatened*	*Least concern*
Yellowfin Tuna	*Thunnus albacares*	*Near Threatened*	*Least concern*
Frigate Tuna	*Auxis thazard*	*Not Assessed*	*Least concern*
Eastern Little Tuna	*Euthynnus affinis*	*Least concern*	*Least concern*
Skipjack Tuna	*Katsuwonus pelamis*	*Least concern*	*Least concern*
Atlantic Bonito	*Sarda sarda*	*Not Assessed*	*Least concern*
Billfish			
Black Marlin	*Istiompax indica*	*Data deficient*	*Data deficient*
Blue Marlin	*Makaira nigricans*	*Vulnerable*	*Vulnerable*
Striped Marlin	*Kajikia audax*	*Near Threatened*	*Near Threatened*
Sailfish	*Istiophorus platypterus*	*Least concern*	*Least concern*
Swordfish	*Xiphias gladius*	*Data deficient*	*Least concern*
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*	*Not Assessed*	*Vulnerable*
Dusky Shark	*Carcharhinus obscurus*	*Data deficient*	*Vulnerable*
Bronze Whaler Shark	*Carcharhinus brachyurus*	*Data deficient*	*Near Threatened*
Great White Shark	*Carcharodon carcharias*	*Least concern*	*Vulnerable*
Shortfin Mako	*Isurus oxyrinchus*	*Vulnerable*	*Endangered*
Longfin Mako	*Isurus paucus*	*Not Assessed*	*Vulnerable*
Whale Shark	*Rhincodon typus*	*Not Assessed*	*Endangered*
Blue Shark	*Prionace glauca*	*Least concern*	*Near Threatened*

**Until recently Southern Bluefin Tuna was globally assessed as 'Critically Endangered' by the IUCN. Although globally the stock remains at a low state, it is not considered overfished as there have been improvements since previous stock assessments. Consequently, the list of species changing IUCN Red List Status for 2020-2021 now list Southern Bluefin Tuna is globally 'Endangered'. In South Africa the stock is considered collapsed (Sink et al. 2019).*

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 white Carcharodon carcharias and whale sharks Rhincodon typus may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts.*

The recapture of a juvenile blue shark off Uruguay, which had been tagged off the Cape of Good Hope, supports the hypothesis of a single blue shark stock in the South Atlantic (Hazin 2000; Montealegre-Quijano & Vooren 2010) and Indian Oceans (da Silva et al. 2010). Using the Benguela drift in a north-westerly direction, it is likely that juveniles from the parturition off the south-western Cape would migrate through the project area en route to South America (da Silva et al. 2010).

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

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

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

The distributions of some of the pelagic sharks (dusky shark, spotted ragged tooth shark, shortfin mako and smooth hammerhead) are provided in Harris et al. (2022) (Figure 38).

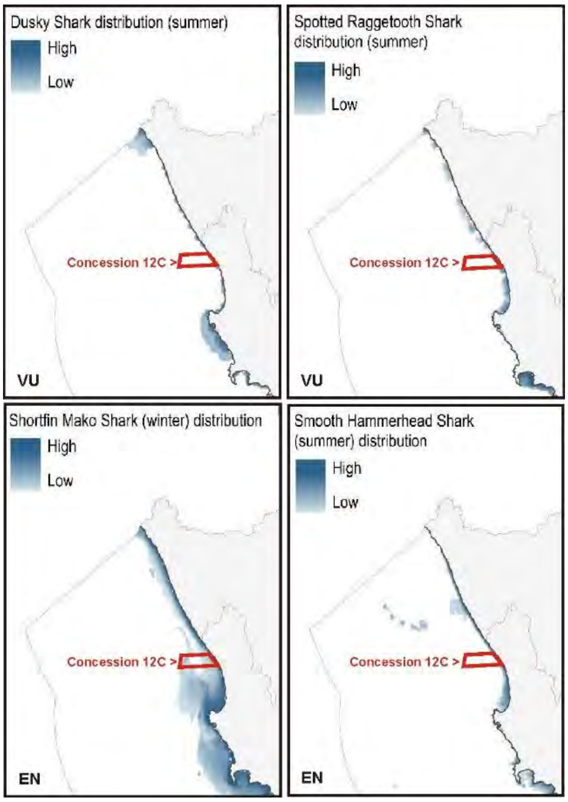


Figure 38: The distribution of various pelagic shark species in relation to Concession 12C (red polygon) (adapted from Harris et al. 2022). The IUCN conservation status is provided.

6.1.1.4.2.4 Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (Dermochelys coriacea) (Figure 39, left), and occasionally the Loggerhead (Caretta caretta) (Figure 39, right) and the Green (Chelonia mydas) turtle. Green turtles are non-breeding residents often found feeding on inshore reefs on the South and East Coasts and are expected to occur only as occasional visitors along the West Coast. The most recent conservation status, which assessed the species on a sub-regional scale, is provided in Table 8.

After completion of the nesting season (October to January) both Leatherbacks and Loggerheads undertake long-distance migrations to foraging areas. Loggerhead turtles are coastal specialists keeping inshore, hunting around reefs, bays and rocky estuaries along the African South and East Coast, where they feed on a variety of benthic fauna including crabs, shrimp, sponges, and fish. In the open sea their diet includes jellyfish, flying fish, and squid (www.oceansafrica.com/turtles.htm). Satellite tagging of loggerheads suggests that they seldom occur west of Cape Agulhas (Harris et al. 2018; Robinson et al. 2019).

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) (Lambardi et al. 2008, Elwen & Leeney 2011; SASTN 2011[4]). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi et al. 2008) (Figure 40).

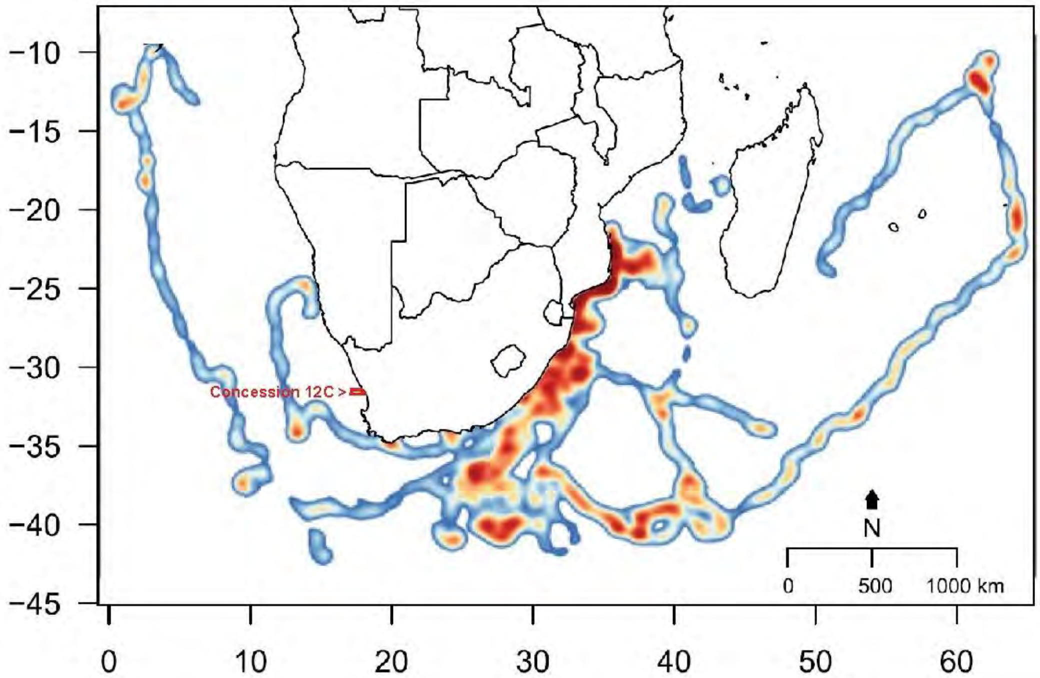
[4] SASTN Meeting – Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.

Figure 39: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

Table 8: 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*

Figure 40: Concession 12C 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 (adapted from Harris et al. 2018).

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

6.1.1.4.2.5 Seabirds

Fifteen species of seabirds breed in southern Africa, including Cape Gannet (Figure 41, left), African Penguin (Figure 41, right), African Black Oystercatcher, four species of Cormorant, White Pelican, three Gull and four Tern species. The breeding areas are distributed around the coast with islands being especially important. The closest breeding islands to concession 12C are Bird Island in Lambert's Bay and the Saldanha Bay Islands approximately 45 km and 155 km to the south of the concession area, respectively. There are breeding colonies of African Penguins at Bird Island (Lambert's Bay), and further south at Dassen Island and Robben Island. In the Western Cape, African Penguins breed mainly from February to October (peak during March to May) when their prey species (anchovy and sardine) are typically most abundant in the area (Crawford et al. 1995). The number of successfully breeding birds at the particular breeding sites varies with food abundance. Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km). Cape Gannets, which breed at only three locations in South Africa (Bird Island Lambert's Bay, Malgas Island and Bird Island Algoa Bay) are known to forage within 200 km offshore (Dundee 2006; Ludynia 2007; Grémillet et al. 2008; Crawford et al. 2011), and African Penguins have also been recorded as far as 60 km offshore. Concession 12C lies within the aggregate core home ranges of African Penguins but to the north and inshore of aggregate core home ranges of Cape Cormorant and Cape Gannet (Figure 42). There is, however, overlap of the concession with the foraging areas for Cape Cormorant and the core use area for African Penguins from Bird Island (Figure 42).

Figure 41: Cape Gannets *Morus capensis* (left) (Photo: NACOMA) and African Penguins *Spheniscus demersus* (right) (Photo: Klaus Jost) breed primarily on the offshore Islands.

Interactions with commercial fishing operations, either through incidental bycatch or competition for food resources, is the greatest threat to southern African seabirds, impacting 56% of seabirds of special concern. Crawford et al. (2014) reported that four of the seabirds assessed as Endangered compete with South Africa's fisheries for food: African Penguins, Cape Gannets and Cape Cormorants for sardines and anchovies, and Bank Cormorants for rock lobsters (Crawford et al. 2015). Populations of seabirds off the West Coast have recently shown significant decreases, with the population numbers of African Penguins currently only 2.5% of what the population was 80 years ago; declining from 1 million breeding pairs in the 1920s, 25,000 pairs in 2009 and 15,000 in 2018 (Sink et al. 2019). Poor prey availability (Crawford et al. 2006), and a shift in prey biomass eastwards in response to climatic changes has lead to high adult mortality and continued population declines in African Penguins (Sherley et al. 2017). For Cape Gannets, the global population decreased from about 250,000 pairs in the 1950s and 1960s to approximately 130,000 in 2018, primarily as a result of a >90% decrease in Namibia's population in response to the collapse of Namibia's sardine resource. In South Africa, numbers of Cape Gannets have increased since 1956 and South Africa now holds >90% of the global population. However, numbers have recently decreased in the Western Cape but increased in Algoa Bay mirroring the southward and eastward shift sardine and anchovy. Algoa Bay currently holds approximately 75% of the South African Gannet population.

Table 9: Breeding resident seabirds present along the South-West Coast (adapted from CCA & CMS 2001). IUCN Red List and National Assessment status are provided (Sink et al. 2019). * denotes endemicity.

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

Cape cormorants and Bank cormorants showed a substantial decline from the late 1970s/early 1980s to the late 2000s/early 2010s, with numbers of Cape cormorants dropping from 106,500 to 65,800 breeding pairs, and Bank cormorants from 1,500 to only 800 breeding pairs over that period (Crawford et al. 2015).

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 15 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the southern Ocean. The species classified as being common in the southern Benguela are listed in

Table 10. The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. Most of the pelagic species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here. The abundance of pelagic seabirds in concession 12C is expected to be low, as their foraging areas all lie offshore of the concession (see maps in Harris et al. 2022).

Demersal and pelagic longlining are key contributors to the mortality of albatrosses (Browed albatross 7%, Indian and Atlantic Yellow-Nosed Albatross 3%), petrels (white-chinned petrel 66%), shearwaters and Cape Gannets (2%) through accidental capture (bycatch and/or entanglement in fishing gear), with an estimated annual mortality of 450 individuals of 14 species for the period 2006 to 2013 (Rollinson et al. 2017). Other threats include predation by mice on petrel and albatross chicks on sub-Antarctic islands, predation of chicks of Cape, Crowned and Bank Cormorants by Great White Pelicans, and predation of eggs and chicks of African Penguins, Bank, Cape and Crowned Cormorants by Kelp gulls. Disease (avian flu), climate change (heat stress and environmental variability) and oil spills are also considered major contributors to seabird declines (Sink et al. 2019).

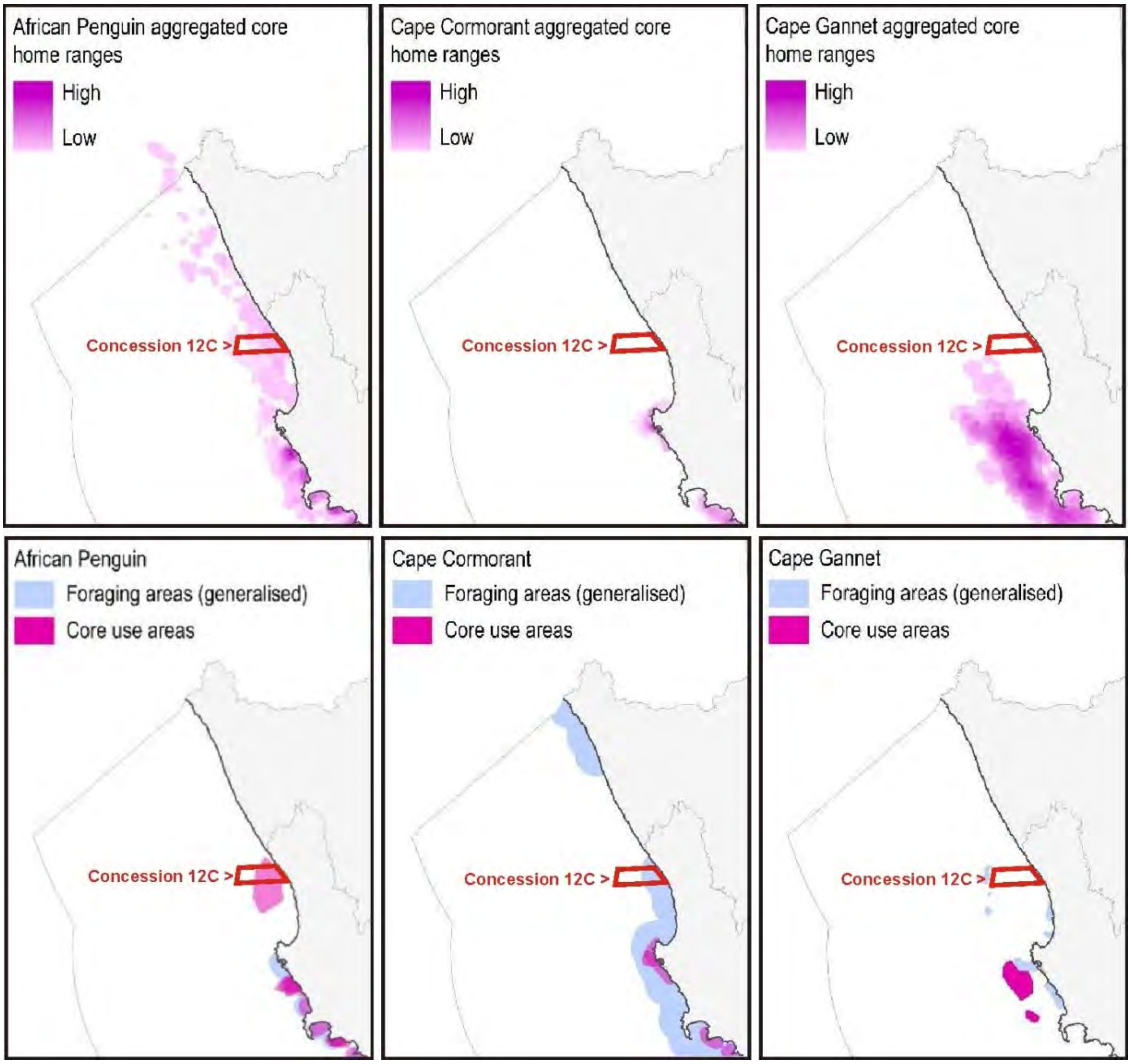


Figure 42: Concession 12C (red polygon) in relation to aggregate core home ranges (top) and generalised foraging areas and core usage areas (bottom) of African Penguins (left), Cape Cormorant (middle) and Cape Gannet (right) (adapted from Harris et al. 2022).

Table 10: Pelagic seabirds common in the southern Benguela region (Crawford et al. 1991). IUCN Red List and Regional Assessment status are provided (Sink et al. 2019).

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

6.1.1.4.2.6 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 five 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 the waters off the West Coast (Table 11). Of the species listed, the blue whale is considered 'Critically Endangered', the sei whale is 'Endangered' and the fin and sperm whales are 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. Apart from the resident species such as the endemic Heaviside's dolphin and dusky dolphin, the Benguela also hosts species that migrate between Antarctic feeding grounds and warmer breeding ground waters, as well as species with a global distribution. The offshore areas have been particularly poorly studied with most available information from deeper waters (>200 m) arising from historic whaling records prior to 1970. In the past ten years, passive acoustic monitoring and satellite telemetry have begun to shed light on current patterns of seasonality and movement for some large whale species (Best 2007; Elwen et al. 2011; Rosenbaum et al. 2014; Shabangu et al. 2019; Thomisch et al. 2019) but information on smaller cetaceans in deeper waters remains poor. Records from marine mammal observers on seismic survey vessels have provided valuable data into cetacean presence although these are predominantly during summer months (Purdon et al. 2020). Information on general distribution and seasonality is improving but data population sizes and trends for most cetacean species occurring on the west coast of southern Africa is lacking.*

Records from stranded specimens show that the area between St Helena Bay (~32°S) and Cape Agulhas (~34°S, 20°E) is an area of transition between Atlantic and Indian Ocean species, as well as those more commonly associated with colder waters of the west coast (e.g. dusky dolphins and long finned pilot whales) and those of the warmer east coast (e.g. striped and Risso's dolphins) (Findlay et al. 1992). Concession 12C 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. The continental slope (200-2,000 m) tends to support the highest diversity of cetaceans, as species from both shelf and pelagic environments may be found there (De Rock et al. 2019). Cetacean density (i.e. number of animals encountered) on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across 1,000s of km. The most common species within the project area (in terms of likely encounter rate not total population sizes) are likely to be the long-finned pilot whale, common dolphin and humpback whale. Southern right whales may also be encountered passing through the Concession en route to their coastal breeding grounds.

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

Table 11 lists the cetaceans likely to be found within the project area, based on all available data sources but mainly: Findlay et al. (1992), Best (2007), Weir (2011), De Rock et al. (2019), Purdon et al. (2020a, 2020b, 2020c) and Harris et al. (2022) (see also Figure 45 and Figure 46). 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.

6.1.1.4.2.6.1 <u>Mysticetes (Baleen whales)</u>

The majority of mysticetes whales fall into the family Balaenopeteridae. Those occurring in the area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales. The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically *separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters. All of these species show some degree of migration either to or through the latitudes encompassed by the broader project area when en route between higher latitude (Antarctic or Subantarctic) feeding grounds and lower latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality may be either unimodal, usually in winter months (June-August, e.g. minke and blue whales), or bimodal (e.g. May to July and October to November), reflecting a northward and southward migration through the area. Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations. Because of the complexities of the migration patterns, each species is discussed separately below.*

BRYDE'S WHALE (BALAENOPTER EDENI) - Two genetically and morphologically distinct populations of Bryde's whales (Figure 43, left) live off the coast of southern Africa (Best 2001; Penry 2010). The "offshore population" lives beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the west coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the broader project area in January - March. 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 inshore population has recently been recognised as its own (yet to be named) sub species (Balaenoptera brydei edeni, Penry et al. 2018) with a total population for this subspecies of likely fewer than 600 individuals. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the west coast with possible movements further north up the West Coast and into Namibia during the winter months (Best 2007). Only the offshore form may be encountered in the offshore portions of the concession area.

Table 11: Cetacean occurrence off the West Coast of South Africa, their seasonality, likely encounter frequency with proposed exploration activities and South African (Child et al. 2016) and Global IUCN Red List conservation status.

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

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

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Southern Right	*Eubalaena australis*	*LF*	*Yes*	*No*	*Year round, ONDJFMA*	*Least Concern*	*Least Concern*

- *Marine animals do not hear equally well at all frequencies within their functional hearing range. Based on the hearing range and sensitivities, Southall et al. (2019) have categorised noise sensitive marine mammal species into six underwater hearing groups: low-frequency (LF), high-frequency (HF) and very high-frequency (VHF) cetaceans, Sirenians (SI), Phocid carnivores in water (PCW) and other marine carnivores in water (OCW).*

Table 12: Seasonality of baleen whales in the broader project area based on data from multiple sources, predominantly commercial catches (Best 2007 and other sources) and data from stranding events (NDP unpubl data). Values of high (H), Medium (M) and Low (L) of the particular species <u>within</u> each row (species) and not comparable between species. For abundance / likely encounter rate within the broader region see Table 11.

	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

The offshore stock was subjected to heavy whaling in the mid-20th century (Best 2001) and there are no current data on population size or stock recovery therefrom and is currently listed as 'Data deficient' (offshore population) and Vulnerable (inshore population) on the South African Red List. The inshore stock is regarded as extremely vulnerable and listed as such on the South African red list as it regularly suffers losses from entanglement in trap fisheries and has been subject to significant changes in its prey base due to losses and shifts in the sardine and small pelagic stocks around South Africa.

Figure 43:** **The Bryde's whale Balaenoptera brydei (left) and the Minke whale Balaenoptera bonaerensis (right) (Photos: www.dailymail.co.uk; www.marinebio.org).

SEI WHALE (BALAENOPTERA BOREALIS) - Almost all information is based on whaling records 1958-1963, most from shore-based catchers operating within a few hundred km of Saldanha Bay. At this time the species was not well differentiated from Bryde's whales and records and catches of the two species intertwined. There is no current information on population recovery, abundance or much information on distribution patterns outside of the whaling catches and the species remains listed as 'Endangered' on the South African Red List. Sei whales feed at high latitudes (40-50˚S) during summer months and migrate north through South African waters to unknown breeding grounds further north (Best 2007). Their migration pattern thus shows a bimodal peak with numbers west of Saldanha Bay being highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most occurring deeper than 1,000 m (Best & Lockyer 2002). A recent survey to Vema Seamount ~1,000 km west of Cape Town during October to November 2019, encountered a broadly-spread feeding aggregation of over 30 sei and fin whales at around 200 m water depth (Elwen et al. in prep). This poorly surveyed area (roughly 32˚S, 15˚E) is just to the Northwest of the historic whaling grounds suggesting this region remains an important feeding area for the species.

FIN WHALE (BALAENOPTERA PHYSALUS) - 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 remains a mystery (Best 2007). Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). The occasional single whale has been reported during humpback whale research in November in the southern Benguela, and a feeding aggregation of ~30 animals was observed in November 2019 ~200 km west of St Helena Bay in ~2,000 m of water. Current sightings records support the bimodal peak in presence observed from whaling data (but with some chance of year-round sightings) with animals apparently feeding in the nutrient rich Benguela during their southward migration as is observed extensively for humpback and right whales (see below) there is clearly is a chance of encounters year round. There are no recent data on abundance or distribution of fin whales off western South Africa, although a sighting in St Helena Bay in 2011 (Mammal Research Institute, unpubl. data) and several sightings in southern Namibia in 2014 and 2015 as well as a number of strandings and acoustic detections (Thomisch et al. 2017) in Namibia, confirm their contemporary occurrence in the region.

LUE WHALE (BALAENOPTERA MUSCULUS) - Antarctic blue whales were historically caught in high numbers off the South African West Coast. Off Saldanha Bay, they were most abundant from May and July, with a secondary peak sometime in August to October (Best 2007). Although there were only two confirmed sightings of the species in the area between 1973 and 2006 (Branch et al. 2007), evidence of blue whale presence off southern Africa is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Tomisch et al. 2016) and off western South Africa (Shanbangu et al. 2019) and in northern Namibia between May and July (Thomisch 2017) support observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia (water depth >1 000 m) confirm their existence in the area and occurrence in autumn months (April to June). Encounters in the concession area are unlikely.

MINKE WHALE (BALAENOPTERA BONAERENSIS / ACUTOROSTRATA) - Two forms of minke whale (Figure 43, 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 (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge (Namibia) shows acoustic presence in June - August and November - December (Thomisch et al. 2016), supporting a bimodal distribution in the area. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa. Both species are generally solitary and densities are likely to be low in the project area.*

PYGMY RIGHT WHALE (CAPEREA MARGINATA) - this is the smallest of the baleen whales reaching only 6 m total length as an adult (Best 2007). The species is typically associated with cool temperate waters between 30°S and 55°S and records from southern and central Namibia are the northern most for the species (Leeney et al. 2013). Its preference for cooler waters, suggests that it is likely to be restricted to the continental shelf areas within the Benguela system, and is may occur in the deeper portions of the concession area.

The most abundant baleen whales in the Benguela are southern right whales and humpback whales (Figure 44). Both species have long been known to feed in the Benguela Ecosystem and numbers since 2000 have grown substantially. The feeding peak in the Benguela is spring and early summer (October – February) and follows the 'traditional' South African breeding season (June – November) and its associated migration (Johnson et al. 2022). Some individual right whales are known to move directly from the south coast breeding area into the west coast feeding area where they remained for several months (Barendse et al. 2011; Mate et al. 2011). Increasing numbers of summer records of both species, from the southern half of Namibia suggest that animals may also be feeding in the Lüderitz upwelling cell (NDP unpubl. data).

Figure 44: The Humpback whale Megaptera novaeangliae (left) and the Southern Right whale Eubalaena australis (right) are the most abundant large cetaceans occurring along the southern African West Coast (Photos: www.divephotoguide.com; www.aad.gov.au).

HUMPBACK WHALES (MEGAPTERA NOVAEANGLIAE): The majority of humpback whales passing through the eastern South Atlantic are migrating to breeding grounds off tropical west Africa, between Angola and the Gulf of Guinea (Rosenbaum et al. 2009; Barendse et al. 2010). Until recently it was believed that that these breeding grounds were functionally separate from those off east (Mozambique-Kenya-Madagascar), with only rare movements between them (Pomilla & Rosenbaum 2005) and movements to other continental breeding grounds being even more rare. Recent satellite tagging of animals between Plettenberg Bay and Port Alfred during the northward migration, showed them to turn around and end up feeding in the Southern Benguela (Seakamela et al. 2015) before heading offshore and southwards using the same route as whales tracked off Gabon and the West Coast of South Africa. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. Furthermore, three separate matches have been made between individuals off South Africa and Brazil by citizen scientist photo-identification (www.happywhale.com). This included whales from the Cape Town and Algoa Bay-Transkei areas. Analysis of humpback whale breeding song on Sub-Antarctic feeding grounds also suggests exchange of singing male whales from western and eastern South Atlantic populations (Darling & Sousa-Lima 2005; Schall et al. 2021; but see also Darling et al. 2019; Tyarks et al. 2021).

In southern African coastal waters, the northward migration stream is larger than the southward peak (Best & Allison 2010; Elwen et al. 2014), suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters *as one moves northwards. On the southward migration, many humpbacks follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs) possibly lingering in the feeding grounds off west South Africa in summer (Elwen et al. 2014; Rosenbaum et al. 2014). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse et al. 2010; Best & Allison 2010; Elwen et al. 2014). The only available abundance estimate put the number of animals in the West African breeding population (Gabon) to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased substantially since this time at about 5% per annum (IWC 2012; see also Wilkinson 2021). The number of humpback whales feeding in the southern Benguela has increased substantially since estimates made in the early 2000s (Barendse et al. 2011). Since ~2011, 'supergroups' of up to 200 individual whales have been observed feeding within 10 km from shore (Findlay et al. 2017) with many hundred more passing through and whales are now seen in all months of the year around Cape Town. It has been suggested that the formation of these super-groups may be in response to anomalous oceanographic conditions in the Southern Benguela, which result in favourable food availability, thereby leading to these unique humpback whale feeding aggregations (Dey et al. 2021; see also Avila et al. 2019; Meynecke et al. 2020; Cade et al. 2021). Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area (see Figure 46), ranging from the coast out beyond the shelf, with year round presence but numbers peaking during the northward migration in June – February and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.*

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

SOUTHERN RIGHT WHALE (EUBALAENA AUSTRALIS) - The southern African population of southern right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered to be a single population within this range (Roux et al. 2011). While in southern African waters, the vast majority of whales remain with a few kilometers of shore, predominantly in sheltered bays. The most recent abundance estimate for this population (2017), estimated the population at ~6,116 individuals including all age and sex classes, which is thought to be at least 30% of the original population size with the population growing at ~6.5% per year since monitoring began (Brandaõ et al. 2018). When the population numbers crashed in 1920, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Namibia (Roux et al. 2001, 2015; de Rock et al. 2019) and Mozambique (Banks et al. 2011).

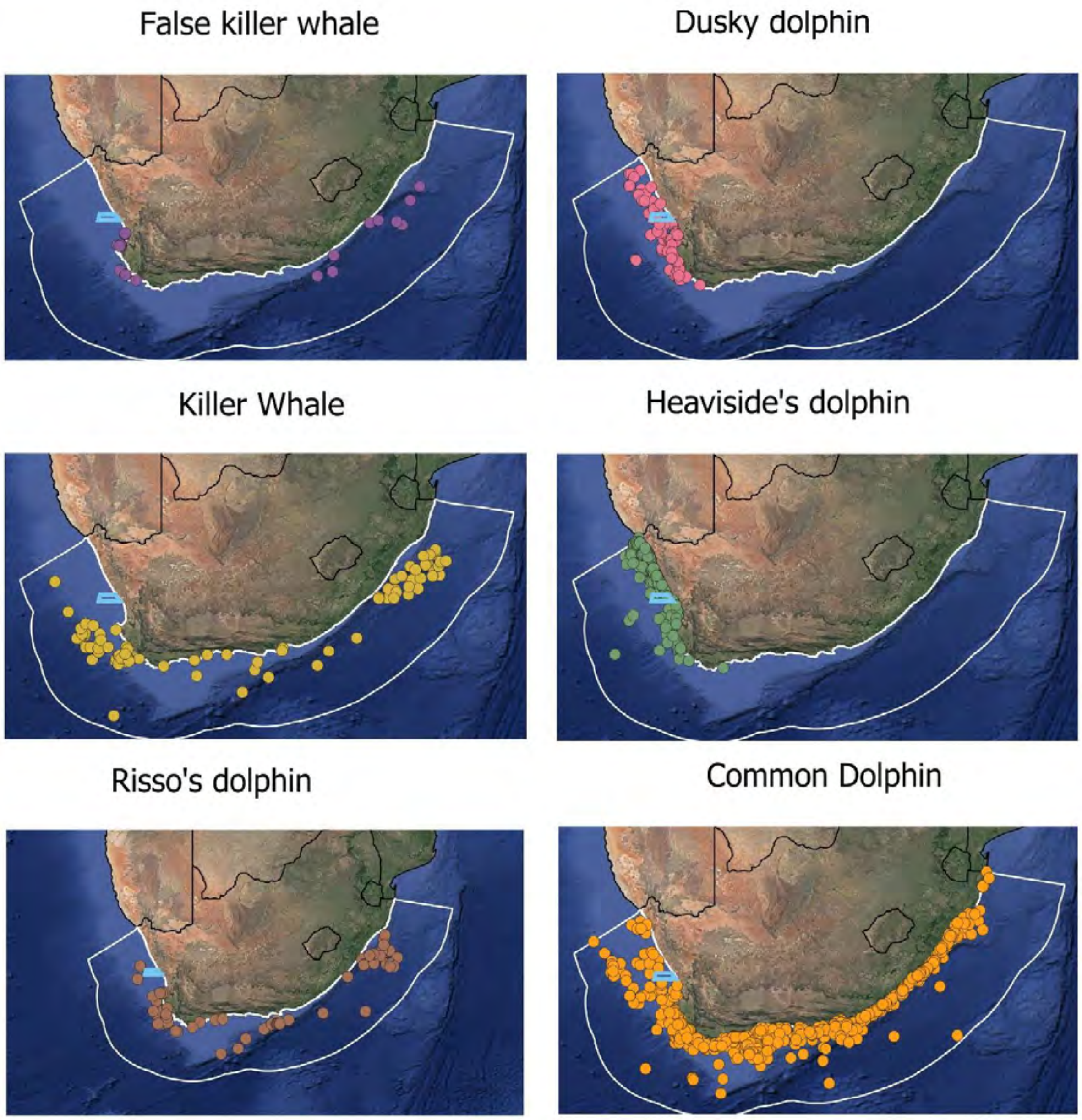


Figure 45: Concession 12C (cyan polygons) in relation to projections of predicted distributions for six odontocete species off the West Coast of South Africa (adapted from: Purdon et al. 2020a).

Some southern right whales move from the South Coast breeding ground directly to the West Coast feeding ground at St Helena Bay (Mate et al. 2011). When departing from feeding ground all satellite tagged animals in that study took a direct south-westward track. Mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding (Peters et al. 2005). While annual surveys have revealed a steady population increase since the protection of the species from commercial whaling, the South African right whale population has undergone substantial changes in breeding cycles and feeding areas (Van Den Berg et al. 2020), and numbers of animal using our coast since those studies were done – notably a significant decrease in the numbers of cow-calf-pairs following the all-time record in 2018, a marked decline of unaccompanied adults since 2010 and variable presence of mother-calf pairs since 2015 (Roux et al. 2015; Vinding et al. 2015; Vermeulen et al. 2020). Analysis of calving intervals suggests that many animals shifted from a 3 year to 4 year calving interval (Brandaõ et al. 2018). The change in demographics are indications of a population undergoing nutritional stress and has been attributed to likely spatial and/or temporal displacement of prey due to climate variability (Vermeulen et al. 2020; see also Derville et al. 2019; Kershaw et al. 2021; van Weelden et al. 2021). Recent sightings (2018-2021) confirm that there is still a clear peak in numbers on the West Coast (Table Bay to St Helena Bay) between February and April. Pelagic concentrations of right whales were recorded in historic whaling records, in a band between 30°S and 40°S between Cape Town and Tristan da Cunha (Best 2007), well offshore of the concession area. These aggregations may be a result of animals feeding in this band, or those migrating south west from the Cape. Given this high proportion of the population known to feed in the southern Benguela, *and the historical records, it is highly likely that large numbers of right whales may pass through the concession area between May and June and then again November to January.*

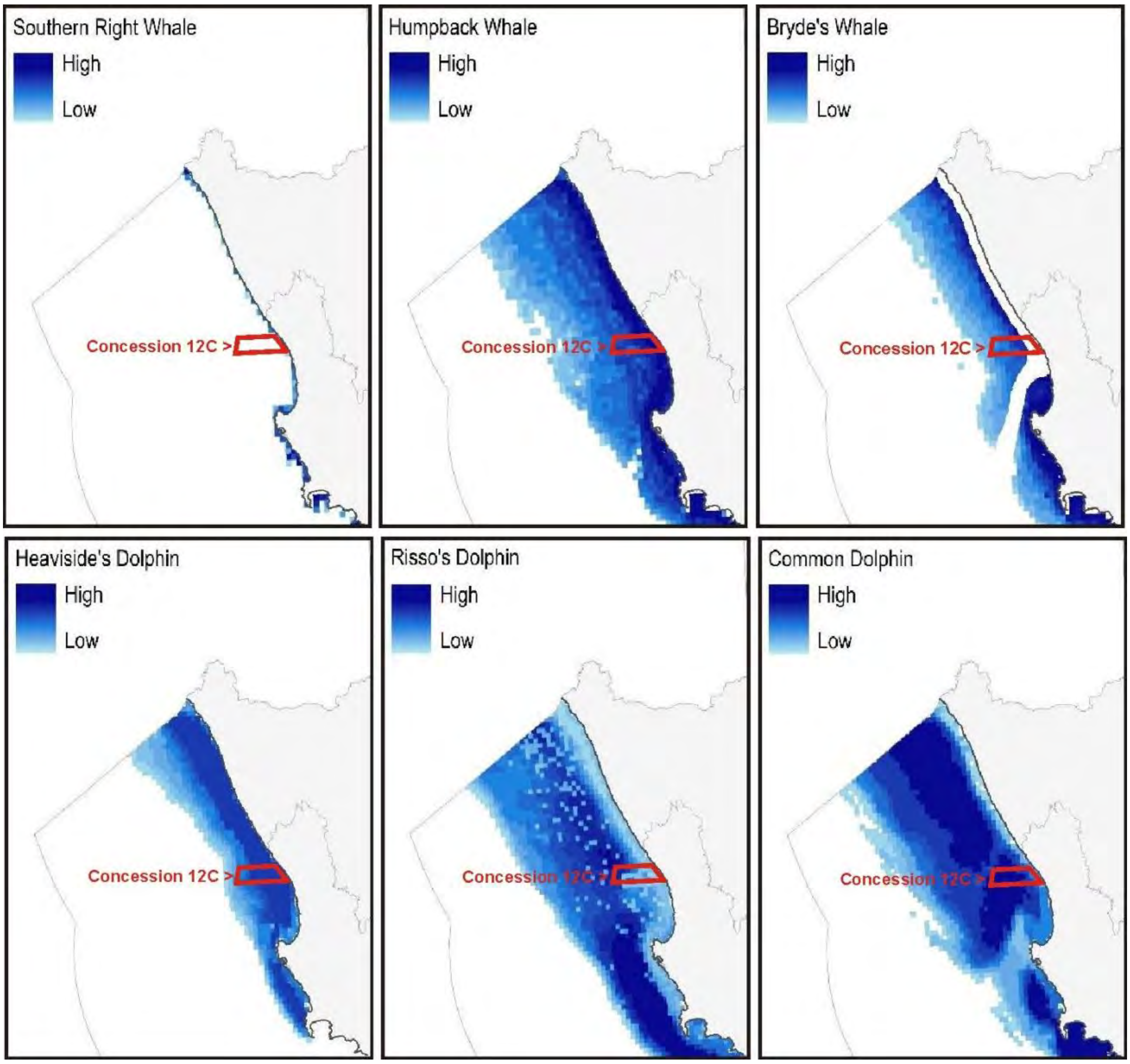


Figure 46: Concession 12C (red polygon) in relation to the predicted distribution of southern right whale (top left), humpback whale (top middle), Bryde's Whale (top right), Heaviside's dolphin (bottom left), Risso's dolphin (bottom middle), and common dolphin (bottom right) and with darker shades of blue indicating highest likelihood of occurrence (adapted from Harris et al. 2022).

Figure 47: Concession 12C (red polygone) in relation to 'blue corridors' or 'whale superhighways' showing tracks of Humpback whales (orange) and Southern Right whales (green) between southern Africa and the Southern Ocean feeding grounds (adapted from Johnson et al. 2022).

6.1.1.4.2.6.2 Odontocetes (toothed whales and dolphins)

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging (Figure 45). Those in the region can range in size from 1.6-m long (Heaviside's dolphin) to 17 m (bull sperm whale).

SPERM WHALE (PHYSETER MACROCEPHALUS) - All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 (Best 2007). Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They live in deep ocean waters, usually greater than 1,000 m depth, although they occasionally come onto the shelf in water 500 - 200 m deep (Best 2007) (Figure 48, left). They are considered to be relatively abundant globally (Whitehead 2002), 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 (Best 2007). Sperm whales are likely to be encountered in relatively high numbers in deeper waters (>500 m) beyond the 12C concession, predominantly in the winter months (April - October). Analysis of recent passive acoustic monitoring data from the edge of the South African continental shelf (800 – 1,000 m water depth, roughly 80 km WSW of Cape Point) confirms year-round presence. Sperm whales 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 monitoring equipment such as Passive Acoustic Monitoring (PAM).

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 southern Africa. Beaked whales are all considered to be true deep water species usually being seen in waters in excess *of 1,000 – 2,000 m deep (see various species accounts in Best 2007). Presence in the concession area may fluctuate seasonally, but insufficient data exist to define this clearly.*

PYGMY AND DWARF SPERM WHALES (KOGIA SPP) - The genus Kogia currently contains two recognised species, the pygmy (K. breviceps) and dwarf (K. sima) sperm whales, both of which most frequently occur in pelagic and shelf edge waters. Their abundance and population trends in South African waters are unknown (Seakamela et al. 2021). Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic, although their narrow-band high frequency echolocation clicks make them detectable and identifiable (at least to the genus) using passive acoustic monitoring equipment. The majority of what is known about the distribution and ecology of Kogiid whales in the southern African subregion is derived mainly from stranding records (e.g. Ross 1979; Findlay et al. 1992; Plön 2004; Elwen et al. 2013, but see also Moura et al. 2016). Dwarf sperm whales are associated with the warmer waters south and west of St Helena Bay. They are recorded from both the Benguela and Agulhas ecosystem (Best 2007) in waters deeper than ~1,000 m, and are thus unlikely to occur in the concession area.

During 2020 the incidence of kogiid strandings between Strandfontein on the West Coast and Groot Brak River on the South Coast (n=17), was considerably higher than the annual average during the previous 10 years (n=7). The dwarf sperm whale (K. sima) accounted for 60% of these strandings, of which most were recorded during autumn and winter. These seasonal stranding patterns are consistent with previously published accounts for the South African coast. In 2020, 40% of the total strandings were recorded in winter and 15% during summer. The occurrence of strandings throughout the year may, however, indicate the presence of a resident population with a seasonal distribution off the South Coast in autumn and winter (Seakamela et al. 2020, 2021). The cause of the strandings is unknown.

KILLER WHALE (ORCINUS ORCA) - Killer whales in South African waters were referred to a single morphotype, Type A, although recently a second 'flat-toothed' morphotype that seems to specialise in an elasmobranch diet has been identified but only 5 records are known all from strandings (Best et al. 2014). Killer whales (Figure 48) have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off South Africa (Best et al. 2010, Elwen et al. in prep), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir et al. 2010). Historically sightings were correlated with that of baleen whales, especially sei whales on their southward migration. In more recent years – their presence in coastal waters (e.g. False Bay) has been strongly linked to the presence and hunting of common dolphins (Best et al. 2010; Sea Search unpublished data). Further from shore, there have been regular reports of killer whales associated with long-line fishing vessels on the southern and eastern Agulhas Bank, and the Cape Canyon to the south-west of Cape Point. Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the concession area at low levels.

FALSE KILLER WHALE (PSEUDORCA CRASSIDENS) – Although the false killer whale is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed (Best 2007). False killer whales are more likely to be confused with the smaller melon-headed or pygmy killer whales with which they share all-black colouring and a similar head-shape, than with killer whales. The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1,000 m, but with a few recorded close to shore (Findlay et al. 1992). They usually occur in groups ranging in size from 1 - 100 animals (Best 2007). The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the Western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007).

PILOT WHALES (GLOBICEPHALA MELAS) – Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it but moving inshore to follow prey (primarily squid) (Mate et al. 2005; Findlay et al. 1992; Weir 2011; Seakamela et al. 2022). They are regularly seen associated with the shelf edge by MMOs, fisheries observers and researchers. The distinction between long-finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species confined to the southwest Indian Ocean (Best 2007), it is likely that the majority of pilot whales encountered in the project area will be long-finned. There are many confirmed sighting of pilot whales along the shelf edge of South Africa and Namibia (de Rock et al. 2019; Sea Search unpublished data, SLR data). Observed group sizes range from 8-100 individuals (Seakamela et al. 2022). A recent tagging study showed long-finned pilot whale movements within latutudes of 33-36°S, along the shelf-edge from offshore of Cape Columbine to the Agulhas Bank, with concentrations in canyon areas, especially around the Cape Point Valley, and to a lesser degree around the Cape Canyon. It is postulated that the pilot whales target prey species in these productive areas (Seakamela et al. 2022).

COMMON DOLPHIN (DELPHINUS SPP.) – Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay et al. 1992; Best 2007), although they are currently considered part of *a single global species (Cunha et al. 2015). The long-beaked common dolphin lives on the continental shelf of South Africa rarely being observed north of St Helena Bay on the west coast or in waters more 500 m deep (Best 2007), although more recent MMO sightings suggest presence to 1,000 m or more (SLR data, Sea Search data). Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region (Findlay et al. 1992). Far less is known about the short-beaked form which is challenging to differentiate at sea from the long-beaked form.*

Figure 48: Sperm whales Physeter macrocephalus (left) and killer whales Orcinus orca (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org).

DUSKY DOLPHINS (LAGENORHYNCHUS OBSCURUS) - In water <500 m deep, dusky dolphins (Figure 49, 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; Sea Search data). Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lambert's Bay (Elwen et al. 2010; Sea Search 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).

HEAVISIDE'S DOLPHINS (CEPHALORHYNCHUS HEAVISIDII) – This species (Figure 49, left) is relatively abundant in the Benguela ecosystem region with 10,000 animals estimated to live in the 400 km of coast between Cape Town and Lambert's Bay (Elwen 2008; Elwen et al. 2009a, 2009b). The Heaviside's dolphin occupies waters from the coast to at least 200 m depth, (Elwen et al. 2006; Best 2007), and may show a diurnal onshore-offshore movement pattern (Elwen et al. 2010b), as they feed offshore at night. Heaviside's dolphins are resident year round and likely to be frequently encountered in the concession area.

RISSO'S DOLPHIN: A medium sized dolphin with a distinctively high level of scarring and a proportionally large dorsal fin and blunt head. Risso's dolphins are distributed worldwide in tropical and temperate seas and show a general preference for shelf edge waters <1,500 m deep (Best 2007; Purdon et al. 2020a, 2020b). Many sightings in southern Africa have occurred around the Cape Peninsula and along the shelf edge of the Agulhas bank (see also Figure 46).

OTHER DELPHINIDS – 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 (Findlay et al. 1992; Best 2007). Nothing is known about the population size or density of these species in the project area but encounters are likely to be rare.

Figure 49: The endemic Heaviside's Dolphin Cephalorhynchus heavisidii (left) (Photo: De Beers Marine Namibia), and Dusky dolphin Lagenorhynchus obscurus (right) (Photo: scottelowitzphotography.com).

BEAKED WHALES (VARIOUS SPECIES) – These whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. They are all considered to be true deep water species usually being seen in waters in excess of 1,000 – 2,000 m deep (see various species accounts in Best 2007). With recorded dives of well over an hour and in excess of 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals (Tyack et al. 2011). All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007). The long, deep dives of beaked whales make them difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives. Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often en masse, have been recorded in association with mid-frequency naval sonar (Cox et al. 2006; MacLeod & D'Amico 2006) and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler (Southall et al. 2008; Cox et al. 2006; DeRuiter et al. 2013). Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, existing evidence suggests that animals change their dive behaviour in response to acoustic disturbance (Tyack et al. 2011), showing a fear-response and surfacing too quickly with insufficient time to release nitrogen resulting in a form on decompression sickness. Necropsy of stranded animals has revealed gas embolisms and haemorrhage in the brain, ears and acoustic fat - injuries consistent with decompression sickness (acoustically mediated bubble formation) (Fernandez et al. 2005). Beyond decompression sickness, the fear/flee response may be the first stage in a multi-stage process ultimately resulting in stranding (Southall et al. 2008; Jepson et al. 2013). This type of stranding event has been linked to both naval sonar and multi-beam echosounders used for commercial scale side scan sonar (Southall et al. 2008). Thus, although hard to detect and avoid, beaked whales are amongst the most sensitive marine mammals to noise exposure and all cautions must be taken to reduce impact. Sightings of beaked whales in the project area are expected to be very low.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

6.1.1.4.2.6.3 Pinnepeds

The Cape fur seal (Arctocephalus pusillus pusillus) (Figure 50) 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. The South African population, which includes the West Coast colonies, was estimated at ca. 725,000 individuals in 2020. This is about 40% of the total southern African population, which has previously been estimated at up to 2 million (Seakamela et al. 2022). Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (Mirounga leoninas), subantarctic fur seal (Arctocephalus tropicalis), crabeater (Lobodon carcinophagus) and leopard seals (Hydrurga leptonyx) (David 1989).

Figure 50: Colony of Cape fur seals Arctocephalus pusillus pusillus (Photo: Jessica Kemper).

There are a number of Cape fur seal breeding colonies within the broader study area: at Bucchu Twins near Alexander Bay, at Cliff Point (~17 km north of Port Nolloth), at Kleinzee (incorporating Robeiland), Strandfontein Point (south of Hondeklipbaai), Elephant Rocks, Paternoster Rocks and Jacobs Reef at Cape Columbine. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). The closest breeding colony to concession 12C is at Elephant Rocks inshore of the concession (Figure 51). They are therefore likely to be encountered during survey and sampling activities throughout concession 12C.

Non-breeding colonies and haul-out sites occur at Doringbaai south of Cliff Point, Rooiklippies, Swartduin and Noup between Kleinzee and Hondeklipbaai, at Spoeg River and Langklip south of Hondeklip Bay, on Bird Island at Lambert's Bay, at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. 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 (Shaughnessy 1979), with bulls ranging further out to sea than females. Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish. Benthic feeding to depths of nearly 200 m for periods of up to 2 minutes has, however, also been recorded (Kirkman et al. 2015).

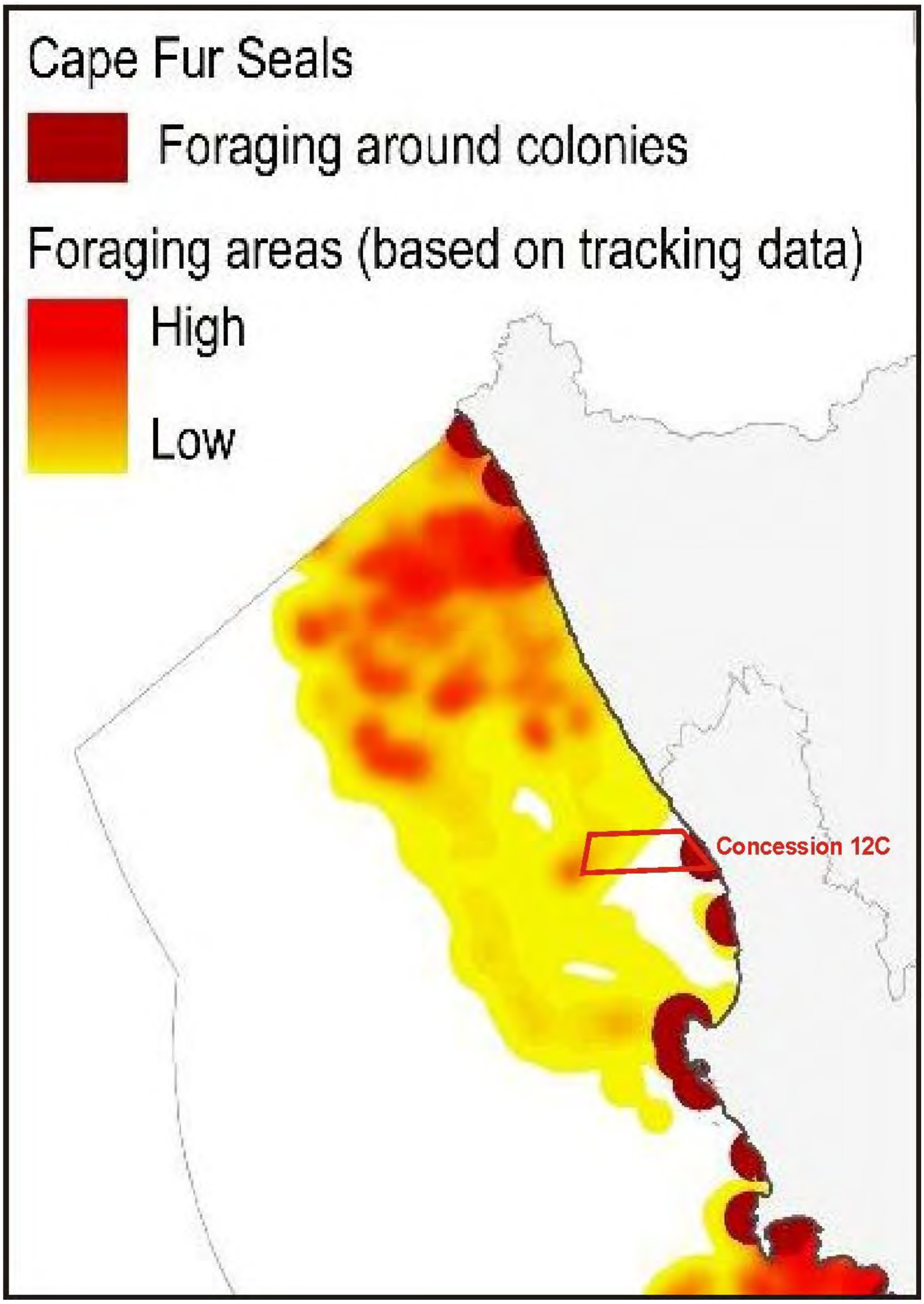


Figure 51: Concession 12C (red polygon) (red polygon) in relation to seal foraging areas on the West and South Coasts. Brown areas are generalised foraging areas around colonies, and areas in shades of red are foraging areas based on tracking data. Darker shades of red indicate areas of higher use (Adapted from Harris et al. 2022).

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

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status is not regarded as threatened. The Cape Fur Seal population in South Africa is regularly monitored by the Department of Environment, Forestry and Fisheries (DEFF) (e.g. Kirkman et al. 2013). The overall population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population (Kirkman et al. 2013).

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

6.1.1.4.3 Coastal Communities

The coastline of the project area is characterised by intertidal sandy beaches, rocky shores and estuaries. These were categorised into ecosystem types by Sink et al. (2019) and assigned a threat status depending on their geographic extent and extent of ecosystem degradation. Although the eastern boundary of concession 12C lies 5 km seawards of the shore, coastal communities and estuaries in the project area are discussed briefly here for the sake of completeness. Table 13 summarises the threat status of these ecosystem types in the broader project area (see also Figure 24).

A general description of intertidal sandy beach and rocky shore habitats on the West Coast is provided below.

6.1.1.4.3.1 Intertidal Sandy Beaches

Much of the coastline between Hondeklipbaai and the Olifants River mouth comprises sandy shores. Sandy beaches are one of the most dynamic coastal environments. With the exception of a few beaches in large bay systems (such as St Helena Bay, Saldanha Bay, Table Bay), the beaches along the South African West Coast are typically highly exposed. Exposed sandy shores consists of coupled surf-zone, beach and dune systems, which together form the active littoral sand transport zone (Short & Hesp 1985). The composition of their faunal communities is largely dependent on the interaction of wave energy, beach slope and sand particle size, which is termed beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan et al. 1993). Generally, dissipative beaches are relatively wide and flat with fine sands and low wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities. Reflective beaches in contrast, have high wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf-zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities. Intermediate beach conditions exist between these extremes and have a very variable species composition (McLachlan et al. 1993; Jaramillo et al. 1995, Soares 2003). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of e.g. kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch & Griffiths 1988). As a result of the combination of typical beach characteristics, and the special adaptations of beach fauna to these, beaches act as filters and energy recyclers in the nearshore environment (Brown & McLachlan 2002).

Table 13: Threat status of the intertidal and shallow subtidal ecosystem types in the broader project area (Sink et al. 2019).

Ecosystem Type	*2019 Threat Status*
Namaqua Exposed Rocky Shore	*Vulnerable*
Namaqua Kelp Forest	*Vulnerable*
Namaqua Mixed Shore	*Vulnerable*
Namaqua Sheltered Rocky Shore	*Vulnerable*
Namaqua Very Exposed Rocky Shore	*Vulnerable*
Southern Benguela Dissipative Intermediate Sandy Shore	*Least Concern*
Southern Benguela Dissipative Sandy Shore	*Least Concern*
Southern Benguela Intermediate Sandy Shore	*Near threatened*
Southern Benguela Reflective Sandy Shore	*Endangered*

Numerous methods of classifying beach zonation have been proposed, based either on physical or biological criteria. The general scheme proposed by Branch & Griffiths (1988) is used below (Figure 52), supplemented by data from various publications on West Coast sandy beach biota (e.g. Bally 1987; Brown et al. 1989; Soares *et al. 1996, 1997; Nel 2001; Nel et al. 2003; Soares 2003; Branch et al. 2010; Harris 2012). The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone. Due to the exposed nature of the coastline in the study area, most beaches are of the intermediate to reflective type. The upper beach dry zone (supralittoral) is situated above the high water spring (HWS) tide level, and receives water input only from large waves at spring high tides or through sea spray. This zone is characterised by a mixture of air breathing terrestrial and semi-terrestrial fauna, often associated with and feeding on kelp deposited near or on the driftline. Terrestrial species include a diverse array of beetles and arachnids and some oligochaetes, while semi-terrestrial fauna include the oniscid isopod Tylos granulatus, and amphipods of the genus Talorchestia. The mid-beach retention zone and low-beach saturation zone (intertidal zone or mid-littoral zone) has a vertical range of about 2 m. This mid-shore region is characterised by the cirolanid isopods Pontogeloides latipes, Eurydice (longicornis=) kensleyi, and Excirolana natalensis, the polychaetes Scolelepis squamata, Orbinia angrapequensis, Nepthys hombergii and Lumbrineris tetraura, and amphipods of the families Haustoridae and Phoxocephalidae (Figure 53). In some areas, juvenile and adult sand mussels Donax serra may also be present in considerable numbers.*

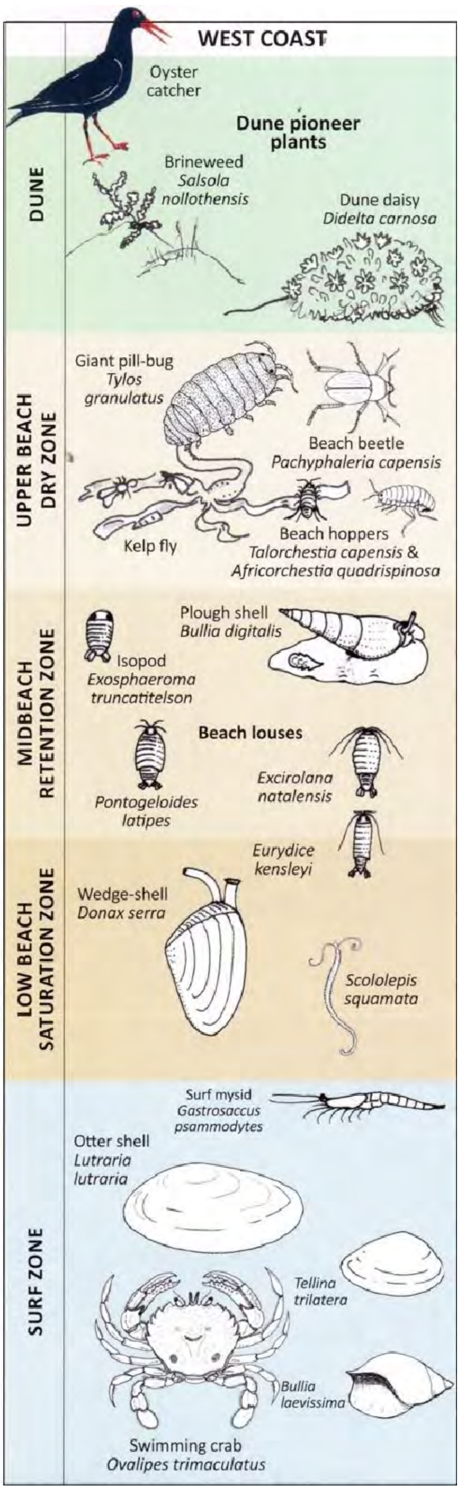


Figure 52: Schematic representation of the West Coast intertidal beach zonation (adapted from Branch & Branch 2018).

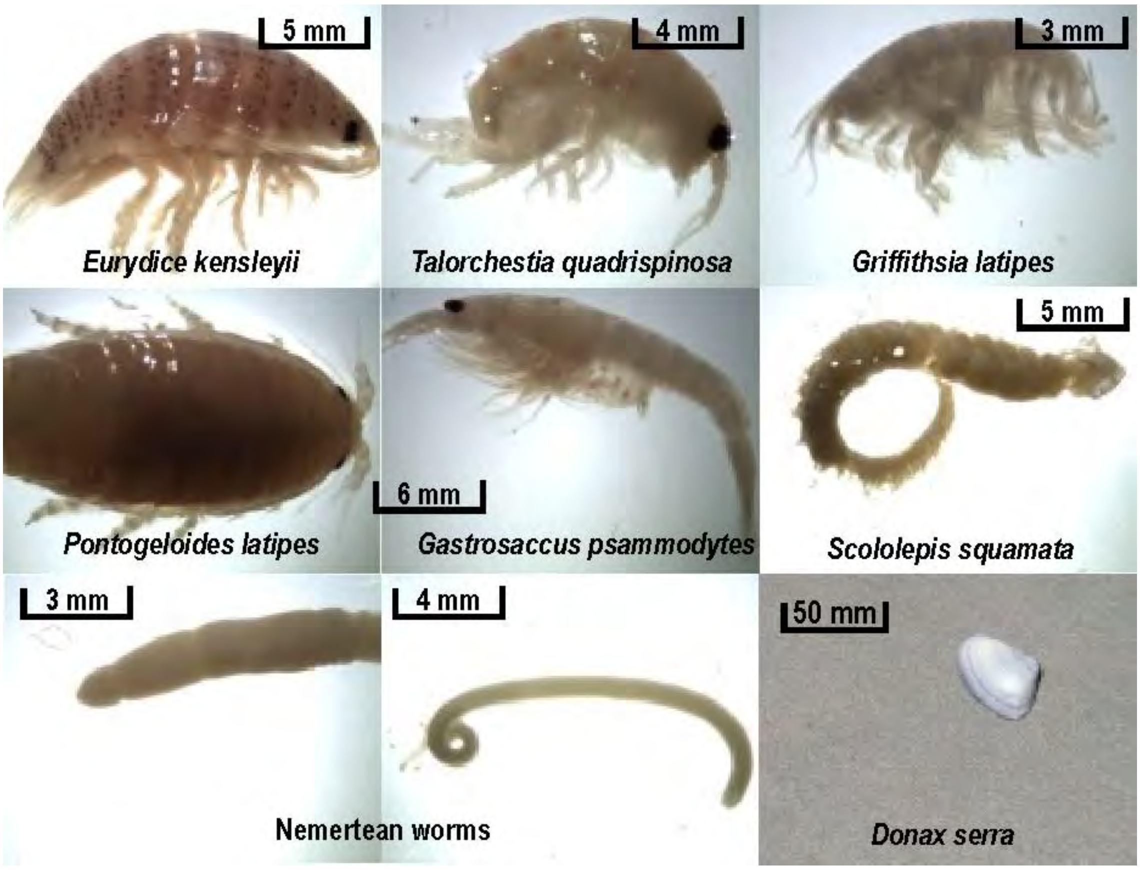


Figure 53: Common beach macrofaunal species occurring on exposed West Coast beaches.

The surf zone (inner turbulent and transition zones) extends from the Low Water Spring mark to about -2 m depth. The mysid Gastrosaccus psammodytes (Mysidacea, Crustacea), the ribbon worm Cerebratulus fuscus (Nemertea), the cumacean Cumopsis robusta (Cumacea) and a variety of polychaetes including Scolelepis squamata and Lumbrineris tetraura, are typical of this zone, although they generally extend partially into the midlittoral above. In areas where a suitable swash climate exists, the gastropod Bullia digitalis (Gastropoda, Mollusca) may also be present in considerable numbers, surfing up and down the beach in search of carrion.

The transition zone spans approximately 2 - 5 m depth beyond the inner turbulent zone. Extreme turbulence is experienced in this zone, and as a consequence this zone typically harbours the lowest diversity on sandy beaches. Typical fauna include amphipods such as Cunicus profundus and burrowing polychaetes such as Cirriformia tentaculata and Lumbrineris tetraura.

The outer turbulent zone extends beyond the surf zone and below 5 m depth, where turbulence is significantly decreased and species diversity is again much higher. In addition to the polychaetes found in the transition zone, other polychaetes in this zone include Pectinaria capensis, and Sabellides ludertizii. The sea pen Virgularia schultzi (Pennatulacea, Cnidaria) is also common as is a host of amphipod species and the three spot swimming crab Ovalipes punctatus (Brachyura, Crustacea).

6.1.1.4.3.2Intertidal Rocky Shores

The following general description of the intertidal and subtidal habitats for the West Coast is based on Field et al. (1980), Branch & Griffiths (1988), Field & Griffiths (1991) and Branch & Branch (2018).

Several studies on the west coast of southern Africa have documented the important effects of wave action on the intertidal rocky-shore community. Specifically, wave action enhances filter-feeders by increasing the concentration and turnover of particulate food, leading to an elevation of overall biomass despite low species diversity (McQuaid & Branch 1985; Bustamante & Branch 1995, 1996a; Bustamante et al. 1997). Conversely, sheltered shores are diverse with a relatively low biomass, and only in relatively sheltered embayments does drift kelp accumulate and provide a vital support for very high densities of kelp trapping limpets, such as Cymbula granatina that occur exclusively there (Bustamante et al. 1995). In the subtidal, these differences diminish as wave exposure is moderated with depth.

West Coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities: The Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones. These biological zones correspond roughly to zones based on tidal heights (Figure 54 and Figure 55).

Tolerance to the physical stresses associated with life on the intertidal, as well as biological interactions such as herbivory, competition and predation interact to produce these five zones.

The uppermost part of the shore is the supralittoral fringe, which is the part of the shore that is most exposed to air, perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny periwinkle Afrolittorina knysnaensis, and the red alga Porphyra capensis constituting the most common macroscopic life.

The upper mid-littoral is characterised by the limpet Scutellastra granularis, which is present on all shores. The gastropods Oxystele variegata, Nucella dubia, and Helcion pectunculus are variably present, as are low densities of the barnacles Tetraclita serrata, Octomeris angulosa and Chthalamus dentatus. Flora is best represented by the green algae Ulva spp.

Toward the lower Mid-littoral or Lower Balanoid zone, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds with a variable representation of: green algae – Ulva spp, Codium spp.; brown algae – Splachnidium rugosum; and red algae – Aeodes orbitosa, Mazzaella (=Iridaea) capensis, Gigartina polycarpa (=radula), Sarcothalia (=Gigartina) stiriata, and with increasing wave exposure Plocamium rigidum and P. cornutum, and Champia lumbricalis. The gastropods Cymbula granatina and Burnupena spp. are also common, as is the reef building polychaete Gunnarea capensis, and the small cushion starfish Patiriella exigua. On more exposed shores, almost all of the primary space can be occupied by the dominant alien invasive mussel Mytilus galloprovincialis. First recorded in 1979 (although it is likely to have arrived in the late 1960s), it is now the most abundant and widespread invasive marine species spreading along the entire West Coast and parts of the South Coast (Robinson et al. 2005). M. galloprovincialis has partially displaced the local mussels Choromytilus meridionalis and Aulacomya ater (Hockey & Van Erkom Schurink 1992), and competes with several indigenous limpet species (Griffiths et al. 1992; Steffani & Branch 2003a, b). Recently, another alien invasive has been recorded, the acorn barnacle Balanus glandula, which is native to the west coast of North America where it is the most common intertidal barnacle. The presence of B. glandula in South Africa was only noticed a few years ago as it had always been confused with the native barnacle Cthamalus dentatus (Simon-Blecher et al. 2008). There is, however, evidence that it has been in South Africa since at least 1992 (Laird & Griffith 2008). At the time of its discovery, the barnacle was recorded from 400 km of coastline from Elands Bay to Misty Cliffs near Cape Point (Laird & Griffith 2008). Thus, it is likely that it occurs inshore of concession 12C. When present, the barnacle is typically abundant at the mid zones of semi-exposed shores.

Along the sublittoral fringe, the large kelp-trapping limpet Scutellastra argenvillei dominates forming dense, almost monospecific stands achieving densities of up to 200/m^2 (Bustamante et al. 1995). Similarly, C. granatina is the dominant grazer on more sheltered shores, also reaching extremely high densities (Bustamante et al. 1995). On more exposed shores M. galloprovincialis dominates. There is evidence that the arrival of the alien M. palloprovincialis has led to strong competitive interaction with S. argenvillei (Steffani & Branch 2003a, 2003b, 2005). The abundance of the mussel changes with wave exposure, and at wave-exposed locations, the mussel can cover almost the entire primary substratum, whereas in semi-exposed situations it is never abundant. As the cover of M. galloprovincialis increases, the abundance and size of S. argenvillei on rock declines and it becomes confined to patches within a matrix of mussel bed. As a result exposed sites, once dominated by dense populations of the limpet, are now largely covered by the alien mussel. Semi-exposed shores do, however, offer a refuge preventing global extinction of the limpet. In addition to the mussel and limpets, there is variable representation of the flora and fauna described for the lower mid-littoral above, as well as the anemone Aulactinia reynaudi, numerous whelk species and the sea urchin Parechinus angulosus. Some of these species extend into the subtidal below.

The invasion of west coast rocky shores by another mytilid, the small Semimytilus algosus, has been noted (de Greef et al. 2013). It is hypothesized that this species has established itself fairly recently, probably only in the last ten years. Its current range extends from the Groen River mouth in the north to False Bay in the south (Ma et al. 2020). Where present, it occupies the lower intertidal zone, where they completely dominate primary rock space, while M. galloprovincialis dominates higher up the shore. Many shores on the West Coast have thus now been effectively partitioned by the three introduced species, with B. glandula colonizing the upper intertidal, M. galloprovincialis dominating the mid-shore, and now S. algosus smothering the low-shore (de Greef et al. 2013).

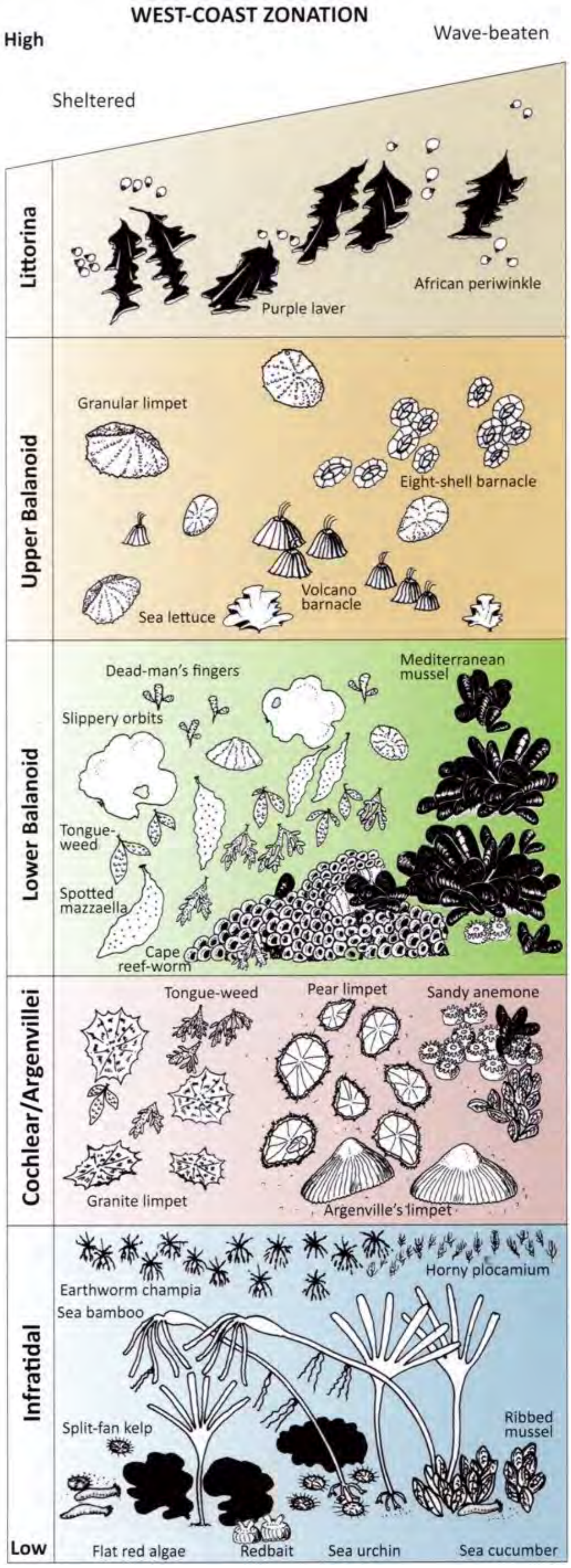


Figure 54: Schematic representation of the West Coast intertidal rocky shore zonation (adapted from Branch & Branch 2018).

Figure 55: Typical rocky intertidal zonation on the southern African west coast.

6.1.1.4.3.3 Estuaries

Estuaries along the West Coast generally fall within the Cool Temperate bioregion. On the West Coast, there are three perennial river mouths that are always open to the sea and have estuarine systems in their lower reaches: the Orange, Olifants and Berg Rivers. The Berg River Estuary, ~120 km south of concession 12C, has the largest and most diverse associated saline and freshwater wetlands compared to all other permanently open estuaries in South Africa. Langebaan is an estuarine lagoon comprising shallow intertidal sand banks and deeper channels that experience tidally driven input of nutrient rich, upwelled water from the sea and groundwater input in the upper reaches. Together, this creates an ecologically productive system that supports long-standing fisheries. The numerous smaller estuaries along the West Coast are intermittently, or seasonally, open (Holgat, Buffels, Swartlintjies, Bitter, Spoeg, Groen, Brak, Sout and Jakkals Rivers). Those estuaries inshore of concession 12C are the intermittently-open Sout River estuary, which lies ~25 km to the north of the northern boundary of the concession, and the permanently-open Olifants River estuary, whwich lies inshore of the southern boundary of concession 12C.

Predominantly open estuaries and estuarine lagoons are particularly important for recruitment for some inshore linefish species and are the most vulnerable to marine pollution events as they receive tidal inflows almost constantly. Estuarine habitats are highly variable environments with salinity, temperature pH and other variables change with the tides, seasons and climatic conditions. Changes in the extent of water coverage and flow may alternately expose estuarine organisms to desiccation and scouring floods. This high variability has led to a high degree of specialisation within estuaries.

The smaller estuaries on the West Coast are generally wave-dominated, with little freshwater inflow to maintain inlet stability and over 75% of South African estuaries close periodically due to wave-driven sandbar formation. If these periods persist for lengthy time periods, warm, hypersaline conditions can form (van Niekerk et al. 2019), which are unfavourable to most estuarine fauna. Toxic algal blooms are also common under these conditions and increase the likelihood of fish and invertebrate mortality.

There are 64 estuarine systems along the West Coast between the Orange River and Cape Agulhas (SANBI 2018) of which approximately 75% are 'Critically Endangered' or 'Endangered', while 13% are considered 'Vulnerable'. The threat status of the estuaries between the Orange River and Langebaan are provided in Table 14.

Estuaries are highly productive systems and offer rich feeding grounds, warmer temperatures and sheltered habitat for many organisms. The high productivity is exploited by many line-fish and harvested invertebrate species either as a nursery or later in life either directly through habitat availability or indirectly through the contribution to overall coastal productivity (van Niekerk et al. 2019). Turpie et al. (2017) estimated the contribution of the estuarine nursery function as R960 million in 2018 terms (equivalent to over R1 billion in 2020) to the South African economy, with the highest value attributed to the estuaries of the south Western and Eastern Cape.

Table 14: Threat status of the estuaries in the broader project area from the Namibian Border to Saldanha Bay (Van Niekerk et al. 2019). Only true estuaries, not micro-systems are listed.

Estuary	*2018 Threat Status*
Orange	*Endangered*
Buffels	*Endangered*
Swartlintjies	*Endangered*
Spoeg	*Endangered*
Groen	*Endangered*
Sout	*Endangered*
Olifants	*Endangered*
Jakkals	*Critically Endangered*
Wadrift	*Endangered*
Verlorenvlei	*Endangered*
Groot Berg	*Endangered*
Langebaan	*Vulnerable*

6.1.1.4.3.4 Coastal Sensitivity

The last coastal sensitivity map for the South African coastline was compiled by Jackson & Lipschitz (1984). An updated National Coastal Assessment is currently being established by the CSIR and DFFE based on the biological components of the 2018 National Biodiversity Assessment (Harris et al. 2019). It includes the detection of coastal erosion hotspots and was completed in June 2020 (DEFF & CSIR 2020). A further report on the analysis of hotspots is in draft form and will be released in early 2021 (DEFF & CSIR 2021). This will take the form of a website with customisable GIS layers including natural resources, ecosystem infrastructure and services, human infrastructure, threats etc. Harris et al. (2019) compiled a GIS habitat map for the entire South African coastline, which identified that 60% of coastal ecosystem types are threatened, thereby having proportionally three times more threatened ecosystem types than the rest of the country. The spatial distribution of threatened coastal ecosystem types in the broader project area is illustrated in Figure 24. Coastal sensitivity would need to be taken into consideration in the event of an oil spill following a vessel accident.

6.1.1.4.4 Summary of Features Specific to the Concession Area

Features specific to concession 12C are summarised below:

- *Concession 12C is 2,212 km^2, in extent in water depths ranging from 75 m to 250 m;*
- *The concession area lies on the continental shelf with the eastern boundary located ~5 km offshore of the mean high water mark off the coastline between Pikkersbaai in the north to 2 km south of the Olifants River mouth in the south;*
- *Seabed sediments along the inshore portion of the concession are dominated by sandy sediments, with the southern Benguela mudbelt stretching across most of the concession, but with southern Benguela Sandy Shelves dominating in the wester portion of the concession;*
- *All of the ecosystem types occurring in the concession area (i.e. the Namaqua Sandy Mid Shelf, Namaqua Muddy Mid Shelf Mosaic, Southern Benguela Sandy Shelves and Southern Benguela Sandy Outer Shelf) have been rates as 'Least Concern';*
- *The sediments are likely to host a range of benthic macrofaunal species including polychaete worms, crustaceans and echinoderms;*
- *The concession is located between the Cape Columbine and Namaqua upwelling cells, and waters are likely to be seasonally cold, nutrient rich and hosting high abundances of phytoplankton, zooplankton and ichthyoplankton;*
- *A wide variety of inshore reef fish, small pelagic and demersal fish species are likely to be encountered, with large pelagic species occurring in the deeper portions of concession 12C;*
- *Migrating leatherback turtles may also occur, as are a variety of pelagic seabirds, African Penguins, Cape Gannets and Cape Cormorants;*
- *Marine mammals likely to be encountered include migrating and resident humpback and southern right whales and small odontocetes known to frequent continental shelf waters;*
- *There is no overlap of concession 12C with coastal or offshore MPAs, but there is overlap with the Benguela Upwelling System transboundary EBSA;*
- *The ecosystem types within concession 12C are considered poorly protected;*

- *Much of the concession area (27.9%) lies within CBA1 1: Natural and CBA 2: Natural areas in which non-destructive prospecting activities is considered to have "restricted compatibility" subject to certain conditions and destructive prospecting (bulk sampling) is considered "not compatible".*
- *There is overlap of concession 12C with the proposed Bird Island / Dassen Island / Heuningnes river and estuary system / Lower Berg river wetlands marine IBA.*

6.1.2 Underwater Heritage

The following was taken from: Underwater Heritage Impact Assessment, page 441.

6.1.2.1 Shipwreck Database

The nature of the environment, poor historical reporting and the length of time since the wrecks occurred means that underwater cultural heritage sites may literally be anywhere and are thus hard to pinpoint with any accuracy beforehand. It is important to have a database because if MUCH sites are uncovered during the project, it will be easier to identify the wreck and thus assess its cultural and historical significance.

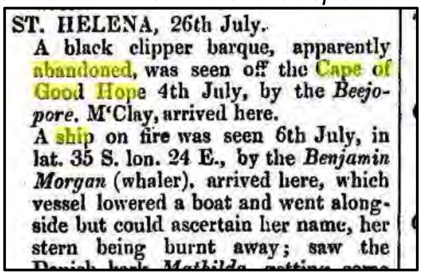
There are several points to bear in mind when compiling and making use of any shipwreck database.

- *There are thousands of reported wrecks around the South African coastline and thousands more that disappeared mid-ocean.*
- *The first recorded European voyages down the west coast of Africa were by the Portuguese. When the Portuguese first sent out their explorers, they stuck close to the coastline, in order to map the land. The present-day Cape Voltas may be a survival of the Portuguese name Volta das Angras. Dias and his fleet passed the Orange River Mouth in 1487/1488* (Axelson, 1973). *Thereafter, the rate of exploration and trade increased exponentially, as is evidenced by the increase in shipwrecks over the centuries.*

These early voyages were not well documented, and the archives often merely report that a fleet of a certain number of vessels left and only a certain amount returned, with only vague references to their place and manner of loss.

Therefore, there are many undocumented wrecks. This statement is borne out by the Cabral Fleet of 1500 (#11-14 below).

- *There is some anecdotal evidence that the Phoenicians circumnavigated Africa* (Herodotus, 1954). *However, if this is true, these ships had to stick right to the coastline and therefore are unlikely to be far offshore.*
- *There's increasing evidence that the Chinese voyages of the 1400s explored parts, if not all, of the African coast* (Paine, 2013). *However, once again the archival evidence to date, and availability to Western researchers, limits this knowledge.*
- *Bear in mind when reading the below database, the term "Abandoned", generally means that the vessel was further out to sea. Older ships were sometimes badly maintained. A lifetime of rough seas had a heavy toll on the old vessels. Through storms and possibly bad maintenance, ships could become death traps. If the vessel was leaking badly and running repairs and continuous pumping had little to no effect, the captain would decide to abandon ship. However, sometimes these vessels would not sink but float along in the currents and could end up thousands of miles from where they were abandoned. There are numerous accounts of such derelicts being spotted. Figure 56 is an example of such a sighting. This vessel was spotted off the Cape south coast, it was on fire and had been abandoned. The whaler that spotted it could not read the name.*



ST. HELENA, 26th July.
A black clipper barque, apparently abandoned, was seen off the Cape of Good Hope 4th July, by the *Beejo-pore*. M'Clay, arrived here.
A ship on fire was seen 6th July, in lat. 35 S. lon. 24 E., by the *Benjamin Morgan* (whaler), arrived here, which vessel lowered a boat and went along-side but could ascertain her name, her stern being burnt away; saw the

Figure 56: London Lloyd's List 13-09-1856

- *The ocean currents could move abandoned vessels hundreds of kilometres away from their reported position, Figure 60 and Figure 61 are examples of seasonal variation in the strength and direction of the ocean currents off the southern tip of Africa.*

The Shipwreck Database uses several conventions to assess the impact of projects on heritage resources (Appendix I). The important ones, in terms of this project are:

Certainty of prediction:

- ***Definite:*** *More than 90% sure of a particular fact. Substantial supportive data to verify assessment*
- ***Probable:*** *More than 70% sure of a particular fact, or of the likelihood of that impact occurring*
- ***Possible:*** *More than 40% sure of a particular fact, or of the likelihood of an impact occurring*
- ***Unlikely:*** *Less than 40% sure of a particular fact, or the likelihood of an impact occurring*

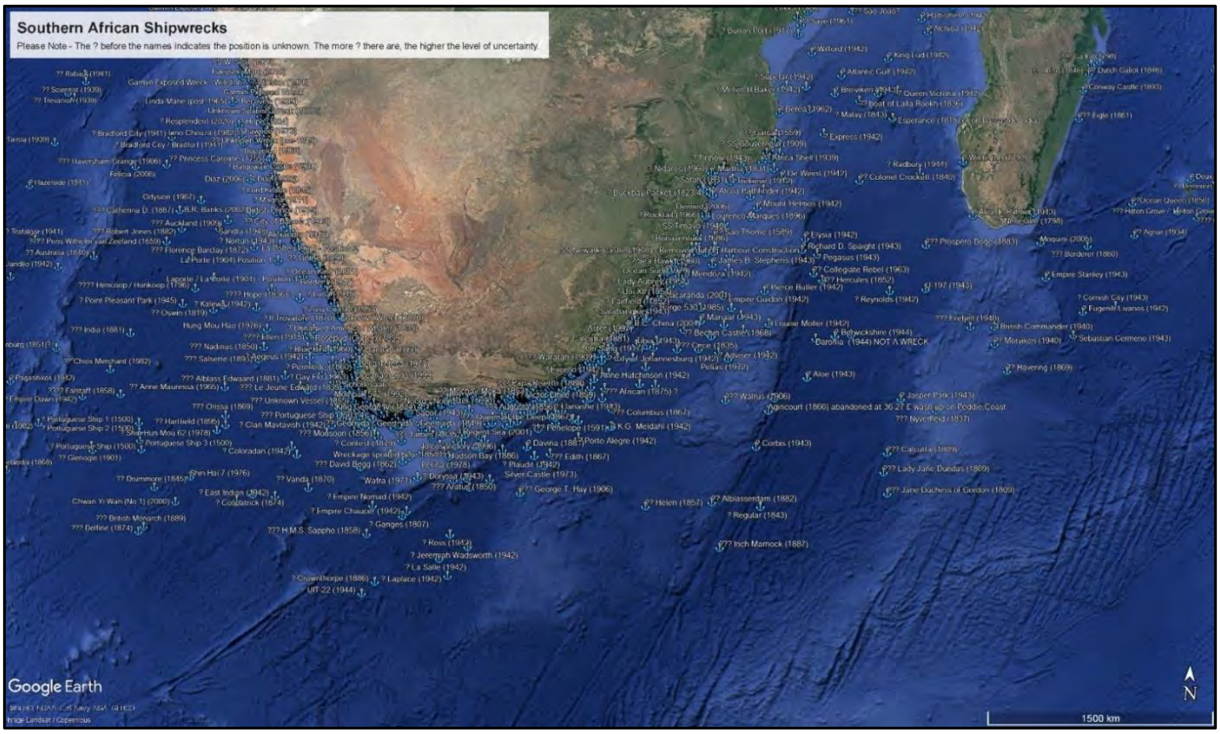


Figure 57: South African Shipwrecks **(Google, 2022; Hocking, 1969; Levine, 1989; Maitland, 2022; Reocities, 2017; SAHRIS, 2017; Turner, 1988; van den Bosch, 2009; U-boat.net, 2022)**

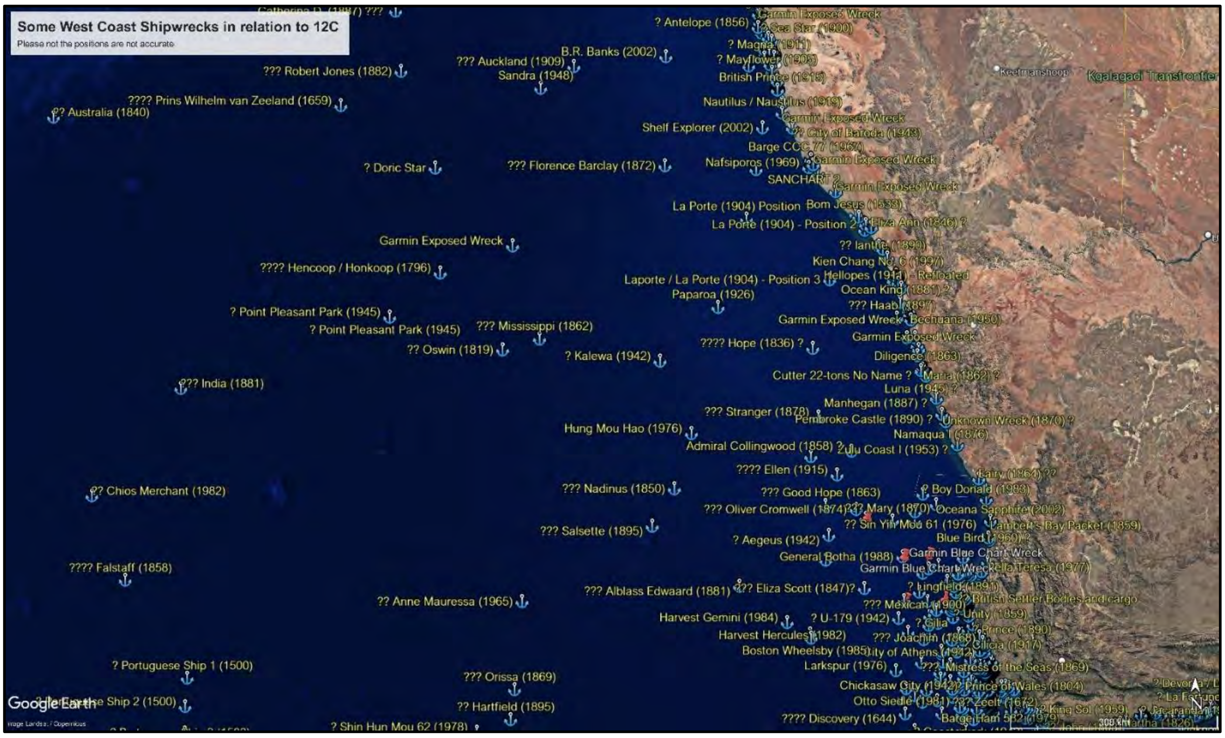


Figure 58: West Coast Shipwrecks (Google, 2022; Hocking, 1969; Levine, 1989; Maitland, 2022; Reocities, 2017; SAHRIS, 2017; Turner, 1988; van den Bosch, 2009; U-boat.net, 2022)

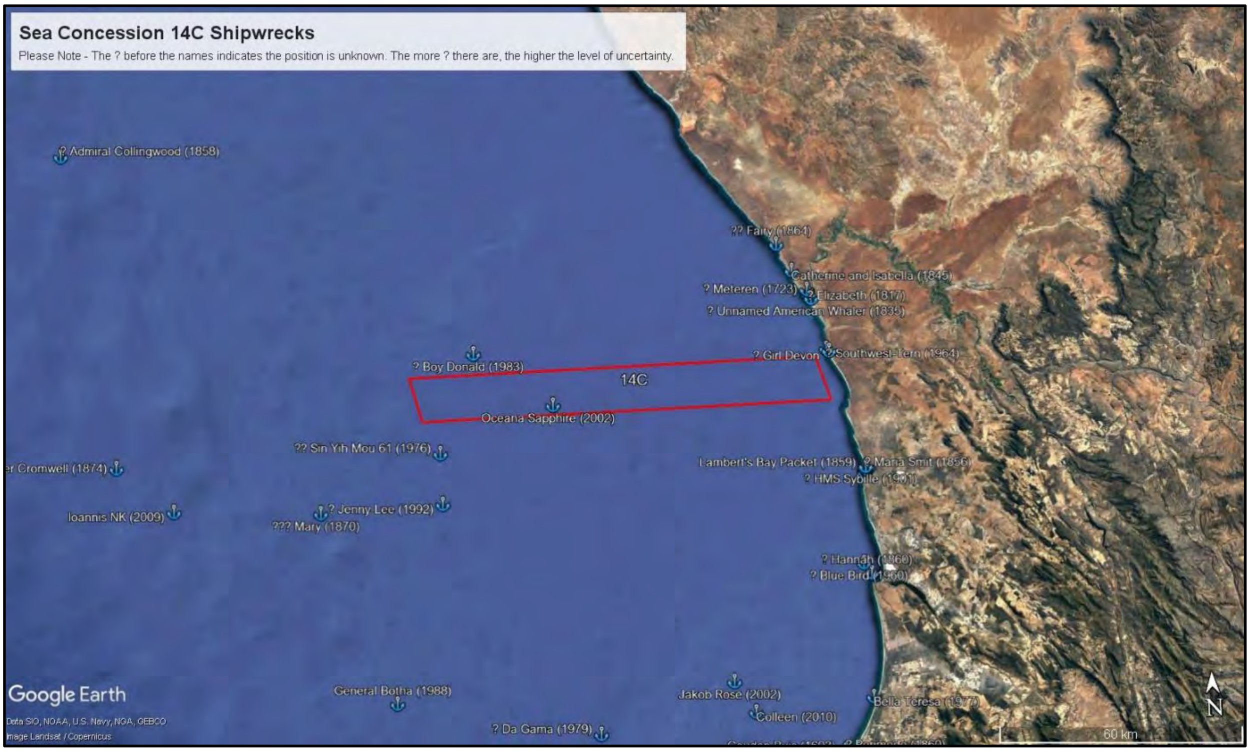


Figure 59: Shipwrecks in and around Sea Concession 12C (Google, 2022; Hocking, 1969; Levine, 1989; Maitland, 2022; Reocities, 2017; SAHRIS, 2017; Turner, 1988; van den Bosch, 2009; U-boat.net, 2022)

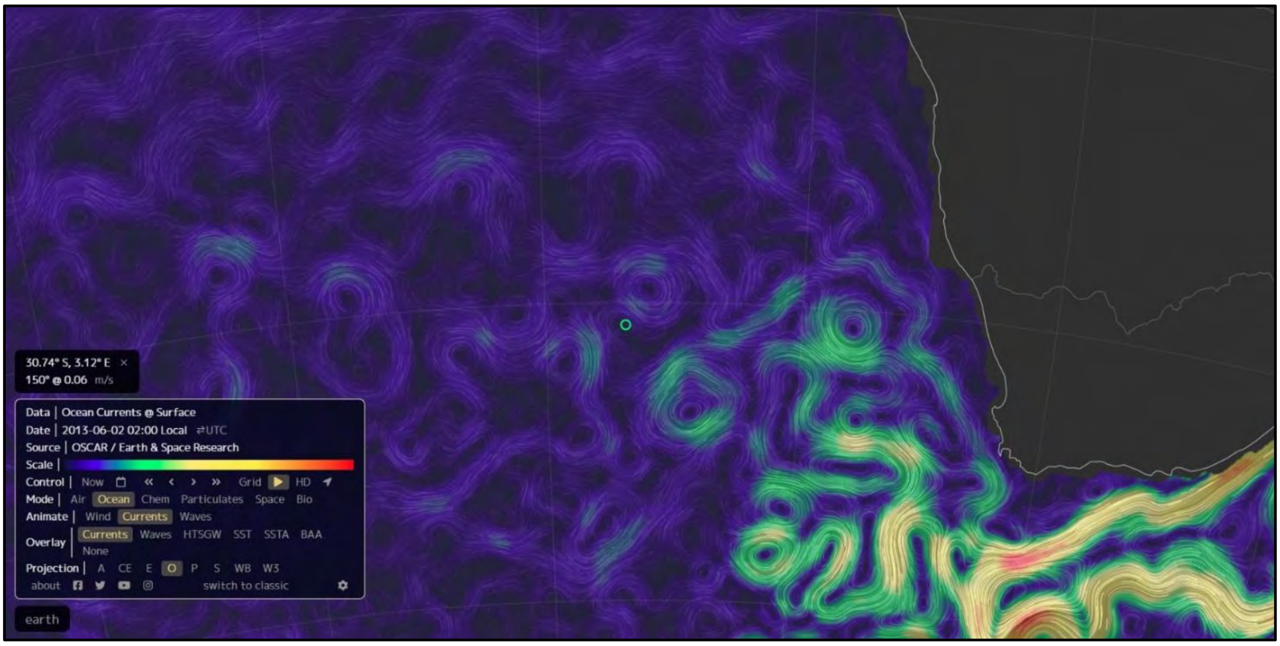


Figure 60: Winter ocean currents around South Africa (Beccario, 2022)

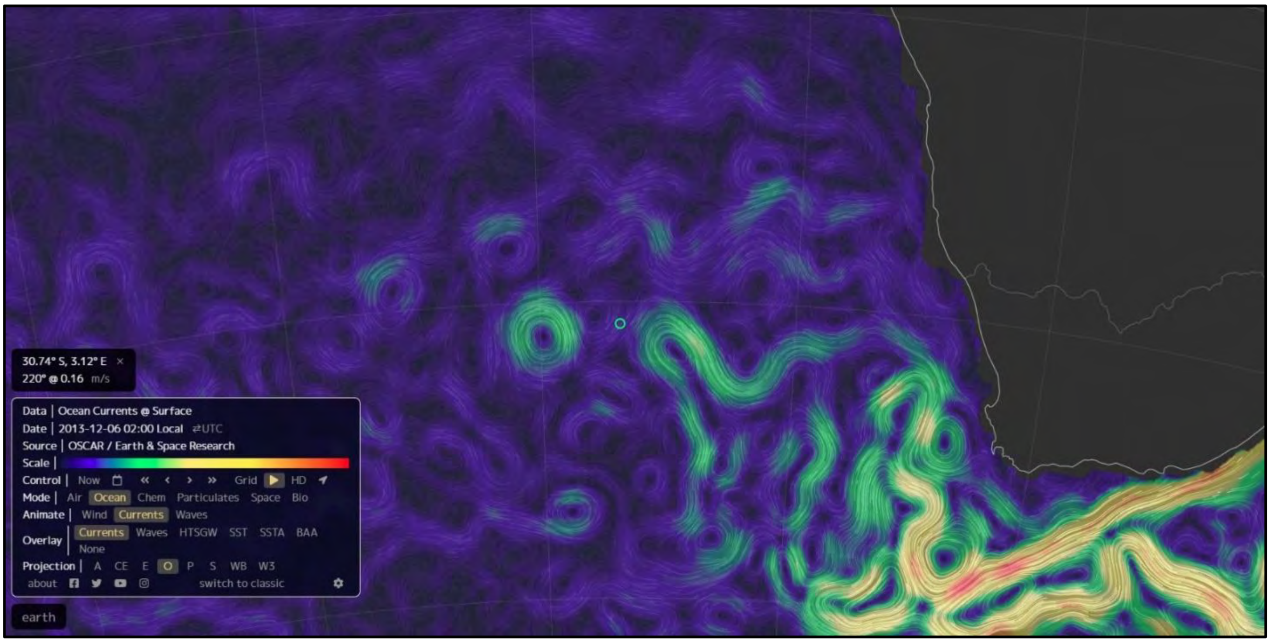


Figure 61: Summer ocean currents around South Africa **(Beccario, 2022)**

6.1.2.1.1 Shipwrecks definitely in 12C

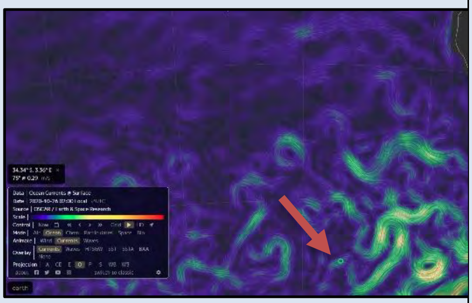
There are no definite shipwrecks in Sea Concession 12C.

6.1.2.1.2 Shipwrecks possibly in 12C

#	Name	Events	Nation	Date	History	Location	Significance
1	Boy Donald	Sank	RSA	1983-03-22	This 20 m long fishing vessel was built in 1961 and owned by the Lamberts Bay Fishing Company. The boat was under Capt J. Hunter when it foundered. At least five of the crew were rescued. It sank rapidly and the search was concentrated in an area 55 miles northwest of Lamberts Bay (van den Bosch, 2009). Therefore, this vessel may be in the concession area.	Off West Coast	None
2	Jenny-Lee		RSA	1992-02-18	This tuna fishing vessel under Capt F. da Luz was sunk after being swamped by a giant wave, approximately 52 NM west of Lamberts Bay (van den Bosch, 2009). It may be in the concession area.	Off West Coast	None

6.1.2.1.3 Shipwrecks Improbably in 12C

#	Name	Events	Nation	Date	History	Location	Significance
Shipwrecks with No heritage significance							
3	Chios Merchant	Leaking, sank	Greek	1982-10-10	It was leaking but under control when the leak worsened dramatically. After sending out an SOS, the crew abandoned the vessel in a sinking condition at 520.9 NM west of the Orange River Mouth (van den Bosch, 2009). It may have drifted quite far from its original reported position.	Circa. 520.9 NM west of the Orange River Mouth	None
4	Sin Yih Mou 61	Exploded, sank	China	1976-3-29	This 300-ton Chinese trawler exploded and sank possibly in the vicinity of Port Nolloth, 129.5 NM northwest of Cape Town (van den Bosch 2009). Levine (Shipwreck History of Southern Africa. Unpublished Database., 1989) states the vessel exploded 60 NM off Port Nolloth. The crew of 15 were rescued by the trawler, Hung Mou Hao. The two reported positions are about 200 km apart. There are three wrecks noted on the marine charts (Garmin Marine Charts, 2022) in the vicinity of the van den Bosch location.	Along the West Coast between Doring Bay and Port Nolloth	None
Shipwrecks with a Low heritage significance							
5	Ellen	Capsized		1915	Capsized by a wave. None of the databases list a location (Pocock, 2015; van den Bosch, 2009). However, the West Coast was a prime fishing area, so it is left in the database.	Unknown	Low

#	Name	Events	Nation	Date	History	Location	Significance
6	Eros (ex. SS Ceres)	Foundered	Britain	1918-05-26	This 174-ton steel steamer, built in 1900 by Selby Shipbuilding & Engineering Co. Ltd in Selby, had been sent to the Cape for the Namaqua Copper Company. After several voyages, it was laid up in order to alter its specifications. On 25 May, it left Table Bay for Port Nolloth under Captain Robert Brooks or Capt Richard Walter Powell (Wrecksite.eu, 2022). However, it foundered en-route. There were 14 crew members on board, and one man died (Levine, 1989). In Green (Eight Bells at Salamander, 1960) According to van den Bosch (SA Shipwreck Database, 2009), the vessel is off Port Nolloth and according to the Miramar Ship Index (Ship Index, 2017), it is off Lambert's Bay. The information is contradictory and further research may show that it grounded on the coast or sank between the two points. However, it is included here for the moment.	West Coast	Low
7	Glenogle	Fire, abandoned	Britain	1901-10-27	This 914-ton steel barque caught fire and was abandoned at 34 38.00S,03 40.00E (Lloyd's Register of British and Foreign Shipping, 1901; van den Bosch, 2009). The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast. Using the online current website (Beccario, 2022), and placing the reported position on the same month and day, one can see how the currents could pull the vessel towards the coast (Figure 62). Obviously, there are many other factors at play, including wind, swell, drag of the vessel, how quickly it sinks, etc. But this shows how vessels can be moved from their place of abandonment and will not be repeated for every abandoned vessel. 	Atlantic Ocean	Low

#	Name	Events	Nation	Date	History	Location	Significance
					Figure 62: Reported position of the Glenogle and the ocean currents at that time of year		
Shipwrecks with a Medium heritage significance							
8	*Admiral Collingwood*	*Foundered*	*Britain*	*1858*	*This 360-ton barque under Captain Smith was bound from London for Algoa Bay when it apparently foundered 320km off St Helena Bay* (Levine, 1989; van den Bosch, 2009) *This may put her in the West Coast area.*	*West Coast*	*Medium*
9	*Australia*	*Fire, sank*	*Britain?*	*1840-12-27*	*This 250-ton brig, under Capt. A. Yule was built in Dundee, Scotland in 1839. It was on its maiden voyage to Australia with passengers and cargo when the vessel caught fire and sank, apparently 9.6 nautical miles (NM), north of the Olifants River Mouth.* *However, it was 4-500 miles (640-800 km) from Cape Town when the fire broke out. One of the long boats contained two bulls that were being shipped from Leith. The noise and fire caused them to break out of the boat, one fell overboard and the other ran down the deck of the brig, until the crew killed it with axes. The long boat could now be launched, and the twenty-eight passengers and crew escaped the burning ship. The burning ship was visible until sunrise the following morning. Two night later, the cable joining the lifeboats broke and they were separated. The following day, they were reunited. A boy died at sea and a man died after they made land, 200 miles northwest of Cape Town after nine nights at sea. The survivors then walked south for four days before reaching the Olifants River where they were assisted by local farmers* (Port Phillip Patriot, 1841). *As the lifeboats came ashore near the concession, there is a remote possibility that the fire was put out by the rising water, but the brig continued to drift into the concession area there are numerous historical reports of this happening.*	*West Coast*	*Medium*
10	*Catterina D / Catherina D.*	*Fire, abandoned*	*Austria*	*1887-10*	*This 610-ton barque from Liverpool for Cape Town with a cargo of coal caught fire. It was apparently abandoned before it sank, 480km west of Hottentot*	*West Coast*	*Medium*

#	Name	Events	Nation	Date	History	Location	Significance
					Point. The captain and crew reached Walvis Bay in the lifeboats (Levine, 1989; van den Bosch, 2009). *As it was abandoned before it sank and could have drifted south, this vessel is included in the database.*		
11	*Elizabeth Jane*	*Unknown*		*1834-01-20*	*This vessel seems to be a whaler that operated in Tasmania and the southern oceans* (van den Bosch, 2009). *Although I can find no further information on its status at this time, I have left it in the database.*	*Unknown*	*Medium*
12	*Florence Barclay*	*Fire, abandoned*	*Britain*	*1872-11-7*	*This 243-ton barque was built in 1866. Under Captain J.H. Voller, it was bound from Hull for Table Bay and Mauritius. Somewhere off the west coast, the vessel caught fire and was abandoned. The crew were in three lifeboats, one of which disappeared during the first night at sea. The other two boats arrived at Pomona Island (Namibia) three days later. The survivors were taken to Table Bay by the Lilla* (Levine, 1989; van den Bosch, 2009). *As the crew beached on the west coast of southern Africa, I have included this vessel.*	*West Coast*	*Medium*
13	*Good Hope*	*Fire, sank*	*Cape?*	*1863-7-31*	*I have very little information on this wreck. Only that it was a Cape trader and burned at sea* (van den Bosch, 2009).	*Unknown*	*Medium*
14	*Haab*	*Abandoned*	*Norway*	*1897-10-8*	*This 861-ton wooden barque was according to Levine* (Shipwreck History of Southern Africa. Unpublished Database., 1989)*, grounded on Dassen Island. Van den Bosch* (SA Shipwreck Database, 2009)*, states the vessel was abandoned 260 NM from Table Bay. According to the Brisbane Courier* (Brisbane Courier, 1897)*, the vessel caught fire and was abandoned, the crew, in lifeboats, eventually landed on Dassen Island.* *Dassen Island is only c. 35 NM from Table Bay (i.e., the Port). 260.5 NM means that the vessel was abandoned in the concession areas and may be anywhere between there and Dassen Island.*	*Between Port Nolloth and Dassen Island*	*Medium*
15	*Hartfield*	*Fire, sank*	*Britain*	*1895-9-9*	*According to van den Bosch* (SA Shipwreck Database, 2009) *and Levine* (Shipwreck History of Southern Africa. Unpublished Database., 1989)*, this 852-ton iron barque caught fire at 34*	*West Coast*	*Medium*

#	Name	Events	Nation	Date	History	Location	Significance
					30.00S,11 30.00E, 259 NM west of Table Bay. *The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast.*		
16	*India*	*Abandoned*	*Sweden*	*1881-8-24*	*This British iron barque, under Capt McPhail, was on a voyage from Britain to Australia, when it began leaking after being battered by several gales. From 2 January to 24 February, the barque limped down the west coast of Africa. At this time, as the leak was so serios, the crew abandoned ship at 7º E. Their lifeboats had been smashed in one of the storms, so when they saw a passing ship, they asked for assistance. When they left the distressed vessel, it was still afloat* (van den Bosch, 2009). *The currents may have pulled it towards the West Coast or further out into the Atlantic.*	*West Coast / Atlantic Ocean*	*Medium*
17	*Joachim*	*Fire, abandoned*	*German*	*1868-10-10*	*Apparently the 763-ton barque under Captain Helenmeyer was on a voyage from Bremen to Rangoon with a cargo of coal. When it "burnt off the Cape". The crew were rescued by the American vessel, China and brought to Cape Town* (Levine, 1989).	*Off the Cape*	*Medium*
18	*Juno*	*Fire, abandoned*	*Sweden*	*1885-4-9*	*The 1274-ton schooner, under Captain T. Keyller was bound from Norway for Melbourne with a cargo of deals (timber). It caught fire and was abandoned at approximately 37 24.00S,11 30.00E. the 22-man crew took to the lifeboats and set off towards the Cape. The currents washed them towards the Orange River. They attempted to beach the lifeboat 32km south of the river but capsized and there were only four survivors. These four were picked up by the Namaqua and taken to Cape Town* (Levine, 1989; van den Bosch, 2009). *It follows that if the current brought the lifeboat towards the Orange River, that the same principle could apply to the abandoned schooner.*	*Atlantic Ocean*	*Medium*
19	*Luba / Luban*	*Fire, abandoned*	*Cape*	*1864-2-11*	*This barque was on its way from Leith for Cape Town with a cargo of coal and coal tar when it caught fire and sank 86.3 NM off Table Bay. The crew were rescued* (Levine, 1989; van den Bosch, 2009).	*West Coast*	*Medium*

#	Name	Events	Nation	Date	History	Location	Significance
					This position is in the general vicinity of the concession.		
20	*Mary*	*Disappeared*	*Britain*	*1870-07-24*	*Under Captain Anderson, this vessel left Simon's Bay for Falmouth and disappeared* (Levine, 1989) *As the intended route goes up the west coast, I have included this vessel.*	*Atlantic Ocean*	*Medium*
21	*Mississippi*	*Abandoned*	*USA*	*1862-08-31*	*This 2030-ton steamship was abandoned about 450 km off the West Coast after severe weather was causing extensive leaks* (The Daily Southern Cross, 1862)*.* *It may have drifted closer to land before sinking.*	*Off West Coast*	*Medium*
22	*Mona*	*Fire, abandoned*	*Britain*	*1887-09*	*The 1045-ton barque under Captain Pearson was on a voyage from Grimsby to Durban with coal when it caught fire at 27º 14´ S 24º 55´ W. The following day the crew took to the lifeboats. After a week, the crew were picked up by the German barque, Livingstone and landed at Mossel Bay* (Levine, 1989)*.* *The current was clearly pushing the survivors towards the Cape coast and, so it follows that their vessel, abandoned before sinking, may also have been pulled by the currents towards the west coast.*	*Off West Coast*	*Medium*
23	*Oliver Cromwell*	*Fire, abandoned*	*Britain*	*1874-8-30*	*This 1112-ton vessel, under Capt. Jack was on a voyage from Newcastle to Aden with a cargo of coal It caught fire 300 miles (482 km) from Table Bay. The 21 crew members entered the lifeboats while the ship was burning. The boat was overloaded and leaking. They had the bail water out the entire trip, and while they did spot one vessel that could have saved them, it did not notice the lifeboat. Three days later they entered Table Bay, and the Saxon took them aboard* (London Magnet, 1874)*.* *As it was abandoned off the west coast, it is included in the database.*	*Off West Coast*	*Medium*
24	*Orissa*	*Fire, abandoned*	*Britain*	*1869-9-27*	*This 634-ton, three-masted, wooden ship was built in 1862. Under Captain R. Adams, bound for Mauritius with a cargo of coal, it caught fire and was abandoned 343.2 NM west of Table Bay* (Levine, 1989; van den Bosch, 2009)	*Atlantic Ocean*	*Medium*

#	Name	Events	Nation	Date	History	Location	Significance
					The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast.		
25	*Oswin*	*Leaking, abandoned*	*Britain*	*1819-1-27*	*This vessel was en-route to the East. According to Captain Ray, the commander of the vessel, the ship rounded the Cape and sprung a leak in the vicinity of the Agulhas Bank and while the pumps were working 24 hours a day, they were unable to make any headway on the leak. By the next day, there was 1.5m of water in the hold and this was increasing. The crew launched the longboat and filled it with supplies. "Embarking in the boat the commander and crew steered for Saint Helena and were from 31 Jan to 12 Feb exposed to great sufferings and anxiety, until they reached Saint Helena. During this time, they ran about 1400 miles and were particularly fortunate in making the Island to a mile."* (The Asiatic Journal and Monthly Register, 1820) *Despite having rounded the Cape, the Benguela current seems to have pulled the vessel back around the Cape while they were attempting to repair it. They state that they travelled 1400 miles after abandoning it.* *Depending on whether this report was using nautical miles or statute miles, makes a difference to the location of the wreck. Statute miles puts the vessel off Lüderitz, nautical miles puts the wreck in the vicinity of the West Coast.*	*Off West Coast*	*Medium*
26	*Stranger*	*Fire, abandoned*	*Britain*	*1878-8-27*	*This 288-ton barque was built in 1872. Under Captain Bendon, it was bound from London to Port Nolloth with a general cargo. The vessel caught on fire and was abandoned at sea. Two days after taking to the lifeboats, the crew arrived at Port Nolloth* (Levine, 1989) *The location of the abandonment puts this vessel firmly in the West Coast area.*	*West Coast*	*Medium*
Shipwrecks with a High heritage significance							
27	*Abberkerk*	*Wrecked*		*1779*	*Built in 1772 for the van Hoorn Chamber. It was 140 Dutch feet long, 850 tons and had a crew of 174-268 people. Under Capt. Kasper Burger, the ship left China on 29 January 1779,*	*Off South Africa*	*High*

#	Name	Events	Nation	Date	History	Location	Significance
					reached the Cape on the 26th of May, and departed for the Netherlands on the 24th of June and was not heard from again (De VOC Site, 2022). *This vessel could be on the west coast.*		
28	*Aegeus*	*Torpedoed, sank*	*Greece*	*1942-10-31*	*This 3 792-ton steamship left Trinidad for Saldanha Bay and then Durban and never arrived* (Hocking, 1969). *After WWII, German records indicated that it was torpedoed by the U-177 at 32° 30'S, 16° 00'E* (U-boat.net, 2022). *These coordinates are just southwest of the concession and are where the U-boat reports torpedoing the vessel, not necessarily where it sank. In addition, the coordinates mentioned are subject to the technical limitations of the period.*	*West Coast*	*High*
29–32	*Cabral Fleet*	*Lost*	*Portugal*	*1500*	*Levine* (Shipwreck History of Southern Africa. Unpublished Database., 1989) *states: "Thirteen vessels under command of Pedro Alvares Cabral – the first Portuguese fleet which sailed annually to the Indies – and found Brazil. Twenty days after the fleet sailed from Brazil, it was struck by storms and four ships, including the one under command of Bartolomeu Dias, foundered. Duffy [Shipwrecks and Empire, 1955] writes that the ships were lost off the Cape of Good Hope, but, according to Axelson [Levine cites personal correspondence], the fleet could not have been off the Cape of Good Hope then; they would have been in the vicinity of the shortly-to-be-discovered islands of Tristao da Cunha."* *There is such scant and contradictory information regarding the loss of these four vessels that I am including them in this database, even though the chances of them being here is exceedingly slim.*	*Unknown – Atlantic Ocean*	*High*
33	*Columbine*	*Torpedoed, sank*	*South Africa*	*1944-06-16*	*This 3 268-ton steamship owned by the South African government was initially a German vessel. It was seized at the start of WWII. On 16 June 1944, it had 52 people on board when it was torpedoed by the U-198. 23 people died when their lifeboat capsized, including two naval officer wives. The coordinates for its torpedoing are 32° 44'S, 17° 22'E* (U-boat.net, 2022; van den Bosch, 2009).	*West Coast*	*High*

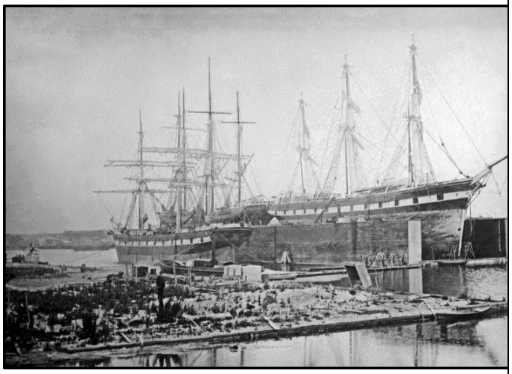
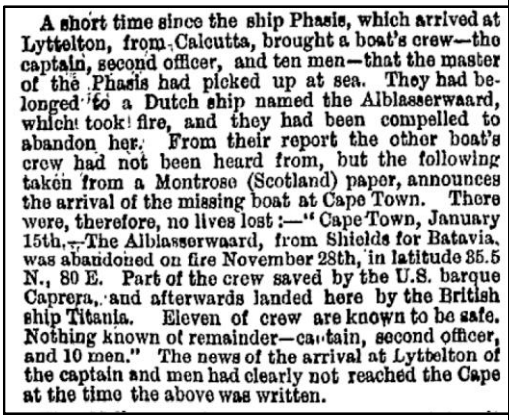
#	Name	Events	Nation	Date	History	Location	Significance
					These coordinates are south of the concession and is where the U-boat reports torpedoing the vessel, not necessarily where it sank. In addition, the coordinates mentioned are subject to the technical limitations of the period.		
34	*Discovery*	*Disappeared*	*Britain*	*1644*	*This ship of 500 tons, was built in 1621 at Woodbridge. Under Capt John Allison. 1640/1 Surat and Persia. Capt John Allison. Its last trading voyage was as follows:* *Depart: Downs 3 Apr 1641* *At: Surat 27 Sep* *At: Bandar Abbas 2 Feb 1642* *At: Surat 13 Apr* *At: Mokha 22 Aug - 31 Oct* *At: Surat 30 Jan 1643 - 18 Feb* *At: Bandar Abbas 27 Apr* *At: Mokha 3 Nov* *At: Surat 29 Jan 1644* *After leaving Surat, India, the ship was not seen again* (Wrecksite.eu, 2022).	*Unknown*	*High*
35	*Honkoop /* *Honcoop / Hencoop*	*Disappeared*	*Netherlands / Britain*	*c.1796*	*This Dutch vessel of 1 150 tons and 20 guns, under Capt Alex Landt was built in 1770 for the Zeeland Chamber was taken by the British at The Battle of Saldanha (1871), it was being sailed at a prize back to England when it disappeared* (van Niekerk, 2015)	*Atlantic Ocean*	*High*
36	*Nortun*	*Torpedoed*	*Panama*	*1943-03-20*	*This 3 663-ton ship was bound from Table Bay to Bahia when it was torpedoed and sunk by the U-516 about 130km south-west of Lüderitz at 28º 00´ S 14º 55´ E* (Levine, 1989; van den Bosch, 2009). *According to U-boat net* (U-boat.net, 2022) *the position is further north at 27° 35'S, 14° 22'E.* *Although these coordinates are well north of the concession, there are conflicting positions, and it is where the U-boat reported torpedoing the vessel, not necessarily where it sank. In addition, the coordinates mentioned are subject to the technical limitations of the period.*	*Off West Coast* *Approximately:* *28º 00´ S* *14º 55´ E* *Or* *27° 35'S* *14° 22'E* ****	*High*
37	*U-179*	*Depth charges*	*Germany*	*1942-10-8*	*U-179 was responsible for torpedoing the British steamship City of Athens, about 45km to the south-east on the same day as the U-boat was surprised*	*West Coast* *Approximately:*	*High*

#	Name	Events	Nation	Date	History	Location	Significance
					on the surface by H.M.S. Active. As it dived, the British vessel launched depth charges. Van den Bosch (SA Shipwreck Database, 2009) *gives its coordinates as 33 25.00S,17 10.00E, U-boat.net* (U-boat.net, 2022) *gives the position as 33.28S, 17.05E. All hands were lost (61 crew).* *These coordinates are well south of the concession and is where the vessel reports depth charging the U-boat, not necessarily where it sank. In addition, the coordinates mentioned are subject to the technical limitations of the period.*	*33 25.00S* *17 10.00E* *Or* *33.28S* *17.05E* **	

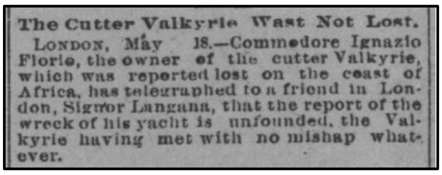
6.1.2.1.4 Wrecks that should be removed from the West Coast Databases

These are included, as they are in many databases and should be removed, for the reasons given below. Their inclusion mitigates against a belief that they were ignored.

#	Name	Events	Nation	Date	History	Location	Significance
1	*Adventurer*	*Wrecked*	*Britain?*	*1843*	*From Sandown Bay (Isle of Wright?) to Table Bay or Algoa Bay. The Reocities* (Reocities Website, 2017) *website states the vessel was lost west of Saldanha. But the newspaper states lost in Sandown Port. Ann Barrett* (Research Coordinator Ryde Social Heritage Group, Isle of Wright, 2017)*, a researcher from the Isle of Wright stated the wreck is not on their lists. The vessel is not listed in Lloyds as per Levine* (Shipwreck History of Southern Africa. Unpublished Database., 1989). *The wreck may be in the South African Sandown Bay near Kleinmond, Western Cape.* *Therefore, South African shipwreck database, I believe it needs more research.*	*Sandown Bay (Kleinmond) or* *Isle of Wright*	
2	*Alblasserwaard (in databases as the* *Alblass Edwaard)*	*Fire and abandoned*		*1881-11-28*	*Caught fire and abandoned on 28-11-1881* (van den Bosch, 2009)*.* *This Dutch "fregat" (Figure 63) was built in 1874 by Franz Harms von Lindern in Alblasserdam, South Holland. It is taken off the books in 1882, listed as wrecked or missing* (Marhisdata, 2022). *The Otago Witness* (Shipping, 1882) *states that the vessel was abandoned midway between Australia and South Africa. One of the lifeboats was picked by and dropped the survivors in New Zealand, the other lifeboat was picked up and the survivors taken to Cape Town (Figure 64).*	*Between Australia and South Africa*	*Medium*

					 **Figure 63: The Alblasserwaard loading ballast in Amsterdam (Marhisdata, 2022)**  A short time since the ship Phasis, which arrived at Lyttelton, from Calcutta, brought a boat's crew—the captain, second officer, and ten men—that the master of the Phasis had picked up at sea. They had belonged to a Dutch ship named the Alblasserwaard, which took fire, and they had been compelled to abandon her. From their report the other boat's crew had not been heard from, but the following taken from a Montrose (Scotland) paper, announces the arrival of the missing boat at Cape Town. There were, therefore, no lives lost:—" Cape Town, January 15th.—The Alblasserwaard, from Shields for Batavia, was abandoned on fire November 28th, in latitude 35.5 N., 80 E. Part of the crew saved by the U.S. barque Caprera, and afterwards landed here by the British ship Titania. Eleven of crew are known to be safe. Nothing known of remainder—captain, second officer, and 10 men." The news of the arrival at Lyttelton of the captain and men had clearly not reached the Cape at the time the above was written. **Figure 64: Report on the Alblasserwaard (Otago Witness, 1882)**		
3	*Antoinette*			*1854*	*The only database that mentions this wreck is SAHRIS* (South African Heritage Resources Information System (SAHRIS), 2017). *I could not find any mention of a vessel with this name wrecking in southern Africa from 1852 – 1856 in any historical newspapers.*		
4	*Berea*	*Disappeared*	*RSA*	*1933-11-4*	*In the databases, this steam whaler disappeared after leaving Table Bay* (Levine, 1989; van den Bosch, 2009). *However, a newspaper article (Figure 65) clearly states that the Berea was whaling in the southern Atlantic Ocean when it foundered* (Sydney Daily Commercial News And Shipping List, 1933).	*Southern Atlantic Ocean*	*Low*

					 **WHALING CASUALTIES.** TRAGEDY TO BEREA FEARED. The seventh casualty of the present season is reported from Capetown, it being feared that the whaler Berea (175 tons) has met with mishap. The master of the tanker Oiltransport, which arrived at Capetown from the Antarctic, reported having taken part in a search for the missing vessel, but without result. The Oiltransport came across a whale with a heavy chain attached to its tail. It was concluded that, when the Berea overran the whale in order to bring it in tail first, the vessel was caught by a huge wave caused by the whale. In all probability the vessel capsized and the Berea's crew had no chance of being saved. The master of the Oiltransport also stated that he had picked up a message from the British factory ship Southern Princess, advising that she had seriously damaged her rudder in a heavy gale and was seeking shelter in the ice-pack. The Oiltransport also had a disabled whale-catcher in tow. ***Figure 65: Report on the search of Berea***		
5	*Earl of Abergavenny*	*Disappeared*	*Britain*	*1805*	*This English East Indiaman, under Captain J. Wordsworth was lost "off the Cape Coast"* (van den Bosch, 2009). *However, removed off the database as it was actually wrecked on The Shambles, Isle of Portland* (Cumming, 2016)	*The Shambles, Isle of Portland*	
6	*Hope*			*1836*	*The only reference to this vessel is in van den Bosch's* (SA Shipwreck Database, 2009)*, and therefore in the SAHRIS* (South African Heritage Resources Information System (SAHRIS), 2017) *database. Possibly lost on the West Coast. However, I can't find any other evidence, in the historical newspapers, of this vessel.*		
7	*Leonine Mary*	*Disappeared*	*Cape*	*1859-2*	*This vessel is an entry mistake and confused for the Leontine Mary, a coaster that sank between Algoa Bay and East London in 1859.*		
8	*Prins Wilhelm van Zeeland*		*Netherlands*	*1659?*	*SAHRIS* (South African Heritage Resources Information System (SAHRIS), 2017) *is the only database that has this wreck. The only reference to this vessel I could find was the Prins Willem which sank near Madagascar in 1662. However, as it is from a period with few records, I am leaving it in the database for now.*		
9	*Valkyrie*	*Wrecked*	*Racing cutter*	*1894-5-16*	*This sailing cutter was apparently lost "Off the coast of Africa"* (van den Bosch, 2009; Anglo American Times, 1894) *However,* *"Valkyrie was subsequently sold to Mr. Florio, an Italian nobleman, but did not fare well in the Continental regattas. Mr. Florio then engaged William Cranfield's brother Lemon and a crew of Rowhedgers for the 1894 Mediterranean regatta season and*	*NOT A WRECK*	

					Valkyrie competed at Monaco, Monte Carlo, Nice, Cannes etc, but against the much larger and up-to-date Britannia she was outclassed. Valkyrie made the news in May 1894 when it was reported that she had been lost with all hands off the coast of Africa. The story proved to be untrue but Lord Dunraven, in his memoirs, admitted that even he did not know what became of her" (Simons, 2020). *Independent verification of this came from a newspaper report in the Philadelphia Enquirer (Figure 66)*  The Cutter Valkyrie Wast Not Lost. LONDON, May 18.—Commodore Ignazio Florio, the owner of the cutter Valkyrie, which was reported lost on the coast of Africa, has telegraphed to a friend in London, Signor Langana, that the report of the wreck of his yacht is unfounded, the Valkyrie having met with no mishap whatever. **Figure 66: Report on the Valkyrie (Philadelphia Inquirer, 1894)**		

*** Please note these coordinates are all approximations. The datums and methods used through time and within various areas, to record latitude and longitude, change. This can cause large deviations in real-world locations. Without knowing the datum and method that was used to record the coordinates, they cannot be converted accurately. In addition, the recording of coordinates has become much more accurate in the 21st century. All coordinates here WGS84.*

6.1.2.2 Conclusions

A wide variety of sources were consulted to build this database. It may well be missing earlier, unrecorded wrecks. There is always the possibility of an early unknown wreck being found, as happened in Oranjemund when the Bom Jesus (1533) was discovered in 2008 during diamond mining operations (Alves, 2011). *There were no submerged objects or wrecks noted on SAN Chart 117* (SA Navy, 1995) *or in the Garmin electronic charts* (Garmin Marine Charts, 2022).

In Sea Concession 12C there may be 37 shipwrecks, dating from the 1500s through to modern times.

According to database, there are no DEFINITE wrecks, within the area. This would be able to be verified with geophysical data.

There are two modern wrecks that are POSSIBLY in Sea Concession 12C. They were reported as being lost near the concession. This would be able to be verified with geophysical data.

The other 35 shipwrecks may be found in this area during work, although it is IMPROBABLE. These are vessels that either disappeared between two ports or were abandoned mid-ocean. One tries, through research, to narrow down the areas where these vessels were lost, if they are still in the list, it is because there is insufficient information to remove them.

Two of the IMPROBABLE shipwrecks are modern (younger than 60 years) and are not protected by the NHRA.

Seven of the vessels are from the early 20th century (prior to 1962), with four that were sunk during World War II.

Nineteen vessels are from the 19th century, the heyday of sailing vessels. Only one vessel is from the 18th century, and two are from the 17th century. Four are from the 16th century, although it is highly unlikely that they are in this area.

The significance of most of the wrecks is low or medium. There are, however, a few that may have a high significance factor. These include very old ships, war-time losses, and other vessels with a specific national or international significance. The significance of a shipwreck is hard to pinpoint without significant research and would have to be dealt with on an ad hoc basis if they are discovered.

The potential for recovering pre-Colonial, Stone Age artefacts must be borne in mind.

At the time of writing this report, no geophysical data for the area was available. When such surveys are undertaken, and any shipwrecks or shipwreck debris is noted, images and coordinates for these should be shared with the heritage practitioner and the MUCH Unit at SAHRA.

This specialist study has found that there is a low possibility that impacts to underwater heritage could occur through the proposed development. The present report finds that the project is feasible, so long as the stipulated management (mitigation) measures are applied. With mitigation there is the possibility of a benefit to our heritage knowledge base through the discovery and recording of previously unknown underwater heritage.

6.1.3 Palaeontological Heritage

The following was taken from: Palaeontological Assessment, page 476.

Cretaceous fossil wood *occurs primarily in the gravels on the flat middle shelf which directly overlie the source Cretaceous formations. Petrified wood is common and includes areas where petrified logs litter the seabed, the "Fossil Forests". Specimens obtained via diamond exploration are providing valuable insights into the palaeo climates of the Cretaceous West Coast, when wide, well-watered coastal plains were covered by forests of primitive yellow wood (podocarp) trees (Bamford & Corbett, 1994; Bamford & Stevenson, 2002; Stevenson & Bamford, 2003).*

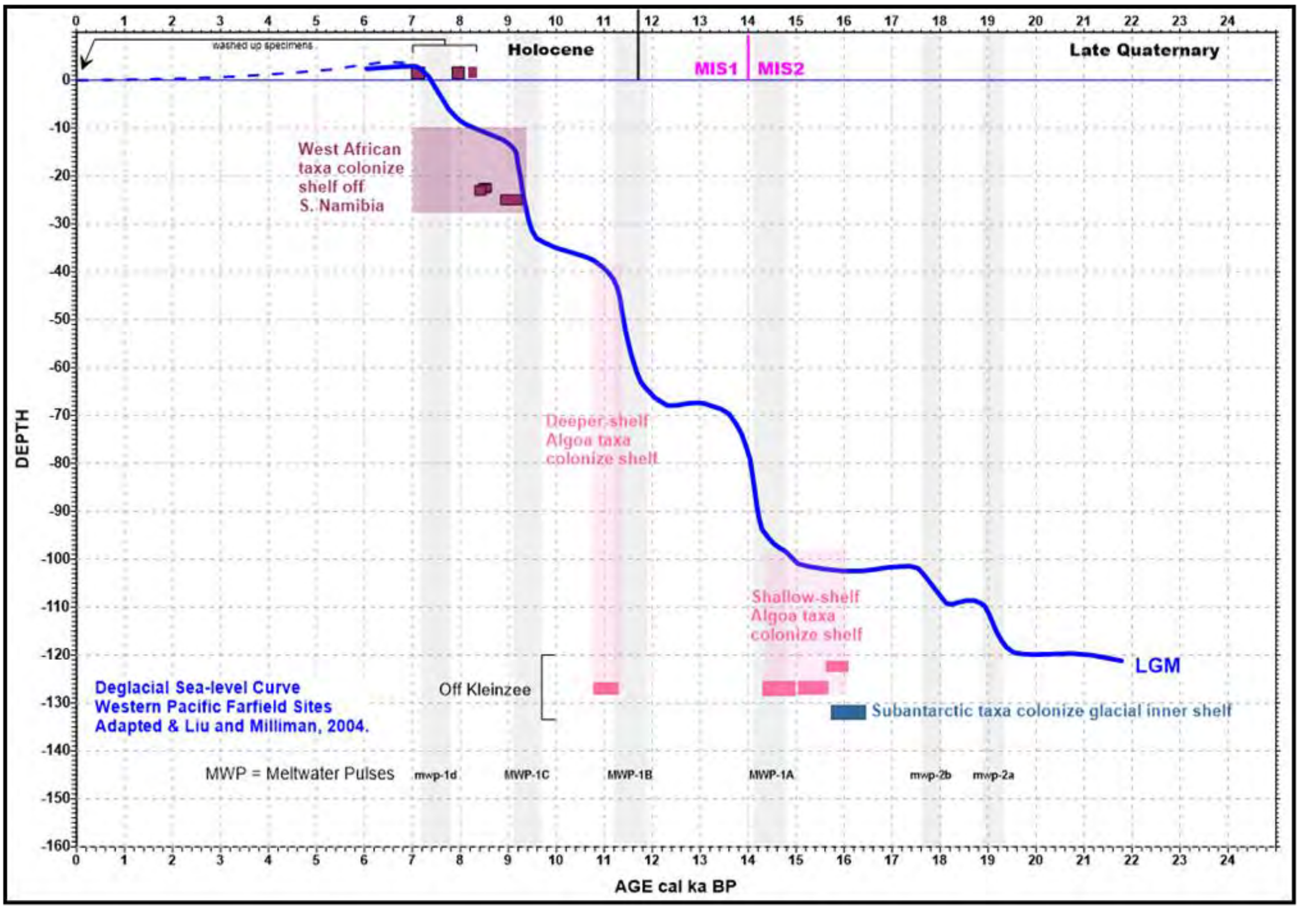


Figure 67: Sea-level curve for the last deglaciation, showing contexts of dated shells from the West Coast Shelf

The ***Cenozoic shelly macrofauna*** *comprises phosphatic shell casts and more rare intact shells of various ages. During later Neogene and Quaternary times the shelf was dominated by upwelling processes, with high organic productivity and authigenic mineralization of seabed rocks, clays and biogenic particles by phosphatization and glauconization. Extensive cemented crusts or "hardgrounds" formed on formations exposed at the seabed. Sea level oscillated repeatedly, dropping to ice-age palaeoshorelines as much as 140 m below present sea level. The hardgrounds were eroded during the ice-age/glacial shallowing episodes, releasing these fossils for incorporation into the LTS gravels.*

Fossil bones and teeth *include the bones and teeth of sharks and other fishes, the skulls of extinct whale species and the occasional remains of land-living animals that roamed the ice-age exposed shelf are also phosphatized and reworked into the latest, loose Last Transgression Sequence sediments on the seabed. A* *sample of this reworked material turns up in bottom-trawl fishnets, scientific dredging and during diamond-mining operations and the specimens which have been donated to scientific institutions have been invaluable contributions (e.g. Bianucci, Lambert & Post, 2007; Bianucci, Post & Lambert, 2007). All such material should be collected.*

***Shells from the Last Transgression Sequence** refers to the "sub-fossil" shells that occur abundantly in the sediments accumulated on the shelf during the last 20 thousand years as it was submerged to increasing depths. The marine shell fossils which occur in the LTS are predominantly the species expected on the West Coast Shelf, in a deepening-water faunal succession with littoral epifaunal species in the basal gravels, succeeded by infaunal bivalves in clean sands, succeeded by bivalves adapted to dwelling in the capping sulphidic muds. However, unexpected species and "extralimitals" (species beyond their normal home range) are actually quite common.*

*For instance, the Last Ice Age palaeoshoreline gravels are dominated by a "Venus shell" clam, Tawera philomela (**Figure 67**). This cold-water species, along with others, reached the Cape coast from the mid-Atlantic islands of Tristan da Cunha and Gough, apparently thrived here and then became extinct locally during the last deglaciation (Pether, 1993). During the subsequent deglaciation/warming, several warm-water species from the south and east coasts "invaded" the western shelf temporarily (***Figure 67***).*

This shows a more marked influence of Agulhas water rounding the Cape and affecting the Benguela System during the global-warming steps of the last deglaciation (Pether, 1994). These Agulhas extralimitals have mainly been found during diamond sampling/mining off northern Namaqualand – one may expect them to be more abundant further south such as in 12C, as well as more species occurring. It is important to obtain a comprehensive sample of these occurrences for future study. In addition to dating the incursions on Agulhas influence, the individual shells are snapshot archives of the palaeoceanographic conditions at the time, as revealed by incremental analyses of stable isotopes and trace elements by "spot trails" across the growth lines of shells.

6.1.4 Socio-economic Environment

The cultural and socio-economic environment is largely dependent upon the regional, local and immediate communities present in the area. The proposed prospecting/survey activity falls within the regional West Coast District Municipality (WCDM) and local Matzikama Municipality.. The nearest coastal towns are Papendorp and Strandfontein, while the nearest inland towns are Ebenhaeser, Lutzville and Koekenaap.

The West Coast has a very rich cultural, heritage and history, with many of the towns being over a century old. The West Coast and local towns are also very popular tourist destinations, being renowned for their beaches, wildlife, hiking trails, whale watching locations, 4x4 routes and variety of holiday accommodations. As very little to no socio-economic or demographic information is available for Papendorp or the three inland towns nearest to the concession area, information is only provided for Strandfontein. Strandfontein comprises a predominantly black and white community with both permanent and vacation residents alike. The primary language is Afrikaans followed by isiXhosa. The level of education in this and the other surrounding towns are relatively low. Since education improves access to employment opportunities, the low levels of education result in an underdeveloped skilled labour workforce and low household income levels. These towns have a high dependency ratio which is commonly observed in developing countries and have been found to show significant relationship with economic growth, poverty, and employment (Vijayakumar 2013). This reiterates the need for a skilled labour force as this is vital to a country's economy, growth and development (Vijayakumar 2013 as in AE (2021)).

6.1.4.1 Demographic profile: West coast district municipality

The West Coast District Municipality extends over an area of 31 099km² and includes five local municipalities (Matzikama, Cederberg, Bergrivier, Saldanha Bay, and Swartland). It supports a total population of 464 056 inhabitants in 122 074 households (Table 6) (WCDM 2021). The population is 50.3% female and 49.7% male, with three predominant population groups: Coloured (66.58%), Black African (16.36%), and White (15.71%) communities. Most of the populations' first language is Afrikaans (83.67%), followed by IsiXhosa (8.58%), English (3.98%) and other indigenous languages (IsiNdebele, Sesotho, and Setswana). The WCDM population dependency ratio is quite high (45.9%) with 68% in the working age group (15–64), followed by the young (25%, 0–14) and the elderly group (7%, 65+), which puts significant strain on the workforce, social systems and the delivery of basic services. Level of education is relatively low (79.1%) compared to the Western Cape (87.2%) and South Africa as a whole (80.9%). In 2019, the WCDM experienced a loss of 389 jobs, which is expected to have a significant impact on the economy should this trend continue. In 2018, the agriculture, forestry and fishing sector was the primary source of employment, creating 70 060 jobs and contributing towards 38.1% of the total employment (as in AE (2021)).

6.1.4.2 Demographic profile: Matzikama municipality

The Matzikama municipality consist of 18 towns, with three coastal settlements (Doringbaai, Papendorp and Strandfontein) and several small inland towns (Ebenhaeser, Lutzville and Koekenaap) which serves as agriculture service centres (MM 2019; WCGPT 2018). The area is defined by an arid environment with a natural irrigation system sustained by the Olifants River. This river comprises 237km of canals and is essential to the surrounding towns as it supplies them with water for domestic, industrial and agricultural use (DWS 2019), in addition to being a fishing ground for many subsistence fisherman. Vredendal is the largest town and also supports the majority of economic activities (WCGPT 2018). The agriculture sector (viniculture) followed by the forestry and fishing sector are the largest contributors towards the municipal GDP and employment in 2018 (Mayson *et al.* 2020; MM 2019). It is estimated that the Matzikama municipality experienced a large decline in its annual GDP growth rate in 2019 due to the COVID-19 pandemic (IDP 2021/22). Should this pandemic continue, it is expected to lead to a further decline in municipal revenue, unemployment and the local economy (IDP 2021/22) (as in AE (2021)).

Strandfontein

Strandfontein (31.7481 S, 18.2303 E) is mostly a residential and holiday resort (Mayer *et al.* 2020), situated along the west coast approximately 50km west of Vredendal. Strandfontein has a population of 431 residents in 92 households (census 2011). The predominant population group is Black African (50.6%), followed by White (33.2%), Coloured (14.8%), Indian/Asian (0.9%), and other (0.5 %). Most of the population's home language is Afrikaans (69.4%), followed by isiXhosa (22.6%), English (3.2%), Sesotho (2.7%), IsiZulu (1.1%), and Sepedi (0.5%). The level of education is relatively low with only 38.6% having completed matric. When compared with Doringbaai and Lambertsbaai, a larger portion of the community in Strandfontein (38%) earns more than R76 400 per year.

6.1.4.3 Fisheries and Other Harvesting

The South African fishing industry consists of approximately 14 commercial sectors operating within the 200 nautical mile Exclusive Economic Zone (EEZ). The western coastal shelf is a highly productive upwelling ecosystem (Benguela current) and supports a number of fisheries.

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 purse-seine fishery targeting pilchard (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Secondary commercial species in the hake-directed fisheries include an assemblage of demersal (bottom-dwelling) fish of which monk fish (*Lophius vomerinus*) and snoek (*Thyrsites atun*) are the most important commercial species. Other fisheries active on the West Coast are the pelagic long-line fishery for tunas and swordfish and the tuna pole and traditional line-fish sectors. West Coast rock lobster (*Jasus lalandi*) is an important trap fishery exploited close to the shoreline (waters shallower than 100m) including the intertidal zone and kelp beds off the West Coast.

On the West Coast of South Africa, major fishing grounds tend to be centred along the shelf break which is located approximately along the 500m isobath. Historically and currently the bulk of the main commercial fish stocks caught on the northern West Coast of South Africa have been landed and processed at the Western Cape ports of Cape Town and Saldanha (less than 1% of the South African commercial allowable catch is landed in the Northern Cape Province). The main reasons for this include lack of local infrastructure, distance to market and relatively low volumes of fish landings. The main commercial sectors operating in the vicinity of the study area are discussed below:

6.1.4.3.1 West Coast Rock Lobster

The West Coast rock lobster occurs inside the 200m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. In South Africa, the fishery is divided into the offshore fishery and the near-shore fishery, both directed inshore of the 100m bathymetric contour. The offshore sector operates in a water depth range of 30m to 100m whilst the inshore fishery is restricted by the type of gear used to waters shallower than 30m in depth.

Fishing grounds are divided into Zones stretching 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. Catch is managed using a TAC set annually for different management areas. The fishery operates seasonally, with closed seasons applicable to different management zones. There is a direct overlap with the proposed prospecting activities and the offshore sector in Zone B, Areas 3 & 4 (**Figure 68**).

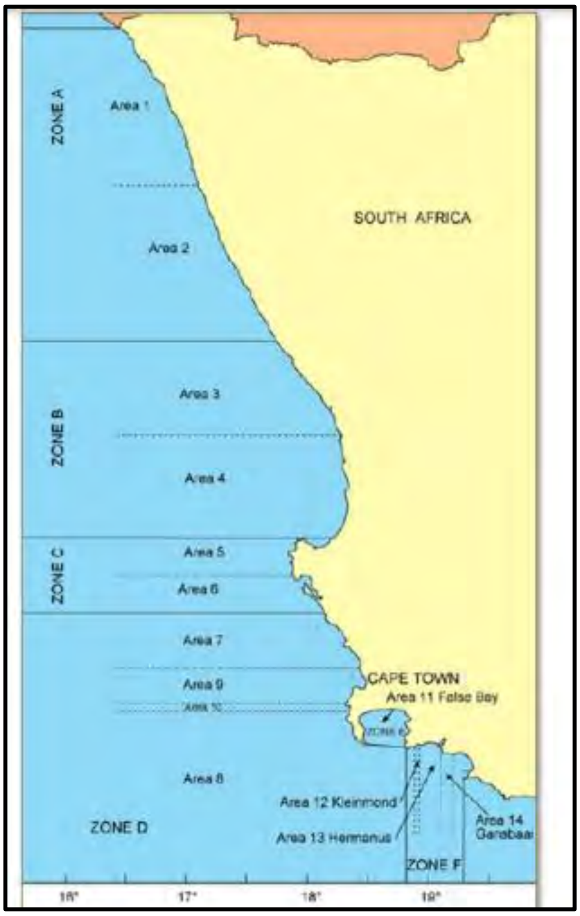


Figure 68: West Coast rock lobster fishing zones and areas. The five super-areas are A1-2 corresponding to Zone A, A 3-4 to Zone B, A5- 6 to Zone C, A7 being the northern-most Area within Zone D, and A8+ comprising Area 8 of Zone D in conjunction with Zone F. Source (DAFF).

6.1.4.3.2 Abalone Ranching

The Abalone *(Haliotus midae*) is endemic to South Africa with the natural population extending east from St Helena Bay in the Western Cape to Port St Johns on the east coast (Branch et al. 2010; SRK 2021).

Seeding of abalone in designated areas (ranching) has led to the establishment of abalone outside this natural range, including sites along approximately 50km of the Namaqualand coast in the Northern Cape. The potential to increase this seeded area to 175km has been made possible through the issuing of “Abalone Ranching Rights” (Government Gazette No. 729 of 20 August 2010) in four concession zones between Alexander Bay and Hondeklipbaai.

Kelp forests are a key habitat for abalone, as they provide a key food source for abalone as well as an ideal ecosystem for abalone’s life cycle (Branch et al., 2010). Light is a limiting factor for kelp beds, which are therefore limited to depths of 10m on the Namaqualand coast (Anchor Environmental, 2012). In the wild, abalone may take 30 years to reach full size of 200mm, but farmed abalone attain 100mm in only 5 years, which is the maximum harvest size (SRK 2021).

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 DEFF (then, the Department of Agriculture, Forestry and Fisheries - DAFF) issued rights for each of four Concession Area Zones. Two hatcheries exist in Port Nolloth producing up to 250 000 spat. To date, there has been no seeding in Zones 1 or 2. However, seeding has taken place in Zones 3 and 4, both of which are situated to the north of the sea concession areas.

6.1.4.3.3 Beach-Seine and Gillnet Fisheries

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 fishers active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South coasts. These fishers utilise 1 373 registered 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*).

The fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas. The number of Rights Holders for 2014 was listed as 28 for beach-seine and 162 for gillnet (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 line-fish 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 (SRK 2021).

Due to the range of beach-seine activities (20m), there would be no overlap with the sea concession areas, however, it is expected that the concession areas do overlap with gillnet fishing areas.

6.1.4.4 Fisheries Research

Surveys of demersal fish resources are carried out in January (West Coast survey encompassing the area between the Namibian border and Cape Agulhas) and April/May (South Coast survey encompassing the area between Cape Agulhas and Port Alfred) each year by DAFF in order to set the annual TACs for demersal fisheries. Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. The gear configuration is similar to that of commercial demersal trawlers; however, nets are towed for a shorter duration of generally 30 minutes per tow. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000m bathymetric contour. Approximately 120 trawls are conducted during each survey over a period of approximately one month.

The biomass of small pelagic species is also assessed bi-annually by an acoustic survey. During these surveys, the survey vessel travels pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200m bathymetric contour. The survey is designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast.

6.1.5 Emissions

6.1.5.1 Air Quality

- Due to the onboard disposal of waste in some cases compliance with the requirements of Marpol Annex VI - Prevention of Air Pollution from Ships will be required for all vessel engines and where vessels are fitted with rubbish incinerators.

6.1.5.2 Noise and vibration

- The vessels will generate noise and vibration on the ocean.
- The prospecting activities will generate some noise.

6.1.5.3 Light Pollution

- The vessel will need to have lighting for security purposes.

6.1.6 Screening Tool and Site Sensitivity Verification Report

Refer to **Appendix C: Screening Tool Reports And Site Sensitivity Verification Report**, **page 216**, which details the findings of the Screening Tool (**Table 15**), and the Site Sensitivity Verification Report.

The sensitivities listed below were identified in the Screening Report for Sea Concession 12C:

Table 15: Summary of Screening Tool Report Sensitivities

THEME	SCREENING TOOL SENSITIVITY RATING
Agricultural Theme & Agricultural Impact Assessment	No rating
Archaeological and Cultural Heritage Theme & Impact Assessment	No rating
Palaeontology Theme & Impact Assessment	No rating

Terrestrial Biodiversity, Plant Species Themes & Impact Assessment	No rating
Animal Species Theme	No rating
Aquatic Biodiversity Theme & Impact Assessment	No rating
Noise Theme	No rating

The "Protocols" require that the EAP or a specialist verify the screening tool report findings. **Table 16** below, provides a summary of the EAP's recommendations.

Table 16: Summary of Recommendations based on Site Sensitivity Verification

	Specialist Assessment	Screening Report Sensitivity Rating	Inclusion or Exclusion	Reasons for exclusion
1	Agricultural Theme & Agricultural Impact Assessment	No rating	Exclusion	The Environmental Assessment Practitioner (EAP) doesn't concur with the identification of the Agriculture impact Assessment and is of the opinion that this impact assessment will be insignificant to the Basic Assessment process. As such, an Agriculture impact Assessment or Compliance Statement will not be conducted.
2	Archaeological and Cultural Heritage Theme & Impact Assessment Palaeontology Theme & Impact Assessment	No rating	Inclusion	According to the screening report, no sensitivity rating has been given in terms of the Archaeological, Cultural Heritage and Palaeontology Themes. Due to the locality and unknown terrain below the surface, the EAP deems the sensitivity as **Medium.** As such, an Offshore Palaeontological Impact Assessment & a Maritime Archaeology Impact Assessment will be included in the BAR.
3	Terrestrial Biodiversity, Plant Species Themes & Impact Assessment	No rating	Exclusion	According to the screening report, no sensitivity rating has been given in terms of terrestrial biodiversity and plant species. The proposed prospecting activity will take place over Sea Concession 12C in the Atlantic ocean and will not take place on terrestrial land. A Marine Ecology Impact Assessment Report will however be conducted for the BAR.
4	Animal Species Theme	No rating	Exclusion	According to the screening report, no sensitivity rating has been given in terms of animal species although an Animal Species Impact Assessment have been identified. Due to the nature of the sea concession area and the locality of the activities takin place below the surface, the EAP rates the sensitivity as **MEDIUM.** As such, a Marine Ecology Impact Assessment Report will be conducted for the BAR.
5	Aquatic Biodiversity Theme & Impact Assessment	No rating	Exclusion	According to the screening report, no sensitivity rating has been given in terms of aquatic biodiversity. The proposed prospecting activity will take place over Sea Concession 12C in the Atlantic ocean and will not effect on any freshwater biodiversity. The Environmental Assessment Practitioner (EAP) concurs with the identification of the Aquatic Biodiversity Impact Assessment and rates the sensitivity as **Medium.** A Marine Ecology Impact Assessment Report will however be conducted for the BAR.
6	Noise Theme	No rating	Exclusion	Due to the nature of the sea concession area and the locality of the activities taking place below the surface with minimal ambient noise, the EAP rates the sensitivity as **insignificant.**

				As such, no Noise Impact Assessment Report will be conducted for the BAR.
7	Radioactivity Theme	No rating	Exclusion	Due to the nature of the sea concession area and the fact that no radioactivity substances will be used, the EAP rates the sensitivity as **insignificant.** As such, no Radioactivity Impact Assessment Report will be conducted for the BAR.

6.2 Description of the current land uses.

6.2.1 Shipping Transport

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the West Coast largely comprising fishing and mining vessels, especially between Kleinsee and Oranjemund. The main shipping lanes are located further offshore of Sea Concession areas 12C.

6.2.2 Oil and Gas Exploration and Production

Oil and gas exploration and production is currently undertaken in a number of licences blocks off the South and East coasts of South Africa (see **Figure 71**).

6.2.3 Exploration

The South African continental shelf and economic exclusion zone (EEZ) have similarly been partitioned into Licence blocks for petroleum exploration and production activities. Oil and gas exploration in the South African offshore commenced with seismic surveys in 1967. Since then, numerous 2D and 3D seismic surveys have been undertaken in the West Coast offshore.

Approximately 40 exploration wells have been drilled since the 1960's. Prior to 1983, reliable technology was not available for removing wellheads from the seafloor. Since then, however, on completion of drilling operations, the well casing has been severed 3m below the sea floor and removed from the seafloor together with the permanent and temporary guide bases. Of the approximately 40 wells drilled, 35 wellheads remain on the seafloor. Location and wellhead details are available from the Hydrographic office of the South African Navy (which issues the details to the public in a notice to mariners) or directly from PASA.

6.2.4 Undersea Cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean as depicted in **Figure 69: African undersea cables**, including the WACS and ACE cables. The SAT3/SAFE cables (SAT-1 [abandoned], SAT-2 and SAT-3) are laid on the seafloor approximately on the 3 000m isobaths, running up the Cape Canyon to land at Melkbosstrand.

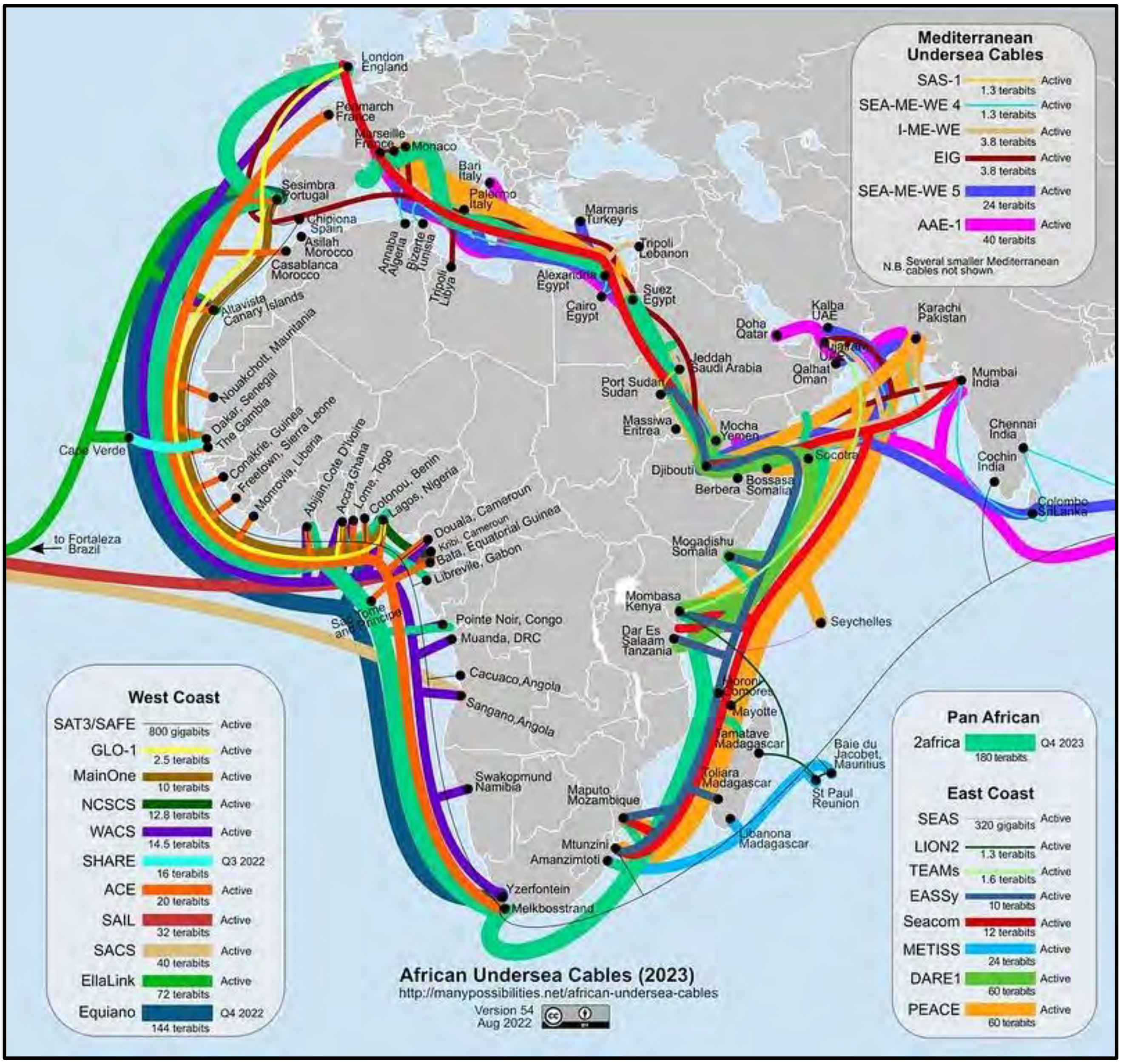


Figure 69: African Undersea Cables. Source: https://manypossibilities.net/african-undersea-cables/

As per the Marine Faunal Impact Assessment:

6.2.5 Other Uses of the Area

The following is from the Marine Biodiversity Assessment, page 252:

6.2.5.1 Beneficial Uses

Other users within and surrounding concession 12C include the commercial fishing industry (see Specialist Report on Fisheries), neighbouring marine diamond mining concession holders and hydrocarbon exploration and production licences. Recreational use of the offshore areas is negligible.

6.2.5.2 Diamond Mining and Minerals Prospecting

Concession 12C lies adjacent to a number of other marine diamond mining concession areas (see Figure 70). The marine diamond mining concessions 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 70). On the Namaqualand coast marine diamond mining activity is primarily restricted to the surf-zone and (a)-concessions, which extend to 1,000 m offshore of the high water mark. Nearshore shallow-water mining is typically 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. Some vessels still operate out of Alexander Bay and Port Nolloth, but activity out of Hondeklip Bay and Lambert's Bay has all but ceased. More recently (since 2020) there has been a renewed interest in some of the concessions around the Olifants River mouth, with numerous applications for geophysical surveys, sampling and bulk sampling being submitted (see Table 20). Interference with vessel-based mining or prospecting activities in adjacent concessions during the proposed prospecting and sampling operations is highly unlikely.*

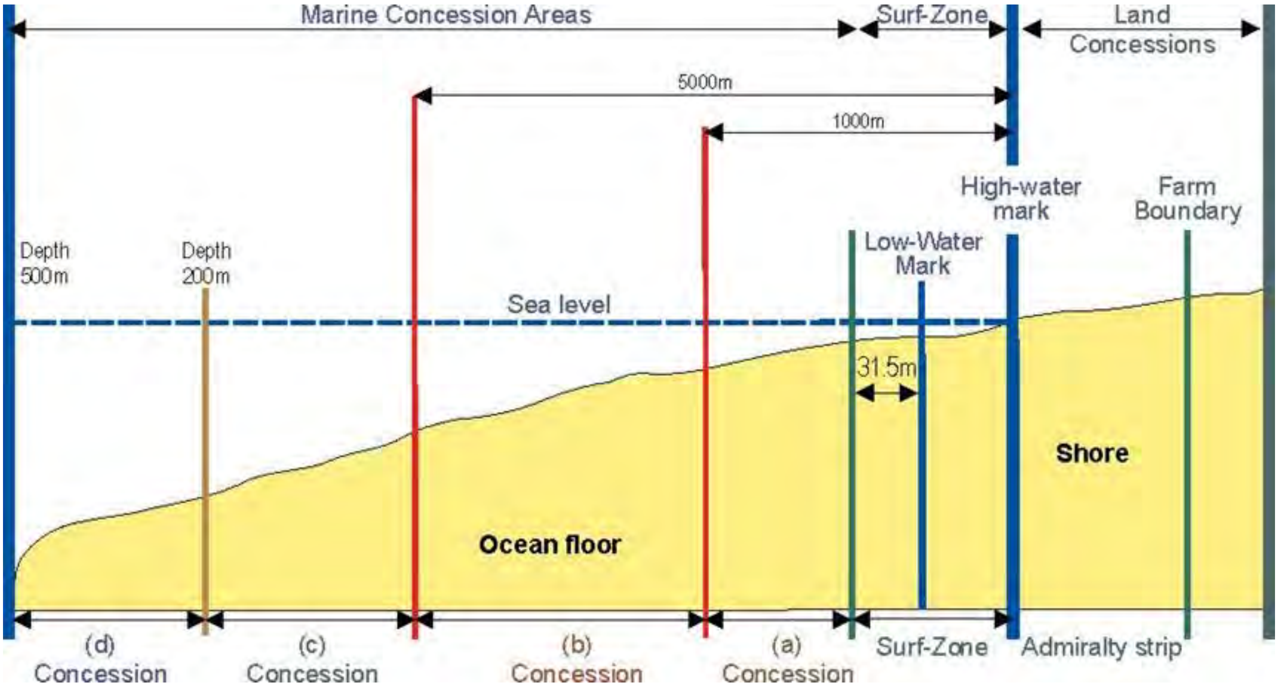


Figure 70: Diagram of the onshore and offshore boundaries of the South African (a) to (d) marine diamond mining concession areas.

Deep-water diamond mining and prospecting is currently limited to operations by Belton Park Trading 127 (Pty) Ltd in concessions 2C and 3C for mining and by De Beers Marine in concessions 4C -6C for prospecting. Other prospecting applications for concessions further south are, however, pending.

6.2.5.3 Hydrocarbons

The South African continental shelf and economic exclusion zone (EEZ) have similarly been partitioned into Licence Blocks for petroleum exploration and production activities. Exploration has included extensive 2D and 3D seismic surveys and the drilling of numerous exploration wells, with ~40 wells having been drilled in the Namaqua Bioregion since 1976. Concession 12C overlaps with PetroSA's Exploration Right 283.

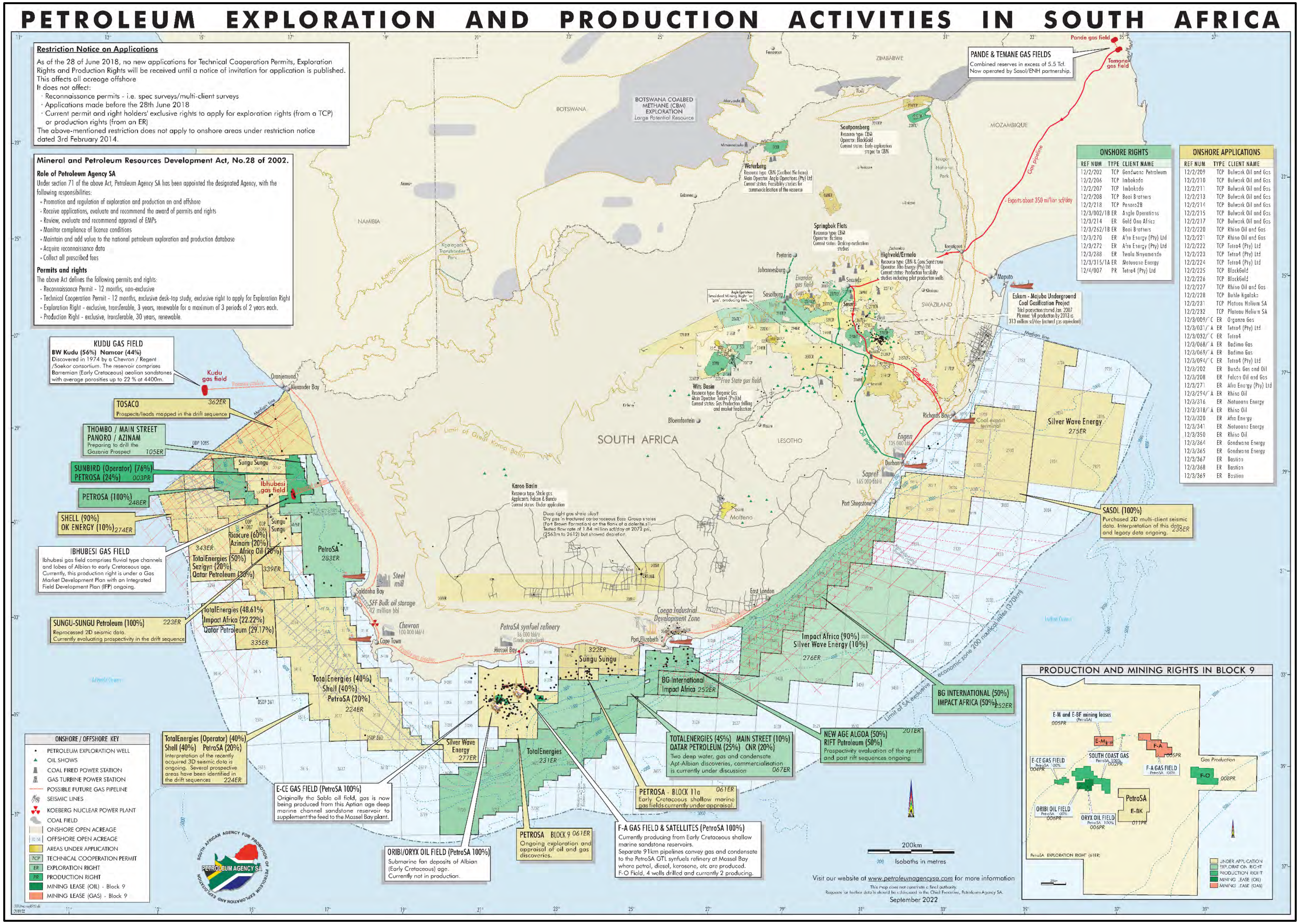


Figure 71: Petroleum licence blocks off the west, south and east coasts of South Africa (After Pasa, 2019).

6.2.6 Description of specific environmental features and infrastructure on the site.

As per the Marine Biodiversity Assessment, page 252:

6.2.6.1 Conservation Areas and Marine Protected Areas

Numerous conservation areas and marine protected areas (MPAs) exist along the West Coast, although these are all located to the north or south of concession 12C. For the sake of completeness, they are briefly described below.

6.2.6.1.1 Sanctuaries

Sanctuaries are considered a type of management area within South Africa's multi-purpose expanded MPA network in which access and/or resource use is prohibited. Sanctuaries in the vicinity of the project area in which restrictions apply are the McDougall's Bay, Stompneusbaai and Saldanha Bay rock lobster sanctuaries, which are closed to commercial exploitation of rock lobsters. These sanctuaries were originally proclaimed early in the 20th century under the Sea Fisheries Act of 1988 as a management tool for the protection of the West Coast rock lobster (Mayfield et al. 2005). There is no overlap of concession 12C with any of these sanctuaries.

6.2.6.1.2 Marine Protected Areas

'No-take' MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) are absent northwards from Cape Columbine (Emanuel et al. 1992; Lombard et al. 2004). This resulted in substantial portions of the coastal and shelf-edge marine biodiversity in the area being assigned a threat status of 'Critically endangered', 'Endangered' or 'Vulnerable' in the 2011 NBA (Lombard et al. 2004; Sink et al. 2012). Using biodiversity data mapped for the 2004 and 2011 NBAs a systematic biodiversity plan was developed for the West Coast (Majiedt et al. 2013) with the objective of identifying both coastal and offshore priority areas for MPA expansion. Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. To this end, nine focus areas were identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas were carried forward during Operation Phakisa, which identified potential offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African EEZ to 5%. The approved MPAs within the broader project area are described briefly below.

*The **Namaqua National Park MPA,** located ~60 km north of concession 12C, provides the first protection to habitats in the Namaqua bioregion, including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape hakes, and the coastal areas support kelp forests and deep mussel beds, which serve as important habitats for the West Coast rock lobster. This 500 km^2 MPA was proclaimed in 2019, both to boost tourism to this remote area and to provide an important baseline from which to understand ecological changes (e.g. introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.*

*The **Rocher Pan MPA**, located ~100 km south of concession 12C, stretches 500 m offshore of the high water mark of the adjacent Rocher Pan Nature Reserve, was declared in 1966. The MPA primarily protects a stretch of beach important as a breeding area to numerous waders.*

Other offshore MPAs along the West Coast (e.g. Benguela Muds MPA and Cape Canyon MPA) are all located over 110 km offshore and south of concession 12C, with the Child's Bank MPA located ~140 km to the northwest of the concession.

6.2.6.1.3 Sensitive Areas

Despite the development of the offshore MPA network a number of 'Endangered' and 'Vulnerable' ecosystem types are currently 'not well protected' and further effort is needed to improve protection of these threatened ecosystem types (Sink et al. 2019). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well protected. Currently, however, most of the Namaqua Sandy Mid Shelf and Namaqua Muddy Mid Shelf Mosaic are poorly protected receiving only 0.2-10% protection (Sink et al. 2019). Within concession 12C, the ecosystem types are all considered 'poorly protected'.

6.2.6.1.4 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 12 EBSAs solely within its national jurisdiction with a further three having recently been proposed. It also shares eight trans-boundary EBSAs with Namibia (3), Mozambique (2) and the high seas (3). 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. The impact management and conservation zones within the EBSAs are under review and currently constitute a subset of the biodiversity priority areas map (see next section); EBSA conservation zones equate to Critical Biodiversity Areas (CBAs), whereas impact management zones equate to Ecological Support Area (ESAs). The relevant sea-use guidelines accompanying the CBA areas would apply.

The following summaries of the EBSAs in the broader project area are adapted from http://cmr.mandela.ac.za/EBSA-Portal/Namibia/. Concession 12C falls within the transboundary Benguela Upwelling System EBSA and lies immediately south of the southern portion of the Namaqua Coastal Area EBSA. The text and figures below are based on the EBSA status as of October 2020 (MARISMA EBSA Workstream 2020).

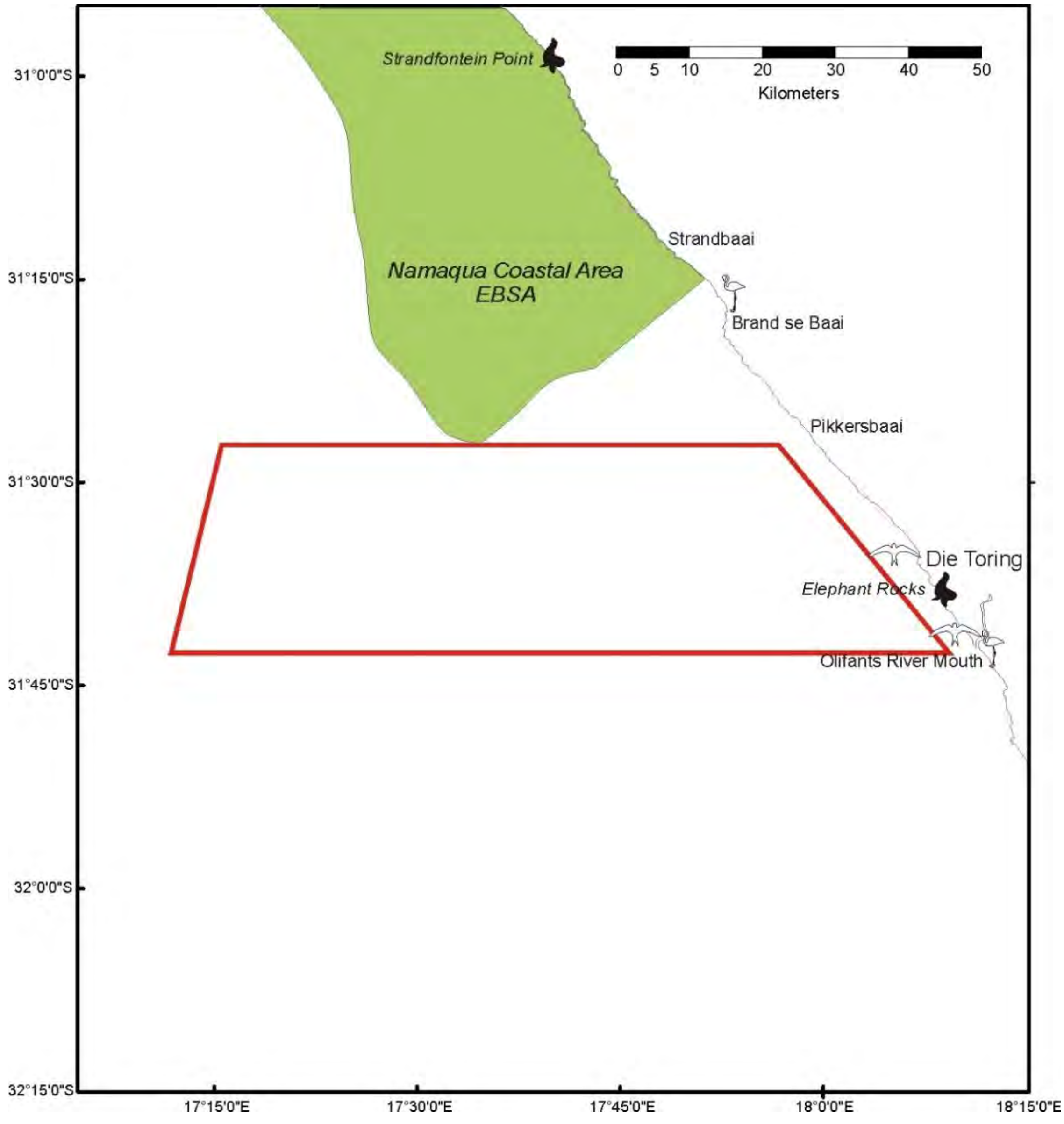


Figure 72: Concession 12C (red polygon) in relation to the location of seabird and seal colonies, seabird and wader breeding colonies and Ecologically and Biologically Significant Areas (EBSAs).

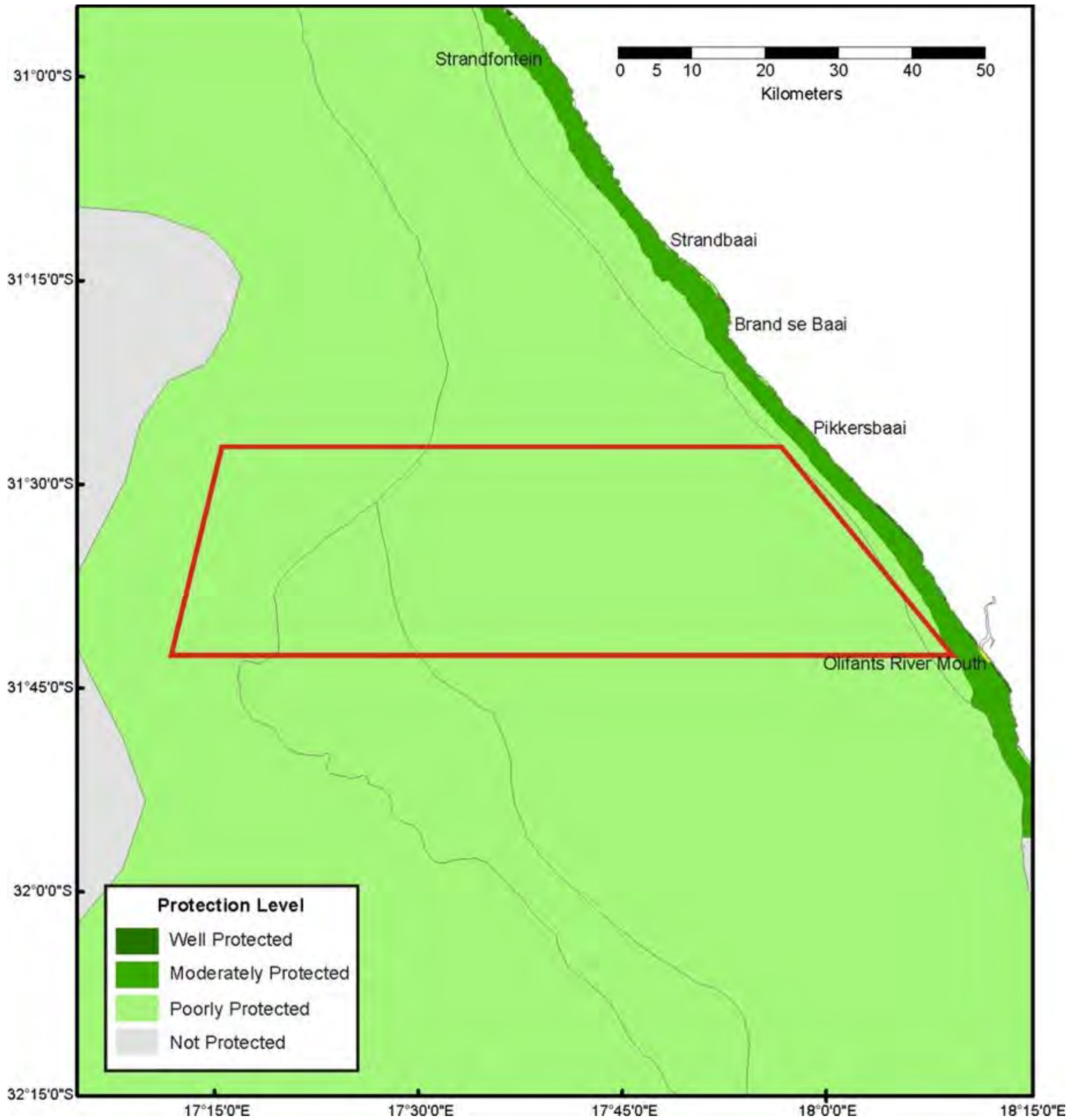


Figure 73: ***Concession 12C (red polygon) in relation to protection levels of 150 marine ecosystem types as assessed by Sink et al. (2019).***

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

*The **Namaqua Coastal Area** EBSA encompasses the Namaqua Coastal Area MPA and 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. There is no overlap of concession 12C with this EBSA (see*

Figure 72*).*

*The **Cape Canyon and Associated Islands** EBSA, at its closest point in St Helena Bay, lies ~54 km south of concession 12C. The EBSA includes the Benguela Muds MPA and the Cape Canyon, which is thought to hosts fragile habitat-forming species. The area is considered important for pelagic fish, foraging marine mammals and several threatened seabird species and serves to protect nine 'Endangered' and 12 'Vulnerable' ecosystem types, and two that are 'Near Threatened'. There are several small coastal MPAs within the EBSA.*

6.2.6.1.5 Biodiversity Priority Areas

The National Coastal and Marine Spatial Biodiversity Plan[5] comprises a map of Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained. The intention is that the CBA Map (CBAs and ESAs) and sea-use guidelines inform the MSP Conservation Zones and management regulations, respectively.

Concession 12C overlaps with areas mapped as Critical Biodiversity Area 1 (CBA 1), Critical Biodiversity Area 2 (CBA 2), and Ecological Support Area (ESA). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there are often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and/or will be larger areas.

Regardless of how CBAs are split, CBAs are generally areas of low use and with low levels of human impact on the marine environment, but can also include some moderately to heavily used areas with higher levels of human impact. Given that some CBAs are not in natural or near-natural ecological condition, but still have very high biodiversity importance and are needed to meet biodiversity feature targets, CBA 1 and CBA 2 were split into two types based on their ecological condition. CBA Natural sites have natural / near-natural ecological condition, with the management objective of maintaining the sites in that natural / near natural state; and CBA Restore sites have moderately modified or poorer ecological condition, with the management objective to improve ecological condition and, in the long-term, restore these sites to a natural/near-natural state, or as close to that state as possible. ESAs include all portions of EBSAs that are not already within MPAs or CBAs, and a 5-km buffer area around all MPAs (where these areas are not already CBAs or ESAs), with the exception of the eastern edge of Robben Island MPA in Table Bay where a 1.5-km buffer area was applied (Harris et al. 2022).

Activities within these management zones are classified into those that are "compatible", those that are "not compatible", and those that have "restricted compatibility" subject to certain conditions. Non-destructive prospecting activities are classified as having "restricted compatibility", subject to certain conditions, in CBAs and ESAs. Destructive prospecting activities with localised impact, e.g. bulk sampling, are considered "not compatible" in CBA Natural and CBA Restore areas and as having "restricted compatibility" within ESAs. Mining construction and operations are similarly classified as being "not compatible" in CBA Natural and CBA Restore areas but as having "restricted compatibility" within ESAs (Harris et.al. 2022). These zones have been incorporated into the most recent iteration of the national Coastal and Marine CBA Map (v1.2 released April 2022) (Harris et al. 2020) (

[5] The latest version of the National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released in April 2022) (Harris *et al.* 2022). The Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g., environment, fishing, transport (shipping), petroleum, mining, and others. It is relevant for the Marine Spatial Planning Working Group where many of these departments are participating in developing South Africa's emerging marine spatial plans. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, EIA practitioners, organisations working in the coast and ocean, civil society, and the private sector.

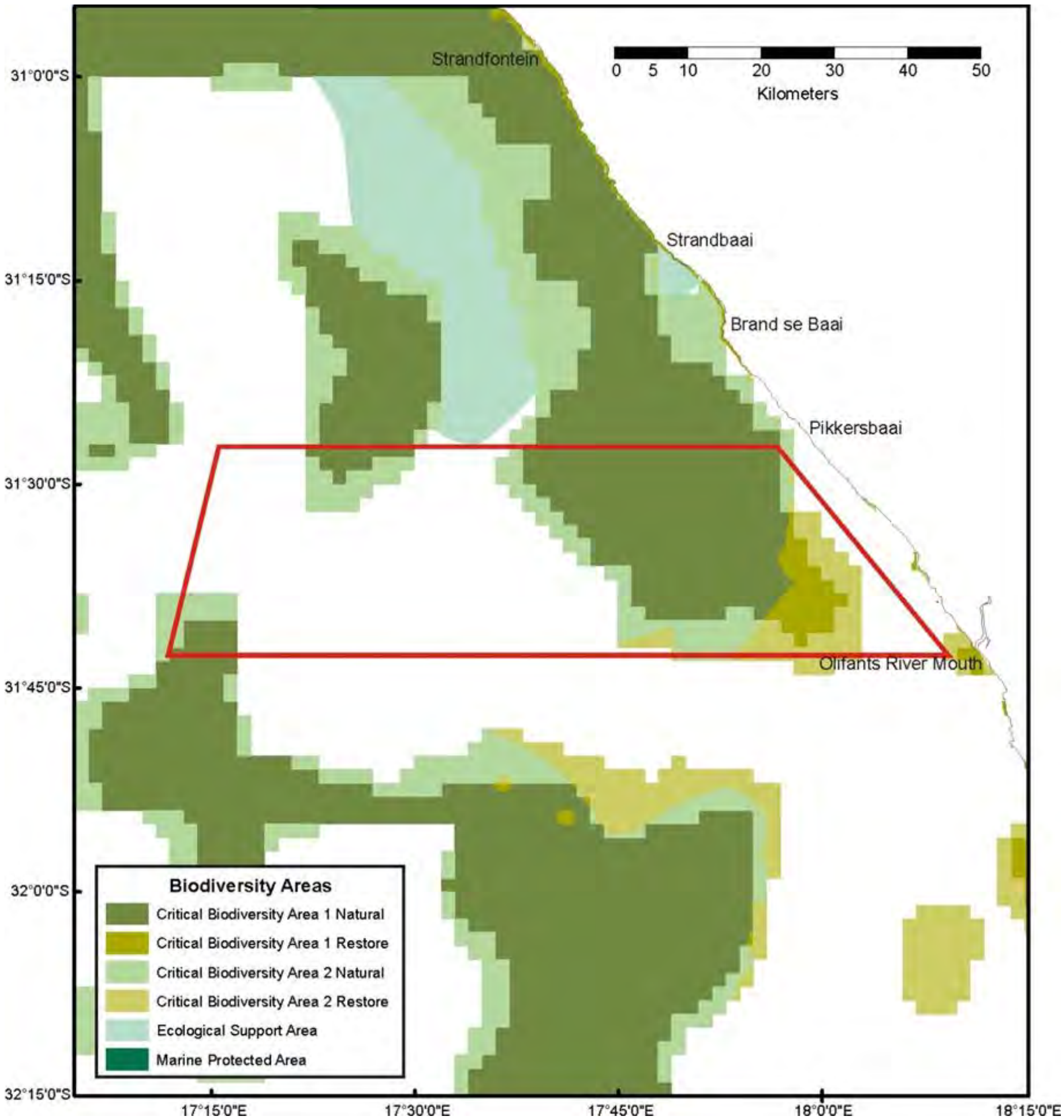


Figure 74:*).*

Overlap with CBA 1: Natural and CBA 2: Natural accounts for 27.9% and 10.0% of the concession area, respectively (

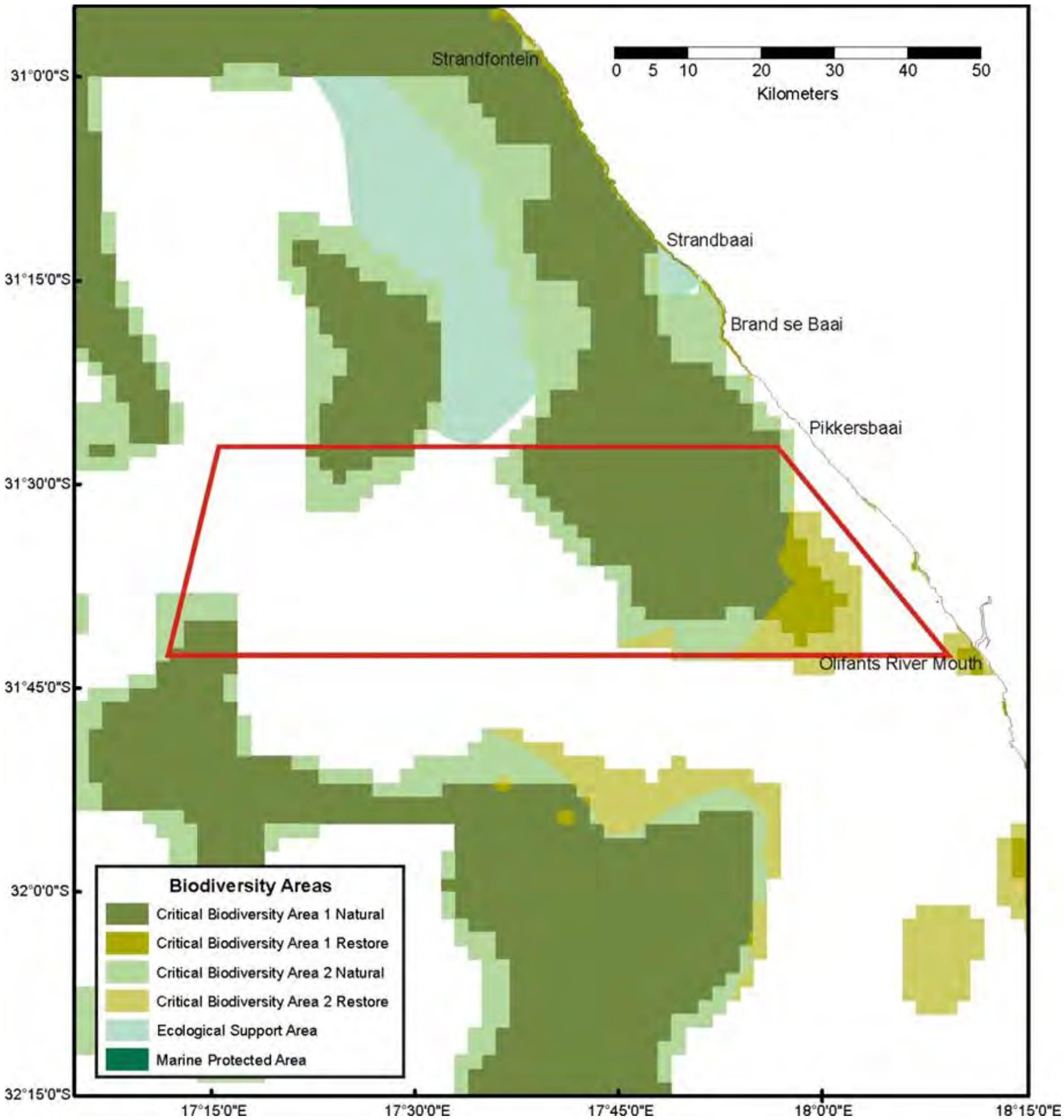


Figure 74:*), whereas overlap with CBA 1: Restore and CBA 2: Restore accounts for 3.4% and 5.0%, respectively.*

6.2.6.1.6 Important Bird Areas (IBAs) and RAMSAR Sites

There are a number of coastal Important Bird Areas (IBAs) in the general project area () (https://maps.birdlife.org/marineIBAs), but none overlap with concession 12C.

Various marine IBAs have also been proposed in South African territorial waters, with a candidate marine IBA suggested off the Orange River mouth and a further candidate marine IBA suggested in international waters *west of the Cape Peninsula (*

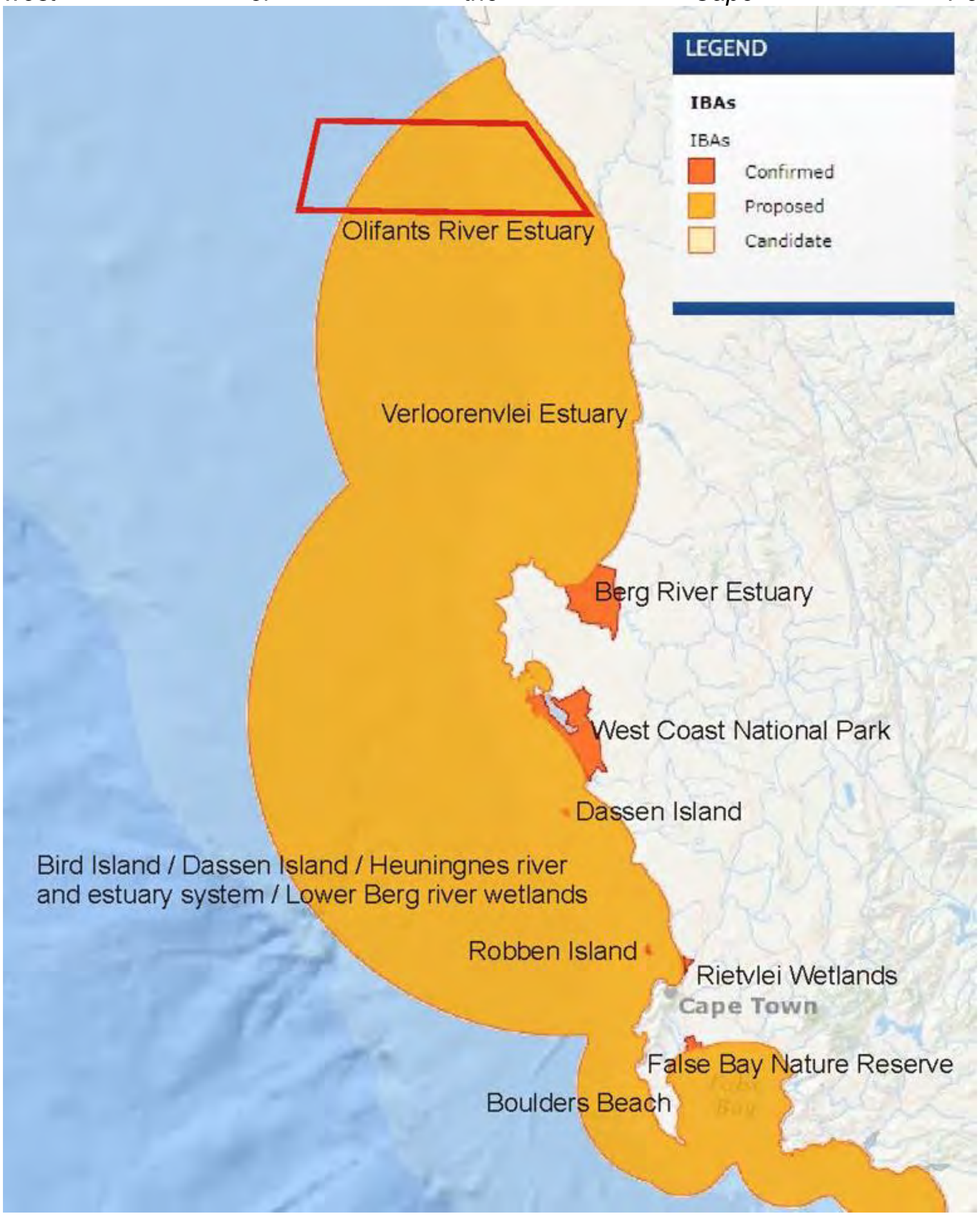


Figure 75:). Concession 12C overlaps with the proposed Bird Island / Dassen Island / Heuningnes river and estuary system / Lower Berg river wetlands marine IBA.

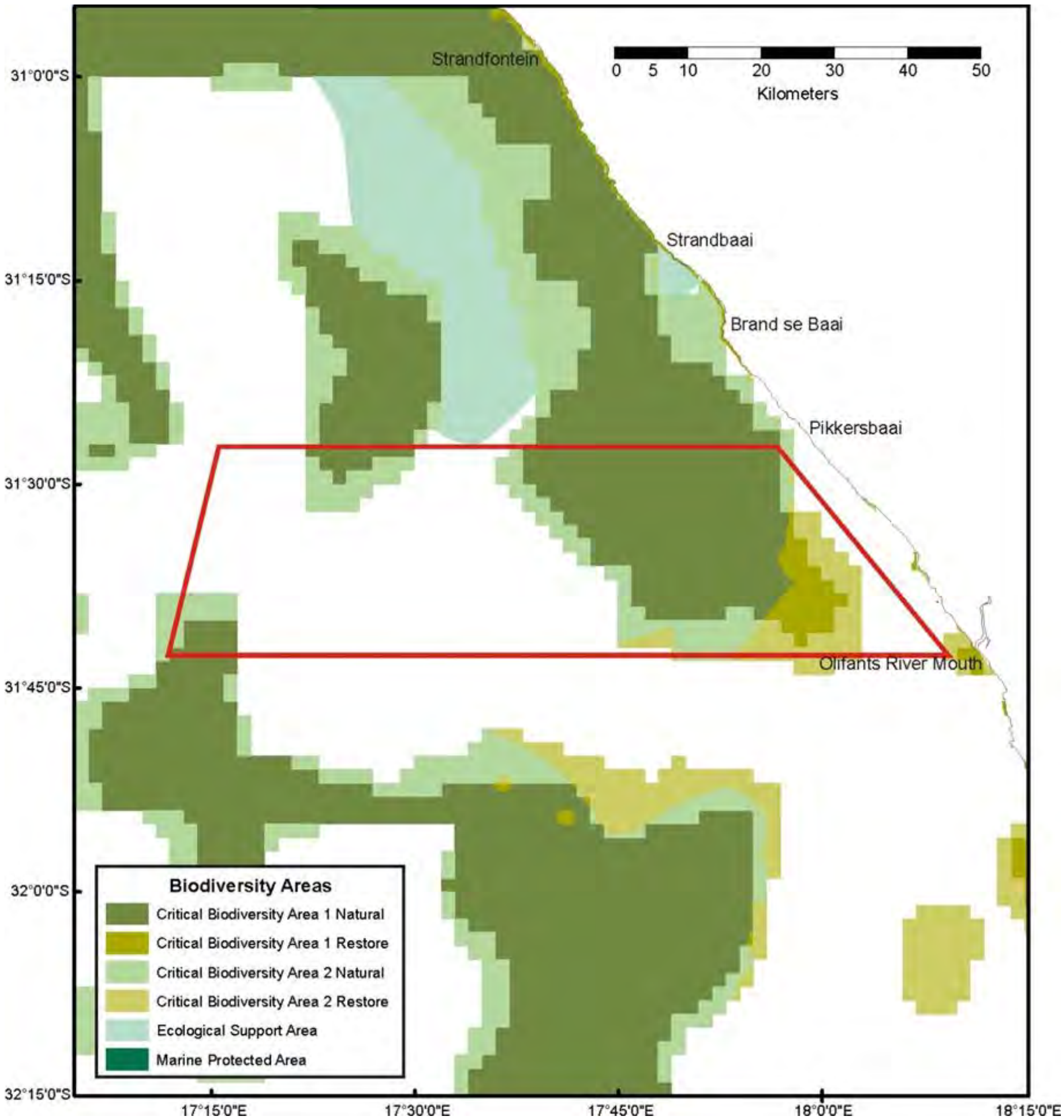


Figure 74: ***Concession 12C (red polygon) in relation to Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Version 1.2) (Harris et al. 2022).***

Table 17: List of confirmed coastal Important Bird Areas (IBAs) and their criteria listings. (www.BirdLife.org.za). Those incorporating or listed as RAMSAR sites are shaded.

Site Name	*IBA Criteria*
Orange River Mouth Wetlands (ZA023)	*A1, A3, A4i, A4iii*
Olifants River Estuary (ZA078)	*A3, A4i*
Verlorenvlei Estuary (ZA082)	*A4i*
Berg River Estuary (ZA083)	*A4i*
West Coast National Park and Saldanha Bay Islands (ZA 084) (incorporating Langebaan RAMSAR site)	*A1, A4i, A4ii, A4iii*

***A1**. Globally threatened species*
***A2**. Restricted-range species*
***A3**. Biome-restricted species*
***A4**. Congregations*
***i**. applies to 'waterbird' species*
***ii**. This includes those seabird species not covered under i.*
***iii**. modelled on criterion 5 of the Ramsar Convention for identifying wetlands of international importance. The use of this criterion is discouraged where quantitative data are good enough to permit the application of A4i and A4ii.*

A Ramsar site is considered wetland designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established by UNESCO in 1971. The convention entered into force in South Africa on 21 December 1975. It provides for national action and international cooperation regarding the conservation of wetlands, and wise sustainable use of their resources. South Africa currently has 27 sites designated as Ramsar Sites, with a surface area of 571,089 hectares. The coastal RAMSAR sites in the general project area are provided in Table 18 below.

Table 18: List of coastal RAMSAR sites in the vicinity of Concession 12C.

Name	*Size (ha)*	*Province*	*Description*
Verlorenvlei	*1 500*	*Western Cape*	*Ramsar site no. 525. One of the largest lakes (and one of South Africa's few coastal freshwater lakes), with associated scrub, shrubland, dune systems, marshland and reedbeds representing a transition zone between two plant communities. The site is an important feeding area for rare pelicans and fish, for moulting and breeding birds, as well as for staging wading birds.*
Berg River Estuary	*1 163*	*Western Cape*	*Ramsar site no. 2466. The Berg River Estuary follows the lower stretch of the River, is one of four perennial estuaries on the West Coast and one of the most important coastal wetlands in South Africa. The estuary boasts the third-largest saltmarsh on the Cape Coast and hosts some unique vegetation with rare plant species. About 127 species of waterbird have been recorded since 1975, some of which are globally threatened (e.g. Cape cormorant) or regionally threatened (Caspian tern). The Site is also important for fisheries, with fish such as white steenbras and white stumpnose partially or fully dependent on it for breeding.*
Langebaan	*6 000*	*Western Cape*	*Ramsar site no. 398. National Park. A large, shallow marine lagoon, includes islands, reedbeds, sand flats, saltmarshes and dwarf shrubland. The lagoon is an important nursery area for a number of fish species and supports a diverse and ecologically important algal and shoreline biota. Important for wintering and staging wading birds, and the numerous breeding birds include the largest colony of gulls in South Africa.*

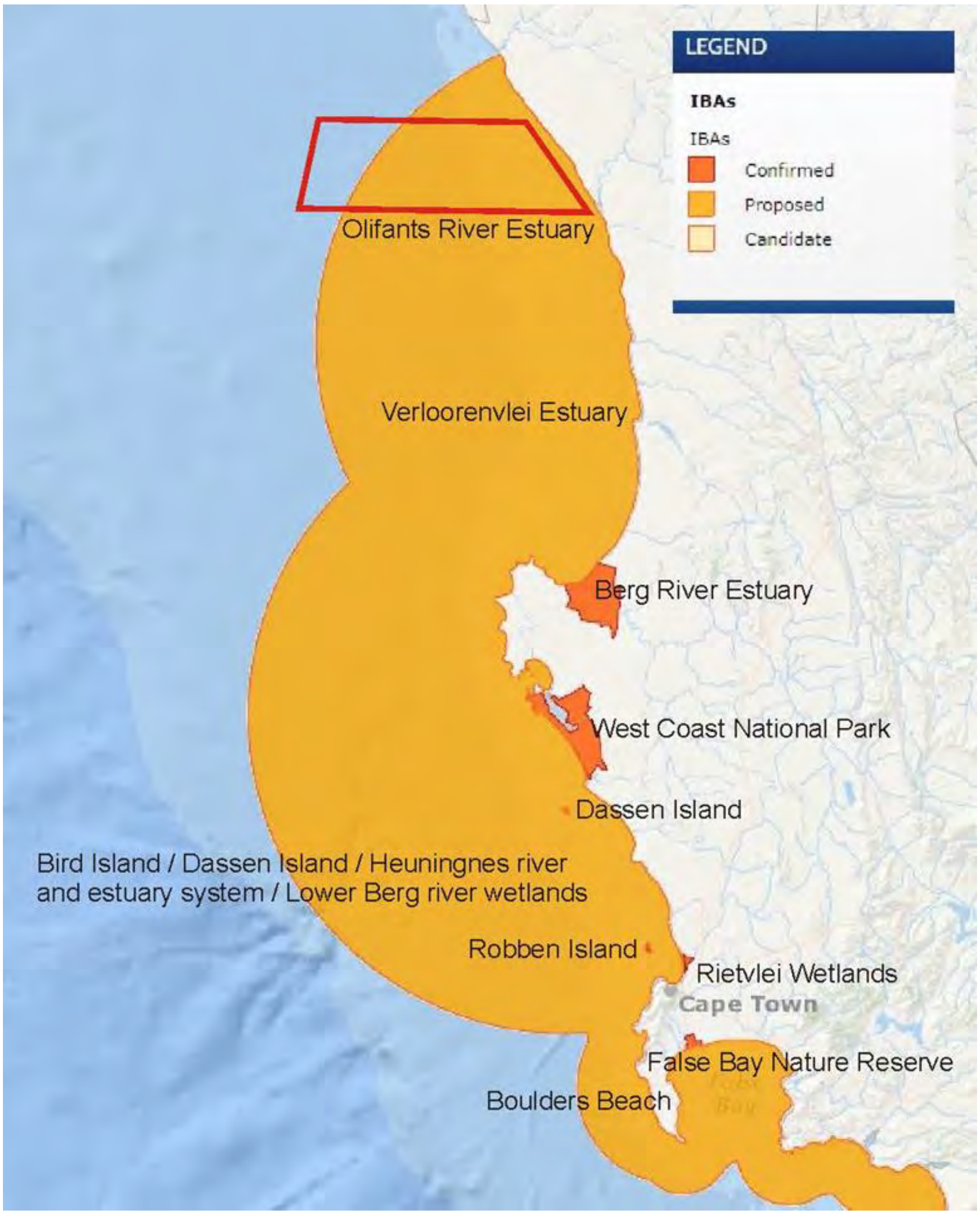


Figure 75: ***Concession 12C (red polygon) in relation to coastal and marine IBAs (Source: https://maps.birdlife.org/marineIBAs).***

2.4.2.7 Important Marine Mammal Areas (IMMAs)

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Modelled on the BirdLife International process for determining IBAs, IMMAs are assessed against a number of criteria and sub-criteria, which are designed to capture critical aspects of marine mammal biology, ecology and population structure. These criteria are:

Criterion A – Species or Population Vulnerability

Areas containing habitat important for the survival and recovery of threatened and declining species.

Criterion B – Distribution and Abundance

Sub-criterion B1 – Small and Resident Populations: Areas supporting at least one resident population, containing an important proportion of that species or population, that are occupied consistently.

Sub-criterion B2 – Aggregations: Areas with underlying qualities that support important concentrations of a species or population.

Criterion C – Key Life Cycle Activities

Sub-criterion C1 – Reproductive Areas: Areas that are important for a species or population to mate, give birth, and/or care for young until weaning.

Sub-criterion C2 – Feeding Areas: Areas and conditions that provide an important nutritional base on which a species or population depends.

Sub-criterion C3 – Migration Routes: Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.

Criterion D – Special Attributes

Sub-criterion D1 – Distinctiveness: Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.

Sub-criterion D2 – Diversity: Areas containing habitat that supports an important diversity of marine mammal species

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs (Figure 76) namely the

- *Southern Coastal and Shelf Waters of South Africa IMMA (166,700 km²),*
- *Cape Coastal Waters IMMA (6,359 km²), and*
- *South East African Coastal Migration Corridor IMMA (47,060 km²).*

These are described briefly below based on information provided in IUCN-Marine Mammal Protected Areas Task Force (2021) (www.marinemammalhabitat.org).

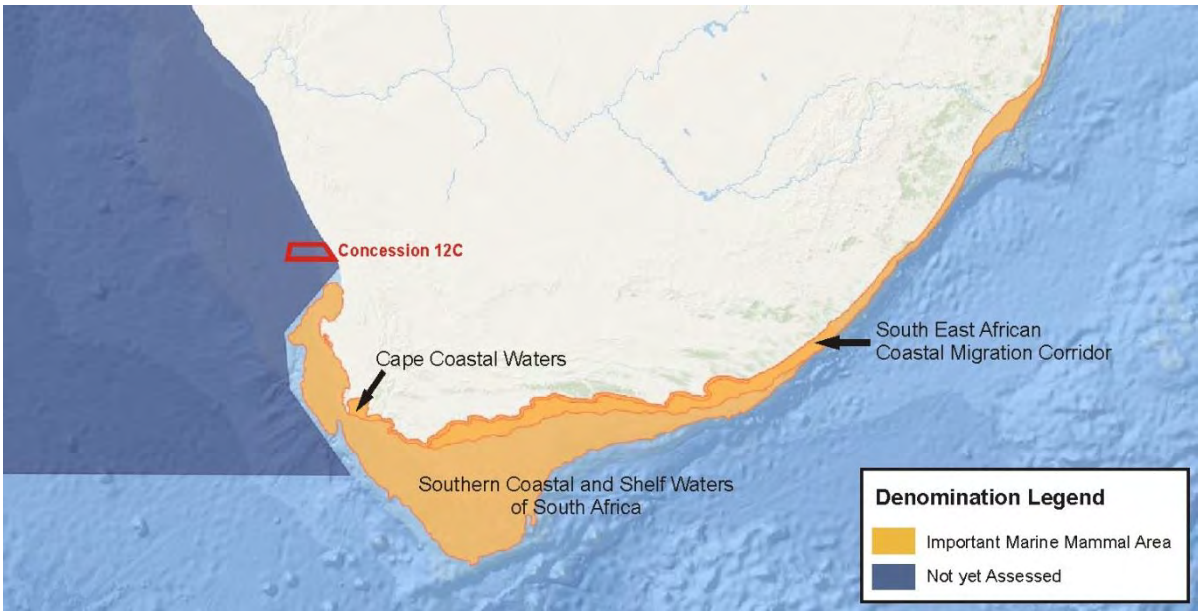


Figure 76: Concession 12C (red polygon) in relation to coastal and marine IMMAs (Source: www.marinemammalhabitat.org/imma-eatlas/).

The 166,700 km² Southern Coastal and Shelf Waters of South Africa IMMA extends from the Olifants River mouth to the mouth of the Cintsa River on the Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2) as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2) including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, humpback whales, killer whales and southern right whales.

The Cape Coastal Waters IMMA extends from Cape Point to Woody Cape at Algoa Bay and extends over some 6,359 km^2. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.

The South East African Coastal Migration Corridor IMMA extends some 47,060 km^2 from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of Southern Hemisphere humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and killer whale.

There is no overlap of concession 12C with the IMMAs.

6.2.7 Environmental and current land use map.

(Show all environmental, and current land use features)

Discussed above in 6.1.1.

7 Impact Assessment

7.1 Impacts and risks

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated).

Potential impacts associated with prospecting in Concession Area 12C were grouped based on major identified receptors which included Marine ecology and fisheries, Underwater Heritage resources, Palaeontology, Socio-economic aspects; and the no-go option. Assessment tables for each of the identified impacts for each of the receptors are presented below along with a summary of the key findings. Further details on impacts to Marine ecology Underwater Heritage resources and Palaeontology aspects are provided in the respective specialist study that were commissioned (Appendix D). Potential impacts were assessed in terms of their nature, extent, duration, intensity, probability of occurrence, potential for mitigation, cumulative effects and overall significance.

7.2 Marine Fauna

7.2.1 Acoustic Impacts of Geophysical Prospecting and Sampling

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). Such 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 may thus interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC 2003). Natural ambient noise will vary considerably with weather and sea state, ranging from about 80 to 120 dB re 1 µPa for the frequency range 10 – 10k Hz (Croft & Li 2017). A comparison of the various noise sources in the ocean is shown in Figure 77.

Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping (Erbe et al. 2018, 2019). Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m with main frequencies from 1 to 500 Hz (McCauley 1994; 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 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock et al. 2003; Duarte et al. 2021). Shabangu et al. (2022) determined that the noise of vessel traffic dominates the soundscape below 500 Hz off the South African West Coast, while wind-generated noise increased with wind speed above 5 m/s and dominates the soundscape above 500 Hz.

As Concession 12C lies well inshore of the main offshore shipping routes that pass around southern Africa (Figure 78), the shipping noise component of the ambient noise environment is expected to minimal (OceanMind Limited 2020). Given the relatively strong metocean conditions but insignificant local shipping traffic specific to the area, ambient noise levels are expected to be below 80 dB re 1 µPa for the frequency range 10 Hz – 10 kHz (SLR Consulting Australia 2022).

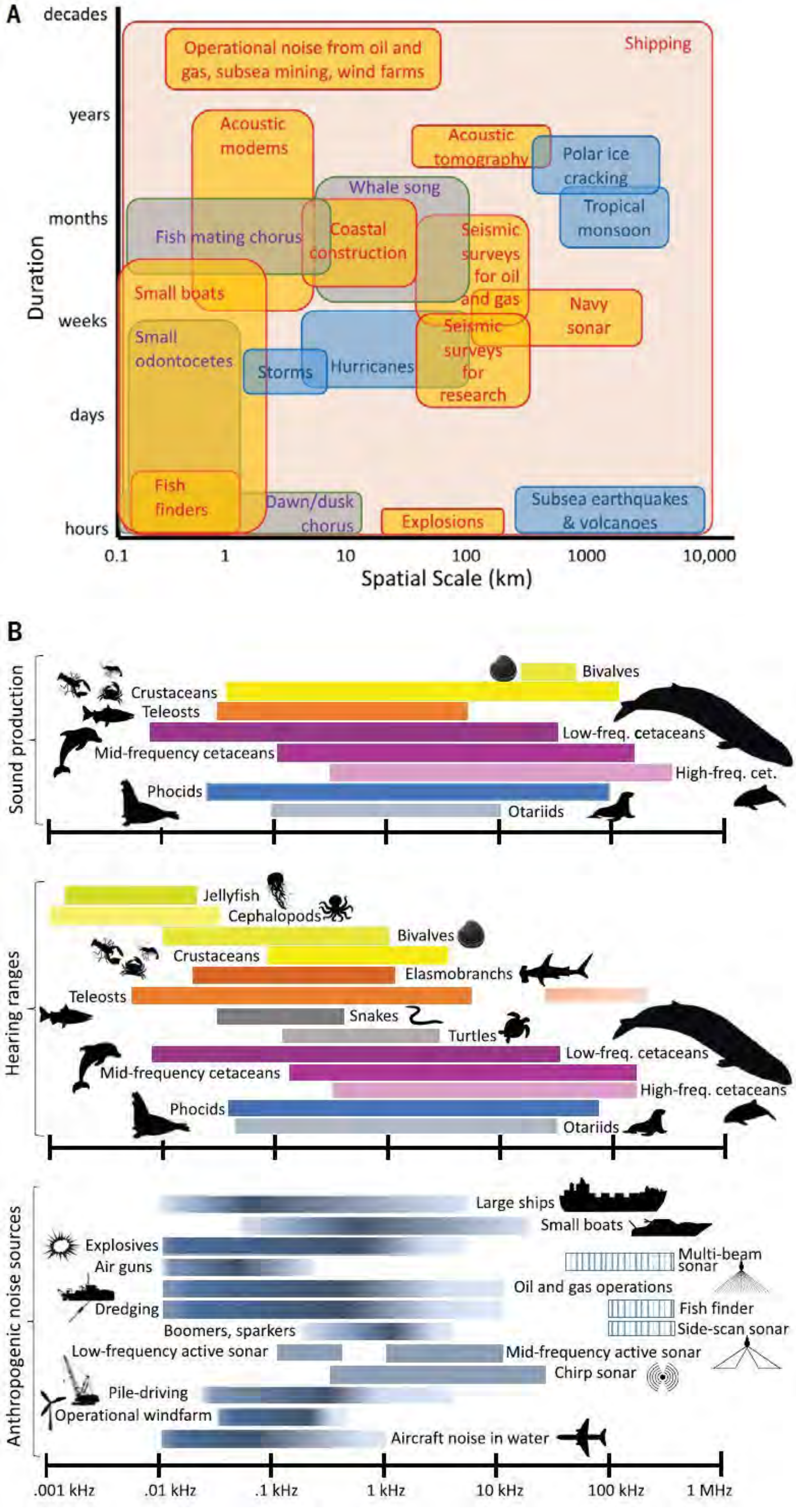


Figure 77: Sources and animal receivers of sound in the ocean. A) Spatial extent and duration of selected sound producing events, and B) Approximate sound production and hearing ranges of marine taxa and frequency ranges of selected anthropogenic sound sources. (Source: Duarte et al. 2021).

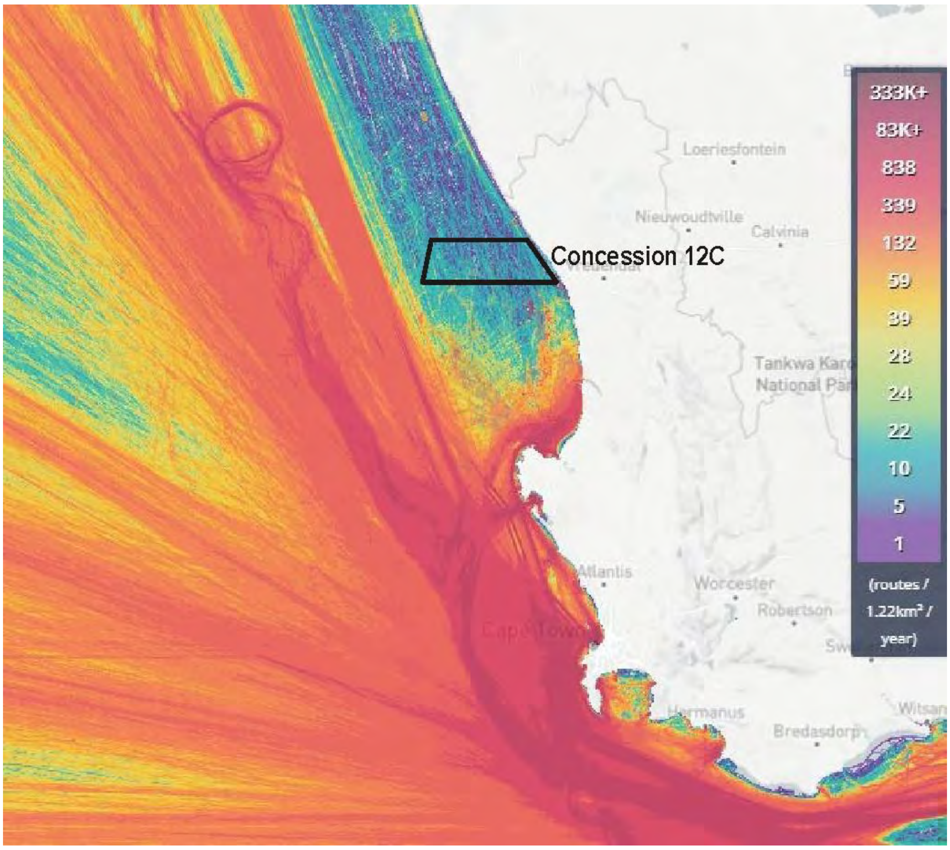


Figure 78: Concession 12C (black polygon) in relation to offshore vessel traffic (adapted from www.marinetraffic.com/en/ais/home, accessed October 2022).

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön 2012; Purdon 2020b) as such sound sources interfere directly or indirectly with the animals' biological activities. Reactions of marine mammals to anthropogenic sounds have been reviewed by McCauley (1994), Richardson et al. (1995), Gordon & Moscrop (1996) and Perry (1998), who concluded that anthropogenic sounds could affect marine animals in the surrounding area in the following ways:

- *Physiological injury and/or disorientation;*
- *Behavioural disturbance and subsequent displacement from key habitats;*
- *Masking of important environmental sounds and communication;*
- *Indirect effects due to effects on prey.*

It is the received level of the sound, however, that has the potential to traumatise or cause physiological injury to marine animals. As sound attenuates with distance, the received level depends on the animal's proximity to the sound source and the attenuation characteristics of the sound. The noise generated by the acoustic equipment utilized during geophysical surveys falls within the hearing range of most fish and marine mammals (Table 19), and at sound levels of between 190 to 230 dB re 1 µPa at 1 m, will be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels (Findlay 2005). However, unlike the noise generated by airguns during seismic surveys, the emission of underwater noise from geophysical surveying and vessel activity is not considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine animals in the region. An acoustic modelling study undertaken for a similar project identified that only directly below the systems (within <10 m of the sources for most hearing groups of marine mammals, but within <100 m of high frequency cetaceans) would sound levels be in the 230 dB range where exposure results in permanent threshold shifts (PTS). The zones for recoverable injury (temporary threshold shifts – TTS) for most hearing groups of marine mammals falls within a few 10s of metres, but within <150 m for high frequency cetaceans. As most pelagic species likely to be encountered within the concession are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur. Whereas the underwater noise from the survey systems may induce localised behavioural changes within a few kilometres of the sound source in some marine mammal, there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry 2005).

Similarly, the sound level generated by drilling operations fall within the 120-190 dB re 1 µPa range at the sampling unit, with main frequencies between 3 – 10 Hz. The noise generated by sampling operations thus falls within the hearing range of most fish and marine mammals, and depending on sea state would be audible for up to 20 km around the vessel before attenuating to below threshold levels (Table 19). In a study evaluating the potential effects of vessel-based diamond mining on the marine mammals community off the southern African West Coast, Findlay (1996) concluded that the significance of the impact is likely to be minimal based on the assumption that the radius of elevated noise level would be restricted to ~20 km around the mining vessel. Whereas the underwater noise from sampling operations may induce localised behavioural changes in some marine mammal, it is unlikely that such behavioural changes would impact on the wider ecosystem (see for example Perry 2005). The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than one that is approaching them (Watkins 1986; Leung-Ng & Leung 2003), or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme et al. 1985).

Table 19: Known hearing frequency and sound production ranges of various marine taxa (adapted from Koper & Plön 2012).

Taxa	*Order*	*Hearing frequency (kHz)*	*Sound production (kHz)*
Shellfish	*Crustaceans*	*0.1 – 3*	
Snapping shrimp	*Alpheus/ Synalpheus spp.*		*0.1 - >200*
Ghost crabs	*Ocypode spp.*		*0.15 – 0.8*
Fish	*Teleosts*		*0.4 – 4*
Hearing specialists		*0.03 - >3*	
Hearing generalists		*0.03 – 1*	
Sharks and skates	*Elasmobranchs*	*0.1 – 1.5*	*Unknown*
African penguins	*Sphenisciformes*	*0.6 - 15*	*Unknown*
Sea turtles	*Chelonia*	*0.1 – 1*	*Unknown*
Seals	*Pinnipeds*	*0.25 – 10*	*1 – 4*
Northern elephant seal	*Mirounga agurostris*	*0.075 – 10*	
Manatees and dugongs	*Sirenians*	*0.4 – 46*	*4 – 25*
Toothed whales	*Odontocetes*	*0.1 – 180*	*0.05 – 200*
Baleen whales	*Mysticetes*	*0.005 – 30*	*0.01 – 28*

7.2.1.1.1 Assessment

*The effects of high frequency sonars on marine fauna is considered to be localised, short-term (for duration of survey i.e. weeks) and of medium intensity. The significant of the impact is considered of **LOW** significance without mitigation.*

*The impact of underwater noise generated during sampling operations is considered to be of low intensity in the target area and for the duration of the sampling campaign. The impact of underwater noise is considered of **VERY LOW** significance without mitigation.*

7.2.1.1.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would reduce to **VERY LOW** significance.*

Impacts of multi-beam and sub-bottom profiling sonar on marine fauna		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Medium*	*Low*
Duration	*Short-term: for duration of survey*	*Short-term*
Extent	*Local: limited to survey area*	*Local*
Probability	*Highly likely*	*Highly likely*
Significance	*Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*
Nature of Cumulative impact	*Considering the number of geophysical surveys conducted in the area by other mineral rights holders, some cumulative impacts can be anticipated. However, any direct impact is likely to be at individual level rather than at species level*	
Reversibility	*Fully reversible – any disturbance of behaviour, auditory "masking" or reductions in hearing sensitivity that may occur as a result of survey noise below 220 dB would be temporary*	
Loss of resources	*Negligible*	
Mitigation potential	*Medium*	

Impacts of noise from sampling operations on marine fauna		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Low*	*No mitigation is proposed*
Duration	*Short-term: for duration of sampling operations*	
Extent	*Local: limited to vicinity of target area*	
Probability	*Likely*	
Significance	*Very Low*	
Status	*Direct - Negative*	
Confidence	*High*	
Nature of Cumulative impact	*None*	
Reversibility	*Fully Reversible - any disturbance of behaviour, auditory "masking" or reductions in hearing sensitivity that may occur would be temporary.*	
Loss of resources	*N/A*	
Mitigation potential	*Low*	

7.2.1.2 Disturbance and loss of benthic fauna during sampling

The proposed sampling activities are expected to result in the disturbance and loss of benthic macrofauna through removal of sediments by the vibrocorer, grab and drill bit. A maximum of 200 core samples, 50 grab samples and 4,800 drill samples would be taken disturbing a maximum total area of ~0.024 km^2.

As benthic fauna typically inhabit the top 20 - 30 cm of sediment, the sample operations would result in the elimination of the benthic infaunal and epifaunal biota in the sample footprints. As many of the macrofaunal species serve as a food source for demersal and epibenthic fish, cascade effects on higher order consumers may result. However, considering the available area of similar habitat on the continental shelf of the West Coast, this highly localised reduction in benthic biodiversity can be considered negligible and impacts on higher order consumers are thus improbable.

The ecological recovery of the disturbed seafloor is generally defined as the establishment of a successional community of species that achieves a community similar in species composition, population density and biomass to that previously present (Ellis 1996). The rate of recovery (recolonisation) depends largely on the magnitude of the disturbance, the type of community that inhabits the sediments in the sampling area, the extent to which the community is naturally adapted to high levels of sediment disturbances, the sediment character (grain size) that remains following the disturbance, and physical factors such as depth and exposure (waves, currents) (Newell et al. 1998). Generally, recolonisation starts rapidly after a sampling/mining disturbance, and the number of individuals (i.e. species density) may recover within short periods (weeks). Opportunistic species may recover their previous densities within months. Long-lived species like molluscs and echinoderms, however, need longer to re-establish the natural age and size structure of the population. Biomass therefore often remains reduced for several years (Kenny & Rees 1994, 1996; Kenny et al. 1998).

The structure of the recovering communities is typically also highly spatially and temporally variable reflecting the high natural variability in benthic communities at depth. The community developing after an impact depends on (1) the nature of the impacted substrate, (2) differential re-settlement of larvae in different areas, (3) the rate of sediment movement back into the disturbed areas and (4) environmental factors such as near-bottom dissolved oxygen concentrations etc. For the current project, much of the proposed sampling would be undertaken in depths beyond the wave base (>40 m) where near-bottom sediment transport is less than in shallower waters affected by swell. Excavations may therefore have slower infill rates and could persist for several months to several years (depending on depth). Long-term or permanent changes in grain size characteristics of sediments may thus occur, potentially resulting in a shift in community structure if the original community is unable to adapt to the new conditions. Depending on the texture of the sediments at the sampling target sites, slumping of adjacent unconsolidated sediments into the excavations can, however, be expected over the very short-term. Although this may result in localised disturbance of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations.

Natural rehabilitation of the seabed following sampling operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf (Penney & Pulfrich 2004; Steffani 2007a, 2007b, 2009a, 2010a, 2010b, 2012; Biccard et al 2017, 2018; Gihwala et al. 2018; Biccard et al.2019; Giwhala et al. 2019). Recovery rates of impacted communities were variable and dependent on the sampling /mining approach, sediment influx rates and the influence of natural disturbances on succession communities. Results of on-going research on the southern African West Coast suggest that differences in biomass, biodiversity or community composition following mining with drill ships or crawlers below the wave base may endure beyond the medium term (5 - 15 years) (Parkins & Field 1998; Pulfrich & Penney 1999; Steffani 2012; Biccard et al.2019; Giwhala et al. 2019). Savage et al. (2001), however, noted similarities in apparent levels of disturbance between mined and unmined areas off the southern African west coast, and areas of the Oslofjord in the NE Atlantic Ocean, which is known to be subject to periodic low oxygen events. Similarly, Pulfrich & Penney (1999) provided evidence of significant recruitments and natural disturbances in recovering succession communities off southern Namibia. These authors concluded that the lack of clear separation of impacted from reference samples suggests that physical disturbance resulting from sampling or mining may be no more stressful than the regular naturally occurring anoxic events typical of the West Coast continental shelf area.

7.2.1.2.1 Assessment

The medium-intensity negative impact of sediment removal during sampling operations and its effects on the associated communities is unavoidable, but as it will be extremely localised amounting to a total of only 0.024 km^2 should all anticipated 4,800 drill samples be taken. The area disturbed constitutes ~0.001 % of the overall area of Concession 12C. When put in the context of the proportion of available Southern Benguela Sandy

*Shelves and Southern Benguela Muddy Shelves habitat types disturbed, the area disturbed is considered negligible. The impact can confidently be rated as being of **VERY LOW** significance without mitigation.*

7.2.1.2.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would remain of **VERY LOW** significance.*

Disturbance and loss of benthic fauna during sampling		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Medium*	*Medium*
Duration	*Short- to Medium-term*	*Short- to Medium-term*
Extent	*Site specific: limited to sampling target area*	*Site specific*
Probability	*Definite*	*Definite*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*

Nature of Cumulative impact	*No cumulative impacts are anticipated during the sampling phase*
Reversibility	*Fully Reversible – the highly localised disturbance at each sampling location will recover naturally with time*
Loss of resources	*Low*
Mitigation potential	*Low (None)*

7.2.1.3 Disturbance to and loss of rock lobsters during sampling operations

The proposed sampling activities will result in the disturbance and removal of sediments by the sampling tools. Following on-board treatment, all oversized and undersized tailings are discharged back to the sea on site.

Concerns have been raised that remote sampling tools may physically suck up rock lobsters migrating between reefs or into deeper water during their seasonal inshore/offshore migrations. The West Coast rock lobster exhibits a strong association with creviced habitats, and avoidance of gravel and sand areas (Beyers & Wilke 1990; Pulfrich & Penney 2001; Pulfrich et al. 2006; see also Cobb 1971; Spanier 1994). Depth distribution and availability of rock lobsters is also strongly influenced by environmental conditions (Newman & Pollock 1971; Pollock 1978; Beyers 1979; Pollock & Beyers 1981; Bailey et al. 1985; Pollock & Shannon 1987; Tomalin 1993, amongst others). During winter lobsters occur in deeper waters, possibly seeking shelter from winter swells, or to feed and release larvae (Pollock & Shannon 1987; Noli & Grobler 1998). During summer (January to April) the lobsters migrate inshore again in response to intrusion off near-bottom low-oxygen water brought inshore by upwelling. This inshore migration and concentration of lobsters in shallower, better-oxygenated water coincides with the commercial fishing season. During such migrations lobsters will leave the shelter of their preferred reef habitats and move across unconsolidated sediments, often in large numbers. This would make them vulnerable both to predation as well as sampling/mining operations targeting areas of unconsolidated sediments in their migration path. Lobsters found on mud or sand are therefore unlikely to be there by preference, but are moving across such areas in response to imposition or relaxation of the near-bottom hypoxia.

The principle impacts of mining activities on rock lobsters relate to alteration of suitable lobster habitat through discharge of tailings. This is discussed further below.

7.2.1.3.1 Assessment

The damage to, and survival of rock-lobsters through mining activities was assessed by Barkai & Bergh (1992) in a manipulated lobster pumping experiment using a small shore-based 'walpomp'. Of the 85 animals sucked up the hose and fed through the screening unit, a total of 61 survived. Most of these were below 60 mm carapace length, and it was found that greater limb and antennae loss resulted in far higher mortality of larger lobsters. In general, however, rock-lobsters are easily able to avoid the pump nozzle and are seldom sucked up during regular diver-assisted mining operations. In the case of sampling using the large diameter drill, where suction pressures are greater, lobsters may not be able to actively avoid the drill head. As the suction head would also create substantial underwater noise and vibrations during operation, it is expected that lobsters would be able to detect this from some distance away and therefore avoid the active mine site. Only in cases where animals are forced to leave an area due to the onset of hypoxia, would the natural flight response to the mining head be overrun by physiological responses.

During a 26-day bulk sampling operation covering an area of ~3,100 m^2 of unconsolidated seabed in Namibia, Tarras-Wahlberg (1999) recorded only 21 rock-lobster and 6 fish on the sorting screens of the mining vessel. Existing data therefore suggest that numbers captured are insignificant compared to the annual quota landed by the commercial rock lobster industry.

By its nature, marine sampling and mining removes unconsolidated sediments with the larger boulders that have been screened out by the mining tools, remaining on the seabed. Studies investigating the impacts of shallow-water mining operations on rock lobsters concluded that removal of sediment from gullies resulted in temporary creation of areas of suitable habitat for lobsters with resultant localised increases in lobster abundance (Pulfrich & Penney 2001). The abundance, mean sizes or catch rates of lobsters were not negatively affected by the mining operations (Barkai & Bergh 1992; Tomalin 1995, 1996; Parkins & Branch 1996, 1997; Pulfrich 1998a; Pulfrich et al. 2003; Pulfrich & Branch 2014), and benthic communities within metres of the mined gulley remained unaffected by the mining-induced disturbance. Disturbance of rock lobsters as a result of shallow-water mining operations were thus considered negligible, particularly when seen in context with responses to natural disturbances such as low oxygen events. The use of remote sampling/mining systems will obviously have effects on a larger scale, but if sampling operations move progressively from one side of the target area to another, there is no reason why sampled areas dominated by boulders would not provide high-profiled habitat for rock lobsters. This habitat creation would, however, be temporary only as sediments from adjacent unmined areas, as well as tailings released from the vessel, would be redistributed into the sampling excavations by wave action and the long-shore littoral drift.

*Reductions in rock lobster populations through large numbers of animals being sucked up by the sampling tool is highly unlikely and would be highly localised, resulting in only a limited loss of resources. The impact would be of low intensity and is consequently deemed to be of **VERY LOW** significance without mitigation.*

7.2.1.3.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would remain of **VERY LOW** significance.*

Disturbance to and loss of rock lobsters		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Low*	*Low*
Duration	*Temporary*	*Temporary*
Extent	*Site specific: limited to sampling area*	*Site specific*
Probability	*Possible*	*Improbable*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*
Nature of Cumulative impact	*The highly localised disturbance and loss of rock lobsters during sampling operations is not expected to result in cumulative impacts*	
Reversibility	*The impact is partially reversible as natural recovery of injured lobsters and the rock lobster populations will occur*	

Loss of resources	*Low*
Mitigation potential	*Low*

7.2.1.4 Crushing of benthic fauna during sampling

Some disturbance or loss of benthic biota adjacent to the sample footprint can also be expected as a result of the placement on the seabed of the drill frame structure during sampling. Epifauna and infauna beneath the footprint of the drill frame would be crushed by the weight of the equipment resulting in a reduction in benthic biodiversity.

7.2.1.4.1 Assessment

*Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive (see for example Savage et al. 2001). Considering the available area of similar habitat on the continental shelf of the West Coast, the reduction in benthic biodiversity through crushing can be considered negligible. The impacts would be of medium intensity but highly localised, and short-term as recolonization would occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to be of **VERY LOW** significance without mitigation.*

7.2.1.4.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would remain of **VERY LOW** significance.*

Crushing of benthic fauna during sampling		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Medium*	*Medium*
Duration	*Short-term*	*Short-term*
Extent	*Site specific: limited to target area*	*Site specific*
Probability	*Definite*	*Definite*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*

Nature of Cumulative impact	*No cumulative impacts are anticipated during the sampling phase*
Reversibility	*Fully Reversible*
Loss of resources	*N/A*
Mitigation potential	*Low (None)*

7.2.1.5 Increased turbidity due to generation of suspended sediment plumes

During drill sampling, the sampled seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel. The screens separate the fine sandy silt and large gravel, cobbles and boulders from the size fraction of interest, the 'plantfeed' (usually 2 - 20 mm). The fine tailings are immediately discarded overboard where they form a suspended sediment plume in the water column, which is advected away from the sampling vessel by wind and ambient currents and is rapidly diluted. The 'plantfeed' is mixed with a high density ferrosilicon (FeSi) slurry and pumped under pressure into a Dense Medium Separation (DMS) plant resulting in a high density concentrate. The majority of the ferrosilicon is magnetically recovered for re-use in the DMS plant and the fine tailings (-2 mm) from the DMS process are similarly deposited over board. Furthermore, fine sediment re-suspension by the sampling tools will generate suspended sediment plumes near the seabed.

After discharge, the tailings material typically forms a negatively-buoyant sediment plume that either mixes directly with the receiving waters as it sinks (surface plume) or sinks as a density-driven current (dynamic plume). The dynamic plume undergoes convective descent through the water column until it either reaches the seabed or achieves neutral buoyancy, at which point it collapses and spreads laterally. As the dynamic plume sinks, some fine sediment may be entrained due to wind-generated turbulence; this is mixed through *the water column and can contribute to the formation of a surface plume. Surface plumes are visible on the surface and thus likely to have a greater effect on organisms in the upper water column than dynamic plumes. In many cases, both types of plumes develop simultaneously, resulting in a composite plume that possess characteristics of surface and dynamic plumes. These are classified as transitional plumes.*

Various factors influence which types of plume form: outflow velocity of tailings discharged from the vessel; water density and movement; and density of the plume (sand and silt composition of the mined sediments can vary greatly). The sampling/mining method also influences the sediment plume, with air-lift systems, which entrain air in the sediment, making the plume more buoyant and persistent in the upper water column, whereas dredge-pumped sediments have little or no air entrained, enabling the plume to sink much faster.

Potential impacts on the water column associated with sediment plumes from sampling/mining vessels are primarily linked with increased turbidity and its effects on light penetration through the water column, remobilisation of dissolved constituents from seabed sediments (see section 4.4.6), and reduction in oxygen levels in the water column resulting from high levels of primary production.

7.2.1.5.1 Assessment

The formation, extent and dynamics of turbidity plumes generated by deepwater mining vessels have been comprehensively investigated in numerous studies (Environmental Evaluation Unit 1996; O'Toole 1997; Carter et al. 1998; Carter & Midgley 2000; CSIR 2006; Carter 2008). During continuous discharge of tailings from remote mining vessels, the major source of water column turbidity results from the dynamic collapse of the sediment-laden jet and the subsequent dilution, spreading and settling of the particulate constituents. In all cases, the suspended sediment concentrations generated at the point of discharge, the extent and area over which plumes disperse, and their duration, depend largely on the proportions of silts, muds and clays (<63 µm) in the mined sediments, as well as the sea-surface conditions during disposal. The higher the proportion of silts and clays in the target sediments, the larger and more persistent the suspended sediment plume is likely to be (Newell et al. 1998; Johnson & Parchure 1999; Posford Duvivier Environment 2001). Modelling studies, field measurements and aerial observations of tailings plumes from mining vessels found that concentrations reduce rapidly with distance from the vessel, indicating fairly fast settlement and dilution of even the fine fractions (Shillington & Probyn 1996; CSIR 1998; Carter & Midgley 2000). In their study of tailings plumes from a deepwater mining vessel using an air-lift Wirth drill off Lüderitz, Carter & Midgley (2000) found that local tailings plumes ranged from 700 - 5,500 m in length and 700 - 3,500 m in width. Maximum plume sediment concentrations near the discharge point were found to be 60 mg/l, compared to background levels of <5 mg/l. These reduce rapidly with distance to a mean of <7 mg/l (maximum of 11 mg/l) 2 km downstream of the mining vessel, confirming fairly rapid settlement and dilution. Similarly, Holton (2015) reported on measurements of suspended solids in the plume that extended downstream of the MV Mafuta, which operates a dredge-pump subsea crawler, in the Atlantic 1 MLA. Elevated turbidity (compared to <2 mg/l background levels) was detected in the upper water column extending to a maximum depth of ~70 m in the immediate vicinity of the mining vessel. The depth of the elevated turbidity signal decreased with distance away from the vessel, and the surface and deeper water expression of the signal dissipated almost entirely within ~500 m from the mining vessel. Beyond this point, little to no evidence of a turbidity signal throughout the water column could be detected.

Distribution and re-deposition of suspended sediments are the result of a complex interaction between oceanographic processes, sediment characteristics and engineering variables that ultimately dictate the distribution and dissipation of the plumes in the water column. Ocean currents, both as part of the meso-scale circulation and due to local wind forcing, are important in distribution of suspended sediments. Turbulence generated by surface waves can also increase plume dispersion by maintaining the suspended sediments in the upper water column.

One of the more apparent effects of increased concentrations of suspended sediments and consequent increase in turbidity, is a reduction in light penetration through the water column with potential adverse effects on the photosynthetic capability of phytoplankton (Poopetch 1982; Kirk 1985; Parsons et al. 1986a, 1986b; Monteiro 1998; O'Toole 1997) and the foraging efficiency of visual predators (e.g. pelagic fish, seabirds and marine mammals) (Simmons 2005; Braby 2009; Peterson et al. 2001). However, due to the rapid dilution and widespread dispersion of settling particles, any adverse effects in the water column would be ephemeral and highly localised. Any biological effects on nectonic and planktonic communities would be negligible (Aldredge et al. 1986). Turbid water is a natural occurrence along the Southern African coast, resulting from aeolian and riverine inputs, resuspension of seabed sediments in the wave-influenced nearshore areas and seasonal phytoplankton production in the upwelling zones.

High sediment loading can also impair the egg and/or larval development of fish and invertebrates may be impaired through. Bivalves and crustaceans in particular may be impacted by near-bottom plumes include. Suspended sediment effects on juvenile and adult bivalves occur mainly at the sublethal level with the predominant response being reduced filter-feeding efficiencies at concentrations above about 100 mg/l. Lethal effects are seen at much higher concentrations (>7,000 mg/l) and at exposures of several weeks.

Due to the naturally turbid nearshore waters, kelp is restricted to the immediate subtidal regions to a maximum depth of ~10 m. Those fringing kelp beds along the coastline opposite concession 12C are unlikely to be affected by the turbidity plumes generated as a result of tailings discharges. Similarly, the depths of the proposed sampling areas lie beyond those at which kelp is likely to occur on adjacent reefs and no shading of these canopy forming macrophytes by sampling-related turbidity plumes is expected.

The unconsolidated sediments in concession 12C comprise primarily medium to fine sands, with a minimal silt and clay fraction. Sediments within the mudbelt are, however, likely to have elevated silt content. Nonetheless, the suspended sediment plumes generated through discharge of tailings during sampling are expected to remain far more localised than those reported from previous studies of deepwater mining vessels. Furthermore, the sediments will be dredge-pumped at a rate orders of magnitude lower than the mining vessels for which the previous studies have been undertaken. The low-intensity, negative impact of suspended sediments generated during sampling and onboard processing operations and its effects on the associated communities will therefore be extremely localised and very short-term. The plumes will be localised to within a few 100 m of the sampling vessel and as they will be ephemeral, negative effects of increased suspended sediment concentrations on marine communities are highly unlikely as biota would be well adapted to naturally high suspended sediment concentrations. Even the highest concentrations in the immediate discharge are unlikely to reach concentrations that would have lethal or sub-lethal effects on marine fauna or inhibit primary productivity of phytoplankton. Coastal and estuarine communities located over 5 km inshore of the eastern boundary of concession 12C would not be affected. The impacts from suspended sediment plumes can confidently be rated as being of VERY LOW significance without mitigation.

7.2.1.5.2 Residual Impact Assessment

As no mitigation is possible or deemed necessary, the residual impact would remain of **VERY LOW** significance.

Increased turbidity in suspended sediment plumes and at the seabed		
	Without Mitigation	Assuming Mitigation
Intensity	Low	No mitigation is proposed
Duration	Temporary: plumes will rapidly dilute and disperse	
Extent	Local: limited to around the vessel and sampling tool	
Probability	Improbable: lethal or sublethal effects on biota are highly unlikely	
Significance	Very Low	
Status	Direct/Indirect - Negative	
Confidence	High	
Nature of Cumulative impact	Increased turbidity in suspended sediment plumes would not result in cumulative impacts	
Reversibility	Suspended sediment plumes are short-lived and any effects will be fully reversible	
Loss of resources	N/A	
Mitigation potential	Low (None)	

7.2.1.6 Remobilisation of contaminants and nutrients

Recently deposited sediments in specific areas on the shelf of the southern African West Coast may be characterised by high levels of heavy metals of marine and/or terrestrial origin (Calvert & Price 1970; Chapman & Shannon 1985). In the Atlantic 1 Mining Licence Area off Oranjemund, Namibia, high metal concentrations have been measured in samples of surficial sediments (Environmental Evaluation Unit 1996; Biccard et al. 2020), some of which exceeded the Recommended Guideline Values (RGV) and in some cases Probable Effects Concentrations (PEC) published by the Benguela Current Commission (BCC). Geographic variation in the levels of trace metals tested in that area was considerable, and it is considered likely that inputs from terrestrial sources (principally the Orange River) are responsible for elevated trace metal levels in proximity to the river mouth. Indeed, on the Namibian shelf, there appears to be a consistent relationship between trace metal concentrations and elevated organic carbon concentrations in the sediments. From this it can be inferred that the distribution of trace metal concentrations will follow that of the high Particulate Organic Carbon (POC) mud belts and that concentrations outside of these will be relatively low. This is consistent with general and widespread observations on sediment trace metals in that they are largely associated with silt and clay sized particles and generally have lower concentrations in coarser sediments (e.g. ANZECC 2000).

Changes in nutrient concentrations off the West Coast are strongly driven by large-scale wind induced upwelling, which brings nutrient-rich waters to the surface. The shelf waters off the West Coast are characterised by elevated concentrations of nutrients in comparison with those in the surface mixed layer of adjacent oceanic waters, and with concentrations in the SACW source waters. Local nutrient regeneration processes within the sediments and water column are thus important throughout the Benguela (Shannon & O'Toole 1998).

The re-suspension of sediments during sampling can release these trace metals and nutrients into the water column. Metal bio-availability and eco-toxicology is complex and depends on the partitioning of metals between dissolved and particulate phases and the speciation of the dissolved phase into bound or free forms (Rainbow 1995; Galvin 1996). Although dissolved forms are regarded as the most bio-available, many of these are not readily utilisable by aquatic organisms. Consequently those forms that are ultimately bio-available and potentially toxic to marine organisms usually constitute only a fraction of the total concentration. Trace metal uptake by organisms may occur through direct absorption from solution, by uptake of suspended matter and/or via their food source. Toxic effects on organisms may be exerted over the short term (acute toxicity), or through bioaccumulation.

7.2.1.6.1 Assessment

Chemical analyses of tailings samples from mining vessels in the Atlantic 1 MLA in southern Namibia and in the SASA 2C-5C concessions found that heavy metal concentrations did not exceeded the South African chronic water-quality guidelines or the "prohibition limit" as imposed by the London Convention, for any of the measured contaminants (Steffani & Pulfrich 2004; CSIR 2006; Carter 2008). In some cases, however, concentrations were in the category which requires some form of "action or special care" (CSIR 2006). Despite concentrations within surficial sediments in the Atlantic 1 MLA being high (Biccard et al. 2020), it appears that those contaminants released during the mining process are rapidly diluted and their concentrations in the water column following discharge of tailings is very low. Furthermore, as plumes generated during sampling are highly dynamic, neither acute effects nor bioaccumulation are likely to be of concern. In concession 12C, organic carbon concentrations in the sediments of the mudbelt may, however, be elevated. Nonetheless, trace metal concentrations are likely to be negligible and potential chemical contamination of the water column and bio-accumulation in the sediments or in biological receptors is highly unlikely. The impacts associated with the potential release of contaminants from disturbed sediments are therefore considered of **VERY LOW** significance.

Similarly, the introduction of nutrients into the upper layers of the water column as a result of tailing discharge is considered negligible given the highly localised area affected by the suspended sediment plumes generated during sampling operations, relative to that influenced by upwelling (Schloemann 1996).

Remobilisation of Contaminants and Nutrients		
	Without Mitigation	Assuming Mitigation
Intensity	Low	No mitigation is proposed
Duration	Temporary: plumes will rapidly dilute and disperse	
Extent	Local: limited to around the vessel and sampling tool	
Probability	Improbable: lethal or sublethal effects on biota are highly unlikely	
Significance	Very Low	
Status	Indirect - Negative	
Confidence	High	

Nature of Cumulative impact	Remobilised contaminants and nutrients in discharged tailings would not result in cumulative impacts
Reversibility	Suspended sediment plumes are short-lived and any effects will be fully reversible
Loss of resources	N/A
Mitigation potential	Low (None)

7.2.1.7 Smothering of benthos in redepositing tailings

During drill sampling, the sampled seabed sediments are pumped to the surface and discharged onto sorting screens, which separate the large gravel, cobbles and boulders and fine silts from the 'plantfeed'. The oversize tailings are discarded overboard and settle back onto the seabed beneath the vessel.

7.2.1.7.1 Assessment

Following discharge overboard of the fine and coarse tailings, these settle back onto the seabed where they can result in smothering of benthic communities adjacent to the sampled areas. Smothering involves physical crushing or smothering, a reduction in nutrients and oxygen, clogging of feeding apparatus, as well as affecting choice of settlement site, and post-settlement survival. In general terms, the rapid deposition of the coarser fraction from the water column is likely to have more of an impact on the soft-bottom benthic community than gradual sedimentation of fine sediments to which benthic organisms are adapted and able to respond. However, this response depends to a large extent on the nature of the receiving community. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonization of impacted areas and the subsequent recovery of disturbed areas of seabed (Maurer et al. 1979, 1981a, 1981b, 1982, 1986; Ellis 2000; Schratzberger et al. 2000; but see Harvey et al. 1998; Blanchard & Feder 2003). In contrast, sedentary communities may be adversely affected by both rapid and gradual deposition of sediment. Filter-feeders are generally more sensitive to suspended solids than deposit-feeders, since heavy sedimentation may clog the gills. Impacts on highly mobile invertebrates and fish are likely to be negligible since they can move away from areas subject to redeposition.

Of greater concern is that sediments discarded during sampling operations may impact rocky outcrop communities adjacent to sampling target areas potentially hosting sensitive slow-growing benthic communities and commercially important species such as rock lobsters. Such communities would be expected only in the shallowest portions of concession 12C. Rocky seabed outcrops in deeper water may also host fragile, habitat forming scleractinian corals, gorgonians and bryozoans. As deep-water corals tend to occur in areas with lower sedimentation rates than typical of nearshore habitats (Mortensen et al. 2001), these benthic suspension-feeders and their associated faunal communities are likely to be more sensitive to increased turbidity and sediment deposition associated with tailings discharges. Exposure of elevated suspended sediment concentrations could result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification. While tolerances to increased suspended sediment concentrations will be species specific, concentrations as low as 100 mg/ℓ have been shown to have noticeable effects on coral function (Rogers 1999). Due to the naturally elevated suspended sediment concentrations along the Benguela coast, those species occurring on the inner and mid shelf off the West Coast are expected to be more tolerant to elevated turbidity levels.

Studies investigating the discard of the oversize tailings during diver-assisted mining found that benthic communities characterising tailings dump sites on reefs were significantly different from those of unaffected reef areas as a result of the change in seabed type, being dominated by detritus feeders. However, the effects remained highly localised and persisted over the short-term only as tailings were rapidly redistributed by wave action (Barkai & Bergh 1992; Parkins & Branch 1995, 1996, 1997; Pulfrich 1998b; Pulfrich & Penney 2001). Excessive and repetitive dumping on the same area may, however, preclude dispersion and thus induce persistent change by reducing biodiversity, changing community structure, potentially altering preferred rock lobster habitat and smothering of benthic organisms, thereby reducing food availability for lobsters.

The abundance of lobsters within a habitat, however, also depends on the availability and suitability of food (Parrish & Polovina 1994; Hudon 1987; Branch & Griffiths 1988; Wahle & Steneck 1991, 1992). Off the West Coast, rock lobsters feed primarily on ribbed mussels, barnacles, urchins and algae (Mayfield et al. 2000). Smothering of reef areas and their associated benthic communities adjacent to sampling targets through the discharge of oversize tailings may therefore indirectly affect rock lobster abundance in an area as well as reducing growth and reproductive rates of the animals.

The impacts would be of low intensity but highly localised extending only a few 10s of metres from the sampling footprint, and short-term as recolonization from adjacent areas or upward migration through deposited sediments would occur rapidly. Considering the available area of unconsolidated seabed habitat on the continental shelf of the West Coast, the reduction in biodiversity of macrofauna associated with unconsolidated sediments through smothering can be considered negligible. The potential impact of smothering on communities in unconsolidated habitats is consequently deemed to be of ***VERY LOW*** *significance. In the case of rocky outcrop communities, however, impacts would be of medium intensity and highly localised, but* potentially enduring over the medium-term due to their slow recovery rates. As the shallower portions of concession 12C, where outcropping reefs may be expected, are located within the (storm) wave base, any fine sediments settling on adjacent reefs would be periodically resuspended and redistributed by near-bottom currents. Smothering effects would therefore likely be ephemeral. The potential impact of smothering on rocky outcrop communities is consequently deemed to be of **LOW to MEDIUM** significance.

7.2.1.7.2 Residual Impact Assessment

With the implementation of the mitigation measures above, the residual impact would remain of **VERY LOW** significance in the case of unconsolidated sediments and of **LOW** significance for rocky outcrops.

Redeposition of discarded sediments on soft-sediment macrofauna		
	Without Mitigation	Assuming Mitigation
Intensity	Low	No mitigation is proposed
Duration	Temporary	
Extent	Local	
Probability	Likely	
Significance	Very Low	
Status	Direct - Negative	
Confidence	High	
Nature of Cumulative impact	Deposition of tailings on unconsolidated seabed would not result in cumulative impacts	
Reversibility	The impact is fully reversible as natural recovery of affected communities will occur from adjacent areas and deposited sediments will be redistributed by swell action	
Loss of resources	Low	
Mitigation potential	Low (None)	

Redeposition of discarded sediments: smothering effects on rocky outcrop communities		
	Without Mitigation	Assuming Mitigation
Intensity	Medium	Low
Duration	Medium-term	Short-term
Extent	Local	Local
Probability	Possible	Improbable
Significance	Low to Medium	Low
Status	Direct - Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Deposition of tailings on rocky outcrops would not result in cumulative impacts	
Reversibility	The impact is fully reversible as natural recovery of affected communities will occur from adjacent areas and deposited sediments will be redistributed by swell action	
Loss of resources	Low	
Mitigation potential	Low	

7.2.1.8 Loss of Ferrosilicon

The only additive used in the diamond extraction process onboard the sampling vessels is Ferrosilicon (FeSi). Although most of the FeSi is magnetically recovered for re-use, recovery is lower when sampling sediments with a high shell content, as the FeSi becomes trapped in the shells. On average ~10 tons are lost annually per vessel of this magnitude during sampling operations.

7.2.1.8.1 Assessment

*Ferrosilicon is made up of sand (silicon) and iron oxides, with small amounts of trace elements. It therefore oxidises rapidly in seawater and has no detrimental effect of marine life. There is, however, a risk of exceeding established water quality guidelines by the heavy metal constituents of the FeSi. Dilution of these trace elements would be rapid, and any effects are likely to be brief. The potential impact would thus be of low intensity, persisting only locally over the short-term and can confidently be considered of **VERY LOW** significance.*

7.2.1.8.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would remain of **VERY LOW** significance.*

Loss of Ferrosilicon		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Low*	*Low*
Duration	*Short-term*	*Short-term*
Extent	*Site specific: limited to around the vessel*	*Site Specific*
Probability	*Likely*	*Possible*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*

Nature of Cumulative impact	*Loss of FeSi would not result in cumulative impacts*
Reversibility	*Fully Reversible*
Loss of resources	*Low*
Mitigation potential	*Medium to High*

7.2.1.9 Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)

During the geophysical surveying and seabed sampling, normal discharges to the sea can come from a variety of sources (from sampling unit and sampling vessel) potentially leading to reduced water quality in the receiving environment. These discharges are regulated by onboard waste management plans and shall be MARPOL compliant. For the sake of completeness they are listed and briefly discussed below:

- ***Deck drainage**: all deck drainage from work spaces is collected and piped into a sump tank on board the drilling unit 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 on land.*
- ***Sewage**: sewage discharges would 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 discharge depth is variable, depending upon the draught of the drilling unit / support vessel at the time, but would not be less than 5 m below the surface.*
- ***Vessel machinery spaces 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. 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 vessel is located more than 12 nautical miles from land. For vessels outside of special areas, discharge of comminuted food wastes is permitted when >3 nautical miles from land and en route. Discharge of food wastes not comminuted may be discharged from vessels en route when >12 nautical miles from shore. The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a standard exploration vessel is expected to be <0.5 m^3.*
- ***Detergents**: detergents used for washing exposed marine deck spaces are discharged overboard. The toxicity of detergents varies greatly depending on their composition, but low-toxicity, biodegradable detergents are preferentially used. Those used on work deck spaces would be collected with the deck drainage and treated as described for deck drainage above.*
- ***Cooling Water:** electrical generation on sampling vessels is typically provided by large diesel-fired engines and generators, which are cooled by pumping water through a set of heat exchangers. The cooling water is then discharged overboard. Other equipment is cooled through a closed loop system, which may use chlorine as a disinfectant. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines[6].*

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.*

7.2.1.9.1 Assessment

The contracted vessels will have the necessary sewage treatment systems in place, and 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

[6] No South African guideline exists for residual chlorine in coastal waters. The Australian/New Zealand (ANZECC 2000) guidelines give a value of 3 µg Cl/ℓ, wheras the World Bank (1998) guidelines stipulate 0.2 mg/ℓ at the point of discharge prior to dilution

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 concession area is suitably far removed from sensitive coastal receptors and the dominant wind and current direction will ensure that any discharges are rapidly dispersed north-westwards and away from the coast. The transit route to the concession area may pass through offshore MPAs, however, the habitat and biota are unlikely to be impacted by intermittent surface discharges, which rapidly disperse to very low concentrations. There is no potential for accumulation of substances discharged 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 project 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 prospecting activities will be segregated, duly identified transported to shore for ultimate valorisation and/or disposal at a licensed onshore 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 project vessels will be of low intensity, short duration and mainly limited to the immediate area around the vessels. The impact is therefore considered to be of **VERY LOW** significance, both without or with mitigation.*

7.2.1.9.2 Residual Impact Assessment

*This potential impact cannot be eliminated because project vessels are needed to undertake the prospecting activities and will generate routine discharges during operations. With the implementation of the project controls and mitigation measures, the residual impact will remain of **VERY LOW** significance.*

Impacts of operational discharges to the sea from the sampling vessel		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Low*	*Low*
Duration	*Short-term*	*Short-term*
Extent	*Local: limited to immediate area around vessel*	*Local*
Probability	*Likely*	*Probable*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*

Nature of Cumulative impact	*None*
Reversibility	*Fully Reversible*
Loss of resources	*N/A*
Mitigation potential	*High*

7.2.1.10 Lighting from Survey and Sampling Vessels

The strong operational lighting used to illuminate the project vessels at night may disturb and disorientate pelagic seabirds 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 and seabirds.

7.2.1.10.1 Assessment

Although little can be done on the project vessels to prevent seabird collisions, reports of collisions or death of seabirds on vessels are rare. Should they occur, the light impacts would primarily take place in the survey/sampling area and along the route taken by the vessels between the concession area and Cape Town.

Most of the seabird species breeding along the West Coast feed relatively close inshore (10-30 km), with African Penguins recorded as far as 60 km offshore and Cape Gannets up to 140 km offshore. These species could thus be expected in the concession area, which lies 1 km from the coastline. Pelagic species occurring further offshore would be unfamiliar with artificial lighting and may be attracted to the vessels. Fish and squid may also be attracted to the light sources potentially resulting in increased predation on these species by higher order consumers. It is expected, however, that seabirds and marine mammals in the area would become accustomed to the presence of the project vessels within a few days.

Operational lights may also result in physiological and behavioural effects on fish and cephalopods, as these may be drawn to the lights at night where they may be more easily preyed upon by other fish, marine mammals and seabirds. This would be more of an issue for a stationary sampling vessel unit than for a survey vessel, which would be constantly moving. As seals are known to forage up to 120 nautical miles (~220 km) offshore, the concession area falls within the foraging range of seals from the nearby colonies. Odontocetes, however, are also highly mobile, supporting the notion that various species are likely to occur in the project area and thus potentially be attracted to the survey/sampling operations.

*As the concession lies some distance from nearby coastal towns (Hondeklipbaai & Lambert's Bay), the increase in ambient lighting in the offshore environment would be of medium intensity and limited to the area in the immediate vicinity of the vessels (site specific) within the concession area (local) over the short-term (weeks). The potential for behavioural disturbance as a result of vessel lighting would thus be of **VERY LOW** significance.*

7.2.1.10.2 Residual Impact Assessment

*With the implementation of the mitigation measures above, the residual impact would remain **VERY LOW**.*

Disturbance and behavioural changes in pelagic fauna due to vessel lighting		
	Without Mitigation	*Assuming Mitigation*
Intensity	*Low*	*Low*
Duration	*Short-term*	*Short-term*
Extent	*Local: limited to immediate area around vessel*	*Local*
Probability	*Possible*	*Possible*
Significance	*Very Low*	*Very Low*
Status	*Direct - Negative*	*Direct - Negative*
Confidence	*High*	*High*

Nature of Cumulative impact	*None*
Reversibility	*Fully Reversible*
Loss of resources	*N/A*
Mitigation potential	*Low*

7.2.1.11 Cumulative Impacts

Cumulative effects are the combined potential impacts from different actions that result in a significant change larger than the sum of all the impacts. Consideration of 'cumulative impact' should include "past, present and reasonably foreseeable future developments or impacts". This requires a holistic view, interpretation and analysis of the biophysical, social and economic systems (DEAT 2004).

Cumulative impact assessment is limited and constrained by the method used for identifying and analysing cumulative effects. As it is not practical to analyse the cumulative effects of an action on every environmental receptor, the list of environmental effects being considered to inform decision makes and stakeholders should focus on those that can be meaningfully (DEAT 2004).

While it is foreseeable that further geophysical exploration for mineral resources and future mining activities could arise if the current Environmental Authorisation is granted, there is not currently sufficient information available to make reasonable assertions as to scale of such future activities. This is primarily due to the current lack of relevant geological information, which the proposed geophysical exploration and sampling process aims to address. There are many other mineral rights holders in the South African nearshore and offshore environment, but most of these are not undertaking any exploration activities at present or would be concurrently with the proposed prospecting operations. Thus, the possible range of the future exploration, prospecting and mining, activities that could arise will vary significantly in scope, location, extent, and duration *depending on whether a resource(s) is discovered, its size, properties and location, etc. As these cannot at this stage be reasonably defined, it is not possible to undertake a reliable assessment of the potential cumulative environmental impacts. It is also possible that the proposed, or future, prospecting and sampling fails to identify an economic mineral resource, in which case the potential impacts associated with the mining phase would not be realised. Possible cumulative impacts from hydrocarbon exploration also need to be kept in mind, although these are typically located further offshore in waters beyond 500 m depth.*

Table 20 summarise the applications for for mineral prospecting rights in the South African Sea Areas (SASA) submitted to the Department of Minerals and Energy, indicating which of these have been successfully taken through to completion. Applications for hydrocarbon exploration off the South African West Coast submitted to the Petroleum Agency of South Africa (PASA) are also shown. The purpose of this table, which may not be complete, is to emphasise two things. Firstly, that a large number of applications are submitted annually and secondly, that only a small percentage of those applications submitted (and potentially approved) are taken through to completion. The number of applications submitted and/or approved can therefore ***not*** *be used as an indication of cumulative impacts.*

Furthermore, the assessment methodology used in the EIA by its nature already considers past and current activities and impacts. In particular, the sensitivity of the receptors, the status of the receiving environment (benthic ecosystem threat status, protection level, protected areas, etc.) or threat status of individual species are taken into consideration, based to some degree on past and current actions and impacts (e.g. the IUCN conservation rating is determined based on criteria such as population size and rate of decline, area of geographic range / distribution, and degree of population and distribution fragmentation).

The most reliable guage of cumulative pressures is provided by Sink et al. (2019) and Harris et al. (2022). The map was generated as part of the NBA 2018 by doing a cumulative pressure assessment in which the impact of both current and historical ocean-based activities on marine biodiversity was determined by spatially evaluating the intensity of each activity and the functional impact to, and recovery time of, the underlying ecosystem types (Figure 79, left). Based on the severity of modification across the marine realm, a map of ecological condition was generated (Figure 79, right). From this it can be determined that the concession area is located in an area experiencing comparatively low cumulative impacts and that the ecological condition is therefore still natural or near-natural offshore and moderately modified in the shallower portions. Coastal and nearshore mining, linefishing, the small pelagic industry, and rock lobster harvesting were identified as the main contributors to cumulative impacts (Harris et al. 2022).

Table 20: Applications for hydrocarbon exploration on the South African West Coast and southern Namibia (grey shading) since 2007, indicating which of these have been undertaken. Applications for mineral prospecting rights are also shown (blue shading).

Year	*Right Holder/Operator*	*Block*	*Activity*	*Approval*	*Conducted*
Minerals Prospecting and Mining					
2011	*Aurumar*	*SASA 1C-9C* *SASA 12C,14C-18C, 20C*	*Heavy Minerals coring*	*Yes*	*Jan-Mar 2011* *2C-5C: Geophysical & coring* *7C-10C: Geophysical & coring* *12c, 14c-18c &20c : Only desktop*
2013-2014	*Belton Park Trading*	*SASA 2C-5C*	*Geophysical surveys, coring, bulk sampling*	*Yes*	*Survey: ongoing in 2C and 3C* *Sampling: ongoing in 2C and 3C* *Various prospecting operations undertaken over duration of prospecting right*
2017	*Belton Park Trading*	*SASA 2C* *(3C was incorporated into mining right area in 2019).*	*Mining*	*Yes*	*Ongoing prospecting and mining has taken place over various campaigns to date:* • *SASA 2C: 9 Aug - 7 Nov 2018;* • *SASA 2C: 13 Mar - 5 May 2019;* • *SASA 2C: 9 Jul - 25 Oct 2019; and* • *SASA 2C & 3C: 27 Feb -to 31 Aug 2020.* *Mining is currently ongoing.*
2018	*De Beers Marine*	*SASA 6C*	*Geophysical surveys, coring, bulk sampling*	*Yes*	*Survey: May-Jul 2021* *Sampling: Dec 2021 – Jan 2022*
2020	*Belton Park Trading*	*SASA 14b, 15b, 17b*	*Geophysical surveys, coring, bulk sampling*	*Yes but appeal still under review*	

2020	*Belton Park Trading*	*SASA 13C,15C, 16C, 17C, 18C*	*Geophysical surveys, coring, bulk sampling*	*Yes but appeal still under review*	
2021	*De Beers Marine*	*SASA 4C & 5C*	*Geophysical surveys, coring, bulk sampling*	*Application in prep.*	
2021	*Samara Mining*	*SASA 4C & 5C*	*Geophysical surveys, coring, bulk sampling*	*Application contested and withdrawn*	
2021-2022	*Moonstone Diamond Marketing*	*SASA 11b, 13b*	*Geophysical surveys, coring, bulk sampling*	*Applications delayed* *Second round EIAs in prep.*	
2022	*Trans-Atlantic Diamonds*	*SASA 14A*	*Geophysical surveys, coring, sampling*	*Yes*	
2022	*Trans-Atlantic Diamonds*	*SASA 11C*	*Geophysical surveys, coring, sampling*	*FBAR submitted to DMRE on 2 March 2022*	
2022	*Nisarox*	*SASA 12B*	*Geophysical surveys, coring, sampling and bulk sampling*	*EIA in prep.*	
Hydrocarbon Exploration					
2007	*PASA*	*Orange Basin*	*2D seismics*	*Yes*	*2D: Nov-Dec 2007*
2008	*PASA*	*West Coast*	*2D seismics*	*Yes*	*2D Sep 2008*
2008	*PetroSA*	*Block 1*	*3D seismic*	*Yes*	*3D: Jan-Apr 2009*
2011	*Forest Oil (Ibhubesi)*	*Block 2A*	*3D seismic survey*	*Yes*	*3D: May – Jul 2011*
2011	*PetroSA*	*Block 5/6 (ER224)* *Block 7 (ER228)*	*3D seismics and CSEM*	*Yes*	*2D: Dec 2012 – Feb 2013* *3D: Jan 2020 – Apr 2020*
2011	*PetroSA*	*Block 1*	*Exploration drilling*	*Yes (June 2011)*	*??*
2012	*BHP Billiton* *(now Ricocure, Azinam & Africa Oil)*	*Block 3B/4B*	*2D and 3D seismics*		
2013	*Spectrum*	*West Coast Multiclient*	*2D seismics*	*Yes*	*2D: April 2015*

2013	*PetroSA*	*Block 1*	*2D and 3D seismics*	*Yes*	*3D: Feb - May 2013 (conducted by Cairn)*
2013	*Anadarko*	*Block 2C*	*2D and 3D seismics, MBES, heatflow, seabed sampling*	*Yes (2013)*	*??*
2013	*Anadarko*	*Block 5/6/7*	*MBES, heatflow, coring*	*Yes*	*MBES: Jan – Mar 2013*
2014	*OK/Shell*	*Northern Cape Ultra Deep* *ER274*	*2D and 3D seismics, MBES, gradiometry and magnetics, seabed sampling*	*Yes*	*Shell audit in 2020* *2D : Feb-Mar 2021*
2014	*Shell*	*Deep Water Orange Basin*	*Exploration drilling*	*Yes*	*Shell relinquished block to TEEPSA*
2014	*Cairn*	*ER 12/3/083*	*2D seismics*	*Yes* *(obtained by PetroSA)*	*2D: Feb-Mar 2014*
2014	*Cairn*	*Block 1*	*Seabed sampling*	*Yes*	
2014-15	*Thombo*	*Block 2B (ER105)*	*Exploration drilling*	*Yes*	*Africa Energy preparing to drill in late 2022/23*
2014	*New Age Energy*	*Southwest Orange Basin*	*2D seismics*		
2015	*Cairn*	*Block 1*	*Exploration drilling*		
2015	*Sunbird*	*West Coast*	*Ibhubesi pipeline*	*Yes*	*No activities undertaken. The EA was renewed for an additional 5 years on 30 June 2022*
2015	*Rhino*	*SW Coast Inshore*	*2D seismics and MBES*		
2015	*Rhino*	*Block 3617, 3717*	*2D and 3D seismics, MBES*	*Yes (Feb 2017)*	*??*
2017	*Impact Africa/TEEPSA (ER335)*	*SW Orange Deep (portion of New Age Energy Block)*	*2D and 3D seismics*		
2018	*PGS*	*West Coast Multiclient*	*2D and 3D seismics*	*Unknown*	
2019	*Anadarko*	*Block 5/6/7*	*2D seismics*	*Yes*	

				(issued to PetroSA in 2013)	
2021	*Searcher*	*West Coast multiclient*	*2D and 3D seismics*	*Yes (Dec 2021)* *Appealed*	*2D: Jan 2022*
2021	*TGS*	*West Coast multiclient*	*2D seismics*	*Yes*	*Decided not to survey*
2021	*Tosaco*	*Block 1* *ER362*	*3D seismics*	*EIA not completed*	
2022	*Ion*	*Deep Water Orange Basin*	*3D seismics*	*Application in prep.*	*EIA not completed*
2022	*Searcher*	*Deep Water Orange Basin*	*3D seismics*	*Application in prep.*	
2022	*Shearwater*	*Deep Water Orange Basin*	*3D seismics*	*Application put on hold*	
2022	*TGS*	*Deep Water Orange Basin*	*3D seismics*	*Application in prep.*	
2022	*PGS*	*Deep Water Orange Basin*	*3D seismics*	*Application in prep.*	
2022	*TEEPSA*	*Block 567*	*Exploration drilling*	*EIA in prep.*	
2022	*TEEPSA*	*Deep Water Orange Basin*	*Exploration drilling*	*EIA in prep.*	

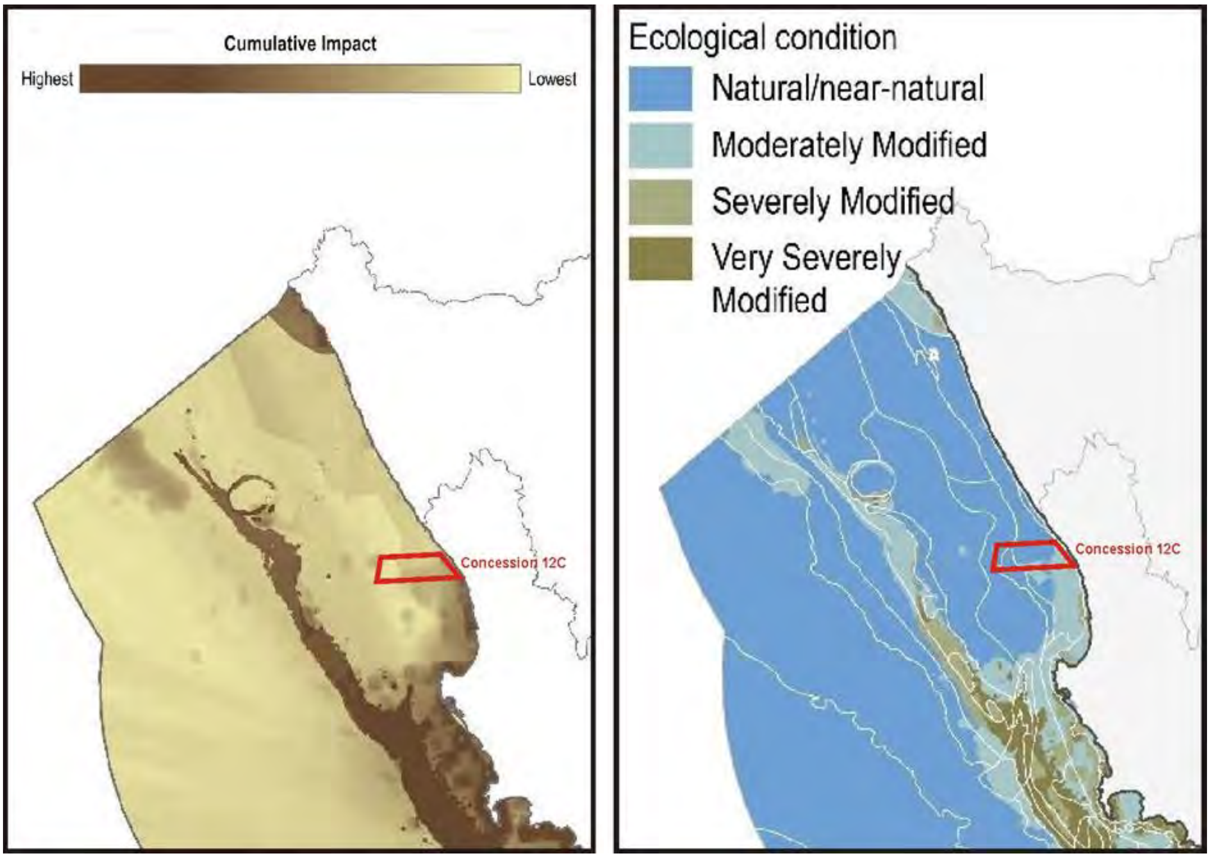


Figure 79: Concession 12C (red polygon) in relation to cumulative impact on marine biodiversity, based the intensity of all cumulative pressures and the sensitivity of the underlying ecosystem types to each of those pressures (left) and the ecological condition of the marine realm based on the severity of modification as a result of the cumulative impacts (adapted from Sink et al. 2019 and Harris et al. 2022).

The primary impacts associated with the geophysical surveying and sediment sampling in the Namaqua Bioregion on the West Coast of South Africa, relate to cumulative anthropogenic noise, physical disturbance of the seabed, discharges of tailings to the benthic environment, and associated vessel presence.

7.2.1.11.1 Underwater Noise

Noise associated with the proposed geophysical surveying would have cumulative impact on marine fauna. Due to the concession being located well inshore of the main vessel traffic routes that pass around southern Africa, ambient noise levels will be comparatively low. Sensitive receptors and faunal species (cetaceans, turtles and certain fish) may thus be affected as faunal behaviour may be influenced to within a few kilometres of the sound source during surveying operations. Noise levels would return back to ambient after surveying is complete.

The assessments of impacts of underwater 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 noise acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term and with multiple exposures, 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 acoustic and non-acoustic stressors stressors (e.g. temperature, competition for food, climate change, shipping noise) (Przeslawski et al. 2015; Erbe et al. 2018, 2019; Booth et al. 2020; Derous et al. 2020). Physiological stress, for example, may not be easily detectable in marine fauna, but can affect reproduction, immune systems, growth, health, and other important life functions (Rolland et al. 2012; Lemos et al. 2021). Confounding effects are, however, difficult to separate from those due to geophysical prospecting operations.

Similarly, potential cumulative impacts on individuals and populations as a result of other geophysical or seismic surveys undertaken either previously, concurrently or subsequently are difficult to assess. Considering the number of seismic surveys recently conducted along the West Coast by the hydrocarbon industry, some cumulative impacts can be anticipated. 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.*

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. 2019). 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. Despite the density of seismic survey coverage over the past decades years ((there have been 21 seismic surveys in South African waters between the 2007/2008 and 2020/2021 financial years (data provided by PASA Jan 2022)), and the ongoing geophysical prospecting by mineral rights holders on the West Coast (see Table 20), 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 geophysical and seismic surveying frequency has increased, suggesting that, for these population at least, there is no evidence of long-term negative change to population size or irreparable harm as a direct result of acoustic survey activities. Although monitoring surveys have revealed a steady population increase since the protection of the species from commercial whaling, more recent results, however, indicate changes in the prevalence of southern rights on the South African breeding ground, including a marked decline of unaccompanied adults since 2010 and extreme fluctuations in the number of cow-calf pairs since 2015. The authors, however, contribute the change in demographics to likely spatial and/or temporal displacement of prey due to climate variability, and not acoustic surveys. To date no trophic cascades off the South African coast have been documented despite a number of seismic and geophysical surveys having been completed. 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 acoustic 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). In the case of this project, the proposed geophysical survey will be undertaken over a comparatively short period (40 days) and well inshore of proposed seismic surveys on the West Coast. Nonetheless, if the geophysical survey is undertaken concurrently with offshore seismic surveys, cumulative impacts can be expected. However, any direct noise impact is likely to be at individual level rather than at species level.

7.2.1.11.2 Impacts of Noise at Ecosystem Level

The structure and function of nearshore and offshore marine ecosystems is influenced both by natural environmental variation (e.g. El Niño Southern Oscillation (ENSO)) and multiple human uses, such as hydrocarbon developments, marine prospecting and mining, and the harvest of marine living resources. The review provided in the impact assessment illustrates that the impacts of anthropogenic noise, at various scales surrounding the stressor, have been recorded in a diverse range of faunal groups. Studies on acoustic impacts, however, largely deal with effects upon individual animals or species, with impacts across large spatial scales, cumulative effects (both of ocean noise and factors other than sound pollution) or multiple species and/or food web levels having rarely been considered.

Below follows a brief discussion of potential population-level and ecosystem-wide effects of disturbance and the application of the integrated ecosystem assessment framework for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components.

With growing evidence of the ecosystem-wide effects of seismic noise (Nieukirk et al. 2012; Kavanagh et al. 2019; Kyhn et al. 2019) and the potential consequences of sub-lethal anthropogenic sounds affecting marine animals at multiple levels (e.g. behaviour, physiology, and in extreme cases survival), there is increasing recognition for the need to consider the effects of anthropogenic noise at population and ecosystem level. The sub-lethal effects of sound exposure may seem subtle, but small changes in behaviour can lead to significant changes in feeding behaviour, reductions in growth and reproduction of individuals (Pirotta et al. 2018), but can have effects that go beyond a single species and may cause changes in food web interactions (Francis et al. 2009; Hubert et al. 2018; Slabbekoorn & Halfwerk 2009).

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

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

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

Due to the difficulties in observing population-level and/or ecosystem impacts, numerical models are needed to provide information on the extent to which sound or other anthropogenic disturbances may affect the structure and functioning of populations and ecosystems. Attempts to model noise-induced changes in population parameters were first undertaken for marine mammals using the population consequences of acoustic disturbance (PCAD) or Population Consequences of Disturbance (PCoD) approach (NRC 2005). The PCAD/PCoD framework assesses how observed behavioural responses on the health of an individual translates into changes in critical life-history traits (e.g. growth, reproduction, and survival) to estimate population-level effects. Since then various frameworks have been developed to enhance our understanding of the consequences of behavioural responses of individuals at a population level. This is typically done through development of bio-energetics models that quantify the reduction in bio-energy intake as a function of disturbance and assess this reduction against the bio-energetic need for critical life-history traits (Costa et al. 2016; Keen et al. 2021). The consequences of changes in life-history traits on the development of a population are then assessed through population modelling. These frameworks are usually complex and under continual development, but have been successfully used to assess the population consequences and ecosystem effects of disturbance in real-life conditions both for marine mammals (Villegas-Amtmann 2015, 2017; Costa et al. 2016; Ellison et al. 2016; McHuron et al. 2018; Pirotta et al. 2018; Dunlop et al. 2021), fish (Slabbekoorn & Halfwerk 2009; Hawkins et al. 2014; Slabbekoorn et al. 2019) and invertebrates (Hubert et al. 2018). The PCAD/PCoD models use and synthesize data from behavioural monitoring programs, ecological studies on animal movement, bio-energetics, prey availability and mitigation effectiveness to assess the population-level effects of multiple disturbances over time (Bröker 2019).

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

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

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

7.2.1.11.3 Disturbance of Sediments

The sampling operations as part of the proposed prospecting activities would impact a maximum area of <0.043 km² in the Namaqua Bioregion, which can be considered an insignificant percentage (0.001 %) of the Namaqua Sandy Inner Shelf and Namaqua Sandy Mid Shelf ecoregions as a whole. Sampling on the inner and mid shelf region south of Hondeklipbaai is currently extremely limited and any cumulative effects from other diamond mining ventures in the region are highly unlikely. The heavy minerals mining being undertaken at Brand-se Baai and in the surf-zone concessions adjacent to concession 12A, is located well inshore of the 12C concession, and no cumulative impacts with beach mining operations are expected.

Cumulative impacts to the benthic environment also include the development of hydrocarbon wells. Since 1976, ~40 wells have been drilled in the Namaqua Bioregion of which 35 wellheads remain on the seabed impacting a combined estimated area of ~10 km². The majority of these occur in the iBhubesi Gas field in Block 2A, which lies well to the north and offshore of concession 12C. Although cumulative impacts from other hydrocarbon ventures are likely to increase in future, these would not affect the habitats in concession 12C.

7.2.1.11.4 Vessel lighting and Operational Discharges

There are numerous light sources and operational discharges from vessels operating within and transiting through the area, although each is isolated in space and most are mobile. Given the extent of the ocean and the point source nature of the lighting, the prevalence of sensitive receptors and faunal species interactions with the light sources is expected to be very low. Light levels would return back to ambient once operations are completed.

Each of the vessels (fishing, shipping, prospecting) operating within the area will make routine discharges to the ocean, each with potential to cause a local reduction in water quality, which could impact marine fauna. However, each point source is isolated in time and widely distributed within the very large extent of the open ocean. At levels compliant with MARPOL conventions no detectable cumulative effects are anticipated.

7.3 Underwater Heritage

7.3.1.1 Impact Tables

Table 21: For Pre-Colonial Sites and Artefacts

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 2	Long-term 3	Medium 6	Improbable	Low	– ve	Medium
Mitigation measures: Induction for site managers on archaeological site and artefact recognition. Reporting of sites to the heritage practitioner for assessment and evaluation.								
With mitigation	Local 1	Low 2	Long-term 3	Medium 6	Improbable	LOW	+ ve	Medium

Table 22: For Section 6.1.2.1.2 Shipwrecks possibly in 12C

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Possible	Very Low	– ve	Medium
Mitigation measures: There is no heritage significance currently. Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would pinpoint the wrecks to avoid damaging equipment. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources for future generations.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Possible	VERY LOW	+ ve	Medium

For Section 6.1.2.1.3 Shipwrecks Improbably in 12C

Table 23: 0 Shipwrecks with No heritage significance

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence

Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Improbable	Very Low	– ve	Medium
Mitigation measures: There is no heritage significance currently. Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would pinpoint the wrecks to avoid damaging equipment. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources for future generations.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Improbable	VERY LOW	+ ve	Medium

Table 24: 0 Shipwrecks with a Low heritage significance

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Long-term 3	Low 5	Improbable	Very Low	– ve	Medium
Mitigation measures: Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would possibly identify wrecks and wreck debris. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources.								
With mitigation	Local 1	Low 1	Long-term 3	Low 5	Probable	LOW	+ ve	Medium

Table 25: 0 Shipwrecks with a Medium heritage significance

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Improbable	Low	– ve	Medium
Mitigation measures: Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would possibly identify wrecks and wreck debris. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources.								
With mitigation	Local 1	Medium 2	Long-term 3	Medium 6	Possible	LOW	+ ve	Medium

Table 26: 0 Shipwrecks with a High heritage significance

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 3	Long-term 3	High 7	Improbable	Medium	– ve	Medium
Mitigation measures: Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would possibly identify wrecks and wreck debris. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources.								
With mitigation	Local 1	Low 3	Long-term 3	High 7	Possible	MEDIUM	+ ve	Medium

Table 27: Summary Table

Impact	Consequence	Probability	Significance	Status	Confidence

Impact Pre-Colonial Sites	*Medium*	*Possible*	*LOW*	*–ve*	*Medium*
With Mitigation	*Medium*	*Possible*	*LOW*	*+ve*	*Medium*
SHIPWRECKS POSSIBLY IN 12C					
Impact 5.2.2	*Low*	*Definite*	*LOW*	*–ve*	*High*
With Mitigation	*Low*	*Definite*	*LOW*	*+ve*	*High*
SHIPWRECKS POSSIBLY IN 12C					
Impact 5.2.3.1	*Low*	*Improbable*	*VERY LOW*	*–ve*	*Medium*
With Mitigation	*Low*	*Improbable*	*VERY LOW*	*+ve*	*Medium*
Impact 5.2.3.2	*Low*	*Improbable*	*VERY LOW*	*-ve*	*Medium*
With Mitigation	*Low*	*Probable*	*LOW*	*+ve*	*Medium*
Impact 5.2.3.3	*Medium*	*Improbable*	*LOW*	*-ve*	*Medium*
With Mitigation	*Medium*	*Possible*	*LOW*	*+ve*	*Medium*
Impact 5.2.3.4	*High*	*Improbable*	*MEDIUM*	*-ve*	*Medium*
With Mitigation	*High*	*Possible*	*MEDIUM*	*+ve*	*Medium*

7.3.1.2 Cumulative Impacts

There has been a recent increase in applications for prospecting and exploration rights along the west coast and increased prospecting/survey activity in the short term and marine mining in the long-term is anticipated. This means that cumulative impacts of marine prospecting and mining should be considered at a broader spatial scale in a strategic manner.

The value and significance of heritage resources is a highly emotive and subjective field. Certain sites are deemed significant due to their age, or the activity they were engaged in at the time of the event, these include slave and war ships, others may be unique in respect of their construction and rarity in the archaeological record. Some wrecks are not unique or even very old but may have spiritual significance to a local fishing community due to fatalities at the time of wrecking. One must be careful to not to project one's own values and belief systems onto the heritage resources and think about future generations. While some wrecks are not necessarily deemed important now, destruction without due diligence can have a negative future impact.

The wreck databases are built on reported wrecks. Ergo, the confidence in the historical reporting around inhabited port areas is generally higher. The west coast's low population density means that confidence in the historical reports is lower. There are, no doubt, many unreported wrecks, particularly older ones. Shipwreck sites are not always easily located. There are generally three stages to the formation of a wreck site. The first stage, the wreck event is precipitated by environmental conditions (storms) interacting with anthropogenic factors (captain's response to the environmental challenge). The second stage is a dynamic stage where the wreck interacts with and is transformed by the environment. The third stage is where the remains are assimilated with the environment. These stages do not necessarily progress linearly, and the stages may cycle, for example a second wreck can occur on the initial wreck and the process starts again; the second and third stages may be cyclical as storms could disturb the assimilated wreck site and transform the site further. Over hundreds of years, the site can be virtually indistinguishable from the surrounding seabed or reef. With the mitigation measures mentioned within this report, and assuming a best-case scenario, wrecks should be located during prospecting phases.

It is not possible to assess cumulative impacts with any level of confidence due to the unknown nature of the heritage resources in the region. Each wreck must be assessed as it is found, and if it is treated with the knowledge that we do not always know if is significant, whether locally or internationally, we can mitigate against high, negative cumulative impacts.

7.4 Palaeontology Impacts

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value with respect to palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered. The absence of management and operator mitigatory actions to be alert for fossils and retrieve them will result in their loss. This loss of the opportunity to recover fossils and record their contexts when exposed at a particular site is a negative, irreversible impact.

If mitigatory efforts are made to watch out for and rescue the fossils then the impact is positive for palaeontology. However, there remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. The fossils may simply not be noticed or not recognized. Even the most diligent attempts at mitigation can only hope to acquire some fraction of the fossils. This is particularly the case if the fossils are sparsely distributed in the deposits, which is generally the case for scientifically-valuable fossil bone material.

A misperception exists that if fossils are sparse in a deposit then the intensity of impact will be low. This is not the case as it is the valuable fossils that are usually scarce, such as fossil bones. The very scarcity of such fossils makes for the added importance of watching for them.

7.4.1.1 Vibracores and Grabs

The palaeontological impact of the vibracoring and grab sampling in Concession 12C is considered to be negligible, in view of the minimal volumes of sediment affected.

In the vibracores the small volumes involved greatly reduce to likelihood of capturing the sparse fossils reworked from the older, pre- late Quaternary formations and the "extralimitals" in the Last Transgression Sequence. The grab samples are purposed for obtaining the upper, modern fauna and are unlikely to capture fossils which are usually lower down. Notwithstanding, the grabs may capture poorly-known modern species.

However, should extralimital Subantarctic and Agulhas species occur in the cores they are more important specimens than those selected from the loose, mixed shells crossing the oversize screens on sampling/mining vessels, as they have context in the geological and faunal succession in the core and the expense to have specimens radiocarbon dated is more worthwhile.

7.4.1.2 Drillship Sampling

The target areas and number of drillship sample sites are yet to be determined on the basis of interpretation of the geophysical survey. For each metre drilled a 5 m^2 drill footprint delivers ~5 m^3 of material to the gravel screening plant on the vessel. For the most part the excavated material is the Last Transgression Sequence deposits with expected "subfossil" extant shell species in the "overburden" of fine sands and silts. Scientifically important extralimital species and rare reworked old fossil shells, bones and teeth occur in the gravels and sands of the lowermost metre of drill holes. Ignoring the variable thickness of "overburden", each drill hole includes a basal, potentially fossiliferous 5 m^3 of material.

7.4.1.3 Extents

In sampling and mining the fossil content of a prescribed volume of deposit is destroyed which is the physical extent of the impact. i.e. the extent is local. On the other hand, fossils uncovered during sampling and mining of the coastal plain and offshore are often of sufficient note to publish about them, which is a scientific impact on a national to international scale. For example, the discoveries of the Cretaceous fossil woods, the Miocene petrified whale fossils and the Subantarctic, Algoa and West African molluscan taxa in the Last Transgression Sequence, are all published in the international scientific literature.

7.4.1.4 Duration

The impact of both the finding or the loss of fossils is permanent. Destroyed fossils are lost to posterity. The found fossils must be preserved for posterity.

7.4.1.5 Intensity

The intensity of the potential impact of sampling and mining on fossil resources is determined by the palaeontological sensitivity of the affected formations - the potential scientific value of the fossils which are included in it, together with the volume of the formation which is excavated. Overall, the palaeontological sensitivity of marine deposits is HIGH (Almond & Pether, 2009) due to a few, crucial fossil bone finds of high scientific importance that provided the age constraints for the formations. However, there are complications as marine formations usually contain more than one type of fossil of differing importance, e.g. common shells and rare bones. Quaternary fossil shell assemblages consist mainly of well-known, usual taxa and it is the unexpected, out of range or unknown, new shell species which are important to distinguish from the expected, common species.

7.4.1.6 Cretaceous Fossil Wood

Large well-preserved chunks of various types of petrified fossil wood are directly derived from the Cretaceous formations exposed on the middle shelf, as well as transported, abraded cobbles and pebbles in the marine gravels. The impact of the rescue or loss of valuable specimens is rated of MEDIUM intensity.

CRITERIA	***WITHOUT MITIGATION***	***WITH MITIGATION***
Extent	*National 4*	*National 4*
Duration	*Permanent 5*	*Permanent 5*
Intensity	*Medium 6*	*Medium 6*
Probability	*Probable 3*	*Probable 3*

Confidence	*High*	*High*
Significance	*Medium negative 45*	*Medium positive 45*
Reversibility	*Irreversible*	
Mitigation potential	*Medium*	

7.4.1.7 Cenozoic Shelly Macrofauna

The fossil shells eroded from the Eocene, Miocene and Pliocene "footwall" formations and incorporated into the overlying LTS basal gravels are usually poorly preserved shell casts and moulds. However, in places on the middle shelf these formations contain beds with well-preserved whole shells which are brought up by the drill. These fossils which are directly derived from the Cenozoic formations are scientifically valuable and practically unstudied. The impact of the rescue or loss of valuable specimens is rated of HIGH intensity.

CRITERIA	***WITHOUT MITIGATION***	***WITH MITIGATION***
Extent	*National 4*	*National 4*
Duration	*Permanent 5*	*Permanent 5*
Intensity	*High 8*	*High 8*
Probability	*Probable 3*	*Probable 3*
Confidence	*High*	*High*
Significance	*Medium-high - negative 51*	*Medium-high - positive 51*
Reversibility	*Irreversible*	
Mitigation potential	*Medium*	

7.4.1.8 Fossil Bones and Teeth

This category includes fossil bones and teeth of any origin as there is no purpose for distinctions when they must be captured before going overboard. Recent fresh bones such as those of fish and seals are common and are excluded. The fossil material is phosphatized (petrified) to various degrees and worn by transport and/or pitted by boring organisms. This material is scarce, but the large volumes involved increase the probability that some will be encountered and could be of high scientific value.

CRITERIA	***WITHOUT MITIGATION***	***WITH MITIGATION***
Extent	*National 4*	*National 4*
Duration	*Permanent 5*	*Permanent 5*
Intensity	*High 8*	*High 8*
Probability	*Probable 3*	*Probable 3*
Confidence	*High*	*High*
Significance	*Medium-high - negative 51*	*Medium-high - positive 51*
Reversibility	*Irreversible*	
Mitigation potential	*Medium*	

7.4.1.9 Shells from the Last Transgression Sequence

The concern here are shell species which are not typical of the normal faunal assemblages of the Namaqua shelf, are unusual and are often sparse. The table below refers to such occurrences.

CRITERIA	***WITHOUT MITIGATION***	***WITH MITIGATION***
Extent	*National 4*	*National 4*
Duration	*Permanent 5*	*Permanent 5*
Intensity	*Medium 6*	*Medium 6*
Probability	*Probable 3*	*Probable 3*
Confidence	*High*	*High*
Significance	*Medium - negative 45*	*Medium - positive 45*
Reversibility	*Irreversible*	
Mitigation potential	*Medium*	

7.5 Socio economic impacts

The former three impacts could potentially impact the livelihoods and household income of three marine fisheries sectors (tuna pole and line, traditional line fish, and Small Pelagic Purse Seine fishers). These impacts were informed by previous Environmental Authorisation Applications done for Sea Concessions.

7.5.1.1 Tuna pole and line

As per the BAR done by Anchor Environmental (2021):

"The South African tuna pole and line sector (TPL) targets longfin tuna Thunnus alalunga, yellowfin tuna T. albacares, bigeye tuna T. obesus and skipjack tuna Katsuwonus pelamis seasonally between November and May. Due to the seasonality of the TPL fishery, fishers also have access to snoek (Thyrsites atun) and yellowtail (Seriola lalandi) that are also important targets of the traditional linefishery. The tuna pole fleet consists of approximately 100 vessels ranging from small outboard powered skiboats (7-9 m length) to inboard diesel-powered deck boats (6-25 m length). The reported longfin tuna catch in 2018 was 2471 tonnes, with a wholesale value of R 124 Million, or 1.2% of the total South African commercial fisheries value (Japp & Wilkinson 2021). The commercial tuna pole fishing grounds lie between Cape Agulhas and the Orange River, but the fleet operates predominantly out of Cape Town and Hout Bay harbours and most fishing effort takes place within 100 nautical miles of these ports (particularly in the Cape Canyon area). Some effort does take place further up the west coast, although this is mostly offshore or to the south of concession area 11C. Over the period 2017-2019 there was no reported TPL fishing effort in the area west of Brand se Baai and inshore of the 200 m isobath, i.e. none within concession 11C (Japp & Wilkinson 2020). Impacts on the TPL fleet due to the proposed prospecting activities within 11C are therefore expected to be insignificant."

As Sea Concession 12C is directly adjacent to 11C, the impact would be similar and is expected to be Ver Low negative.

7.5.1.2 Traditional Linefish Sector

As per the BAR done by Anchor Environmental (2022):

Most (85%) subsistence fishers employ traditional line fishing methods, which is generally considered labour intensive and associated to low revenue output (Brick & Hasson 2018). Line fishers operate in shallow water (generally <100 m depth) and would potentially be negatively impacted by coastal and nearshore seismic exploration, prospecting and mining operations (particularly recreational, small scale and subsistence shore fishing). Traditional line fishers use simple handheld lines or rod with no more than 10 baited hooks per line whereas the commercial line fishers use motorised boats and is managed by Total Applied Effort (TAE) (DAFF 2013). The traditional line fishing sector targets multiple species (up to 200 species) of which 95 species are commercially and recreationally significant (DAFF 2013). The line fisheries along the west coast (Line fish management Zone A - Orange River to Cape Infanta) mostly target the nomadic coastal migrant species, snoek (Thyrsites atun) and yellowtail (Seriola lalandi), as well as the reef dwelling Hottentot sea bream (Pachymetopn blochii). Snoek typically contributes the highest catch weight in the commercial line fisheries (total landings of up to 5 800 tonnes) (Kerwath et al., 2017). The management framework includes a comprehensive suite of line fish regulations including minimum size limits, daily bag limits, closed seasons, closed areas, commercial fishing bans for certain species and the capping of the commercial effort with zonal based Total Allowable Effort (TAE) (Kerwath et al., 2017).

Concession area 11C is however relatively far offshore in water deeper than 100 m, and far from suitable launch sites. A spatial analysis of the reported commercial linefish catch data does not show any activity in reporting blocks that overlap with Concession Area 11C and exploration activities in this concession area are expected to have negligible impacts on the traditional linefish sector. The proposed prospecting in concession area 11C is therefore expected to have a negligible socio-economic impact on the direct and indirect dependants from the traditional linefishing sector.

As Sea Concession 12C is directly adjacent to 11C, and also far offshore in water deeper than 100m and suitable launch sites, the impact would be similar and is expected to be Very Low negative.

7.5.1.3 Small Pelagic Purse Seine Fisheries

The small pelagic fishery is described in the has the largest catch volume for any of the South African fishery sectors and has the second largest annual catch value, estimated at around R2.164 billion in 2017, which is approximately one fifth of the combined value of South African Fisheries (Japp & Wilkinson 2021). The industry supports around 4 500 full time staff, 2 500 seasonal staff and more than 700 fishers. The support industries contribute an estimated further 2 400 jobs. The management of the small pelagic fishery is described in the marine specialist report (Hutchings et al 2021). Stock status of anchovy and round herring are currently considered optimal, whilst sardine stocks are considered depleted (DEFF 2020).

The small pelagic purse-seine fishery operates between the Orange River and East London mostly in nearshore waters (within 10 km of the coast). The 11C Concession Area does overlap with identified fishing areas for anchovy and with the sardine directed fishing ground (Norman et al., 2018). A quantitative spatial analysis using commercial catch return data (all small pelagic species combined) for the period 2006-2011, however, suggests that Concession Area 11C itself, does not constitute an area where a substantial proportion of the average annual purse seine catch is made. Despite overlapping with six small pelagic reporting grid blocks, concession 11C lies at the northern extreme of the small pelagic fishing grounds and the total catch reported for these blocks was only ~150 tonnes (out of a national total of around 300 000 tonnes).

The fishery is unlikely to be significantly negatively affected by small temporary closures/exclusion zones around survey vessels and geotechnical survey sites and potential negative impacts on the livelihoods and household income of participants in this fishery are considered unlikely. The socioeconomic impact is assessed as 'very low', and 'insignificant' after recommended mitigation measures.

As Sea Concession 12C is directly adjacent to 11C, and and a bit more to the South, the impact would be similar and is expected to be Very Low negative.

7.5.1.4 Potential positive impacts

Mining is economically important as it can create broad scale employment opportunities and boost the national and local economy. As a result, the potential impact on the socio-economic performance will be insignificant on a local scale (i.e., in Strandfontein community,). Conversely, investment from the applicant in South Africa will have a greater positive impact on the regional economy.

Impact rating of the prospecting activity on the local socio-economic performance

Insignificant

Impact rating of the prospecting activity on the on the regional socio-economic performance

Low +

8 Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;

(Describe how the significance, probability, and duration of the aforesaid identified impacts that were identified through the consultation process was determined in order to decide the extent to which the initial site layout needs revision).

The criteria for the description and assessment of environmental impacts were drawn from the National Environmental Management Act, 1998 (Act No. 107 of 1998).

The level of detail was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed it is necessary to establish a rating system, which is consistent throughout all criteria. For such purposes, each aspect was assigned a value, ranging from 1-5, depending on its definition.

Potential Impact

This is an appraisal of the type of effect the proposed activity would have on the affected environmental component. Its description should include what is being affected and how it is being affected.

Extent

The physical and spatial scale of the impact is classified as:

- Local

The impacted area extends only as far as the activity, e.g., a footprint.

- Site

The impact could affect the whole or a measurable portion of the site.

- Regional

The impact could affect the area including the neighbouring erven, the transport routes, and the adjoining towns.

- National

Significantly beyond Saldanha Bay and adjacent land areas

Duration

The lifetime of the impact, which is measured in relation to the lifetime of the proposed base:

- Short term

The impact either will disappear with mitigation or will be mitigated through a natural process in a period shorter than any of the phases.

- Medium term

The impact will last up to the end of the phases, whereafter it will be entirely negated.

- Long term

The impact will continue or last for the entire operational lifetime of the Development but will be mitigated by direct human action or by natural processes thereafter.

- Permanent

This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

Intensity

The intensity of the impact is considered here by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. These are rated as:

- Low

The impact alters the affected environment in such a way that the natural processes or functions are not affected.

- Medium

The affected environment is altered, but functions and processes continue, albeit in a modified way.

- High

Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

This will be a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

Probability

This describes the likelihood of the impacts occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:

- Improbable

The possibility of the impact occurring is none, due either to the circumstances, design or experience.

- Possible/Probable

The possibility of the impact occurring is very low, due either to the circumstances, design or experience.

- Likely

There is a possibility that the impact will occur to the extent that provisions must, therefore, be made.

- Highly Likely

It is most likely that the impacts will occur at some stage of the Development. Plans must be drawn up before conducting the activity.

- Definite

The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on.

Determination of Significance – Without Mitigation

The significance is determined through a synthesis of impact characteristics and is an indication of the importance of the impact in terms of both physical extent and time scale. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, the significance is noted as "positive." The significance is rated on the following scale:

- No significance

The impact is not substantial and does not require any mitigation action.

- Low

The impact is of little importance but may require limited mitigation.

- Medium

The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.

- High

The impact is of significant importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

Determination of Significance – With Mitigation

The significance is determined through a synthesis of impact characteristics. It is an indication of the importance of the impact in terms of both physical extent and time scale and therefore indicates the level of mitigation required. In this case, the prediction refers to the foreseeable significance of the impact after the successful implementation of the suggested mitigation measures. Significance with mitigation is rated on the following scale:

- No significance

The impact will be mitigated to the point where it is regarded to be insubstantial.

- Low

The impact will be mitigated to the point where it is of limited importance.

- Low to medium

The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.

- Medium

Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.

- Medium to high

The impact is of significant importance. Through implementing the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

- High

The impact is of significant importance. Mitigation of the impact is not possible on a cost-effective basis. The impact continues to be of significant importance, and taken within the overall context of the project, is a fatal flaw in the project proposal. This could render the entire development option or the entire project proposal unacceptable.

8.1 The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected.

(Provide a discussion in terms of advantages and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties)

Refer to section 7.1 above for a comprehensive discussion relating to the positive and negative impacts of prospecting in Concession area 12C.

8.2 The possible mitigation measures that could be applied and the level of risk.

(With regard to the issues and concerns raised by affected parties provide a list of the issues raised and an assessment/ discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered).

From the **Marine Biodiversity Assessment, page 252**:

8.2.1 Impacts on Marine Fauna

8.2.1.1 Acoustic Impacts of Geophysical Prospecting and Sampling

No mitigation measures are possible, or considered necessary for the generation of noise by the sampling tools and vessels.

Despite the low significance of impacts for geophysical surveys, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals (JNCC 2017). These have been revised to be more applicable to the southern African situation.

No.	*Mitigation measure*	*Classification*
1	*Onboard Marine Mammal Observers (MMOs) should conduct visual scans for the presence of cetaceans and penguins around the survey vessel prior to the initiation of any acoustic impulses.*	*Avoid / Abate on site*
2	*Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment.*	*Avoid / Abate on site*
3	*“Soft starts” should be carried out for any equipment of source levels greater than 210 dB re 1 μPa at 1 m over a period of 20 minutes to give adequate time for marine mammals and diving seabirds to leave the vicinity.*	*Avoid / Abate on site*
4	*Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the marine mammal and/or penguin has vacated the area.*	*Avoid*
5	*Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations. As no seasonal patterns of abundance are known for odontocetes occupying the proposed concession area, a precautionary approach to avoiding impacts throughout the year is recommended.*	*Avoid*
6	*If feasible schedule the survey to take place between February and May thereby avoiding the main seabird breeding seasons (March to October) and penguin summer moult periods (October to January).*	*Avoid*
7	*Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.*	*Abate on site*
8	*A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.*	*Avoid / Abate on site*

8.2.1.2 Disturbance and loss of benthic fauna during sampling

No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to drill sampling. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area.

No.	*Mitigation measure*	*Classification*
1	*Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area*	*Avoid*

8.2.1.3 Disturbance to and loss of rock lobsters during sampling operations

The following mitigation measures are recommended:

No.	*Mitigation measure*	*Classification*
1	*Monitor sorting screens during drill sampling and terminate operations should large numbers of lobsters appear on the screens over a short period of time*	*Abate on site*
2	*Avoid sampling in the immediate vicinity of rocky outcrop areas or other identified sensitive habitats in the licence area*	*Avoid*

8.2.1.4 Crushing of benthic fauna during sampling

No direct mitigation measures are possible, or considered necessary for the indirect loss of benthic macrofauna in unconsolidated sediments due to crushing by the drill-frame structure. However, the following mitigation measures are recommended:

No.	*Mitigation measure*	*Classification*
1	*Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area*	*Avoid*
2	*Implement dynamically positioned sampling vessels in preference to vessels requiring anchorage*	*Avoid*

8.2.1.5 Increased turbidity due to generation of suspended sediment plumes

No mitigation measures are possible, or considered necessary for the discharge of fine tailings from the sampling vessel and the generation of suspended sediments plumes near the seabed by the sampling tools.

8.2.1.6 Remobilisation of contaminants and nutrients

No mitigation measures are possible, or considered necessary for the possible remobilisation of contaminants and nutrients in the sediments.

8.2.1.7 Smothering of benthos in redepositing tailings

No mitigation measures are possible, or considered necessary for the loss of macrobenthos due to smothering by redepositing sediments. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area.

No.	*Mitigation measure*	*Classification*
1	*Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area*	*Avoid*

No.	Mitigation measure	Classification
2	Make of geophysical data to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.	Avoid

8.2.1.8 Loss of Ferrosilicon

The following mitigation measures are recommended:

No.	Mitigation measure	Classification
1	Reduce FeSi loss through the implementation of shell crushers or ball mills	Abate on site
2	Maintain accurate records of all FeSi used and discarded overboard with tailings	Repair / restore

8.2.1.9 Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)

In addition to compliance with MARPOL 73/78 regulations regarding waste discharges mentioned above, the following measures will be implemented to reduce wastes at the source:

No.	Mitigation measure	Classification
1	Prohibit operational discharges when transiting through a marine protected area during transit to and from the concession	Avoid/reduce at source
2	Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system	Avoid / Reduce at Source
3	Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.	Avoid/Reduce at Source
4	Use a low-toxicity biodegradable detergent for the cleaning of the deck and any spillages	Reduce at Source

8.2.1.10 Lighting from Survey and Sampling Vessels

The strong operational lighting used to illuminate the project vessels at night may disturb and disorientate pelagic seabirds 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 and seabirds.

The use of lighting on the project vessels cannot be eliminated due to safety, navigational and operational requirements. Recommendations for mitigation include:

No.	Mitigation measure	Classification
1	The lighting on the vessel(s) should be reduced to a minimum compatible with safe operations whenever and wherever possible.	Avoid/Reduce at Source
2	Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised	Avoid/Reduce at Source
3	Keep disorientated, but otherwise unharmed, seabirds in dark containers (e.g. cardboard boxes) for subsequent release during daylight hours.	Repair or Restore
4	Report ringed/banded birds to the appropriate ringing/banding scheme (details are provided on the ring).	Repair or restore

8.2.2 Underwater Heritage

Taken from **Underwater Heritage Impact Assessment, page 441**:

8.2.2.1 For Pre-Colonial Sites and Artefacts

Mitigation measures:

Induction for site managers on archaeological site and artefact recognition.

Reporting of sites to the heritage practitioner for assessment and evaluation.

8.2.2.2 Shipwrecks possibly in 12C

Mitigation measures:

- *There is no heritage significance currently.*
- *Induction for site managers on archaeological site and artefact recognition.*
- *Geophysical surveys would pinpoint the wrecks to avoid damaging equipment.*
- *Reporting of sites to the heritage practitioner for assessment and evaluation.*
- *Avoiding the wrecks would preserve these MUCH resources for future generations.*

8.2.2.3 For Shipwrecks Improbably in 12C

8.2.2.3.1 Shipwrecks with No heritage significance

Mitigation measures:

There is no heritage significance currently.

Induction for site managers on archaeological site and artefact recognition.

Geophysical surveys would pinpoint the wrecks to avoid damaging equipment.

Reporting of sites to the heritage practitioner for assessment and evaluation.

Avoiding the wrecks would preserve these MUCH resources for future generations

8.2.2.3.2 Shipwrecks with a Low heritage significance

Mitigation measures:

Induction for site managers on archaeological site and artefact recognition.

Geophysical surveys would possibly identify wrecks and wreck debris.

Reporting of sites to the heritage practitioner for assessment and evaluation.

Avoiding the wrecks would preserve these MUCH resources.

8.2.2.3.3 Shipwrecks with a Medium heritage significance

Mitigation measures:

Induction for site managers on archaeological site and artefact recognition.

Geophysical surveys would possibly identify wrecks and wreck debris.

Reporting of sites to the heritage practitioner for assessment and evaluation.

Avoiding the wrecks would preserve these MUCH resources.

8.2.2.3.4 Shipwrecks with a High heritage significance

Mitigation measures:

Induction for site managers on archaeological site and artefact recognition.

Geophysical surveys would possibly identify wrecks and wreck debris.

Reporting of sites to the heritage practitioner for assessment and evaluation.

Avoiding the wrecks would preserve these MUCH resources.

8.2.3 Palaeontology Impacts

From the **Palaeontological Assessment, page 476**:

The exploration and mining for diamonds in the marine environment is a once-off, never to be repeated opportunity to obtain fossils from various areas of the continental shelf, from deposits of various ages. It is cutting-edge, commercially-driven exploration at a scale and detail unaffordable by the state. In order to not overlook such opportunity to advance science co-operatively, the ambit of contemporary environmental management includes such concerns. The additional input from fossil information will be of benefit for the geological interpretation of the deposits. A find of an important fossil can generate favourable publicity. In the longer term, the offshore fossil heritage should also be made available in more permanent exhibitions at an appropriate facility.

The EMPs for the prospecting and mining rights areas must therefore include provisions for the collection of representative examples of the fossils that occur therein. As part of Environmental Awareness Training, geological staff involved in logging must be informed of the need to watch for fossil material and rescue such from the vibracores, grab samples and the drillship gravel oversize screen.

The prospecting/mining company must apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during sampling and mining, as per the NHRA.

8.2.4 Fisheries, socio-economic and other shipping

8.2.4.1 Essential mitigation measures

- Undertake surveys when fishing effort is lowest (preferably out of fishing seasons).
- Appoint a fisheries liaison officer (FLO) to facilitate communication with the Small Pelagic Fishing Industry Association. The FLO should report daily on vessel activity and respond and advise on action to be taken in the event of encountering purse seine fishing vessels in the survey area.
- The survey and sampling vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions should be taken to minimise the possibility of an offshore accident. Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Safety equipment and training of personnel to ensure the safety and survival of the crew in the event of an accident is a further legal requirement; and

8.2.4.2 Best Practice Mitigation

Prior to survey commencement, the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof: ·

- Fishing industry / associations:
  - ➢ SA Marine Linefish Management Association (SAMLMA);
  - ➢ South African Pelagic Fishing Industry Association (SAPFIA); and,
  - ➢ Local fishing communities.
- Other associations and organs of state ➢ DFFE;
  - ➢ SAMSA;
  - ➢ South African Navy Hydrographic office; and
  - ➢ Overlapping and neighbouring right holders.

These stakeholders should again be notified at the completion of surveying when the survey vessel(s) is/are off location. The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed timeframes of surveys and day-to-day location of the survey vessel(s), and (3) an indication of the required safety zone(s) and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.

8.3 Motivation where no alternative sites were considered.

The concession holder does not have the right to prospect in any other areas. No alternatives sites were therefore considered in this Basic Assessment Process. In addition, the concession area is targeted as it is known to contain kimberlite pipes which is a source of diamonds and other mineral deposits.

8.4 Statement motivating the alternative development location within the overall site.

8.4.1.1 (Provide a statement motivating the final site layout that is proposed)

Refer to Section 4 above.

The project site has been selected based on the history and the identification of the sea concession areas.

In summary, therefore:

- The **Preferred Alternative** is the <u>prospecting of diamonds</u>, as per the layout shown in **Figure 2 (page 6)**.
- The preferred and only **location** alternative of the prospecting activity is as per **Figure 2 (page 6),** which indicates the concession area. No access roads, infrastructure or services are required. No electricity powerline connections are required.
- The preferred and only **activity** alternative is the prospecting of diamonds over Sea Concession 12C shown in **Figure 2 (page 6)**.
- The preferred **technology and operational** alternatives is the use of geophysical surveys, drill sampling and pre-/feasibility studies.

The operational approach is practical and based on best practices to ensure a phased approach of prospecting followed by rehabilitation in sequential stages.

There are therefore no other reasonable or feasible sites, layouts, activities, technologies, or operational alternatives for further consideration in the impact assessment component, other than the mandatory “no-go” alternative that must be assessed for comparison purposes.

Areas of conservation concern will be avoided to preserve the integrity of these environments. Furthermore, reef areas will also be avoided as these are known to be hotspots for marine biodiversity. As no geophysical sampling have been conducted in this area to date, the exact position of reefs and other areas that need to be avoided have not yet been identified. These areas will be identified only after the seismic surveys have been completed. Consultation with stakeholder during the Public Participation Process will further elucidate areas that need to be avoided. The preferred alternative within the site is thus subject to change pending results from the geophysical survey and consultation with stakeholders.

8.5 Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity.

(Including (i) a description of all environmental issues and risks that erer 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.)

The National Environmental Screening Tool was used to assess terrestrial habitat adjacent to Concession Area 12C. The purpose of a screening process is to identify any environmental site sensitivities within the area.

Specialists were appointed to assess these site sensitivities and any potential impacts associated with prospecting in this area. Information from these studies and the screening tool, together with the expertise from the EAP and consultation with stakeholders will be used to identify and assess the potential impacts of prospecting in this area.

Refer to the Impact Assessment Methodology detailed in Section 8 above and employed in the rating of impacts detailed in the Impact Tables attached at **Appendix E, page 496**.

Refer to Section 6.5 above and **8.5.1** below, which references the findings from **page 496** and the measures to avoid, reverse, mitigate or manage the identified impacts to determine the extent of the residual risks that need to be managed and monitored.

8.5.1 Assessment of each identified potentially significant impact and risk

(This section of the report must consider all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties).

Also refer to Appendix E, page 496

<table>
<tr>
<th>NAME OF ACTIVITY (E.g. For prospecting - drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc…etc…etc E.g. For mining,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc…etc…etc.)</th>
<th>POTENTIAL IMPACT (Including the potential impacts for cumulative impacts) (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)</th>
<th>ASPECTS AFFECTED</th>
<th>PHASE In which impact is anticipated (e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)</th>
<th>SIGNIFICANCE if not mitigated</th>
<th>MITIGATION TYPE (modify, remedy, control, or stop) through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc)

E.g.
Modify through alternative method.
Control through noise control
Control through management and monitoring through rehabilitation..</th>
<th>SIGNIFICANCE if mitigated</th>
</tr>
<tr>
<td>Planning Phase</td><td>N/A</td><td>N/A</td><td>Planning Phase</td><td>N/A</td><td>N/A</td><td>N/A</td>
</tr>
<tr>
<td>Stakeholder consultation</td><td>N/A</td><td>Consultation with communities & I&APs</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td>
</tr>
<tr>
<td>Geophysical seismic survey and seafloor mapping</td>
<td>Impacts of multi-beam and sub-bottom profiling sonar on marine fauna</td>
<td>Marine Fauna</td>
<td>Planning/Survey Phase</td>
<td>Low -</td>
<td>No mitigation measures are possible, or considered necessary for the generation of noise by the sampling tools and vessels.
Despite the low significance of impacts for geophysical surveys, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals (JNCC 2017). These have been revised to be more applicable to the southern African situation.

<table>
<tr><th>No.</th><th>Mitigation measure</th><th>Classification</th></tr>
<tr><td>1</td><td>Onboard Marine Mammal Observers (MMOs) should conduct visual scans for the presence of cetaceans and penguins around the survey vessel prior to the initiation of any acoustic impulses.</td><td>Avoid / Abate on site</td></tr>
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<tr><td>5</td><td>Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations. As no seasonal patterns</td><td>Avoid</td></tr>
</table>
</td>
<td>Very Low</td>
</tr>
</table>

					of abundance are known for odontocetes occupying the proposed concession area, a precautionary approach to avoiding impacts throughout the year is recommended. 6 – If feasible schedule the survey to take place between February and May thereby avoiding the main seabird breeding seasons (March to October) and penguin summer moult periods (October to January). – Avoid 7 – Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November. – Abate on site 8 – A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying. – Avoid / Abate on site	
Geophysical seismic survey and seafloor mapping	Impacts of noise from sampling operations on marine fauna	Marine Fauna	Planning/Survey & Prospecting Phase	Very Low	No mitigation measures are proposed .	Very Low
Drill sampling or prospecting	Disturbance and loss of benthic fauna during sampling	Benthic fauna	Prospecting / Sampling	Very Low	No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to drill sampling. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area. No. – Mitigation measure – Classification 1 – Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area – Avoid	Very Low
Drill sampling or prospecting	Disturbance to and loss of rock lobsters	Rock Lobsters	Prospecting / Sampling	Very Low	No. – Mitigation measure – Classification 1 – Monitor sorting screens during drill sampling and terminate operations should large numbers of lobsters appear on the screens over a short period of time – Abate on site 2 – Avoid sampling in the immediate vicinity of rocky outcrop areas or other identified sensitive habitats in the licence area – Avoid	Very Low
Drill sampling or prospecting	Crushing of benthic fauna during sampling	Benthic fauna	Prospecting / Sampling	Very Low	No. – Mitigation measure – Classification 1 – Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area – Avoid 2 – Implement dynamically positioned sampling vessels in preference to vessels requiring anchorage – Avoid	Very Low
Drill sampling or prospecting and Closure	Potential impacts on the water column associated with sediment plumes from sampling/mining vessels are primarily linked with increased turbidity and its effects on light penetration through the water column, remobilisation of dissolved constituents from seabed sediments (see section 4.4.6), and reduction in oxygen levels in the water column resulting from high levels of primary production.	Marine Fauna - light penetration through the water column, remobilisation of dissolved constituents from seabed sediments and reduction in oxygen levels in the water column resulting from high levels of primary production	Prospecting / Sampling	Very Low	No mitigation measures are possible, or considered necessary for the discharge of fine tailings from the sampling vessel and the generation of suspended sediments plumes near the seabed by the sampling tools.	Very Low
Drill sampling or prospecting and Closure	The re-suspension of sediments during sampling can release these trace metals and nutrients into the water column. Metal bio-availability and eco-toxicology is	Marine Fauna	Prospecting / Sampling	Very Low	No mitigation measures are possible, or considered necessary for the possible remobilisation of contaminants and nutrients in the sediments.	Very Low

<table>
<tr><td></td><td>complex and depends on the partitioning of metals between dissolved and particulate phases and the speciation of the dissolved phase into bound or free forms (Rainbow 1995; Galvin 1996). Although dissolved forms are regarded as the most bio-available, many of these are not readily utilisable by aquatic organisms. Consequently those forms that are ultimately bio-available and potentially toxic to marine organisms usually constitute only a fraction of the total concentration. Trace metal uptake by organisms may occur through direct absorption from solution, by uptake of suspended matter and/or via their food source. Toxic effects on organisms may be exerted over the short term (acute toxicity), or through bioaccumulation.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Drill sampling or prospecting and Closure</td><td>Smothering effects on rocky outcrop communities</td><td>rocky outcrop communities</td><td>Prospecting / Sampling</td><td>Very Low</td><td>No mitigation measures are possible, or considered necessary for the loss of macrobenthos due to smothering by redepositing sediments. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area.
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<tr><td>2</td><td>Make of geophysical data to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.</td><td>Avoid</td></tr>
</table></td><td>Very Low</td></tr>
<tr><td>Drill sampling or prospecting and Closure</td><td>Redeposition of discarded sediments on soft-sediment macrofauna</td><td>soft-sediment macrofauna</td><td>Prospecting / Sampling</td><td>Very Low</td><td>The following mitigation measures are recommended:
<table>
<tr><th>No.</th><th>Mitigation measure</th><th>Classification</th></tr>
<tr><td>1</td><td>Reduce FeSi loss through the implementation of shell crushers or ball mills</td><td>Abate on site</td></tr>
<tr><td>2</td><td>Maintain accurate records of all FeSi used and discarded overboard with tailings</td><td>Repair / restore</td></tr>
</table></td><td>Very Low</td></tr>
<tr><td>Prospecting and Closure</td><td>Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)</td><td>marine environment</td><td>Operational;</td><td>Very Low</td><td>In addition to compliance with MARPOL 73/78 regulations regarding waste discharges mentioned above, the following measures will be implemented to reduce wastes at the source:
<table>
<tr><th>No.</th><th>Mitigation measure</th><th>Classification</th></tr>
<tr><td>1</td><td>Prohibit operational discharges when transiting through a marine protected area during transit to and from the concession</td><td>Avoid/reduce at source</td></tr>
<tr><td>2</td><td>Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system</td><td>Avoid / Reduce at Source</td></tr>
</table></td><td>Very Low</td></tr>
</table>

					3 – Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc. – Avoid/Reduce at Source 4 – Use a low-toxicity biodegradable detergent for the cleaning of the deck and any spillages – Reduce at Source	
Prospecting and Closure	Disturbance and behavioural changes in pelagic fauna due to vessel lighting	Pelagic Fauna	Operational;	Very Low	The use of lighting on the project vessels cannot be eliminated due to safety, navigational and operational requirements. Recommendations for mitigation include: No. – Mitigation measure – Classification 1 – The lighting on the vessel(s) should be reduced to a minimum compatible with safe operations whenever and wherever possible. – Avoid/Reduce at Source 2 – Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised – Avoid/Reduce at Source 3 – Keep disorientated, but otherwise unharmed, seabirds in dark containers (e.g. cardboard boxes) for subsequent release during daylight hours. – Repair or Restore 4 – Report ringed/banded birds to the appropriate ringing/banding scheme (details are provided on the ring). – Repair or restore	Very Low
Prospecting and Closure	Collision of Vessels with Marine Fauna and Entanglement in Gear	Marine Fauna	Operational;	Very Low	No. – Mitigation measure – Classification 1 – All vessel operators should keep a constant watch for marine mammals and turtles in the path of the vessel. – Abate on site 2 – Ensure vessel transit speed between the concession area and port is a maximum of 12 kts (22 km/hr), except within 25 km of the coast where it is reduced further to 10 kts (18 km/hr) as well as when sensitive marine fauna are present in the vicinity. – Avoid/reduce at source 3 – Should a cetacean become entangled in mooring buoys or towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DEA to provide specialist assistance in releasing entangled animals – Repair / restore 4 – Report any collisions with large whales to the International Whaling Commission (IWC) database, which has been shown to be a valuable tool for identifying the species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk (Jensen & Silber 2003). – Repair or restore	Very Low
Prospecting and Closure	Equipment lost to the seabed	Equipment and seabed/marine environment and fauna	Operational	Very Low	No. – Mitigation measure – Classification 1 – Ensure containers are sealed / covered during transport and loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system. – Avoid 2 – Minimise the lifting path between vessels. – Avoid 3 – Maintain an inventory of all equipment and undertake frequent checks to ensure these items are stored and secured safely on board each vessel. – Avoid 4 – Notify 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. – Repair / restore	Very Low
Prospecting and Closure	Operational Spills and Vessel Accidents	seabed/marine environment and fauna	Operational	Very Low	In addition to the best industry practices and project standards, the following measures must be implemented to manage the impacts associated with small accidental spills: No. – Mitigation measure – Classification 1 – Ensure that vessels operate in accordance with South African Maritime safety regulations to minimise risks of accidents – Avoid / reduce at source 2 – Refuelling of vessels is to occur under controlled conditions in a harbour only, i.e. bunkering at sea is not permitted – Avoid / reduce at source 3 – Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel. – Avoid / reduce at source 4 – Ensure that the vessel operator has prepared and implemented a Shipboard Oil Pollution Emergency Plan and an Oil Spill Contingency Plan. In doing so, take cognisance of the South African Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981), Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986) and Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987), which sets out national policies, principles and arrangements for the management of emergencies including oil pollution in the marine environment. – Abate on and off site	Very Low

					5 – Use low toxicity dispersants cautiously and only with the permission of DFFE. – Abate on and off site 6 – 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 – Abate on site 7 – Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station. – Restore	
Operational	Impacts on Underwater Heritage Resources	Pre-Colonial Sites And Artefacts Shipwrecks Possibly In 12c Shipwrecks Improbably In 12c Shipwrecks With No Heritage Significance Shipwrecks With A Low Heritage Significance Shipwrecks With A Medium Heritage Significance Shipwrecks With A High Heritage Significance	Operational	Low - Low – Very Low – Very Low – Low – Low – Medium -	Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would possibly identify wrecks and wreck debris. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources. Induction for site managers on archaeological site and artefact recognition. Geophysical surveys would possibly identify wrecks and wreck debris. Reporting of sites to the heritage practitioner for assessment and evaluation. Avoiding the wrecks would preserve these MUCH resources.	Low + Low + Very Low + Very Low + Low + Low + Medium +
	Impacts on Underwater Palaeontological Resources	Cretaceous Fossil Wood Cenozoic Shelly Macrofauna Fossil Bones and Teeth Shells from the Last Transgression Sequence	Operational	Medium – Medium to High - Medium to High - Medium -	The EMPs for the prospecting and mining rights areas must therefore include provisions for the collection of representative examples of the fossils that occur therein. As part of Environmental Awareness Training, geological staff involved in logging must be informed of the need to watch for fossil material and rescue such from the vibracores, grab samples and the drillship gravel oversize screen. The prospecting/mining company must apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during sampling and mining, as per the NHRA. Vibracores and Grab Samples Fossils may be found during the processing of the vibracores and grab samples. These may be obvious, such as petrified bone and teeth and shell casts, usually phosphatic. All material of potential interest must have the details of context recorded and be kept for identification by an appropriate specialist and if significant, to be deposited in a curatorial institution such as the IZIKO SA Museum. The identification of extralimital, Agulhas "sub-fossil" shell species in the loose shells of the Last Transgression Sequence requires a level of seashell knowledge. The best outcome for a set of cores from this poorly-known area is that they are the subject of a detailed study, such as for a B.Sc. Honours or M.Sc. project, with radiocarbon dates. It is possible that a core or two might intersect rarely preserved lagoonal deposits which are important for providing points on the sea-level curve applicable to the West Coast (Runds *et al*., 2018). Collection of Fossil Material during Prospecting and Mining As part of the normal sampling and mining process the material crossing the oversize screen (Figure 6) must be monitored for the occurrence of the various fossil types. Potential fossil material should be collected for later identification and evaluation. For overall monitoring purposes it is suggested that a few small bulk samples of shells (~5 litres) be collected on occasion. The idea is to sample the typical assemblage at a few points in the sampling/mining area. It is possible that an uncommon assemblage may be encountered, such as a shallow-water fauna or a lagoonal fauna, in which case it should also be sampled. Data to be recorded during fossil collection includes: • Date • Company name • Sample no. • Collector's name • Position (co-ordinates) • Water depth • Sample subsurface depth • Vessel • Brief description and photographs • A copy of the graphic log of the sample drill hole or mining face showing the vertical sequence of units and the estimated location of the fossil in the sequence.	Medium + Medium to High + Medium to High + Medium +

					 A map of the fossil finds in the particular sampling/mining area, such as a contoured multibeam bathymetric image showing the context of samples in relation to the bedrock topography and sediment bodies. Collected samples are to be temporarily stored by the company. Figure 6. The gravel oversize screen on a typical diamond mining vessel where the geological personnel monitor the material being dredged and where fossil collection takes place When a collection of fossil material has been accumulated, the appointed palaeontologist should undertake the identification and evaluation of the fossil material and compile the report for submission to SAHRA. A selection of material could be removed for further study. The Environmental Manager/Officer is to liaise with the appointed palaeontologist on the progress of the fossil collection and the scheduling of the evaluation. During all operations, personnel can send queries and images by email to an appointed palaeontologist for evaluation and prompt feedback.	
Vessel operation and physical presence	Disturbance	Vessels and shipping	Operational Phase – Phase 1, 2 and 3	Insignificant	N/A	Insignificant
Vessel and equipment operation during all activities including seismic surveys, core, grab and drill sampling	Reduction in fishing success and decline in socio-economic conditions	Local fishing communities dependent upon these resources and local economy	Operational Phase – Phase 1, 2 and 3	Very Low to insignificant	• Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through design measures and noise control of survey equipment; • Control through management • Remedy through suspending activities.	Insignificant
Prospecting activities	Increase in local economic opportunities and socio-economic values	Local communities	Operational Phase – Phase 1, 2 and 3	Insignificant positive	N/A	N/A
Prospecting activities	Increase in regional economic opportunities and socio-economic values	WCDM and South African economy	Operational Phase – Phase 1, 2 and 3	Low positive	N/A	N/A

The supporting impact assessment conducted by the EAP must be attached as an appendix, marked **Appendix E, page 496**

8.5.2 Summary of specialist reports.

(This summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form):-

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT (Mark with an X where applicable)	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED
Marine Fauna Impact Assessment	*Recommended Environmental Management Actions* *Most potential environmental impacts resulting from the proposed prospecting activities would be integrally managed in such a way as to prevent or minimise them. This is particularly the case for waste management, pollution control, equipment recovery and disaster prevention. Other potential but unlikely impacts (e.g. occurrence / behaviour of marine mammals around survey and sampling vessels) should be closely monitored to ensure that adequate responses can be implemented, should a significant impact be detected.* *The only impact which cannot be prevented or minimised through these integrated environmental management measures is the primary impact resulting from the removal of seabed sediments as part of the sampling itself. As there is no practical way of actively 'rehabilitating' these excavations other than discarding tailings back into the sampled area, recovery of the impacted habitats must rely on the gradual but continuous natural movement and deposition of fine sediments onto the seabed. Considering the comparatively small area of seabed impacted by sampling activities, the development of a monitoring plan to demonstrate natural recovery processes is not deemed necessary during the prospecting phase.* *Should prospecting activities indicate economic viability of the resource, allowances for a well-designed benthic monitoring programme should be made during the feasibility phase of the project.* *Conclusions* *If all environmental guidelines, and appropriate mitigation measures and management actions advanced in this report, and the EIA and EMPr for the*	All proposed mitigation measures have been included in the BAR and EMPr X X	All proposed mitigation measures have been included in the BAR and EMPr in Section 8.2, 8.5.2, 9.1.7, Draft environmental management programme.

	proposed prospecting operations as a whole, are implemented, there is no reason why the proposed prospecting activities should not proceed.	X	
Underwater Heritage Impact Assessment	*Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated/recorded (with an approved Mitigation Permit from the MUCH Unit at SAHRA) and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.* *Objectives* *Protection of heritage sites within the project boundary against vandalism, destruction, and theft.* *The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during development activities.* *The following shall apply:* *The proposed geophysical surveys should be inspected for wrecks and wreck debris. If any are noted or suspected, these images should be shared with the heritage practitioner for evaluation and assessment against the database.* *The Environmental Control Officer should be given a short induction, by the heritage practitioners, on archaeological site and artefact recognition.* *The contractors and workers should be notified that archaeological sites might be exposed during the prospecting activities.* *Should any heritage artefacts be exposed during prospecting, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;* *All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice*	All proposed mitigation measures have been included in the BAR and EMPr.	All proposed mitigation measures have been included in the BAR and EMPr in Section 8.2, 8.5.2, 9.1.7, Draft environmental management programme.

	from these specialists, the Environmental Control Officer will advise the necessary actions to be taken; *Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and* *Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological, or palaeontological artefacts, as set out in the NHRA (Act No. 25 of 1999), Section 51. (1).*		
Underwater Palaeontological Impact Assessment	*The exploration and mining for diamonds in the marine environment is a once-off, never to be repeated opportunity to obtain fossils from various areas of the continental shelf, from deposits of various ages. It is cutting-edge, commercially-driven exploration at a scale and detail unaffordable by the state. In order to not overlook such opportunity to advance science co-operatively, the ambit of contemporary environmental management includes such concerns. The additional input from fossil information will be of benefit for the geological interpretation of the deposits. A find of an important fossil can generate favourable publicity. In the longer term, the offshore fossil heritage should also be made available in more permanent exhibitions at an appropriate facility.* *The EMPs for the prospecting and mining rights areas must therefore include provisions for the collection of representative examples of the fossils that occur therein. As part of Environmental Awareness Training, geological staff involved in logging must be informed of the need to watch for fossil material and rescue such from the vibracores, grab samples and the drillship gravel oversize screen.* *The prospecting/mining company must apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during sampling and mining, as per the NHRA.* *Vibracores and Grab Samples* *Fossils may be found during the processing of the vibracores and grab samples. These may be obvious, such as petrified bone and teeth and shell casts, usually phosphatic. All material of potential interest must have the details of context recorded and be kept for identification by an appropriate specialist and if significant, to be deposited in a curatorial institution such as the IZIKO SA Museum.* *The identification of extralimital, Agulhas "sub-fossil" shell species in the loose shells of the Last Transgression Sequence requires a level of seashell knowledge. The best outcome for a set of cores from this poorly-known area is that they are the subject of a detailed study, such as for a B.Sc. Honours or*	All proposed mitigation measures have been included in the BAR and EMPr.	All proposed mitigation measures have been included in the BAR and EMPr in Section 8.2, 8.5.2, 9.1.7, Draft environmental management programme.

	M.Sc. project, with radiocarbon dates. It is possible that a core or two might intersect rarely preserved lagoonal deposits which are important for providing points on the sea-level curve applicable to the West Coast (Runds et al., 2018). *Collection of Fossil Material during Prospecting and Mining* *As part of the normal sampling and mining process the material crossing the oversize screen (Figure 6) must be monitored for the occurrence of the various fossil types. Potential fossil material should be collected for later identification and evaluation.* *For overall monitoring purposes it is suggested that a few small bulk samples of shells (~5 litres) be collected on occasion. The idea is to sample the typical assemblage at a few points in the sampling/mining area. It is possible that an uncommon assemblage may be encountered, such as a shallow-water fauna or a lagoonal fauna, in which case it should also be sampled.* *Data to be recorded during fossil collection includes:* *Date* *Company name* *Sample no.* *Collector's name* *Position (co-ordinates)* *Water depth* *Sample subsurface depth* *Vessel* *Brief description and photographs* *A copy of the graphic log of the sample drill hole or mining face showing the vertical sequence of units and the estimated location of the fossil in the sequence.* *A map of the fossil finds in the particular sampling/mining area, such as a contoured multibeam bathymetric image showing the context of samples in relation to the bedrock topography and sediment bodies.* *Collected samples are to be temporarily stored by the company.* *When a collection of fossil material has been accumulated, the appointed palaeontologist should undertake the identification and evaluation of the fossil material and compile the report for submission to SAHRA. A selection of*		

	material could be removed for further study. The Environmental Manager/Officer is to liaise with the appointed palaeontologist on the progress of the fossil collection and the scheduling of the evaluation. *During all operations, personnel can send queries and images by email to an appointed palaeontologist for evaluation and prompt feedback.*		

Attach copies of Specialist Reports as appendices

9 Environmental impact statement

9.1.1 Summary of the key findings of the environmental impact assessment;

Potential direct, indirect and cumulative impacts of the proposed prospecting and sampling activities on the environment have been identified, described and assessed in this report. Risks and impacts associated with the proposed activities range from medium to insignificant but with effective mitigation these can all be reduced to low, very low or insignificant. Potential impacts of most concern include seismic disturbance to marine mammals, crushing f marine fauna, and disruption of fishing activities.

Both positive and negative impacts associated with not continuing with the prospecting activities, were identified. The negative impacts include lost opportunities in terms of collecting baseline environmental data, determining the presence of offshore mining resources and socio-economic benefits. This impact is, however, considered to be of low significance. The positive implications of the no-go option, on the other hand, is that there would be no effects on the biophysical environment in the proposed area. This was also assessed to be of low significance considering the lost opportunity in terms of scientific data and economic opportunities.

The significance ratings of impacts after mitigation on the key aspects of the “preferred alternative” and the “no go” alternative are shown per phase in the following tables.

Table 28: Summary of the key findings of the environmental impact assessment

<table>
<tr><th>IMPACTS AND ASPECTS</th><th>PREFERRED AND ONLY ALTERNATIVE - RISKS</th><th>NO-GO ALTERNATIVE</th></tr>
<tr><td>1. Impacts of multi-beam and sub-bottom profiling sonar on marine fauna</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>2. Impacts of noise from sampling operations on marine fauna</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>3. Disturbance and loss of benthic fauna during sampling</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>4. Disturbance to and loss of rock lobsters.</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>5. Crushing of benthic fauna during sampling</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>6. Increased turbidity in suspended sediment plumes and at the seabed</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>7. Remobilisation of contaminants and nutrients.</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>8. Smothering effects on rocky outcrop communities</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>9. Redeposition of discarded sediments on soft-sediment macrofauna</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>10. Loss of Ferrosilicon</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>11. Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>12. Disturbance and behavioural changes in pelagic fauna due to vessel lighting</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>13. Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>14. Collision of Vessels with Marine Fauna and Entanglement in Gear</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>15. Equipment lost to the seabed</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>16. Operational Spills and Vessel Accidents</td><td>Medium to Low -</td><td>NO IMPACT</td></tr>
<tr><td colspan="2">17. Impacts on Underwater Heritage Resources
<table>
<tr><td>PRE-COLONIAL SITES AND ARTEFACTS</td><td>Shipwrecks possibly in 12C</td><td>Shipwrecks Improbably in 12C</td><td>Shipwrecks with No heritage significance</td><td>Shipwrecks with a Low heritage significance</td><td>Shipwrecks with a Medium heritage significance</td><td>Shipwrecks with a High heritage significance</td></tr>
<tr><td>Low +</td><td>Low +</td><td>Very Low +</td><td>Very Low +</td><td>Low +</td><td>Low +</td><td>Medium +</td></tr>
</table></td><td>NO IMPACT</td></tr>
<tr><td colspan="2">18. Impact on Underwater Palaeontological Resources
<table>
<tr><td>Cretaceous Fossil Wood</td><td>Cenozoic Shelly Macrofauna</td><td>Fossil Bones and Teeth</td><td>Shells from the Last Transgression Sequence</td></tr>
<tr><td>Medium +</td><td>Medium – High +</td><td>Medium – High +</td><td>Medium +</td></tr>
</table></td><td>NO IMPACT</td></tr>
<tr><td>19. Tuna pole and line fishing</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>20. Traditional Linefish Sector</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>21. Small Pelagic Purse Seine Fisheries</td><td>Very Low -</td><td>NO IMPACT</td></tr>
<tr><td>22. Prospecting activity on the local socio-economic performance</td><td>Very Low +</td><td>NO IMPACT</td></tr>
<tr><td>23. Prospecting activity on the regional socio-economic performance</td><td>Very Low +</td><td>NO IMPACT</td></tr>
</table>

All of the negative identified impacts will occur for a limited period and the extent of the negative impacts will be localised. All of the identified impacts can be suitably mitigated. There is a correlation between cumulative impacts post-mitigation, and the significance rating of impacts after mitigation as indicated in **Appendix E, page 496.**

9.1.2 Final Site Map

Provide a map at an appropriate scale which superimposes the proposed overall activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers .Attach as **Appendix**

Refer to **Figure 2** (page 6) above for the location of the prospecting area over Sea Concession 12C that comprise this Prospecting Right Application.

The final site map and buffers will be completed pending consultation with I&APs during the Public Participation Process and results from the seismic surveys. The current site map has been attached as **Appendix 7**.

9.1.3 Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;

Refer to Section 8.5.1 above, and 9.1.1.

9.1.4 Proposed impact management objectives and the impact management outcomes for inclusion in the EMPr;

Based on the assessment and where applicable the recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.

9.1.5 Management Objectives

The proposed impact management objectives are listed below:

- Objective 1 - To create a safe and rehabilitated post-prospecting environment.
  - Ensure a safe prospecting area with no potentially dangerous areas like deep excavations and unauthorised access.
- Objective 2 - To minimise pollution or degradation of the environment

- Provide sufficient information and guidance to plan the diamond prospecting activities in a manner that would reduce impacts as far as practically possible.

  - Limit residual environmental impact on marine environment and faunal by ensuring that no fuel or oil spills occur in the prospecting area or nearby vicinity area causing contamination.
  - Access potable water in a sustainable manner from the sources.
  - Discarding of water and waste as per approved methodology.
  - Ensure that no solid waste or rubble is dumped in the ocean.
  - Ensure that international best practices and guidelines are adhered to.
- Objective 3 – To minimise impacts on the community and to provide optimal post-prospecting social opportunities
  - Ensure that workers remain within the prospecting area.
  - Operate during approved working hours only.
  - Minimise the generation of noise and light.
  - Respond rapidly to any complaints received.
  - Minimal negative aesthetic impact.
  - Optimised benefits for the social environment.

9.1.6 Outcomes

- By providing sufficient information to strategically plan the prospecting activities, unnecessary social and environmental impacts be avoided.
- Ensure an approach that will provide the necessary confidence in terms of environmental compliance.
- Provide a management plan that is effective and practical for implementation.
- Through the implementation of the proposed mitigation measures, it is anticipated that the identified social and environmental impacts can be managed and mitigated effectively.

- Noise and light generation can be managed through consultation and applying mitigation measures and by maintaining equipment and applying noise abatement equipment if necessary.
- Marine faunal disturbance will be limited to the absolute minimum required.
- Contamination by hydrocarbons can be managed by conducting proper vehicle maintenance, refuelling with care to minimise the chance of spillages and by having a spill kit available on each site.
- Impacts to the marine environment can be managed by limiting prospecting areas to the minimal required area.

9.1.7 Aspects for inclusion as conditions of Authorisation.

Any aspects which must be made conditions of the Environmental Authorisation

It is the opinion of the EAP that the following conditions should form part of the authorisation:

- All environmental legislation must be complied with. Specific aspects to be adhered to from environmental legislation include National Environmental Management Act, Act 107 of 1998 (NEMA), Minerals and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA).

9.1.8 Description of any assumptions, uncertainties and gaps in knowledge.

(Which relate to the assessment and mitigation measures proposed)

It is assumed that all relevant project description information has been provided by the applicant and that all information provided is correct.

Information pertaining to the geology, bathymetry and topography of the area is based on a desktop approach and available bathymetry data. This information might therefore change pending the results of seismic surveys to be undertaken as part of the prospecting activities.

This information might therefore change pending the results of the seismic surveys. After completion of the survey, information should be reviewed to determine if the EMPr is still valid.

Due to the paucity of data for this concession area, the exact location of the grab, core and drill samples are yet to be determined, pending the results of the seismic surveys.

It is assumed that the project description and activities will not change after the completion of this report.

9.1.9 Reasoned opinion as to whether the proposed activity should or should not be authorised

9.1.9.1 Reasons why the activity should be authorised or not.

A statement will be finalised pending consultation with stakeholders during the public participation period.

It is the opinion of the EAP that the proposed mining right activity should be authorised.   In reaching this conclusion the EAP has considered that:

- The “preferred alternative” takes into account location alternatives, activity alternatives, layout alternatives, technology alternatives and operational alternatives.
- The approach taken is that it is preferable to avoid significant negative environmental impacts, wherever possible. There are no significant environmental impacts associated with the proposed activity and most are rated as Low to Insignificant.
- The site, and the offshore west coast, is located on areas classified as Critical Biodiversity Area or Ecological Support Area, the site has been disturbed by previous prospecting, bulk sampling and mining activities. It is the opinion of the EAP that the underlying biodiversity objectives and ecological functioning will not be compromised beyond returning of functionality , subject to the strict adherence to the **EMPr** (Draft environmental management programme**., page 160**) and Rehabilitation, Decommissioning and Closure Plan (**Appendix F: Final Rehabilitation, Decommissioning and Mine Closure Plan, page 532**).
- The activity has been assessed to have a positive socio-economic impact, especially in terms of the creation of employment and the provision of diamonds for the local and international markets.
- Provided the recommended mitigation measures are implemented in an environmentally sound manner and mining activities are managed in accordance with the stipulations of the **EMPr**, and Rehabilitation, Decommissioning and Closure Plan (**Appendix F: Final Rehabilitation, Decommissioning and Mine**

Closure Plan, page 532), the potential negative impacts associated with the implementation of the preferred alternative can be reduced to acceptable levels.

9.1.9.2 Conditions that must be included in the authorisation

See section 6.11 above

9.1.10 Period for which the Environmental Authorisation is required.

The proposed activity is set to take place seasonally during a two-month time period and reasonable sea conditions over a three to five-year prospecting period. This will largely be influenced by the data and findings collected during initial phase of the proposed prospecting activities. The authorisation is thus required for five years plus a potential to extend the right by an additional three years.

10 Undertaking

Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic assessment report and the Environmental Management Programme report.

Included in 1.6 below.

11 Financial Provision

State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.

Approximately R 27 000 is available to complete decommission and rehabilitation of the areas.

11.1.1 Explain how the aforesaid amount was derived.

This amount was derived based on market research, quotations and information from other similar surveys. The following was taken from the Final Closure, Decommissioning and Rehab Plan in **Appendix F: Final Rehabilitation, Decommissioning and Mine Closure Plan, page 532**

11.1.1.1 Quantified Closure elements

11.1.1.1.1 Onshore Processing and logistical Area

The following risk-based criteria and assumptions were used to calculate the final rehabilitation, decommissioning and closure cost for on shore processing and provision of logistical facilities:

- No mining will take place on shore only processing and provision of logistical facilities.
- Return of land to its pre-mining land capability where possible
- All compacted areas due to hauling and stockpiling must be ripped to 300 mm
- Any item that has no salvage value to the mine, but could be of value to individuals, will be sold (zero salvage assumed in cost estimation) and the remaining treated as waste and removed from site
- Existing tracks will be used and new tracks must be restricted to the absolute minimum.
- Removal of all structures and infrastructure except for the infrastructure leased from the landowner.
- Remove all assets
- All vehicles, plant and workshop equipment will be removed for salvage or resale
- All fixed assets that can be profitably removed will be removed for salvage or resale
- All structures will be demolished and terracing and foundations removed to the lesser of 500 mm below the original ground level
- Inert waste, which is more than 500 mm underground, such as pipes, will be left in place
- A hazardous disposal site will not be constructed and all hazardous waste will be removed from site and transported to the nearest licensed facility
- All services related to the operation, water supply lines and storage on site will have to be demolished; the closure cost is therefore included in this estimate

Area covered by normal surface disturbance (including product stockpile) 1.5Ha

Compacted area - Stockpile and hauling area including roads 1.0Ha

Remove waste from temporary storage and scrap from salvage yard

Clean out Wash/Service Bay, Bunded Fuel Storage and Temporary Waste storage

Final clean-up 2.0Ha

11.1.1.1.2 Offshore Exploration

The following risk-based criteria and assumptions were used to calculate the final rehabilitation, decommissioning and closure cost for on offshore exploration operations:

- All prospecting activities including primary processing will take place on the vessel off shore.
- Formal rehabilitation of the sea bed below the low water mark is presently not possible, and in any event at present scales and rates of marine diamond mining not deemed necessary, as sediment and organisms are redistributed effectively by natural water movements particularly in <40 meters depth.
- Return tailings to the sea in the vicinity of their origin,
- No waste or other materials will be dumped on the sea bed or into the water column.
- Facilitate calculation of benthic "rehabilitation" rates through:
  - supply DMR with a map of surface areas, calculations of volumes, records of surficial sediment types disturbed for each year of prospecting, and
  - calculate areas and locations disturbed historically and supply to DMR.
- Restrict the rate of mining to <15% (water depths <40m) or <3% (water depths >40m) per year of the total concession area, until either adequate MPA's are set aside by Government or confidence in estimates of benthic recovery rates (at various depths and sediment types) have been improved by the appropriate scientific research.

11.1.2 Confirm that this amount can be provided for from operating expenditure.

(Confirm that the amount, is anticipated to be an operating cost and is provided for as such in the Mining work programme, Financial and Technical Competence Report or Prospecting Work Programme as the case may be).

Aqua Marine Diamonds 12 (Pty) Ltd will be supported TIG Construction (Pty) Ltd) (Reg 2018/389984/07) with regard to financial resources.

A resolution by TIG Construction (Pty) Ltd) (Reg 2018/389984/07) to this regard is attached as appendix 2.1

Refer to the Prospecting Works Programme.

11.2 Specific Information required by the competent Authority

11.3 Compliance with the provisions of sections 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998). the EIA report must include the:-

11.3.1 Impact on the socio-economic conditions of any directly affected person. (Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as an Appendix .

Please refer to section 7 regarding the initial assessment of the socio-economic conditions of the communities. This section will be completed after consultation with the I&APs during the official Public Participation Process.

High-level socio-economic impacts and mitigation measures are included in **Table 16**.

Potential socio-economic impacts have been addressed in Sections **7.5**. High-level socio-economic impacts and mitigation measures are included in **8.5**.

A full consultation process is being implemented during the environmental authorisation process. The purpose of the consultation is to provide affected and interested persons with the opportunity to raise any potential concerns. Comments received or concerns raised in the PPP will be addressed as part of the Final BAR and **Appendix B**, page 191.

11.3.2 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act. (Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act, attach the investigation report as Appendix 2.19.2 and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6.and 2.12.herein).

A Specialist Heritage Impact Assessment and Palaeontological Impact Assessment (attached at **Appendix D, page 441**) have been prepared. Both reports will be submitted to the South African Heritage Resources Agency (SAHRA) during the 30-day public participation comment period. Recommendations and conclusions from **Appendix D, page 441** are included in Section 8, page 132 above, and any additional measures stipulated by SAHRA will be included in the Final BAR, **EMPr** (Part B) on page 160, Impact Table (**Appendix E, page 496**) and Final Rehabilitation, Decommissioning and Mine Closure Plan (Appendix F: Final Rehabilitation, Decommissioning and Mine Closure Plan**, page 532**).

The Heritage Impact Assessment Report and Palaeontological Assessment have been attached as Appendix D. The applicable mitigation measures have been included in the relevant sections.

Prospecting activities could potentially have an impact on submerged Prehistoric Heritage, Marine Palaeontological Resources present within Concession area 12C. The significance of prospecting-related impacts on such material was assessed to be very low for Prehistoric Heritage and Palaeontological Resources. This is due to the fact that there is little or no potential for the presence of historical shipwrecks in the concession area. There is potential for the status of the potential impacts to be changed from negative to positive if core samples are retained for assessment of paleoenvironmental and prehistoric lithic material.

11.4 Other matters required in terms of sections 24(4)(a) and (b) of the Act.

(the EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as **Appendix 4)**.

Section 2 of NEMA sets out a number of principles that are relevant to the:

- EIA process, such as:
  - Adopt a risk-averse and cautious approach;
  - Anticipate and prevent or minimise negative impacts;

- Pursue integrated environmental management;
- Involve stakeholders in the process; and
- Consider the social, economic and environmental impacts of activities; and regarding the
* Project such as:
  - Place people and their needs at the forefront of concern and serve their needs equitably;
  - Ensure development is sustainable, minimises disturbance of ecosystems and landscapes, pollution and waste, achieves responsible use of non-renewable resources and sustainable exploitation of renewable resources;
  - Assume responsibility for project impacts throughout its life cycle; and the
  - Polluter pays for remediation costs.

This EIA process complies with the principles set out in section 2 of NEMA through its adherence to the EIA Regulations 2014 (as amended), and associated guidelines, which set out clear requirements for, inter alia, impact assessment and stakeholder involvement, and through the assessment of impacts and identification of mitigation measures during the Impact Assessment Phase.

* The Preferred and Only Alternative is considered in the Impact Assessment Phase (see Section 6) and the Impact Tables attached at **Appendix E, page 496**.
* The potential social and environmental impacts of the project are identified, assessed and evaluated using the impact assessment methodology (Section 9.4) to understand the significance of each positive and negative impact. The Impact Tables are attached at **Appendix E, page 496**.
* An **EMPr** has been compiled (page 160) of this report to ensure that potential environmental impacts are prevented or minimised.
* Mitigation measures are recommended in the Impact Assessment Phase to allow for unavoidable impacts on the environment and people's environmental rights to be minimized and remedied.
* Opportunities for public participation are allowed in the EIA process.
* The needs and interests of I&APs will be taken into account.
* All relevant information is being made available for public comment before submission to DMR, as part of the public participation process.
* should comments be received from the relevant government departments and I&APs on the BAR; these comments will inform the decisions taken by DMR regarding the Environmental Authorisation of the project.

PART B: ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1 Draft environmental management programme.

1.1 Details of the EAP,

(Confirm that the requirement for the provision of the details and expertise of the EAP are already included in PART A, section 1(a) herein as required).

Refer to Section 1.1 In Part A above.

1.2 Description of the Aspects of the Activity

(Confirm that the requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in PART A, section (1)(h) herein as required).

Refer to Section 7 and Table 30 above.

1.3 Composite Map

(Provide a map (Attached as an Appendix) at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers)

This is addressed in Section 6.1 in each environmental baseline map, in conjunction with the Prospecting Layout in Figure 4 and Figure 5.

1.4 Description of Impact management objectives including management statements

This is addressed in Section 9.1.5 in Part A above.

1.5 Determination of closure objectives.

(ensure that the closure objectives are informed by the type of environment described)

Objective 1 - To create a safe and healthy post-mining environment

- Develop a landscape that reduces the requirement for long term monitoring and management
- Prevent degradation of coastal areas through littering, dumping of scrap mining equipment and scarring of the landscape by the proliferation of beach access roads and tracks, tailings dump etc.
- Prevent waste discharges leading to pollution of freshwater on land and seawater.

Objective 2 - To create a stable, free draining post mining landform, which is compatible with the surrounding landscape

- Economically viable and sustainable offshore area without physical and associated ecological modification as close as possible to its natural state.
- Prevent disturbance to important biological communities such as seals, birds, whales and dolphins, damage to coastal vegetation and the loss of or damage to cultural and heritage sites.
- Minimise the compromised water quality and sediment inundation of areas adjacent to those being mined due to mine tailings (oversize and undersize sediments) discharge and disposal.

Objective 3 – To provide optimal post-mining social opportunities

- Optimised benefits for the social environment
- Minimise the operation of exclusion zones around mining operations, both on the coast and at sea, that may preclude or limit access to the areas by other users, e.g. commercial fishermen
- Prevent over-subscription of the sparse services and infrastructure that exists on the West Coast.

It is generally accepted that offshore disturbed areas take longer to recover than those in shallow water further inshore. Full recovery is expected to take place within the short to medium term (i.e. 6 - 15 years), as the sampled areas are expected to have slow infill rates and may persist for extended periods (years). Furthermore, biomass often remains reduced for several years as long-lived species like molluscs and echinoderms need longer to re-establish the natural age and size structure of the population. No direct mitigation is considered necessary for seabed sampling and localised smothering of the benthos (tailings disposal). However, it is possible to implement careful planning and management of potential discharges to ensure that tailings are not discarded onto sensitive reef habitat.

On completion of the prospecting activities, the applicant would have to apply for a closure certificate from the DMRE. This process would trigger a listed activity.

1.5.1 Volumes and rate of water use required for the operation.

Potable water will be obtained from a municipal source before launching. Process water taken from the ocean if required. If processing is done onshore, water will be used from the existing facility.

1.5.2 Has a water use licence has been applied for?

No Water Use Licence is required for the proposed prospecting.

1.5.3 Impacts to be mitigated in their respective phases

Measures to rehabilitate the environment affected by the undertaking of any listed activity

As mentioned above, no direct mitigation or rehabilitation is considered necessary although careful planning and management of potential discharges to ensure that tailings are not discarded onto sensitive reef habitat, should be implemented.

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
Site Access & Site Establishment			No site access and establishment will take place		
Prospecting in progress The operation directly relates to prospecting of an offshore mineral resource (diamonds) and requires a prospecting right in terms of section 16 of the MPRDA. Prospecting is planned within Sea Concession area 12C using both non-invasive and invasive sampling activities, none of which require infrastructure. Sampling will be conducted in three phases to detect the presence of	OPERATIONAL	Total Area ±221 254Ha Core samples footprint ±1.57m², & volume ±4.71m³. Grab samples footprint ±5m² & volume ±1.5m³ LDD footprint ± 2.4ha	**IMPACT 1: Impacts of multi-beam and sub-bottom profiling sonar on marine fauna** • Despite the low significance of impacts for geophysical surveys, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals (JNCC 2017). These have been revised to be more applicable to the southern African situation • Onboard Marine Mammal Observers (MMOs) should conduct visual scans for the presence of cetaceans and penguins around the survey vessel prior to the initiation of any acoustic impulses. • Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment. • "Soft starts" should be carried out for any equipment of source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals and diving seabirds to leave the vicinity. • Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the marine mammal and/or penguin has vacated the area. • Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations. As no seasonal patterns of abundance are known for odontocetes occupying the proposed concession area, a precautionary approach to avoiding impacts throughout the year is	NEMA Section 2 Principles Environmental Authorisation	Throughout prospecting

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
paleo-beach deposits, which are known from other concessions to contain diamondiferous gravels. Prospecting operations are expected to occur sporadically within the concession area. Geophysical Surveys (Phase 1 Non-Invasive) including Swath bathymetry and sub-bottom profiling Corel Sampling (Phase 2a Invasive) Grab Sampling (Phase 2a Invasive) Large Diameter Drilling (Phase 2b Invasive)			recommended. • If feasible schedule the survey to take place between February and May thereby avoiding the main seabird breeding seasons (March to October) and penguin summer moult periods (October to January).		
			IMPACT 2: Impacts of noise from sampling operations on marine fauna • No mitigation proposed **IMPACT 3: Disturbance and loss of benthic fauna during sampling** • No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to drill sampling. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area. **IMPACT 4: Disturbance to and loss of rock lobsters** • Monitor sorting screens during drill sampling and terminate operations should large numbers of lobsters appear on the screens over a short period of time • Avoid sampling in the immediate vicinity of rocky outcrop areas or other identified sensitive habitats in the licence area **IMPACT 5: Crushing of benthic fauna during sampling** • Sampling activities of any kind must avoid rocky outcrop areas or other identified sensitive habitats in the concession area • Implement dynamically positioned sampling vessels in preference to vessels requiring anchorage **IMPACT 6: Increased turbidity in suspended sediment plumes and at the seabed** • No mitigation measures are possible, or considered necessary for the discharge of fine tailings from the sampling vessel and the generation of suspended sediments plumes near the seabed by the sampling tools. **IMPACT 7: Remobilisation of contaminants and nutrients** • No mitigation measures are possible, or considered necessary for the possible remobilisation of contaminants and nutrients in the sediments **IMPACT 8: smothering effects on rocky outcrop communities** **The following recommendations are made:** • No mitigation measures are possible, or considered necessary for the loss of macrobenthos due to smothering by redepositing sediments.	NEMA Section 2 Principles Environmental Authorisation	During the estimated 10-year lifespan of the activity. Start of activity and continuous as mining progresses over the site during the operational period. Upon cessation of each activity where applicable. Immediately in the event of spills.

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area • Make of geophysical data to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.		
			IMPACT 9: Redeposition of discarded sediments on soft-sediment macrofauna • No mitigation measures are possible, or considered necessary for the discharge of fine tailings from the sampling vessel and the generation of suspended sediments plumes near the seabed by the sampling tools..		
			IMPACT 10: Loss of Ferrosilicon • Reduce FeSi loss through the implementation of shell crushers or ball mills • Maintain accurate records of all FeSi used and discarded overboard with tailings		
			IMPACT 11: Pollution of the marine environment through • In addition to compliance with MARPOL 73/78 regulations regarding waste discharges mentioned above, the following measures will be implemented to reduce wastes at the source: • Prohibit operational discharges when transiting through a marine protected area during transit to and from the concession • Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system • Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc. • Use a low-toxicity biodegradable detergent for the cleaning of the deck and any spillages		
			IMPACT 12: Disturbance and behavioural changes in pelagic fauna due to vessel lighting The use of lighting on the project vessels cannot be eliminated due to safety, navigational and operational requirements. Recommendations for mitigation include: • The lighting on the vessel(s) should be reduced to a minimum compatible with safe operations whenever and wherever possible.		

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			• 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 (e.g. cardboard boxes) for subsequent release during daylight hours. • Report ringed/banded birds to the appropriate ringing/banding scheme (details are provided on the ring).		
			IMPACT 13: Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s) • In addition to compliance with MARPOL 73/78 regulations regarding waste discharges mentioned above, the following measures will be implemented to reduce wastes at the source: • Prohibit operational discharges when transiting through a marine protected area during transit to and from the concession • Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system • Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc. • Use a low-toxicity biodegradable detergent for the cleaning of the deck and any spillages		
			IMPACT 14: Collision of Vessels with Marine Fauna and Entanglement in Gear • All vessel operators should keep a constant watch for marine mammals and turtles in the path of the vessel. • Ensure vessel transit speed between the concession area and port is a maximum of 12 kts (22 km/hr), except within 25 km of the coast where it is reduced further to 10 kts (18 km/hr) as well as when sensitive marine fauna are present in the vicinity. • Should a cetacean become entangled in mooring buoys or towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DEA to provide specialist assistance in releasing entangled animals • Report any collisions with large whales to the International Whaling Commission (IWC) database, which has been shown to be a valuable tool for identifying the species most affected, vessels involved in		

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			collisions, and correlations between vessel speed and collision risk (Jensen & Silber 2003).		
			IMPACT 15: Equipment lost to the seabed • Ensure containers are sealed / covered during transport and loads are lifted using the correct lifting procedure and within the maximum lifting capacity of crane system. • Minimise the lifting path between vessels. • Maintain an inventory of all equipment and undertake frequent checks to ensure these items are stored and secured safely on board each vessel. • Notify 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.		
			IMPACT 16: *Operational Spills and Vessel Accidents* • In addition to the best industry practices and project standards, the following measures must be implemented to manage the impacts associated with small accidental spills • Ensure that vessels operate in accordance with South African Maritime safety regulations to minimise risks of accidents • Refuelling of vessels is to occur under controlled conditions in a harbour only, i.e. bunkering at sea is not permitted • Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel. • Ensure that the vessel operator has prepared and implemented a Shipboard Oil Pollution Emergency Plan and an Oil Spill Contingency Plan. In doing so, take cognisance of the South African Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981), Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986) and Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987), 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		

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			• Ensure adequate resources are provided to collect and transport oiled birds to a cleaning station.		
			IMPACT 17: Impacts on Underwater Heritage Resources • Induction for site managers on archaeological site and artefact recognition. • Geophysical surveys would possibly identify wrecks and wreck debris. • Reporting of sites to the heritage practitioner for assessment and evaluation. • Avoiding the wrecks would preserve these MUCH resources. • Induction for site managers on archaeological site and artefact recognition. • Geophysical surveys would possibly identify wrecks and wreck debris. • Reporting of sites to the heritage practitioner for assessment and evaluation. • Avoiding the wrecks would preserve these MUCH resources.		
			IMPACT 18: Impacts on Palaeontological Resources The EMPs for the prospecting and mining rights areas must therefore include provisions for the collection of representative examples of the fossils that occur therein. As part of Environmental Awareness Training, geological staff involved in logging must be informed of the need to watch for fossil material and rescue such from the vibracores, grab samples and the drillship gravel oversize screen. The prospecting/mining company must apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during sampling and mining, as per the NHRA. **1.6 Vibracores and Grab Samples** Fossils may be found during the processing of the vibracores and grab samples. These may be obvious, such as petrified bone and teeth and shell casts, usually phosphatic. All material of potential interest must have the details of context recorded and be kept for identification by an appropriate specialist and if significant, to be deposited in a curatorial institution such as the IZIKO SA Museum. The identification of extralimital, Agulhas “sub-fossil” shell species in the loose shells of the Last Transgression Sequence requires a level of seashell knowledge. The best outcome for a set of cores from this poorly-		

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			known area is that they are the subject of a detailed study, such as for a B.Sc. Honours or M.Sc. project, with radiocarbon dates. It is possible that a core or two might intersect rarely preserved lagoonal deposits which are important for providing points on the sea-level curve applicable to the West Coast (Runds *et al*., 2018). **1.7 Collection of Fossil Material during Prospecting and Mining** As part of the normal sampling and mining process the material crossing the oversize screen (Figure 6) must be monitored for the occurrence of the various fossil types. Potential fossil material should be collected for later identification and evaluation. For overall monitoring purposes it is suggested that a few small bulk samples of shells (~5 litres) be collected on occasion. The idea is to sample the typical assemblage at a few points in the sampling/mining area. It is possible that an uncommon assemblage may be encountered, such as a shallow-water fauna or a lagoonal fauna, in which case it should also be sampled. Data to be recorded during fossil collection includes: • Date • Company name • Sample no. • Collector's name • Position (co-ordinates) • Water depth • Sample subsurface depth • Vessel • Brief description and photographs • A copy of the graphic log of the sample drill hole or mining face showing the vertical sequence of units and the estimated location of the fossil in the sequence. • A map of the fossil finds in the particular sampling/mining area, such as a contoured multibeam bathymetric image showing the context of samples in relation to the bedrock topography and sediment bodies. Collected samples are to be temporarily stored by the company.		

<table>
<tr><th>ACTIVITIES</th><th>PHASE</th><th>SIZE AND SCALE OF DISTURBANCE</th><th>MITIGATION MEASURES</th><th>COMPLIANCE WITH STANDARDS</th><th>TIME PERIOD FOR IMPLEMENTATION</th></tr>
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Figure 6. The gravel oversize screen on a typical diamond mining vessel where the geological personnel monitor the material being dredged and where fossil collection takes place

When a collection of fossil material has been accumulated, the appointed palaeontologist should undertake the identification and evaluation of the fossil material and compile the report for submission to SAHRA. A selection of material could be removed for further study. The Environmental Manager/Officer is to liaise with the appointed palaeontologist on the progress of the fossil collection and the scheduling of the evaluation.

During all operations, personnel can send queries and images by email to an appointed palaeontologist for evaluation and prompt feedback.</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>IMPACT 19: Tuna pole and line fishing
None.</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>IMPACT 20: Traditional Linefish Sector</td><td></td><td></td></tr>
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ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			None.		
			IMPACT 21: Small Pelagic Purse Seine Fisheries • Undertake surveys when fishing effort is lower (preferably out of fishing seasons). Appoint a fisheries liaison officer (FLO) to facilitate communication with the Small Pelagic Fishing Industry Association. The FLO should report daily on vessel activity and respond and advise on action to be taken in the event of encountering purse seine fishing vessels in the survey area.		
			IMPACT 22 & 23: Prospecting activity on the local & regional socio-economic performance The applicant should aim to incorporate codes of good practice on Broad Based Black Economic Empowerment issued under the section 9 of the Broad Based Black Economic Empowerment Act, Act 53 of 2003, as amended by Act 46 of 2013.		
Final Rehabilitation And Decommissioning And Closure Phase	DECOMMISSIONING	Total Area ±221 254Ha Core samples footprint ±1.57m², & volume ±4.71m³. Grab samples footprint ±5m² & volume ±1.5m³ LDD footprint ± 2.4ha	**IMPACT 1: SURVEY/SAMPLING VESSEL TO LEAVE AREA** • Ensure that no debris or dropped equipment that may be detrimental to environment or other users of the sea is left on the seafloor. The benefits of retrieval of debris or equipment must first be weighed up against the potential health and safety risks. **IMPACT 2: COMMUNICATION AND INFORMATION TO RELEVANT PARTIES OF MINING COMPLETION** • Inform all key stakeholders (see Section 7.2.1.2) that the mining vessel is off location. • Notify the SAN Hydrographic office when the programme is complete so that the Navigational Warning can be cancelled. • Take steps to share data collected during the sampling programme (e.g. ROV video footage of the benthic environment), if requested, to resource managers (including DEA, South African National Biodiversity Institute and appropriate research institutes). **IMPACT 3: REHABILITATION AND CLOSURE** • Apply for closure, submit the following documentation to the DMR: o A final layout plan; o A Closure Plan; o An Environmental Risk Report; o A Final Audit Report; and	NEMA Section 2 Principles Environmental Authorisation	On completion of prospecting

ACTIVITIES	PHASE	SIZE AND SCALE OF DISTURBANCE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
			o A completed application form to transfer environmental responsibilities and liabilities, if such transfer has been applied for.		
			IMPACT 3: FINAL WASTE DISPOSAL • Dispose all waste retained onboard at a licensed waste site using a licensed waste disposal contractor.		

1.7.1 Impact Management Outcomes

(A description of impact management outcomes, identifying the standard of impact management required for the aspects contemplated in paragraph ();

ACTIVITY	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE In which impact is anticipated	MITIGATION TYPE..	STANDARD TO BE ACHIEVED
Planning and design Phase	N/A	N/A	Planning Phase – Phase 1	N/A	Avoiding impacts
Desktop study and literature review	N/A	Planning Phase – Phase 1	N/A	Avoiding impacts	Desktop study and literature review
Stakeholder consultation	N/A	Local communities	Planning, Operational and Closure Phase	Management	Avoiding and mitigating impacts. NEMA; EIA Regulations
Geophysical seismic survey	Noise disturbance impacting marine fauna	Fish, Marine mammals, Marine mammals, Turtles	Operational Phase	• Control through noise control; • Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through design measures and noise • control of survey equipment; • Remedy through suspending activities.	Limit noise levels Limit impacts, injury or death to animals; SANS 10103
Geological modelling	N/A	N/A	Operational Phase	N/A	To limit impacts by means of selecting specific sites for drilling and avoiding sensitive sites
Vessel operation	Injury or death of Megafauna such as whales due to collision with survey vessels	Megafauna such as whales	Operational Phase	Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Control through modifying activities such as vessel speed	Avoiding impacts such as injury or death to animals and damage to vessels
Grab sampling	Disturbance of marine fauna due to physical	Benthic macrofauna	Operational Phase	•Control and modify activities through avoidance in terms of time and space;	Limit impacts and disturbance;

	activities and sediment plumes			•Stop impacts through avoidance and terminating activities; • Remedy through suspending activities.	
Core sampling	Disturbance of marine fauna due to physical activities and sediment plumes	Benthic macrofauna	Operational Phase	See above	Limit impacts and disturbance
Drill sampling	Disturbance of marine fauna due to physical activities and sediment plumes	Benthic macrofauna	Operational Phase	See above	Limit impacts and disturbance; Listing Notice 1
Grab, core and drill sampling	Destruction and loss of Prehistoric Heritage, palaeontological and Maritime archaeological resources, particularly historical shipwrecks	Prehistoric Heritage, palaeontological (fossils) and Maritime archaeological resources, particularly historical shipwrecks	Operational Phase	• Avoidance of certain sites • Remedy through collection and preservation of samples	Limit impacts and destruction of Prehistoric Heritage, palaeontological and Maritime archaeological resources; Heritage Act
Tailings disposal	Disturbance of benthic macrofauna and due to physical activity and sediment plumes	Phytoplankton and consumers such as fish and invertebrates	Operational Phase	No essential or potential mitigation measures identified **Best Practice:** Planning and management of potential discharges to ensure that tailings are not discarded onto potentially sensitive habitats	To limit impacts by means of selecting specific sites for drilling and avoiding sensitive sites
Waste discharges	Waste discharges and pollution, deteriorating water quality and disturbance	The marine environment and ecosystem functions	Operational Phase	• Management through informing staff; • Management through compliance with relevant waste standards and protocols; • Control and modify activities;	Limit impacts; limit waste through management; NEM:WA. Adherence to South African Water Quality Guidelines and MARPOL

				• Stop impacts through avoidance and terminating activities; • Remedy through design measures;.	
Vessel operation and physical presence	Disturbance to vessels, shipping activities and fishing activities	Vessels and shipping	Operational Phase	• Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through design measures and noise control of survey equipment; • Control through management • Remedy through suspending activities.	Limit disturbance
Vessel and equipment operation during all activities	Reduction in fishing success and decline in socio-economic conditions of Local fishing communities dependent upon these resources and local economy	Species targeted during fishing, fishing operations and local fishing communities dependent upon these resources	Operational Phase	See above	NEMA; EIA Regulations; Limit disturbance and impact on local communities
Grab, core and drill sampling	Prehistoric Heritage, palaeontological (fossils) and Maritime Heritage resources, particularly historical shipwrecks	Prehistoric Heritage, palaeontological (fossils) and Maritime Heritage resources, particularly historical shipwrecks	Operational Phase	• Avoidance of certain sites • Remedy through collection and preservation of samples	Limit destruction of resources. Preservation of resources
Data acquisition and synthesis	N/A	N/A	Operational Phase	N/A	N/A
Feasibility study and resource estimation	N/A	N/A	Operational Phase	N/A	N/A

Decommissioning and Closure	N/A	N/A	Decommissioning Phase	N/A	Closure certificate; NEMA
Rehabilitation	N/A	N/A	Decommissioning Phase	N/A.	N/A

1.7.2 Impact Management Actions

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

ACTIVITY	POTENTIAL IMPACT	MITIGATION TYPE	TIME PERIOD FOR IMPLEMENTATION	COMPLIANCE WITH STANDARDS
Planning and design Phase Desktop study and literature review	N/A	N/A	Prior to commencement	Avoiding impacts
Stakeholder consultation	N/A	Management	Prior to commencement of operation and throughout the entire process	Avoiding and mitigating impacts. NEMA; EIA Regulations
Geophysical seismic survey	Noise disturbance impacting marine fauna	• Control through noise control; • Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through design measures and noise control of survey equipment; • Control through management such as through use of an independent Marine Mammal Observer;. • Remedy through suspending activities.	Throughout the seismic survey operation	Limit noise levels Limit impacts, injury or death to animals; SANS 10103
Geological modelling	N/A	N/A	After the modelling, sites for drilling and sites for avoidance should be selected	To limit impacts by means of selecting specific sites for drilling and avoiding sensitive sites

Vessel operation	Injury or death of Megafauna such as whales due to collision with survey vessels	• Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Control through management such as through use of an independent Marine Mammal Observer;. • Control through modifying activities such as vessel speed	Throughout the entire prospecting survey during which the vessel is being operated	Avoiding impacts such as injury or death to animals and damage to vessels
Grab sampling	Disturbance of marine fauna due to physical activities and sediment plumes	• Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through suspending activities.	During grab sampling	Limit impacts and disturbance;
Core sampling	Disturbance of marine fauna due to physical activities and sediment plumes	See above	During core sampling	Limit impacts and disturbance
Drill sampling	Disturbance of marine fauna due to physical activities and sediment plumes	See above	During drill sampling	Limit impacts and disturbance; Listing Notice 1
Grab, core and drill sampling	Destruction and loss of Prehistoric Heritage, palaeontological and Maritime heritage resources, particularly historical shipwrecks	• Avoidance of certain sites • Remedy through collection and preservation of samples	Before sampling commences and during	Limit impacts and destruction of Prehistoric Heritage, palaeontological and Maritime heritage resources; Preservation of resources Heritage Act

Tailings disposal	Disturbance of benthic macrofauna and due to physical activity and sediment plumes	No essential or potential mitigation measures identified **Best Practice:** Planning and management of potential discharges to ensure that tailings are not discarded onto potentially sensitive habitats	During the planning phase	To limit impacts by means of selecting specific sites for drilling and avoiding sensitive sites
Waste discharges	Waste discharges and pollution, deteriorating water quality and disturbance	• • Management through informing staff; • • Management through compliance with relevant waste standards and protocols; • • Control and modify activities; • • Stop impacts through • avoidance and terminating activities; • • Remedy through design measures;. •	Throughout the entire prospecting operation	Limit impacts; limit waste through management; NEM:WA
Vessel operation and physical presence	Disturbance to vessels, shipping activities and fishing activities	• Control and modify activities through avoidance in terms of time and space; • Stop impacts through avoidance and terminating activities; • Remedy through design measures and noise control of survey equipment; • Control through management • Remedy through suspending activities.	Throughout the entire prospecting survey during which the vessel is being operated	Limit disturbance

Vessel and equipment operation during all activities	Reduction in fishing success and decline in socio-economic conditions of Local fishing communities dependent upon these resources and local economy	See above	Planning phase and operational phase	NEMA; EIA Regulations; Limit disturbance and impact on local communities
Data acquisition and synthesis	N/A	N/A	N/A	N/A
Feasibility study and resource estimation	N/A	N/A	N/A	N/A
Decommissioning and Closure	N/A	N/A	Upon the cessation of prospecting	Closure certificate; NEMA
Rehabilitation	N/A	N/A.	N/A	N/A

1.8 Financial Provision

1.8.1 Determination of the amount of Financial Provision.

As detailed in Section 11 above

1.8.2 Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under the Regulation.

Objective 1 - To create a safe and healthy post-mining environment

- Develop a landscape that reduces the requirement for long term monitoring and management
- Prevent degradation of coastal areas through littering, dumping of scrap mining equipment and scarring of the landscape by the proliferation of beach access roads and tracks, tailings dump etc.
- Prevent waste discharges leading to pollution of freshwater on land and seawater.

Objective 2 - To create a stable, free draining post mining landform, which is compatible with the surrounding landscape

- Economically viable and sustainable offshore area without physical and associated ecological modification as close as possible to its natural state.
- Prevent disturbance to important biological communities such as seals, birds, whales and dolphins, damage to coastal vegetation and the loss of or damage to cultural and heritage sites.
- Minimise the compromised water quality and sediment inundation of areas adjacent to those being mined due to mine tailings (oversize and undersize sediments) discharge and disposal.

Objective 3 – To provide optimal post-mining social opportunities

- Optimised benefits for the social environment
- Minimise the operation of exclusion zones around mining operations, both on the coast and at sea, that may preclude or limit access to the areas by other users, e.g. commercial fishermen
- Prevent over-subscription of the sparse services and infrastructure that exists on the West Coast.

1.8.3 Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties.

The closure objectives are included in this Draft BAR and in the Rehabilitation, Decommissioning and Mine Closure Plan **(Appendix F, page 532**) which is being made available to all registered Interested and Affected Parties.

1.8.4 Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure.

Refer to the Rehabilitation, Decommissioning and Mine Closure Plan, which includes the Environmental Risk Assessment in **Appendix F, page 532.**

1.8.5 Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.

The closure objectives are to return the land disturbed by mining activities back to its original condition. The Rehabilitation Plan provides the detail on how this will be achieved as detailed in **Appendix F, page 532.**

1.8.6 Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.

Refer to Part A, Section 11, and **Appendix F, page 532** of this report.

1.8.7 Confirm that the financial provision will be provided as determined.

Refer to Part A, Section 11 of this report

1.8.8 Indicate the frequency of the submission of the performance assessment/ environmental audit report.

An external environmental performance audit and the EIA & **EMPr** performance assessment shall be conducted annually interchangeably by an independent environmental assessment practitioner.

1.8.9 Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon, including

- Monitoring of Impact Management Actions
- Monitoring and reporting frequency
- Responsible persons
- Time period for implementing impact management actions
- Mechanism for monitoring compliance

Table 29: Mechanisms for Monitoring Compliance

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
All prospecting activities	All commitments are contained in the EIA Report and accompanying **EMPr**.	Ensure commitments made within the approved EIR and **EMPr** are being adhered to.	Site Manager and EAP.	Undertake and submit an environmental performance audit to DMR, as per EA conditions.. Undertake and submit an environmental performance audit every two years to DMRE
Geophysical seismic survey	Noise	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to.	Geologist. Environmental Control Officer, appointed crew member	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.
Vessel operation	Collision causing injury or death of marine fauna	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to.	Captain, appointed crew member	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be done as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
Grab sampling, core and drill sampling	Disturbance of marine fauna and Sediment plumes	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to.	Geologist;	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.
Grab, core and drill sampling	Destruction and loss of Prehistoric Heritage, palaeontological and Maritime heritage resources, particularly historical shipwrecks	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to.	Geologist and trained heritage representative	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be done as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.
Tailings disposal	Visual inspection of Disturbance and destruction, erosion and gulleys, if possible	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to.	Geologist	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be done as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.
Waste discharges	Waste discharges and pollution, deteriorating water quality	Ensure that the Prospecting Work Programme, mitigation measures and conditions as set out in the EMPr, are being adhered to. Implementation of effective waste management	ECO	Impact management actions should be implemented at all times during the activities or as per the EMPr. Reporting should be done as per EA conditions either by the ECO or the appointed crew member to ensure that management actions are being implemented.
Vessel operation and physical presence	Disturbance to vessels	See above	Captain	See above

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
Vessel and equipment operation during all activities	Reduction in fishing success and decline in socio-economic conditions	See above & Ensure stakeholders and regularly consulted and implement a stakeholder complaints register.	Fishing Liaison Officer	See above
Closure & Rehabilitation	Rehabilitation, lost equipment, return to original land form	Inspection of all rehabilitated areas to assess whether gulleys and erosion is occurring and to implement corrective action where required.	Geologist	A final audit report for site closure must be submitted to the DMR for approval, or as per the EA conditons.

1.8.10 Environmental Awareness Plan

1.8.10.1 Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.

Environmental awareness and training include:

- Awareness training for contractors and employees.
- Job-specific training – training for personnel performing tasks that could cause potentially significant environmental impacts.
- Comprehensive training – on emergency response, spill management, etc.
- Specialised skills.
- Training verification and record-keeping.

Before commencement of the mining activities all new employees and contractors who are involved with such activities should attend relevant induction and training. It is standard practice for employees and the employees of contractors that will be working on a new project or at a new site to attend an induction course where the nature and characteristics of the project and the site are explained.

The training course should include key information abstracted from the **EMPr** pertaining to the potential environmental impacts, the mitigation measures that will be applied, the monitoring activities that will be undertaken and the roles and responsibilities of contractors and personnel.

The **EMPr** document will also be made available to attendees.

1.8.10.2 Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.

Environmental risks and how to manage them are dealt with in the induction course referred to in Section 1.8.10 above. Should an incident of environmental pollution or damage occur it will be analysed and appropriate prevention and/or mitigation measures developed. These measures will be added to the **EMPr** and conveyed to the relevant personnel.

All unplanned incidents with the potential to cause pollution or environmental degradation or conflict with local residents will be reported to the Mineral Resources Manager within 24 hours.

Hydrocarbon Spills: Hydrocarbon spills that are considered to be emergency incidents are large-scale spills (cover a surface area >1m²), resulting from situations such as: a leaking diesel bowser; an oil drum that is knocked over; and large spillages from equipment.

Activities that are involved in the clean-up of such instances include:

- The containment of the spill;
- The removal of all contaminated material; and,
- The disposal (at a licensed hazardous disposal facility) or bioremediation (at a licensed facility) of this material.

Fire: There is the potential for fire to occur onboard of the sea vessel and equipment.

Vehicles and Equipment: Fire extinguishers will be available on site where prospecting activities will take place and on the vessels. All staff members will be trained in the use of fire-fighting equipment.

First aid and life-guarding: At least one person on board should be trained in first aid and in life saving as prospecting will take place offshore and a distance from medical aid and services.

1.8.11 Specific information required by the Competent Authority

(Among others, confirm that the financial provision will be reviewed annually).

Not applicable at this stage

1.9 UNDERTAKING

The EAP herewith confirms

1. the correctness of the information provided in the reports ☒
2. the inclusion of comments and inputs from stakeholders and I&APs ; ☐
3. the inclusion of inputs and recommendations from the specialist reports where relevant; ☒and
4. that the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected. parties are correctly reflected herein. ☒

Signature of the environmental assessment practitioner:

GroenbergEnviro (Pty) Ltd

Name of company:

31/10/2022

Date: