Environmental Scoping Assessment (ESA) Report:

The Proposed Offshore Exploration Activities of Precious Stones on Exclusive Prospecting License (EPL) No. 6929 west of the Skeleton Coast National Park in the Kunene Region, Namibia

ECC Application Reference: App-002810

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EXECUTIVE SUMMARY

Linco Investments (hereinafter referred to as The Proponent) has been granted an Exclusive Prospecting Licence (EPL) No. 6929 by the Ministry of Mines and Energy (MME). The tenure of the licence is from the 27th of September 2018 to the 26th of September 2021. The 77 730-hectare (ha) EPL is prospective for Precious Stones (diamonds).

The tenement is located about 400km north of Swakopmund and 200km of southwest of Opuwo along the Skeleton Coast of Namibia parallel to the present shoreline, near Terrace Bay.

The site area (EPL) is located west of the Skeleton Coast Park, a proclaimed nature reserve in the Kunene Region The area lies within water depths of about +/-4 meters below sea level (mbsl) to +80mbsl.

The exploration and mining related activities are however one of the listed activities in the 2012 EIA Regulations of the Environmental Management Act No. 7 of 2007 that that may not be undertaken without an Environmental Clearance Certificate (ECC). Subsequently, to ensure that the proposed activity is compliant with the national environmental legislation the project Proponent (Linco Investment) had appointed an independent environmental consultant to undertake the required Environmental Assessment (EA) process and apply for the ECC on their behalf.

It is for this reason that the Proponent appointed Excel Dynamic Solutions (Pty) Ltd to undertake the EA or environmental scoping assessment (ESA) and apply for the ECC. The application for the ECC was compiled and submitted to the Competent Authority (Ministry of Mines and Energy (MME)) on the 21st of July 2021. The date stamped copy of the ECC by MAWLR was also uploaded on the online portal for the Ministry of Environment, Forestry and Tourism (MEFT) as the environmental custodian for project registration purposes. Upon submission of an Environmental Scoping Assessment (ESA) Report and draft Environmental Management Plan (EMP), an ECC for the proposed project will be considered by the Environmental Commissioner at the MEFT's Department of Environmental Affairs and Forestry (DEAF).

Public Consultation

Public Consultation Activities

The public consultation process was conducted according to the requirements of Regulation 21 of the EIA Regulations. However, the complete fulfilment of this Regulation was slightly affected by the COVID-19 Regulations. Regardless, the Environmental Consultant tried all the possible ways to ensure that they reached as many people as possible to get involved in the process. The communication with the interested and affect parties (I&APs) about the proposed project was done through the following means and in this order to ensure that the public is notified and afforded an opportunity to comment on the proposed project activities:

- Registration of pre-identified stakeholders and interested & affected parties (I&APs) and updating the list throughout the environmental assessment process.
- Placement of newspaper adverts in two newspapers, *New Era* and *The Namibian* both on the 22nd and 29th of June 2021.
- Circulation of the background information document (BID) to pre-identified stakeholders and I&APs and to new I&APs (upon registration request).
- Three A3 public notices (posters) that contained public meeting invitation details were placed at the following places:
    - In Swakopmund at the Erongo Regional Council notice board since the harbour infrastructures to be used by the exploration vessel would be taking off from the Walvis Bay Harbour which falls under the Erongo Region jurisdiction
    - In Opuwo at the Kunene Regional Council notice board because on the onshore eastern side, the EPL borders the Skeleton Coast National Park which falls under the Kunene Region jurisdiction.
    - Walvis Bay Municipality notice board (in Walvis Bay) because the town houses the harbour infrastructure/facilities which will provide services to the exploration vessel.
- Two slot online public consultation meetings were arranged and the link shared with all registered I&APs a week prior to the meeting date. The meeting slots were scheduled for Thursday, the 15th of July 2021 at 10h30 in the morning and 14h30. However, the meeting was a no-show. The Consultant assumed the meeting was a no-show due to some of the following reasons:
        - Lack of interest in the project because the project is offshore, and most members of the public do not see the need to get involved in.

- Due to the global pandemic of the coronavirus, people may rather be worried about navigating their lives through the COVID-19 situation and its regulations. Some may have been interested but internet connection or operating electronic devices to join online gatherings/meetings could had been a limiting factor, etc.

Potential Impacts identified

The following potential impacts were identified:

Positive impacts:

- Creation of jobs to the locals (primary, secondary, and tertiary employment).
- Helps boost local economic growth.
- Open other investment opportunities.
- Contribution to regional economic development.

Negative impacts:

- Possible destruction of marine faunal and floral habitats as well as removal of nutrients.
- Potential significant impacts on marine mammals - especially the seismic surveys during exploration but also the long-term mining if it takes place. The area in question has a high density of Heaviside's and dusky dolphins as well as seasonally migrating humpback whales.
- Potential marine pollution due to accidental hydrocarbon spills from exploration equipment would impact marine fisheries resources.
- Potential occupational health, safety and security risks associated with mishandling of exploration equipment as well as from accidents or emergencies at sea.

The potential negative impacts were assessed, and mitigation measures provided accordingly.

RECOMMENDATIONS AND CONCLUSIONS

The potential impacts (both positive, and negative) that are anticipated from the proposed project activities were identified, described, and assessed. The potential negative impacts of were rated as medium significant and appropriate mitigation measures were recommended for effective implementation and continuous monitoring by the Proponent, their contractors and project related personnel. The aim will be to reduce the potential impacts from medium significance to low in the long run and bring the impact under control throughout the project operations. These

management and mitigation measures are provided under chapter 7 of this ESA report, and as management action and monitoring plans in the draft EMP.

The public was consulted as required by the EMA and its 2012 EIA Regulations (Section 21 to 24). This was done via the two newspapers used for this environmental assessment (New Era and the Namibian newspapers in July 2021); A notice for public consultation meeting was sent out. However, on the day of the meeting no one showed up. Three A3 public notices (posters) were placed at three different locations' notice boards. The posters that contained public meeting invitation details were placed at the following places:

- In Swakopmund at the Erongo Regional Council notice board since the harbour infrastructures to be used by the exploration vessel would be taking off from the Walvis Bay Harbour which falls under the Erongo Region jurisdiction
- In Opuwo at the Kunene Regional Council notice board because on the onshore eastern side, the EPL borders the Skeleton Coast National Park which falls under the Kunene Region jurisdiction.
- Walvis Bay Municipality notice board (in Walvis Bay) because the town houses the harbour infrastructure/facilities which will provide services to the exploration vessel.

The findings of this assessment were deemed sufficient and conclude that no further detailed assessments are required to the ECC application.

It is therefore recommended that an Environmental Clearance Certificate be issued for the proposed exploration activities, subject to the following recommendations:

- All required permits, licenses and approvals for the proposed activities should be obtained as required.
- The Proponent complies with the legal requirements governing this type of project and its associated activities.
- All mitigations provided in this Report and the management action plans in the draft EMP should be implemented and monitoring conducted as recommended.
- All the necessary environmental and social (occupational health and safety) precautions provided should be adhered to.
- The monitoring of the implementation of mitigation measures should be conducted, applicable impact's actions taken, reporting done and recorded as recommended in the draft EMP.

- Environmental (EMP) Compliance Monitoring should be conducted on a bi-annual basis by the project Safety, Health and Environmental Officer or an independent Environmental Consultant throughout the exploration phase. Environmental Compliance monitoring reports should be compiled and submitted to the DEAF Portal as per provision made thereon (the MEFT/DEAF's portal).

These recommendations are primarily aimed at improving environmental management, ensuring sustainability and promote harmonious co-existence of the project activities and the host environment.

Conclusion

The potential positive and negative impacts stemming from the proposed project and its associated activities were identified, assessed and mitigation measures made thereof. The mitigation measures recommended in this report and management action plans provided in the draft EMP, can be deemed sufficient to avoid and/or reduce (where impact avoidance impossible) the risks to acceptable levels.

Excel Dynamic Solutions (Pty) Ltd is, therefore, confident that these measures are sufficient, and thus recommends that the Proponent be issued with the Environmental Clearance Certificate (ECC). However, the ECC should be issued on condition that the provided management measures and action plans are effectively implemented and monitored on site.

Monitoring of the environmental components described in the impact assessment should be conducted by the Proponent and applicable Competent Authority. This is to ensure that all potential impacts identified in this study and other impacts that might arise during implementation are properly identified in time and addressed. Lastly, should the ECC be issued, the Proponent will be expected to be compliant with the ECC conditions as well as legal requirements governing the project and its related activities.

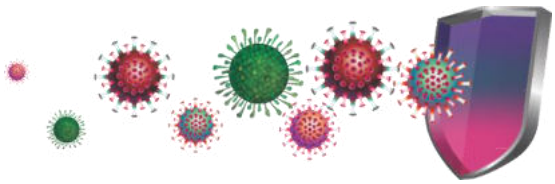
Limitations

EDS warrants that the findings and conclusion contained herein were accomplished in accordance with the methodologies set forth in the Scope of Work and Environmental Management Act (EMA) of 2007. These methodologies are described as representing good customary practice for conducting an Environmental Impact Assessment of a property for the purpose of identifying recognized environmental conditions. There is a possibility that even with the proper application of these methodologies there may exist on the subject property conditions that could not be identified within the scope of the assessment, or which were not reasonably

identifiable from the available information. The Consultant believes that the information obtained from the record review and during the public consultation processes concerning the proposed exploration activities/works is reliable. However, the Consultant cannot and does not warrant or guarantee that the information provided by the other sources is accurate or complete. The conclusions and findings set forth in this report are strictly limited in time and scope to the date of the evaluations. No other warranties are implied or expressed.

Some of the information provided in this report is based upon personal interviews, and research of available documents, records, and maps held by the appropriate government and private agencies. This report is subject to the limitations of historical documentation, availability, and accuracy of pertinent records and the personal recollections of those persons contacted.

COVID-19 Influences:



COVID-19 has changed the way the world thinks, acts, and does business. The pandemic has forced a comprehensive review of business practices, a higher level of engagement with technology to offset the constraints due to social distancing, restrictive travel, and a focus on social responsibility. The Consultant had to change very little in the way they operate and provide public consultation services.

Although the Consultant operated with limited travel during the environmental assessment to comply with the measures and regulations put in place to curb the spread of Covid-19, various other platforms were used to communicate the project information. These platforms included emails, public notices (A3 posters), and newspaper adverts.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AMSL	Above Mean Sea Level
BID	Background Information Document
CV	Curriculum Vitae
DEAF	Department of Environmental Affairs and Forestry
DMS	Dense Medium Separation
DP	Dynamic Positioning
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
EDS	Excel Dynamic Solutions
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
EPL	Exclusive Prospecting License
ESA	Environmental Scoping Assessment
GG	Government Gazette
GN	Government Notice
I&APs	Interested and Affected Parties
ITCZ	Intertropical Convergence Zone
JNCC	The Joint Venture for conservation committee
MARPOL	International Convention for the Prevention of Pollution from Sips
MBES	Multibeam Echo Sounder
MME	Ministry of Mines and Energy
MEFT	Ministry of Environment, Forestry and Tourism

Abbreviation	Meaning
MFMR	Ministry of Fisheries and Marine Resources
MFO	Marine Fauna Observer
PAM	Passive acoustic monitors
PPE	Personal Protective Equipment
RAP	Restricted Area Permit
Reg	Regulation
ROV	Remotely Operated Vehicle
S	Section
SST	Sea surface temperature
TOR	Terms of Reference

KEY TERMS AND DEFINITIONS

TERM	DEFINITION
Alternative	A possible course of action, in place of another that would meet the same purpose and need of the proposal.
Baseline	Work done to collect and interpret information on the condition/trends of the existing environment.
Benthic	Anything associated with or occurring on the bottom of a body of water.
Benthic Zone	One of the ecological regions of a body of water. It comprises the bottom such as the ocean floor or the bottom of a lake, the sediment surface, and some sub-surface layers. Organisms living in this zone that is, on or in the bottom of the body of water are called benthos.
Biophysical	That part of the environment that does not originate with human activities (e.g., biological, physical and chemical processes).
Cumulative Impacts/Effects Assessment	In relation to an activity, means the impact of an activity that in it may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

TERM	DEFINITION
Decision-maker	The person(s) entrusted with the responsibility for allocating resources or granting approval to a proposal.
Ecological Processes	Processes which play an essential part in maintaining ecosystem integrity. Four fundamental ecological processes are the cycling of water, the cycling of nutrients, the flow of energy and biological diversity (as an expression of evolution).
Environment	As defined in Environmental Management Act - the complex of natural and anthropogenic factors and elements that are mutually interrelated and affect the ecological equilibrium and the quality of life, including – (a) the natural environment that is land, water and air; all organic and inorganic matter and living organisms and (b) the human environment that is the landscape and natural, cultural, historical, aesthetic, economic and social heritage and values.
Environmental Management Plan (EMP)	As defined in the EIA Regulations (Section 8(j)), a plan that describes how activities that may have significant environments effects are to be mitigated, controlled, and monitored.
Exclusive Prospecting Licence	Is a license that confers exclusive mineral prospecting rights over land of up to 1000 km^2 in size for an initial period of three years, renewable twice for a maximum of two years at a time
Interested and Affected Party (I&AP)	In relation to the assessment of a listed activity includes - (a) any person, group of persons or organization interested in or affected by an activity; and (b) any organ of state that may have jurisdiction over any aspect of the activity. Mitigate - practical measures to reduce adverse impacts. Proponent – as defined in the Environmental Management Act, a person who proposes to undertake a listed activity. Significant impact - means an impact that by its magnitude, duration, intensity, or probability of occurrence may have a notable effect on one or more aspects of the environment.
Fauna and Flora	All the animals and plants found in an area.
Mitigation	The purposeful implementation of decisions or activities that are designed to reduce the undesirable impacts of a proposed action on the affected environment.

TERM	DEFINITION
Monitoring	Activity involving repeated observation, according to a pre-determined schedule, of one or more elements of the environment to detect their characteristics (status and trends).
Proponent	Organization (private or public sector) or individual intending to implement a development proposal.
Public Consultation/Involvement	A range of techniques that can be used to inform, consult, or interact with stakeholders affected by the proposed activities.
Protected Area	Refers to a protected area that is proclaimed in the Government Gazette, according to the Nature Conservation Ordinance number 4 of 1975, as amended.
Scoping	An early and open activity to identify the impacts that are most likely to be significant and require specialized investigation during the EIA work. Can, also be used to identify alternative project designs/sites to be assessed, obtain local knowledge of site and surroundings, and prepare a plan for public involvement. The results of scoping are frequently used to prepare a Terms of Reference for the specialized input into full EIA.
Terms of Reference (ToR)	Written requirements governing full EIA input and implementation, consultations to be held, data to be produced and form/contents of the EIA report. Often produced as an output from scoping.

1 INTRODUCTION

1.1 Project Background

Linco Investments (hereinafter referred to as The Proponent) has been granted an Exclusive Prospecting Licence (EPL) No. 6929 by the Ministry of Mines and Energy (MME). The tenure of the licence is from the 27th of September 2018 to the 26th of September 2021, hence expired and pending renewal. The 77 730-hectare (ha) EPL is prospective for Precious Stones (diamonds).

The tenement is located about 400km north of Swakopmund and 200km of southwest of Opuwo along the Skeleton Coast of Namibia parallel to the present shoreline, near Terrace Bay. The locality map of the EPL is shown in **Figure 1.**

The site area (EPL) is located offshore west of the Skeleton Coast Park, a proclaimed nature reserve in the Kunene Region The area lies within water depths of about +/-4 meters below sea level (mbsl) to +80mbsl.

The Proponent intends to conduct offshore mineral exploration activities within the EPL leading to the estimation and delineation of the target resource. **As a requirement for renewal of the mineral right certificate, and approval for mineral exploration activity on EPL 6929, the Proponent is required to submit an Environmental Assessment Report (EAR) and draft Environmental Management Plan (EMP) to the Ministry of Environment, Forestry and Tourism (MEFT) and MME. On approval, The Proponent would be issued with an Environmental Clearance Certificate (ECC) from the MEFT, which would enable the renewal of the EPL by the Mining Commissioner at the MME which is currently in a ''Pending Renewal'' status on the Mining Cadastre Map Portal.**

The exploration and mining related activities are however one of the listed activities in the 2012 EIA Regulations of the Environmental Management Act No. 7 of 2007 that that may not be undertaken without an Environmental Clearance Certificate (ECC). Subsequently, to ensure that the proposed activity is compliant with the national environmental legislation, an environmental assessment process had to be undertaken and ECC applied for the activities.

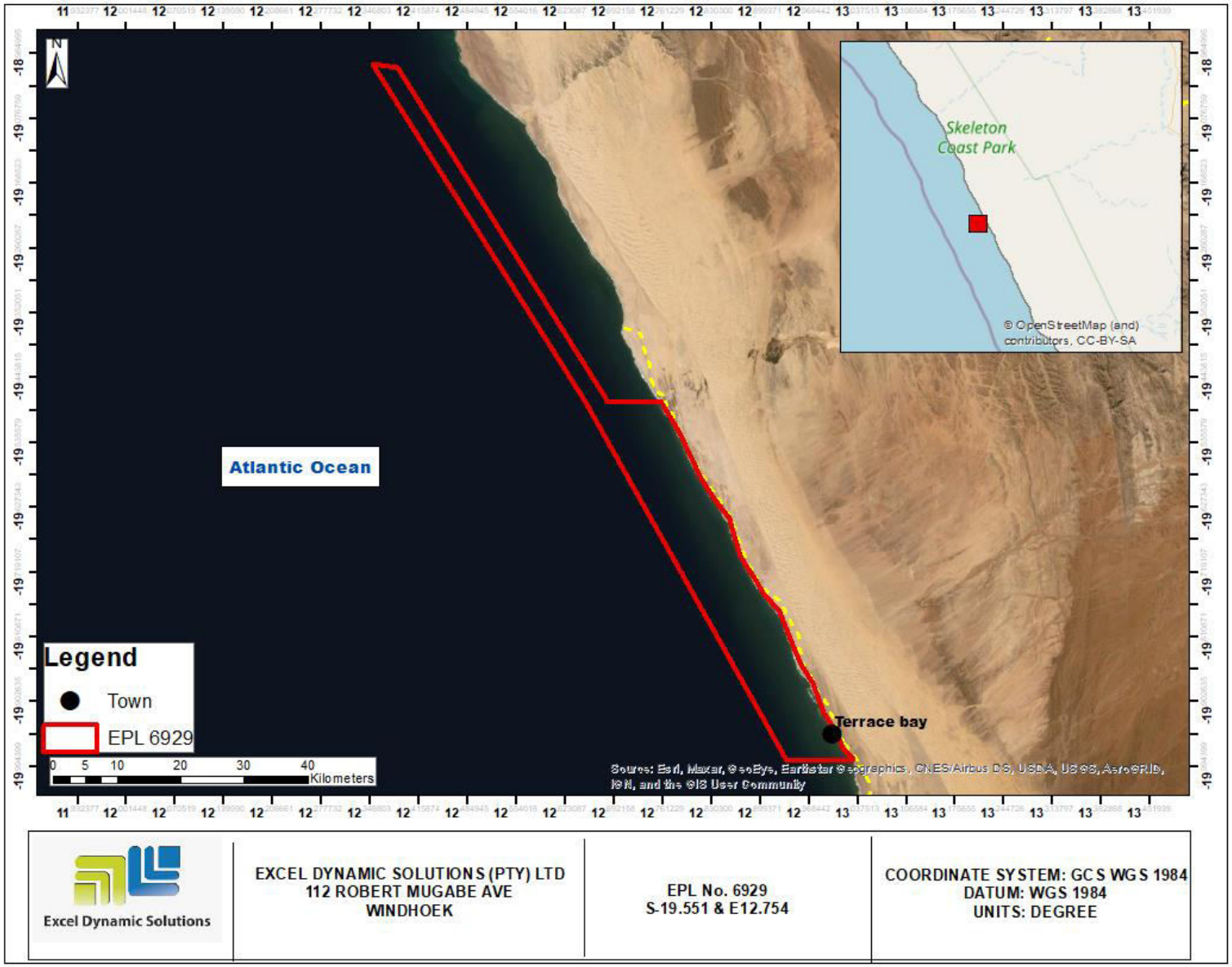


Figure 1: Locality map of EPL 6929 offshore Namibia

1.2 Terms of Reference (TOR), Scope of Work and Document Contents

The ESA Study has been commissioned and conducted in accordance with the Environmental Management Act (EMA) No. 7 of 2007, and its 2012 EIA Regulations, whereby the proposed exploration and associated activities is one of the listed activities in these Regulations of the EMA that may not be undertaken without an Environmental Clearance Certificate (ECC). The listed activities that are relevant to proposed project are as follows:

- ***''****3.1 The construction of facilities for any process or activities which requires a license, right of other forms of authorization, and the renewal of a license, right or other form of authorization, in terms of the Minerals (Prospecting and Mining Act, 1992).*
- *3.2 other forms of mining or extraction of any natural resources whether regulated by law or not.*
- *3.3 Resource extraction, manipulation, conservation, and related activities.*

Subsequently, an application for the Environmental Clearance Certificate (ECC) accompanied by the Background Information Document (BID) and was hand delivered on the 21st of July 2021 to the Office of the Executive Director at the Ministry of Mines and Energy (MME), the *Competent Authority* in Windhoek - **Appendix A**.

Furthermore, an ESA process will need to be undertaken, completed, and an ESA Report and draft EMP compiled and submitted to the Department of Environmental Affairs and Forestry (DEAF) of the Ministry of Environment, Forestry and Tourism (MEFT) for evaluation and consideration of ECC issuance.

The purpose of the ESA and subsequent issuance of the ECC is to ensure that the proposed project activities are undertaken in an environmentally friendly and sustainably manner, through the effective implementations of recommended environmental management and mitigation measures to minimize the adverse identified impacts while maximizing the positive impacts.

This Report has been compiled as a required output of an environmental assessment process after the ECC application has been submitted to the Competent Authority. The ESA Report, together with the draft EMP and all its appendices will be submitted to the DEAF for evaluation.

Apart from the introductory chapter, this Report covers the following chapters:

- Project description and associated activities - (**Chapter 2**).
- Project alternatives considered (that were found to be environmentally friendly and technically feasible) - **Chapter 3**).

- The legal requirements governing the proposed project and its related activities, i.e., the legislations that the proposed development will need to comply with (**Chapter 4**).
- The relevant pre-project environmental conditions of the project site and surrounding area as presented under **Chapter 5**.
- The Public Consultation Process undertaken to inform, invite and engage the public (stakeholders and interested & affected parties) on the proposed project- **Chapter 6**.
- The presentation and assessment of key potential identified impacts associated with the proposed development (**Chapter 7**) - This chapter presents both the positive and negative (adverse) as well as cumulative impacts, assessment methodology and the assessment of the negative impacts. The mitigation measures in the form of management and mitigation action plans, with timeframe and implementation responsibilities are given in draft Environmental Management Plan (EMP) under **Appendix B**.
- The recommendations and conclusions to the environmental assessment are presented under **Chapter 8**, while **Chapter 9** is a list of data sources (literature) consulted for the assessment.

1.3 The Need for the Proposed Project (Motivation)

Mining accounts for 12.5% of Namibia's Gross Domestic Product (GDP). The mining industry is one of the largest contributors to the Namibian economy; therefore, it contributes to the improvement of livelihoods. In Namibia, exploration for minerals is done mainly by the private sector. Exploration activities have a great potential to enhance and contribute to the development of other sectors. The mining sector forms the vital part of some of Namibia's development plans, namely: Vision 2030, National Development Plan 5 (NDP5) and Harambee Prosperity Plan (HPP). Thus, mining is essential to the development goals of Namibia in contributing to meeting the ever-increasing global demand for minerals, and for national prosperity. Successful exploration work can lead to offshore mining activity on the EPL 6929, which would feed into the development plans.

Partaking of the local organisations/groups in the offshore mining sector would enhance the already existing marine mining activity offshore Namibia and provide employment opportunities to Namibians.

As a portable repository of value, precious stones would contribute greatly to the generation of foreign currency and positively contribute to the national GDP. This in turn, can support the aim of achieving a balance between the establishment and dissemination of wealth.

1.4 Appointed Environmental Assessment Practitioner

To satisfy the requirements of the EMA and its 2012 EIA Regulations, the Proponent appointed an independent team of Environmental Consultants at Excel Dynamic Solutions (Pty) Ltd (hereinafter referred to as EDS, The Environmental Consultant or Assessment Practitioner (EAP)) to conduct the required ESA process on their (Proponent's) behalf. The findings of the ESA process are incorporated into this Report. The ESA Report and the draft EMP as well as associated documents will be submitted as part of an application for an ECC to the Environmental Commissioner at the Department of Environmental Affairs and Forestry (DEAF) of the Ministry of Environment, Forestry and Tourism (MEFT).

The ESA process and this Report and the draft EMP were conducted and compiled by Ms. Fredrika Shagama, respectively. Ms. Shagama is a qualified and experienced hydrogeologist & EAP with over 5 years of experience in water and environmental consulting and a member of the Namibian Hydrogeological Association and International Association of Hydrogeologists. She is also registered as a Practitioner with the Environmental Assessment Professionals of Namibia (EAPAN). The ESA project is headed by Mr. Nerson Tjelos, a qualified and experienced Geoscientist and experienced Environmental Assessment Practitioner with (EAP). Mr Tjelos is also the ESA documents reviewer. The curricula vitae (CV's) for both Ms. Shagama and Mr. Tjelos are presented in **Appendix C.**

The following chapter is presentation of the proposed project activities, in terms of project inputs, process, outputs and resources in the planned project phases.

2 PROJECT DESCRIPTION: PROPOSED EXPLORATION ACTIVITIES

This chapter comprises of the planned project activities as well as services infrastructure and resources required to explore for the precious stones within EPL 6929.

It should be noted that the proposed project exploration activities will only commence after issuance of the ECC by the Environmental Commissioner and securing of all required permits and or license that need to be obtained prior to implementation (exploration). Upon issuance of the ECC and obtaining the necessary and required documentations as well as securing of

financial and technical resources, the Proponent will then prepare for the actual exploration activities.

The proposed exploration program for EPL 6929 will be undertaken in various phases, i.e., in a phased approach that will start with target identification within the EPL area to reduce the cost of exploration. The aim of exploration works is to acquire the necessary data required for further decision making and investment options. Due to the paucity of major datasets, the license area may be regarded as virgin ground.

Exploration duration: The planned geophysical surveys and sampling may last several months and will be done in stages on different parts of the EPL. The mapping and sampling will be done a period of about nine to sixteen (16) months depending on the availability of funds, technical support, and the initial findings (i.e., first 2 months) of the exploration programme. Exploration activities will take place during the daytime only. All these activities will only be undertaken upon the approval of the ESA Report and issuance of the environmental clearance certificate by the Environmental Commissioner.

For easy follow of information presentation, the planned project activities in terms of input, processes, and outputs are provided based on implementation phases outlined under the sections below.

2.1 Planning Phase

Prior to exploration activities, the Proponent will plan for the project, which also include this ESA Study. The planning phase is aimed at presenting some key concepts of the project alongside a general overview of the study area, the legal landscape to be considered, and a preliminary assessment of the main aspects that might affect the feasibility of the project and or its associated activities. Thereafter, the environmental, technical, and financial aspects of the project is assessed by identifying potential risks and proposing management and mitigation measures where possible.

Prior to commencement of any site work, the Proponent will also ensure that all the required permits and licenses pertaining to certain project activities are obtained from relevant authorities. This also the phase during which the Proponent procuring the required equipment, machinery, and vehicles (for onshore use related to the project), resources and arranging for the availability of the exploration vessel and related infrastructure.

The exploration crew will also be established and appointed during this phase as well as application and issuance of Restricted Area Permits (RAPs) for the crew.

2.2 Project Resources, Input, Services, and Infrastructure Requirements

The following resources, services, infrastructure, and equipment will be required for the project (exploration) activities.

2.2.1 Human Resources

For exploration activities, there will be crew on the vessel to include members such as geologist(s), vessel manager/captain, marine engineers, and other required personnel. The exact number of people to form up this crew is not yet known at this stage, but it is anticipated that the crew will be formed up by ten (10) people, both semi-skilled and skilled. The crew will be accommodated onboard the exploration vessel during the exploration period offshore (or per the typical work shift of 28-days on and 28-days off).

2.2.2 Water Supply

Potable water for use aboard the exploration vessel will be sourced from one of the nearest supplying towns (the exact area of water supply will be confirmed and provided in the EA Report). This water will then be stored in tanks on the vessel. Purification of water through a desalination process on board will also be used to produce additional potable water.

2.2.3 Fuel Supply

The marine exploration vessel will use Marine Gas Oil as fuel for operation. Marine Gas Oil will also be used for offshore generators to supply power for operating the equipment for exploration.

2.2.4 Accessibility (roads) and Harbour Services

From land, the eastern part of EPL is accessed from C34 by D2302. From which offshore parts of the EPL will be accessed by means of vessels from the nearest Port, which is Walvis Bay. The exploration vessel will therefore also use the Walvis Bay harbour infrastructure.

2.2.5 Waste management

The exploration vessel will be equipped with secured waste containers for different types of waste. Metal waste will be sent to shore for recycling. The galley waste will be ground by onboard macerator pumps and disposed of overboard, as in accordance with the International Convention

for Prevention of Marine Pollution from Ships (MARPOL). Wastewater containing <15ppm oil will be discharged overboard. Other waste types may be incinerated at the approved and designated waste facilities on land, and the remainder will also be sent to shore via tug.

In addition, and as per inputs by the interested and affected parties (I&APs), any plastic will need to be properly managed. This will be accomplished by either removing plastic before leaving shore and put into recycling or bring it back to shore for recycling.

2.2.6 Security

All crew members aboard the exploration vessel will be required to possess a Restricted Area Permit (RAP) in terms of the Diamond Act 13 of 1999 (and the Regulations) from the Ministry of Mines and Energy (MME). The Proponent will ensure that these permits are applied for and obtained for every crew member.

2.3 Phase 1: Regional Target Selection

The first phase should involve Identification of possible structural conduits which may have facilitated the migration of diamonds northwards. Secondly, using the regional magnetic data an attempt should be made to map out potential palaeochannels which may be associated to diamondiferous gravels within the EPL area (the regional magnetic data may be purchased from the National Petroleum Corporation of Namibia (NAMCOR). This phase should also involve identification of geological units (some data may be deduced from adjacent relinquished grounds) favorable for hosting diamond mineralization.

2.4 Phase 2: Geophysical Survey (Non-Invasive)

Once a target is identified during Phase 1, a systematic geophysical survey program may be commissioned (using a survey vessel (chartered vessel)) - **Figure 2**. To establish the geological situation of the area it is proposed for an initial survey to be undertaken towards east-west orientation to intersect the geological structure perpendicular. The initial data will include Multibeam echo sounder and side scan sonar including the seismic profiling at least at a survey spacing of about 20-50km. This will be done to develop the geological model of the area. The detailed geosurvey techniques are outlined in **Table 1.**

2.4.1 Exploration Equipment

Marine geophysical surveying will be conducted using a chartered vessel with an approximate length of 50m using the dynamic positioning (DP) system. This method allows the resultant sonographic mosaic charts and seismic profiles to be produced with reasonable accuracy.

Equipment that will be used during the geophysical survey include the following.

- Multibeam echo sounder (MBES) and swath bathymetry systems
- Side-scan sonar equipment
- High frequency seismic profiling system (low energy <12Hz Magnetometer Systems)
- Direct visual observation using underwater video systems usually mounted on Remotely Operated Vehicles (ROV) – **Figure 3.**

The list of proposed equipment is subjected to change depending on the available technology when the mineral licence is renewed and the technical and financial requirements to conduct diamond exploration during that time.

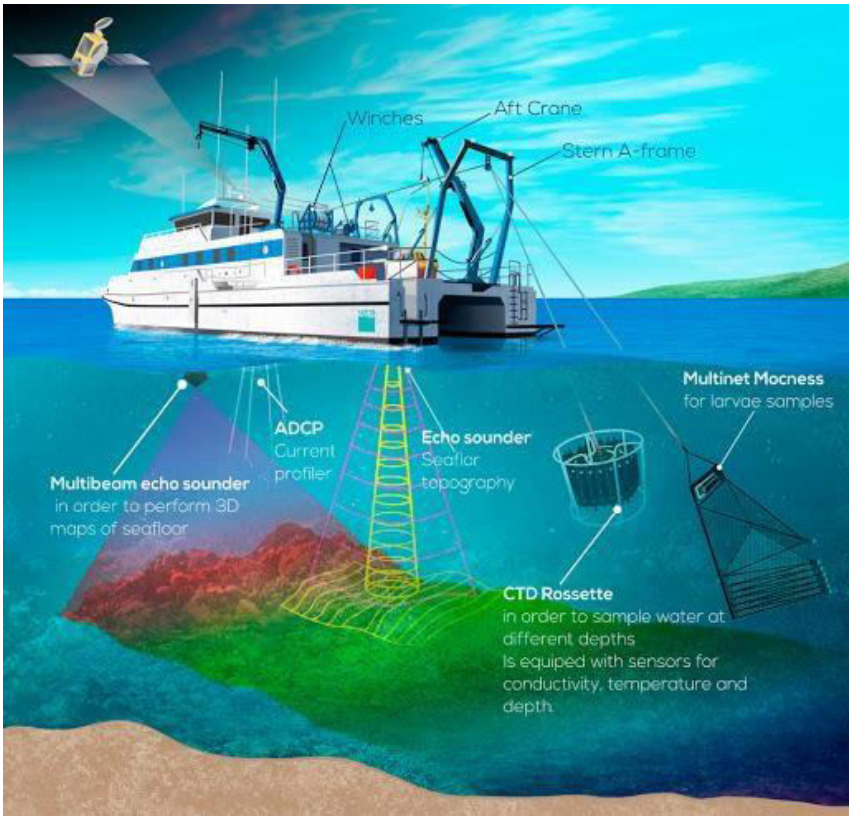


Figure 2: Schematic illustration of a geophysical survey vessel (

- Sampling will utilize a specialized vessel with an approximate length of 100m, which can carry a processing plant, accommodation space as well as a drill platform.

Figure 3: A chartered sampling vessel the mv Explorer from IMDH ((www.imdh.com as cited by EDS, 2020)

2.5 Phase 3: Sampling Programme

To establish the mineralisation potential of the license area a sampling programme is proposed (see detailed sampling type and objectives in **Table 1**). However, the sampling programme will depend on the result of the geophysical survey particularly the bathymetry data as bathymetry shows the morphology of the sea floor on which sampling grid layout may be based. Brown field's exploration is guided by extending known mineralization trends into the areas of undercover. However due to a lack of major datasets this area may still be regarded as greenfields.

It is envisaged that sampling will be short-term and focused on limited sample points as part of a grid survey to determine the viability of the resource. The benthic communities surrounding the sampling sites will be able to repopulate and renourish the affected sampling areas. However, this will need to be confirmed by a desktop Benthic Study to be conducted as part of this scoping environmental assessment. The impacts of mining itself, should the resource prove viable, will be subject to a more detailed impact assessment, along with mitigation measures (once the EPL is ready to be converted into a mining license).

The sampling programme comprises the following four components (described under the next subsections according to Excel Dynamic Solutions, 2021):

- Primary scalping screens,
- Secondary screens,
- Dense Medium Separation (DMS) Plant, and X-ray recovery.

2.5.1 Primary and Secondary Scalping Screen

The material is pumped to the primary scalping screens which separated undersize material (<1.25mm) and oversize materials (>22mm) which then returned to the sea as reject fractions. The coarse material falling between the size fraction of >1.5mm to <22mm the proceeds towards the secondary scalping screens for further fractionation and removal of gangue minerals and other seabed constituents.

2.5.2 DMS Plant

The final coarser material then proceeds to the densifying plant where sorting further takes place through dense media separation. A dense medium separation plant facilitates the process called Dense Media Separation. During this process, gold, diamonds, and other gems minerals will be separated from the waste material, using gravity. The process requires the use of FeSi powders, which is mixed with water to form a fine suspension until it reaches the desired density. The diamond is then submerged into the fins suspension, in order for dense media separation to take place. Particles that are denser than the medium will report the process underflow as sinks, while less dense particles will report to the process overflow as floats.

2.5.3 X-RAY Plant (Recovery)

Material that passes through the dense media separation proceed to the X-ray where gangue materials are separated from diamonds. Diamonds are then recovered from final concentrate on-board the vessels through sorting in a high security area in accordance with the Diamond Act 13 of 1999.

2.6 Decommissioning of Project Activities

The decommissioning referred to here is the cessation of exploration activities upon either discovering an economic feasible and worthy deposit or unsuccessful exploration works. Either way, the Proponent will need to properly decommission the activities to either prepare the selected areas of the EPL for the mining phase or upon a non-successful exploration abandon the site.

Table 1: Geophysical surveys and Sampling approaches proposed for EPL 6929 to facilitate local geology interpretations

Data	Geosurvey Technique	Data Usage
Geophysical survey		
Bathymetry and water depth contours	Hydrographic single beam echo sounder and swath bathymetric systems	-Mapping of sea floor morphology (creation of digital terrain maps). -Mapping of Palaeo-channels which may host diamondiferous gravels
Seafloor surface	Side scan sonar equipment	-Mapping of sea floor geology that will facilitate the delineation of bedrock, gravel and overburden materials.
Seafloor sediment thickness mapping	Seismic profiling system: (1) High-resolution vertical data preferably 2D seismic with measuring capacity up to at 10m penetration, and (2) Medium vertical resolution data up to 4m penetration capacity with ability to penetrate large cobbles and boulders.	-Creation of sediment thickness models.
Sampling approach/technique		
Stages	**Sampling Type**	**Objectives of Sampling**
Stage 1	Exploration sampling (Greenfields)	-This sampling is undertaken to establish the presence of mineralisation within the identified prospecting feature. Sampling may not exceed 500m between localities
Stage 2	Follow-up sampling (Brownfields)	-Sampling taken to establish geological boundaries, spatial extent and characteristics of mineralisation within the selected feature. During this campaign, sampling may not exceed 200m between localities.
Stage 3	Close spaced sampling	-The closed spaced sampling is undertaken to delineate the resource and establish associated grade. A sampling grid of 100x150m may be used.

3 PROJECT ALTERNATIVES

Alternatives are defined as the "*different means of meeting the general purpose and requirements of the activity*" (EMA, 2007). This section will highlight the different ways in which the project can

be undertaken and to identify the alternative that will be the most practical, but least damaging to the environment is identified.

Once the alternatives have been established, these are examined by asking the following three questions:

(a) What alternatives are technically and economically feasible?

(b) What are the environmental effects associated with the feasible alternatives?

(c) What is the rationale for selecting the preferred alternative?

(d) The alternatives considered for the proposed development are discussed in the following subsections.

3.1 Types of Alternatives Considered

3.1.1 The "No-go" Alternative

The “No-go” alternative is the option of not proceeding with the activity, which typically implies a continuation of the status quo. In this case, this would mean, no exploration works on the EPL.

Should the proposed project not be allowed to go ahead, the actual potential of the EPL would not be determined. Added to this, income for the Proponent and employment will not be generated and created, respectively.

The “no action” alternative simply implies that the status quo remains, and nothing happens. Discontinuing the exploration proposal would mean that none of the potential impacts (positive and negative) identified would occur. The current land use for the EPL would also remain unchanged.

Considering the above losses, the “no-action/go” alternative was not considered a viable option.

3.1.2 Exploration Location

The prospecting/exploration location is dependent on the geological setting (regional and local), the economic geology, and the exploration of the EPL area. Therefore, finding an alternative location for the planned exploration activities is not possible. This means that the mineralization of the target commodities is area specific, therefore, exploration targets are primarily determined by the geology (host rocks) and the tectonic environment of the site (ore forming mechanism).

Given the fact that the EPL nor its future exploration targets cannot be relocated, it will be of utmost importance to reduce the project footprints within the actual active sites of the EPL by

ensuring that exploration works and related activities on the EPL are limited within the tenement only.

The above presented project activities and associated resources are governed by certain polices, laws, regulations, etc. (legal framework). These are in terms of local, regional, national and at some extent, international. The applicable legal framework to the proposed project and its activities are provided under chapter 4. The legal framework that requires permitting and or licensing prior to project implementation are provided as such under the draft EMP.

4 LEGAL FRAMEWORK: LEGISLATION, POLICIES AND GUIDELINES

A review of applicable and relevant Namibian legislation, policies, and guidelines to the proposed offshore exploration activities is given in this section. This review serves to inform the project Proponent, Interested and Affected Parties, and the decision-makers at the DEAF of the requirements and expectations, as laid out in terms of these instruments, to be fulfilled when undertaking the proposed activities.

4.1 The Environmental Management Act (No. 7 of 2007)

The Act aims at promoting sustainable management of the environment and use of natural resources. The Environmental Management Act (EMA) is broad; it regulates land use development through environmental clearance certification and/or Environmental Impact Assessments. The Act provides for the clearance certification for prospecting, exploration, and mining activities. It further stipulates requirements to complete the required documentation to obtain an Environmental Clearance Certificate (ECC) for permission to undertake this activity.

4.2 The Diamond Act (No. 13 of 1999)

The relevance of the Act to the proposed project includes Part 7 of the Act: Diamond Prospecting or mining vessels, Section 57 (Registration of diamond prospecting or mining vessels) Subsection 1, especially states that:

- Every producer, holder of an exclusive prospecting licence, contractor and sub-contractor engaged in offshore prospecting or mining shall in the prescribed manner register any vessel in use or to be used by him or her as a diamond prospecting or mining vessel.

Other applicable legal obligations to the proposed exploration activities are presented in **Table 2**.

Table 2: The list of applicable national and international legislations governing the proposed project and related activities

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
NATIONAL, REGIONAL AND LOCAL		
The Constitution of the Republic of Namibia, 1990 as amended	The Constitution of the Republic of Namibia (1990 as amended) addresses matters relating to environmental protection and sustainable development. Article 91(c) defines the functions of the Ombudsman to include: *"…the duty to investigate complaints concerning the over-utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia…"* *Article 95(l) commits the state to actively promoting and maintaining the welfare of the people by adopting policies aimed at the:* *"…Natural resources situated in the soil and on the subsoil, the internal waters, in the sea, in the continental shelf, and in the exclusive economic zone are property of the State."*	By implementing the environmental management plan, the establishment will be in conformant to the constitution in terms of environmental management and sustainability. Ecological sustainability will be main priority for the proposed development.
The Regional Councils Act (No. 22 of 1992)	This Act sets out the conditions under which Regional Councils must be elected and administer each delineated region. From a land use and project planning point of view, their duties include, as described in section 28 "to undertake the planning of the development of the region for which it has been established with a view to physical, social, and economic characteristics, urbanisation patterns, natural resources, economic development potential, infrastructure, land utilisation pattern and sensitivity of the natural environment. The main objective of this Act is to initiate, supervise, manage, and evaluate development.	The relevant Regional Councils are Interested &Affected Parties and must be consulted during the Environmental Assessment (EA) process. The project site area falls near onshore of the Kunene Regional Council and for services provision such as harbour infrastructure for the exploration vessel, these falls under the Erongo Regional Council. Therefore, the two regional councils should be consulted.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Local Authorities Act No. 23 of 1992	To provide for the determination, for purposes of local government, of local authority councils; the establishment of such local authority councils; and to define the powers, duties, and functions of local authority councils; and to provide for incidental matters.	The Municipality of Walvis Bay is the local authority that will be needed for services provision such as harbour infrastructure (for the exploration vessel) waste disposal, etc, therefore they should be consulted.
Minerals (Prospecting and Mining) Act (No. 33 of 1992)	Section 52 requires mineral license holders to enter into a written agreement with affected landowners before exercising rights conferred upon the license holder (**this Section does not apply to this EPL since it is offshore, but consultation with the custodian, MFMR**). Section 52(1) mineral licence holder may not exercise his/her rights in any town or village, on or in a proclaimed road, land utilised for cultivation, within 100m of any water resource (borehole, dam, spring, drinking trough etc.) and boreholes, or no operations in municipal areas, etc.), which should individually be checked to ensure compliance. Section 54 requires written notice to be submitted to the Mining Commissioner if the holder of a mineral license intends to abandon the mineral license area. Section 68 stipulates that an application for an exclusive prospecting license (EPL) shall contain the particulars of the condition of, and any existing damage to, the environment in the area to which the application relates and an estimate of the effect which the proposed prospecting operations may have on the environment and the proposed steps to be taken to prevent or minimize any such effect. Section 91 requires that rehabilitation measures should be included in an application for a mineral license.	The Proponent should carry out an assessment of the impact on the receiving environment. The Ministry of Fisheries and Marine Resources (MFMR) should be consulted in this regard. The Proponent should include as part of their application for the EPL, measures by which they will rehabilitate the areas where they intend to carry out mineral exploration activities. The Proponent may not carry out exploration activities within the areas limited by Section 52 (1) of this Act.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Marine Resources Act (No. 27 of 2000)	To provide for the conservation of the marine ecosystem and the responsible utilization, conservation, protection, and promotion of marine resources on a sustainable basis; for that purpose, to provide for the exercise of control over marine resources; and to provide for matters connected therewith.	The proposed project activities will be undertaken in the marine environment which hosts a diversity of benthos. Therefore, the Proponent should ensure that their activities do not compromise the marine ecosystems for continued conservation and protection of marine resources.
Mine Health & Safety Regulations, 10th Draft	Makes provision for the health and safety of persons employed or otherwise present in mineral licenses area. These deal with among other matters; clothing and devices; design, use, operation, supervision, and control of machinery; fencing and guards; and safety measures during repairs and maintenance.	The Proponent should comply with all these regulations with respect to their employees.
Petroleum Products and Energy Act (No. 13 of 1990) Regulations (2001)	Regulation 3(2)(b) states that "No person shall possess or store any fuel except under authority of a licence or a certificate, excluding a person who possesses or stores such fuel in a quantity of 600 litres or less in any container kept at a place outside a local authority area"	The Proponent should obtain the necessary authorisation from the MME for the storage of fuel on board during exploration.
Public Health Act (No. 36 of 1919)	Section 119 states that "no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health."	The Proponent and all its employees or contractors should ensure compliance with the provisions of these legal instruments.
Health and Safety Regulations GN 156/1997 (GG 1617)	Details various requirements regarding health and safety of labourers.	
Public and Environmental Health Act No. 1 of 2015	The Act serves to protect the public from nuisance and states that no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health.	The Proponent and their contractors should ensure that the project infrastructure, vehicles, equipment, and machinery are designed and operated in a way that is safe, or not injurious or dangerous to project workers and public health.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
		The Proponent should ensure that the public as well as the environmental health is preserved and remain uncompromised.
Atmospheric Pollution Prevention Ordinance (No.11 of 1976)	This ordinance provides for the prevention of air pollution.	Measures should be instituted to ensure that potential harmful emissions from exploration related activities are prevented and or kept at acceptable levels. In other words, the proposed project and related activities should be undertaken in such a way that they do not pollute or compromise the surrounding air quality.
Hazardous Substance Ordinance, No. 14 of 1974	The ordinance provides for the control of toxic substances. It covers manufacture, sale, use, disposal and dumping as well as import and export. Although the environmental aspects are not explicitly stated, the ordinance provides for the importing, storage, and handling.	The Proponent should handle and manage the storage and use of hazardous substances on site/board so that they do not harm or compromise the site environment
Petroleum Products and Energy Act (No. 13 of 1990) Regulations (2001)	Regulation 3(2)(b) states that "No person shall possess or store any fuel except under authority of a licence or a certificate, excluding a person who possesses or stores such fuel in a quantity of 600 litres or less in any container kept at a place outside a local authority area.	The Proponent should obtain the necessary authorization from the MME for the storage of fuel on-site.
Labour Act (No. 6 of 1992)	The Ministry of Labour, Industrial Relations and Employment is aimed at ensuring harmonious labour relations through promoting social justice, occupational health and safety and enhanced labour market services for the benefit of all Namibians. This ministry insures effective implementation of the Labour Act no. 6 of 1992.	The Proponent should ensure that the project activities, do not compromise the safety and welfare of workers.
APPLICABLE INTERNATIONAL POLICIES, PRINCIPLES, STANDARDS, TREATIES AND CONVENTIONS		
Statue	**Provision**	**Implication for the project and its activities**

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Equator Principles	A financial industry benchmark for determining, assessing, and managing environmental and social risk in projects (August 2013). The Equator Principles have been developed in conjunction with the International Finance Corporation (IFC), to establish an International Standard with which companies must comply with to apply for approved funding by Equator Principles Financial Institutions (EPFIs). The principles apply to all new project financings globally across all sectors. **Principle 1:** Review and Categorization **Principle 2**: Environmental and Social Assessment **Principle 3:** Applicable Environmental and Social Standards **Principle 4:** Environmental and Social Management System and Equator Principles Action Plan **Principle 5:** Stakeholder Engagement **Principle 6:** Grievance Mechanism **Principle 7:** Independent Review **Principle 8:** Covenants **Principle 9:** Independent Monitoring and Reporting **Principle 10:** Reporting and Transparency	These principles are an attempt to: '…encourage the development of socially responsible projects, which subscribe to appropriately responsible environmental management practices with a minimum negative impact on project-affected ecosystems and community-based upliftment and empowering interactions.'

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
The International Finance Corporation (IFC) Performance Standards	The International Finance Corporation's (IFC) Sustainability Framework articulates the Corporation's strategic commitment to sustainable development and is an integral part of IFC's approach to risk management. The Sustainability Framework comprises IFC's Policy and Performance Standards on Environmental and Social Sustainability, and IFC's Access to Information Policy. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. As of 28 October 2018, there are ten (10) Performance Standards (Performance Standards on Environmental and Social Sustainability) that the IFC requires a project Proponents to meet throughout the life of an investment. These standard requirements are briefly described below. **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts **Performance Standard 2**: Labour and Working Conditions **Performance Standard 3:** Resource Efficient and Pollution Prevention and Management **Performance Standard 4:** Community Health and Safety **Performance Standard 5:** Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement (**not applicable to an offshore EPL**) **Performance Standard 6:** Biodiversity Conservation and Sustainable Management of Living Natural Resources **Performance Standard 7**: Indigenous Peoples/Sub-Saharan African Historically Undeserved Traditional Local Communities (**not applicable to an offshore EPL**)	The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the Client (Borrower) in relation to project-level activities. In the case of its direct investments (including project and corporate finance provided through financial intermediaries), IFC requires its clients to apply the Performance Standards to manage environmental and social risks and impacts so that development opportunities are enhanced. IFC uses the Sustainability Framework along with other strategies, policies, and initiatives to direct the business activities of the Corporation to achieve its overall development objectives.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	Performance Standard 8: Cultural Heritage (**not applicable to an offshore EPL**) **Performance Standard 9:** Financial Intermediaries (FIs) **Performance Standard 10:** Stakeholder Engagement and Information A full description of the IFC Standards can be obtained from http://www.worldbank.org/en/projects-operations/environmental-and-social-framework/brief/environmental-and-social-standards?cq_ck=1522164538151#ess1	
The United Nations Convention to Combat Desertification (UNCCD) 1992	Addresses land degradation in arid regions with the purpose to contribute to the conservation and sustainable use of biodiversity and the mitigation of climate change. The convention objective is to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas to support poverty reduction and environmental sustainability.	The project activities should not be such that they contribute to desertification.
Convention on Biological Diversity 1992	Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use. Promote the protection of ecosystems, natural habitats, and the maintenance of viable populations of species in natural surroundings	Removal of vegetation cover and destruction of natural habitats should be avoided and where not possible minimised
Stockholm Declaration on the Human Environment, Stockholm (1972)	It recognizes the need for: “a common outlook and common principles to inspire and guide the people of the world in the preservation and enhancement of the human environment.	Protection of natural resources and prevention of any form of pollution.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
The 1982 United Nations Convention on the Law of the Sea	The law of the sea has been a centerpiece of international law for centuries. While it has long been concerned with the breadth of countries' territorial seas and the matter of maritime boundaries, a consideration for the ecological component of the oceans is a modern phenomenon. Although the inherent friction between coastal states and maritime states is as old as international law itself, no major convention concerning the law of the sea existed until most recently (see International Trade Agreements). An international conference held in 1958, the United Nations Conference on the Law of the Sea, referred to as UNCLOS I, codified much of the existing custom into four conventions: the Convention on the Territorial Sea and the Contiguous Zone, the Convention on the High Seas, the Convention on Fishing and Conservation of the Living Resources of the High Seas, and the Convention on the Continental Shelf.	

The legal requirements above have been listed and explained as per their relevance to the project. The project is being carried in a specific environment that may be affected. Thus, the environmental baseline (receiving environment) of the project area is presented under the next chapter.

5 THE RECEIVING ENVIRONMENT

The proposed exploration activities will be undertaken in specific environmental and social conditions, and it is crucial to understand these pre-project conditions of the benthic environment. This will aid in laying down background "information" of the status quo and future projections of environmental conditions after the implementation of the project. This also aids in identifying the sensitive environmental and social features that may need to be protected through the effective implementation of impact specific management and mitigation measures.

The baseline information has also been complemented by review of existing different and relevant data sources conducted in the immediate surroundings of the marine environment and as complemented by data provided by the two Marine specialists who conducted the Desktop Benthic Study for this ESA.

The summary of selected biophysical and social baseline information about the prospecting area and associated areas under the following subsections. The biophysical conditions described under subsection 5.1 to 5.3 have been sourced from the Desktop Benthic Study by the specialists (Shaanika and Mateus, 2021) - **Appendix G**.

5.1 Climatic and Oceanic Settings

This section describes atmospheric and oceanic conditions along the Namibian coast and depended on the availability of literature, emphasis was placed on the Northern coastal region and Möwe Bay (the closest settlement with a weather station to EPL 6929 area.

5.1.1 Precipitation and Air Temperature

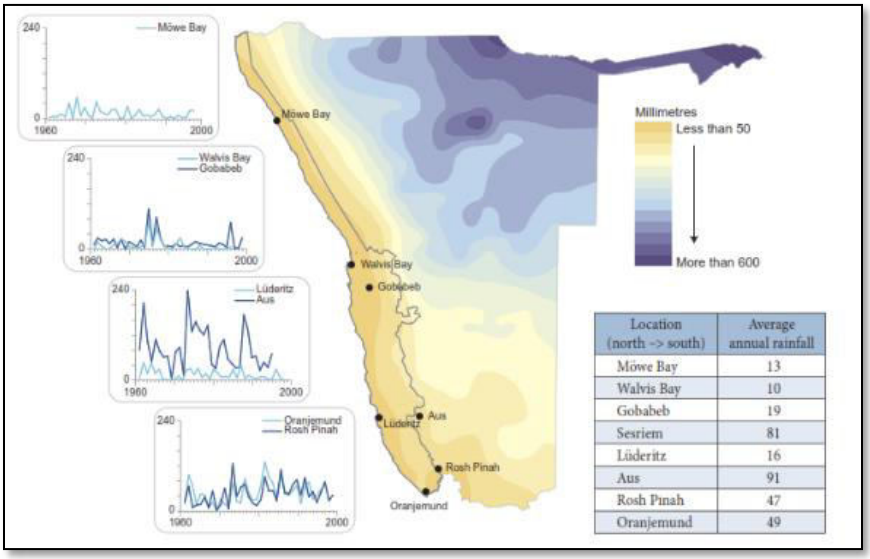
The Namibian coastline is having high humidity percentage, due to the moisture from the adjacent Atlantic Ocean (Mendelsohn *et al*., 2002). June is the least humid month with a humidity range of 60-80 %, February is the most humid month with a humidity over 90%. This humidity results in fog (Mendelsohn *et al*., 2002) - **Figure 4**. Rain is seldom recorded, mainly occurring when the moist air from inland overpowers the sea breeze (Mendelsohn *et al*., 2002). The annual average rainfall along the coast is less than 50 mm, the annual average rainfall at Möwe Bay is 13 mm and 10-15 days of 1mm of rainfall a year has been recorded (Mendelsohn *et al.,* 2002; Robertson *et al*., 2012) - **Figure 5**.

Due to relatively low radiation and sunshine (compared to inland), the temperature along the Namibian coastline is generally less than 20 ˚C (Robertson *et al*., 2012). With Möwe Bay having an average temperature range of 16-18 ˚C, minimum range of 10-12 ˚C and maximum range of 22- 26 ˚C (Mendelsohn *et al*., 2002). The highest ever temperature record at Möwe Bay is 40 ˚C and the lowest record is 5 ˚C (Robertson et al., 2012). On average Möwe Bay receives 5 - 6 hours of sunshine per day (Mendelsohn *et al*., 2002) - **Figure 6**.

AVERAGE MAXIMUM AND MINIMUM % RELATIVE HUMIDITY

Place	Maximum	Minimum
Coastline		
Möwe Bay	94	79
Swakopmund	96	69
Walvis Bay	95	73
Lüderitz	91	70
Oranjemund	89	47
Inland		
Uis	76	18
Rössing	79	26
Gobabeb	86	23
Aus	57	17

Figure 4: Relative humidity along the Namibian coastline (Robertson et al., 2012 as cited by Shaanika and Mateus, 2021)



Location (north -> south)	Average annual rainfall
Möwe Bay	13
Walvis Bay	10
Gobabeb	19
Sesriem	81
Lüderitz	16
Aus	91
Rosh Pinah	47
Oranjemund	49

Figure 5: Average annual rainfall in Namibia and total annual rainfall recorded at four weather stations along the coast (Robertson et al., 2012 as cited by Shaanika and Mateus, 2021)

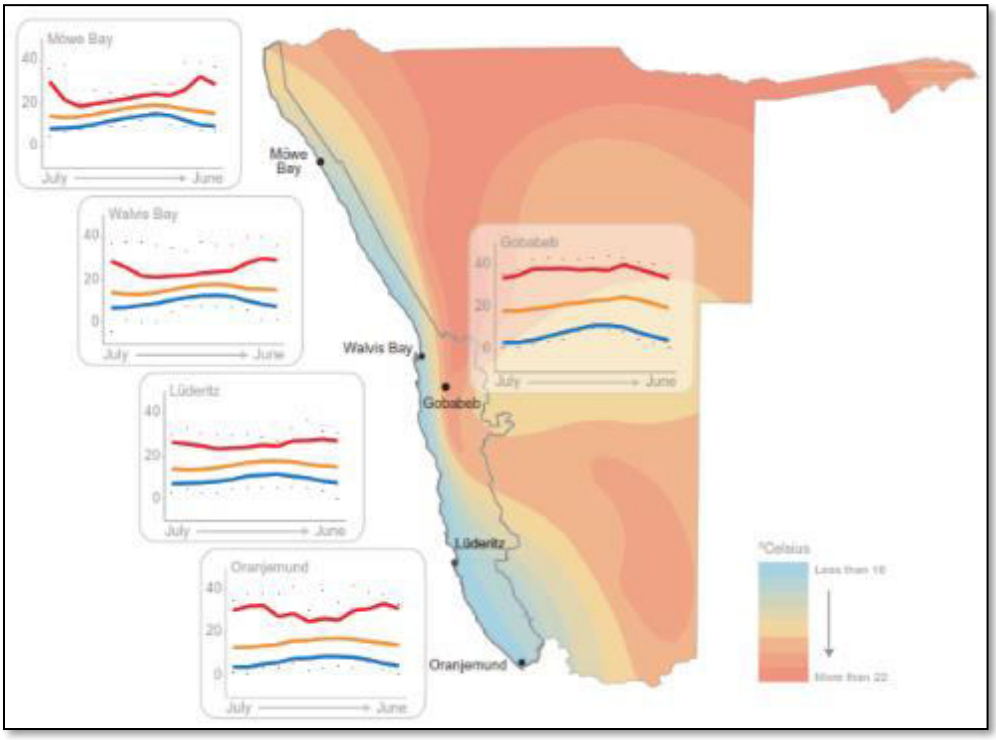
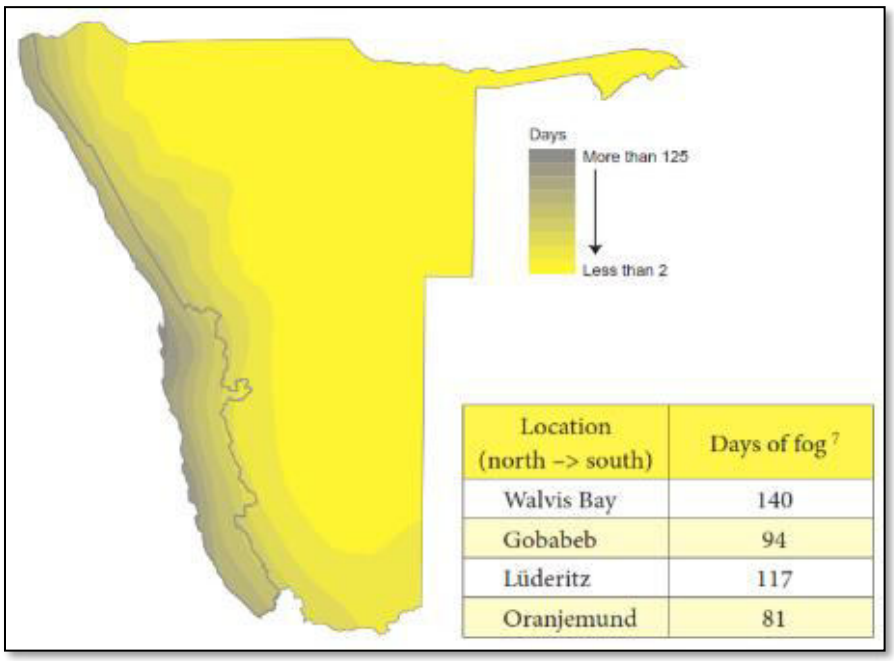


Figure 6: Average temperatures (in °Celsius) across Namibia (Robertson et al., 2012 as cited by Shaanika and Mateus, 2021)

5.1.2 Fog

Fog is frequently recorded in the Namib desert, occurring an average of 125 days a year along the Namibian coastline (Robertson et al., 2012), the fog occurs due to moist air from the sea cooling due to either radiation, advection, or frontal processes (Spirig et al., 2019). Fog is a vital source of water to the desert flora (Gottlieb et al., 2019) and fauna (Eckardt et al., 2013) **Figure 7**.



Location (north -> south)	Days of fog [7]
Walvis Bay	140
Gobabeb	94
Lüderitz	117
Oranjemund	81

Figure 7: The average number of fog days per year (Robertson et al., 2012 as cited by Shaanika and Mateus, 2021).

5.1.3 Atmospheric Conditions and Wind

Namibia is a situated between 17 degrees and 29 degrees south of the equator (Mendelsohn et al., 2002). Subjecting it to three major Climatic belts, the Intertropical Convergence Zone (ITCZ), the Subtropical High-Pressure Zone, and the temperate zone (Heerden & Hurry, 1992). The ITCZ provides moist air from both the Atlantic and Indian ocean (Heerden & Hurry, 1992). These converges in the low-pressure zone, where warm air rises, condensing and forming water vapour (Heerden & Hurry, 1992). The Subtropical High-Pressure Zone has dry cold air from the Botswana and South African Anti-cyclones and the Temperate zone mainly comes westerly and low-pressure systems and cold front from west to east, the system originates from the southern seas (Heerden & Hurry, 1992) (Mendelsohn *et al*., 2002).

These three climate belts migrate throughout, from south to north throughout the year in relation to the position of the sun, causing the two distinct seasons in the southern hemisphere, summer (warm) and winter (cold) (Heerden & Hurry, 1992). The ITCZ is dominant during summer and the temperate zone is dominant during winter (Heerden & Hurry, 1992). These belts ultimately influence the weather patterns (Precipitation, wind, sunlight, humidity etc.) over most of Southern Africa including Namibia's Coastline (Robertson *et al*., 2012).

The wind is the perhaps the defining climatic feature of the Namib desert and inherently of the marine and coastal environment (Tyson & Seely, 1980; Mendelsohn et al., 2002). Southernly wind dominate the entire coastline, blowing at speed of up to 40 km/h. The winds tend to be calmer in the morning and pick up speed at around 14:00 (Robertson *et al*., 2012).

The wind averages about 20km/h Möwe Bay, peaking around April and May at speeds of 25 km/h, like the entire coastline Möwe Bay is dominated by the southernly wind, with south westerly and south easterly winds also relatively common (Robertson et al., 2012). Möwe Bay is reported to calm 14% of the time (Mendelsohn *et al*., 2002) **Figure 8.**

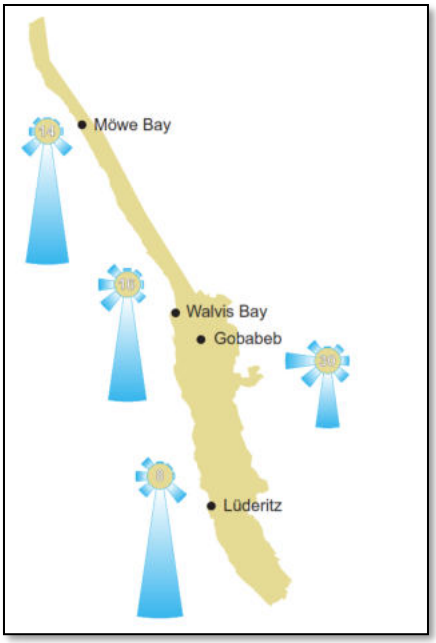


Figure 8: Wind roses for Lüderitz, Walvis Bay, Gobabeb and Möwe Bay. The length of each arm or petal of the rose is proportional to the frequency of wind received from that direction, while the figure in the middle of the rose is the percentage of time that calm conditions were recorded (Robertson et al., 2012).

5.1.4 Oceanic Currents and Upwelling

The Namibian Ocean is characterized by the Benguela current that flows along the coast northward from the cold southern Atlantic Ocean waters. This current runs from Cape Peninsula (South Africa) to around the Kunene River mouth (between Namibia and Angola).

There is an underwater and counter shore current flowing southwards Benguela current, winds traveling at 360 - 1080 km/h (varies seasonally with varying wind speeds) pushes cold water northwards (Robertson *et al.,* 2012) – **Figure 9B**.

The Coriolis (the earth acts on moving objects as it rotates, causing them to deflect anticlockwise in the southern hemisphere) force together with winds from inland pushes surface water offshore (Ekman transport), causing a vacuum that is filled by water from the ocean's depth, this is essentially upwelling. Upwelling provides a lot of nutrients to the Benguela Large Marine Ecosystem **Figure 9B**. There are four main upwelling cells along the Namibian coast namely the Lüderitz cell around Lüderitz (strongest), central Namibian cell around Walvis Bay, Northern Namibian cell near Möwe Bay and the Kunene Cell around the Kunene River mouth (Robertson *et al.,* 2012) – **Figure 9A**.

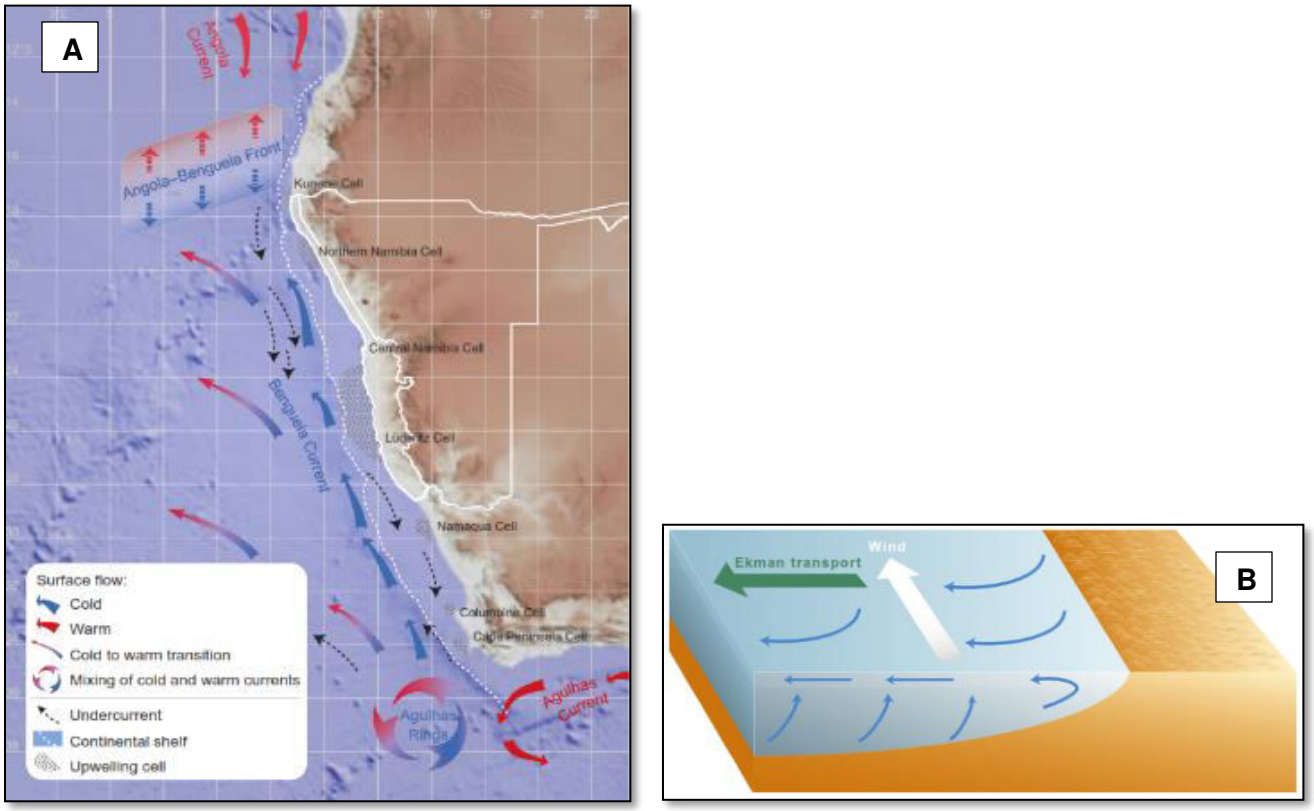


Figure 9: The main features of Benguela current (A) and Upwelling along the Namibian coast is driven by wind and Ekman transport (B), Robertson *et al.*, 2012

The sea surface temperature (SST) along Namibia's coastline varies throughout the year, coldest during winter (May- November) when the winds are strongest and the Lüderitz cells is dominating the entire coastline, with SST ranging from 13-14 ˚C. From December to April the Central and North coast is warmer, SST ranges from 16-19 ˚C (Robertson *et al.*, 2012) - **Figure 10**.

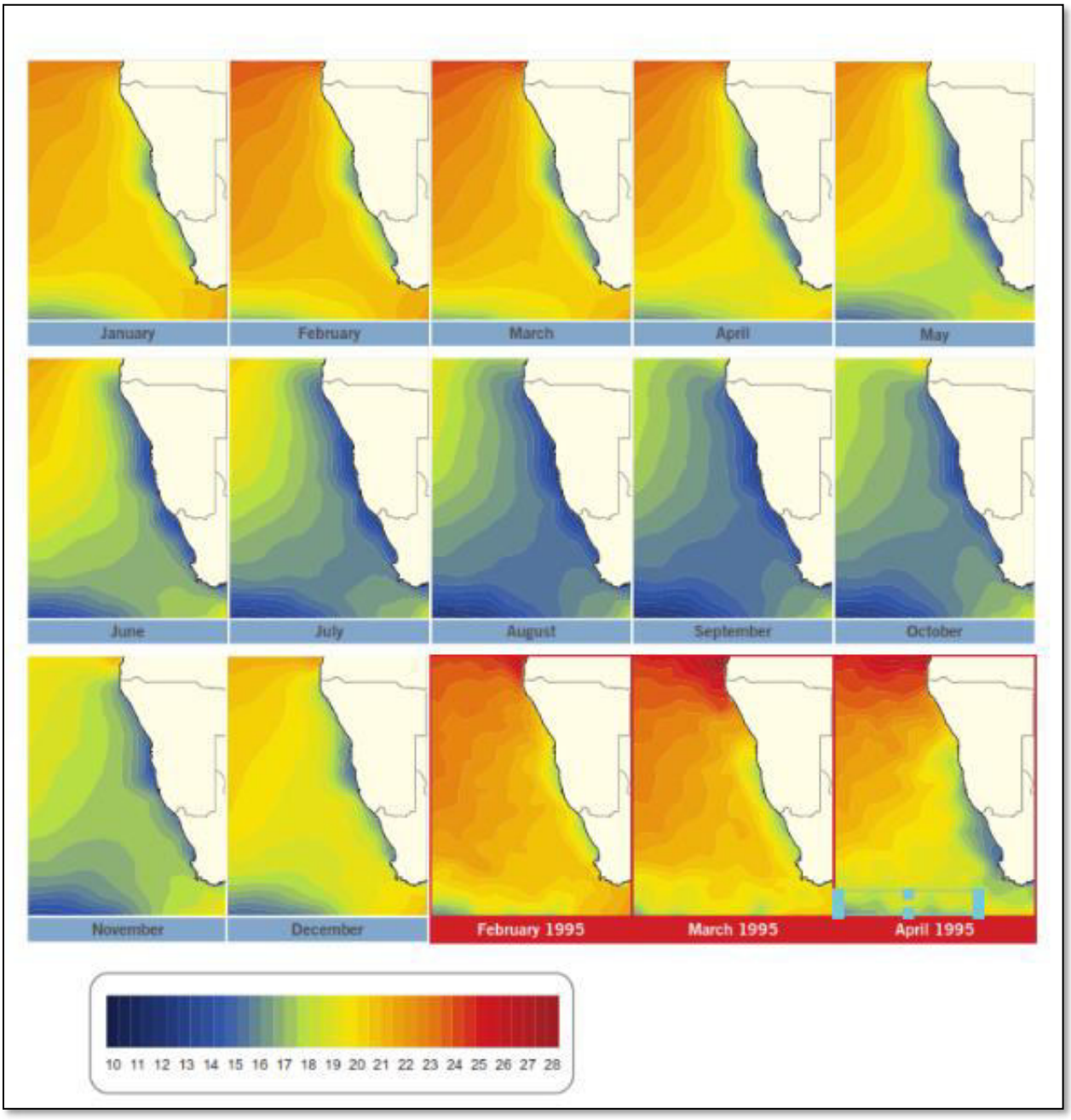


Figure 10: Average temperatures (°Celsius) of the sea surface each month over the period January 1990 to December 2009. Also shown are surface temperatures for three months during the Benguela-Niño in 1995 (Robertson *et al.*, 2012)

5.1.5 Variability

The Namibian coastal zone does experience unusual weather and climatic condition (Mendelsohn *et al*., 2002). When the warm water from the Angola pushes southward much longer than usual, in a phenomenon known as Benguela Nino, the ocean SST rises significantly and has adverse impact on marine flora and fauna. These events have been recorded in 1963, 1984 and 1995, causing 8 ˚C increase in SST along Namibia coastline (Robertson *et al*., 2012) - **Figure 10**.

East winds are a rather common occurrence along the Namibian coastline, but their hot (up to 40 degrees Celsius) and dry (less than 20% humidity) nature, make them a notable weather condition to be aware of as they are a nuisance to the communities of the coastal settlements (Liebenberg-Enslin *et al*., 2017). These winds frequent between April and September, generally setting in the early morning hours and dying out in the afternoon (Robertson *et al*., 2012). The east wind, essentially sandstorms transport hundreds of tons dust westward over the Atlantic Ocean (Mendelsohn et al., 2002; Liebenberg-Enslin et al., 2017). As the east wind flow toward the ocean the air pressure drops causing the air to heat up as it drops from the interior highlands (1500-2000 m) (Tyson & Seely, 1980; Liebenberg-Enslin *et al*., 2017).

5.2 Geology and Bathymetry

5.2.1 Regional Geology

The oldest rocks along the skeleton coast formed between 1000- 7000 million years ago (Schoeman, 1988). Rocks such as a mica schist, gneiss and granite are part of the Damara sequence (Schoeman, 1988). Möwe Bay has grey granites, cut by grey dolerite dykes and pink feldspar. Between the Hoarusib and Khumib Rivers blue -grey rock surfaces emerge, marked by strands of pink feldspar and white quartz (Schoeman, 1988). Around the Hoanib River gneiss rocks appear as reddish-brown low ridges, running parallel to the coast. Cutting through the Hoanib and Khumib Rivers past the Ogams fountain and through to the Hartmann Valley (Schoeman, 1988).

Between 120- 170 million years as the African and south American continents drifted apart. Vast quantities of lava were spread across the Namib landscape (Schoeman, 1988). These lava floods

formed the Etendeka lavas, appearing around Terrace Bay, Möwe Bay, Rocky Point and Cape Frio running parallel to the coast (Schoeman, 1988).

5.2.2 Stratigraphy and Local Geology

Beneath the waves of the Namibian coast the continental shelf width varies, averaging between 100 - 140 km wide. With the narrowest sections occurring northward toward Angola (30 km wide near the Kunene River mouth), The edge of the continental shelf is about 350- 400 meters. The Study area (EPL 6929) falls well within the continental shelf. The EPL area is relatively shallow averaging depths less than 150 meters - **Figure 11B**.

Between the Uniab River mouth (20.10 S 13.18 E) south of study area and Khumib River mouth (18.87 S 12.42 E) north of the study area - **Figure 12B**. The texture of the benthic sediment ranges from sand, muddy sand, sandy mud, and mud, with sand texture dominating, with patches of muddy texture occurring (Robertson *et al*., 2012) - **Figure 11A**. This texture indicates sediment from river sources (terrigenous sediments) (Robertson *et al*., 2012), there are two other ephemeral rivers between the Uniab and Khumib Rivers, namely Hoarusib and Hoanib Rivers (Molly & Tapio, 2003) - **Figure 12B**. Terrigenous sediments dominate most of the inner and shallow area of the continental shelf (**Figure 12A)**. Diatom sediments also occur, evidence of the highly productive upwelling activities along the Namibian coast (Robertson *et al.,* 2012).

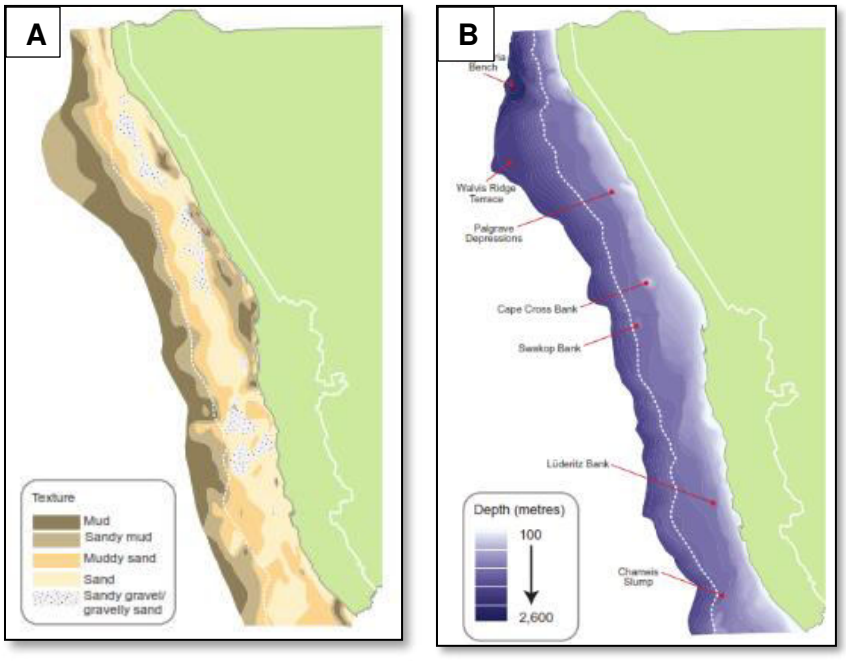


Figure 11: The bathymetry or depths of the ocean between the coastline, continental shelf shown with dotted white line (A) and texture of the surface sediments (B) (Robertson *et al*., 2012)

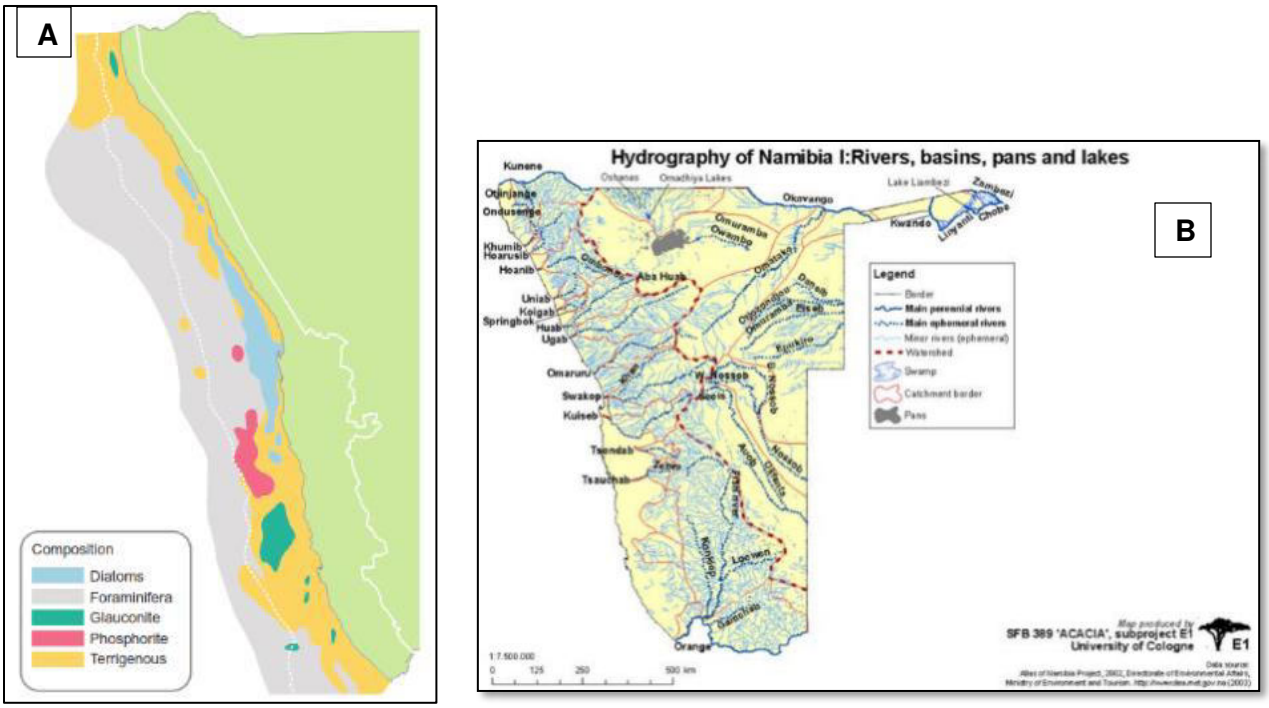


Figure 12: the predominant sedimentary material (A), (Robertson et al., 2012 and hydrography and rivers of Namibia (B)

The stratigraphy of the Namibia seabed is made up of 8 layers of varying thickness, this report will focus on the stratigraphy between Walvis Bay and Kunene River mouth as described in *Baby et al.,* 2018. These geological layers are defined by the period they were formed (and are described from newest to oldest).

- The 8th (Late Miocene–Pliocene*)* and 7th (Oligo-Miocene) layers are essentially the seafloor and are continuously being formed. They were formed less than 150 million years ago and have a thickness of less than 50 meters into the earth crust.
- The 6th layer is the Paleocene-Oligocene, which formed between 330- 150 million years ago, and is 50 - 120 meters thick.
- The 5th & 4th (early Turonian -top Maastrichtian) layer is between 467.5 - 330 million years old, and is about 250 - 375 meters thick,
- Cenomanian is the 3rd layer is the which formed between 500-475.5 years ago and is 200 - 325 meters thick.
- The 2nd layer is Albian, between 565 - 475.5 million years old, and is 130-150 meter thick.
- The 1st layer is the late Hauterivian top Aptian, which developed between 653- 565 years ago. This sits on the syn and the continental crust.

The structure of the basement and general distribution of the main geological layers of the Atlantic margin in Namibia and south Africa are shown in **Figure 13** below.

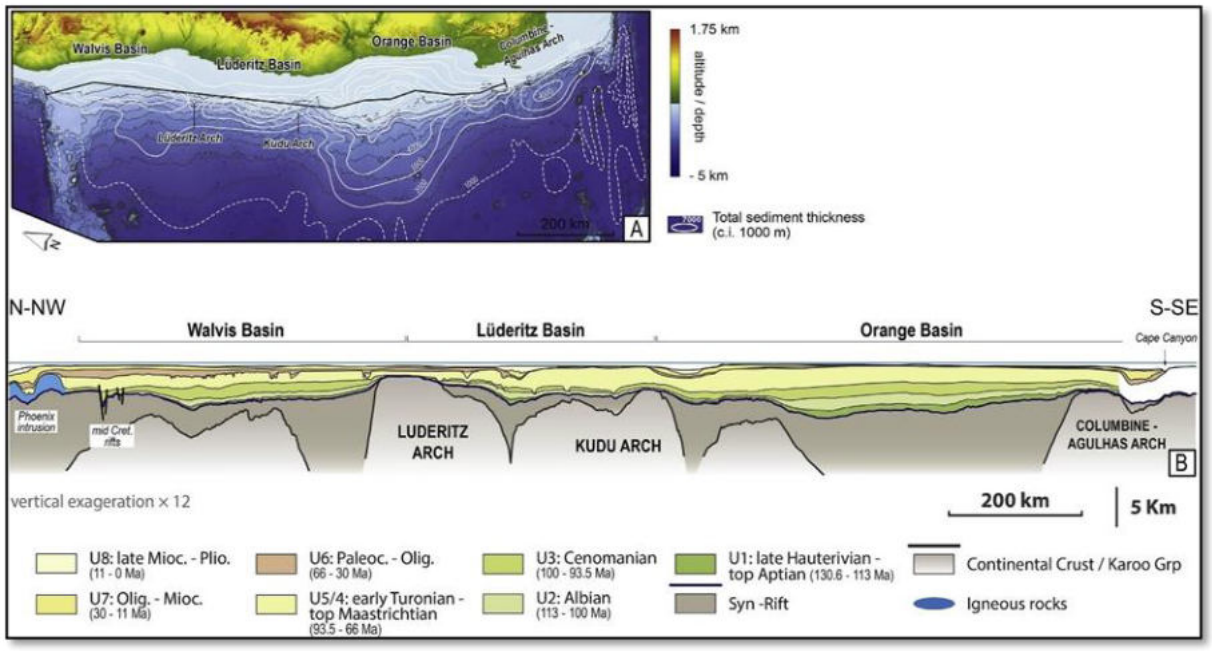


Figure 13: The structure of the basement and general distribution of the main geological layers of the Atlantic margin in Namibia and south Africa, 1 MA = 5 million years. (Baby et al., 2018).

5.3 Marine Ecology

5.3.1 Coastal and Near Shore

The coastal and near shore zone includes all ecologically distinct units on or near the coast (intertidal and subtidal zones) as well as the near shore marine environment (up to 30m in depth). The study area falls within the northern Benguela region, a warm temperate Namib province along the Skeleton coast (Bridgeford, 2012). Skeleton coast is a flat, mostly featureless sand inundated coast which consists of two relatively large rocky outcrops at Möwe Bay and Rocky Point as well as some smaller ones at Torra Bay, Terrace Bay, and False Cape Fria (Bridgeford, 2012; Engledow, 1998; Harris *et al.,* 2013; Pulfritch, 2017). The coastline encompasses about 54% of sandy beaches, 28% is mixed sandy and rocky shores, 16% is rocky shores and the remaining 2% consists of lagoons (Tony, Alice, John, & Roger, 2012). The wind-induced upwelling physical processes highly influence the environment and shape the marine ecology which offers a greater level of habitat heterogeneity.

The marine ecosystems along the northern coast comprise a limited range of habitats that include:

- sandy intertidal and substrates
- intertidal rocky shores and subtidal zones
- the water bodies

The southern African West Coast region general benthic communities are ubiquitous with considerable spatial and temporal variabilities depending on the substratum type, wave exposure, and/or depth zone (Bustamante & Branch, 1996; Engledow, 1998). A few relatively typical species from each of these habitats are described below, focusing on both dominant and commercially important species, as well as potentially sensitive species, that may be affected by the proposed exploration project.

a) Sandy substrate habitats and biota

Zoobenthos refers to the community of animals living on (epibenthic) or burrowing in (benthic) the sediments of a water body. Benthos is classified according to size, microbenthos <0.1mm, meiobenthos 0.1–1mm, macrobenthos >1mm and megabenthos > 10mm. Sandy beaches are dynamic coastal environments, where faunal communities are influenced largely by wave energy, slope, and particle size interactions. The morphodynamics of sandy beaches are mainly classified as dissipative, reflective, or intermediate beaches (Branch & Griffiths, 1988). The dissipative beaches have fine sands, high wave energy, and the rich intertidal faunal communities. Reflective beaches have low wave energy, are coarse-grained, have steep intertidal beach faces, and contain distinct fauna communities. In the intermediate zone between the dissipative and reflective coasts, species composition is extremely variable, depending on food availability (Branch & Griffiths, 1988). **Figure 14** below shows the types of sandy beaches along the Namibian coast.

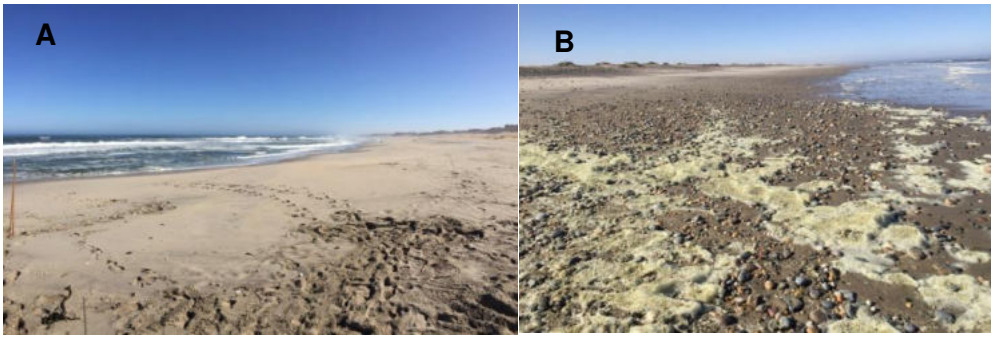


Figure 14: Sandy beach (A) and (B) a medium sized sand, with pebble and cobble deposits beach in the intertidal zone and surf zone off the Namibian coast (photo by Mateus N.L)

The sandy beach fauna distribution assessment along the Namibian coast is based on sporadic studies during the 1980s Tarr *et al*., (1985) and a recent biodiversity survey (Kreiner *et al*., 2019). The biomass of invertebrates is moderate to high as a significance of the nutrient-rich tidal waters along the coastline. The most abundant taxa along the Namibian shores are insects and spiders associated with washed up kelp wrack, nematodes, platyhelminths (flatworms), amphipods (small shrimp-like crustaceans) and ghost crabs (Tony *et al*., 2012). Zoogeography reflects species distribution patterns, but communities and their composition can change greatly over short distances as physical conditions change (Emanuel *et al*., 1992; Tarr *et al*., 1985). The subtidal substrate benthic soft bottom communities depend primarily on water depth and sediment size; however, other variables such as current velocity, organic content, and food abundance play a role.

Sandy beach macrofaunal community structure and zonation along the northern coast encompass a wide range of species with tropical affinities around Bosluis Bay and temperate towards Toscanini (Molly & Tapio, 2003; Tarr *et al*., 1985). The distribution of benthic invertebrates along the five beaches off the northern coast, Bosluis Bay (9 species), Angra Fria (10 species), Hoarusib (7 species), Möwe Bay (9 species) and Toscanini (6 species) (Kreiner et al., 2019). Relatively low abundance and distribution of isopods, *Excirolana natalensis*, *Tylos granulatus*, *Excirolana latipes*, *Eurydice kensleyi* and *Amphipods*, *Africorchestia quadrispinosa*, and *Gastrosaccus namibensis* along the sandy beaches inter tidal zones (Kreiner *et al*., 2019).

b) Rocky habitat and biota

i. Inter tidal rocky shores

The northern coast of Namibia is mainly covered in gravel plains and shifting dunes and is bordered to the east by the Namib Desert. The rocky shorelines that occur on the southern African west coast are strongly influenced by sediments and include considerable quantities of sand mixed in with the benthic biota. The species composition of the rocky shore's biota varies significantly based on geography. In sheltered shorelines as compared with exposed shorelines, the species of fauna and flora biomass supported per unit area differ greatly. The Namibian coastline features a variety of benthic habitats along the rocky intertidal shores. The functional classification is based on the trophic status of the taxa residing at the intertidal zone (autotrophs, grazers, rappers, filter feeders, herbivores, and predators) (Harris *et al*., 2013). Grazers consist

mostly of limpet species, rappers include limpet species that specifically trap kelp fronds beneath their shells, the filter feeders are particularly mussels and the reef worm *Gunnarea capensis*, mobile predators and scavengers such as carnivorous whelks, anemones, crustose algae, and foliose algae which collectively is made up by the articulated (geniculate) coralline algae; corticated algae; ephemeral seaweeds and canopy-forming kelps (Pulfrich & Branch, 2013).

The region along the northern coast near Rocky Point and Möwe Bay is comprised of the project zone. In the exposed shoreline, invertebrates have a much larger biomass than in the sheltered intertidal zone. At Rocky point, the sheltered sites are characterized by gently sloping, irregular rocky/sandy bench stretching along south end of sheltered bay in front of small kelp bed from high shore to low shore mainly bare rock (62%) and sand (21%) zones (Kreiner *et al*., 2019). The sheltered benches at rocky point comprised zones of Granularis, Algal/sand, Pachymenia (Aeodes), Gracilaria/Chondria and Mowe bay zones Littorina, Upper Chthamalus, Lower Chthamalus, Corallina/Pachymenia, Corallina and Argenvillei/kelp. The semi exposed zones consist of Upper Chthamalus, Lower Chthamalus, Mussel/ Chthamalus, Pachymenia and Corallina beds (Kreiner et al., 2019). An overlap of the trophic structures of both rocky and sandy shores can be found on mixed shores with fluctuating degree of sand coverage compared to more homogenous shores (Harris *et a*l., 2013).

ii. Rocky subtidal reefs

Communities near the subtidal areas often feature dense stands of kelp or eelgrass, as well as numerous types of invertebrates, such as amphipods, polychaete worms, snails, clams, sea urchins, and crabs. Suspended sediment plumes reduce predators and grazers on subtidal reefs and increased biomass of filter feeders and ephemeral green algae possibly due to light reduction (Pulfrich *et al.,* 2003; Dethier *et al*., 1993). The exposed rocky shores along the northern coast of Namibia mainly encompass zones of Littorina/Oxystele, Chthamalus, Mussel/Chthamalus and Algal/Perna communities (Kreiner et al., 2019). At rocky point and Mowe bay, a horizontal platform to mid regions with vertical and sharply lowest areas receiving waves impact typical species found include *Afrolittorina knysnaensis*, *Chthamalus dentatus*, *Mytilus galloprovincialis*, *Bunodactis reynaudi*, *Chthamalus dentatus*, *Polysiphonia virgate*, *Scutellastra granularis*, *Semimytilus algosus* and *Scutellastra argenvillei* (Kreiner *et al*., 2019).

5.3.2 Benthic Communities

Namibia's shelves have high productivity and mineralization with diverse benthic biomasses and communities adapted for chronic and massive exposure to both organic and inorganic material. This community was studied from different perspectives via baseline studies and monitoring assessments along the Namibian coast. A summary is provided below focusing on the areas near the project area.

The largest proportion of macrofauna abundance and biomass along the west coast constitute of polychaetes, crustaceans and molluscs with inherently patchy distributions reflecting the high natural spatial and temporal variability (Eisenbarth & Zettler, 2016; Mertzen, 2013; Tony et al., 2012). Benthic macrofauna abundance decrease from the shelf towards the lower slope along the Namibian coast (Eisenbarth & Zettler, 2016). On the shelf, high biomass of polychaetes, bivalves *Sinupharus galatheae* and the gastropod *Nassarius vinctus* can be found along the northern coast. Similar abundances within the fringe of the project area around Rocky point, the inner shelf comprise relative abundances of colonial marine cnidarians, Pennatulacea, Actinaria, Asteroidia Mertzen, (2013) **Figure 15** and in the outer shelf abundance of same taxa were recorded in much higher abundances (Mateus unpublished data). The sulphide-rich (H2S) seabed sediments off the northern Benguela upwelling system fuels extensive mats of large sulphide-oxidizing bacteria on the seabed, which create detoxified habitat niches and food for the animals living there (Currie *et al*., 2018). High concentrations of H2S characterize the inner shelf surface sediments between 19°S and 27°S dominated by *Thiomargarita namibiensis* and some species of *Beggiatoacea* (Currie *et al*., 2018).

Along the Southern African west coast, water depth and sediment composition play an important role in determining physical environment and, therefore, the structure of macrofauna biodiversity. Soft-bottom communities are composed of epifauna and bottom-dwelling invertebrates and vertebrates which are in turn dependent on the benthic macrofauna for nutrition. Offshore, this habitat is home to the largest populations of the commercially important deep-sea red crab *Chaceon maritae*, which lives at depths of 300 to 1000m with higher densities in the northern region of Namibia (Pulfrich, 2017; Mateus, n.d.).

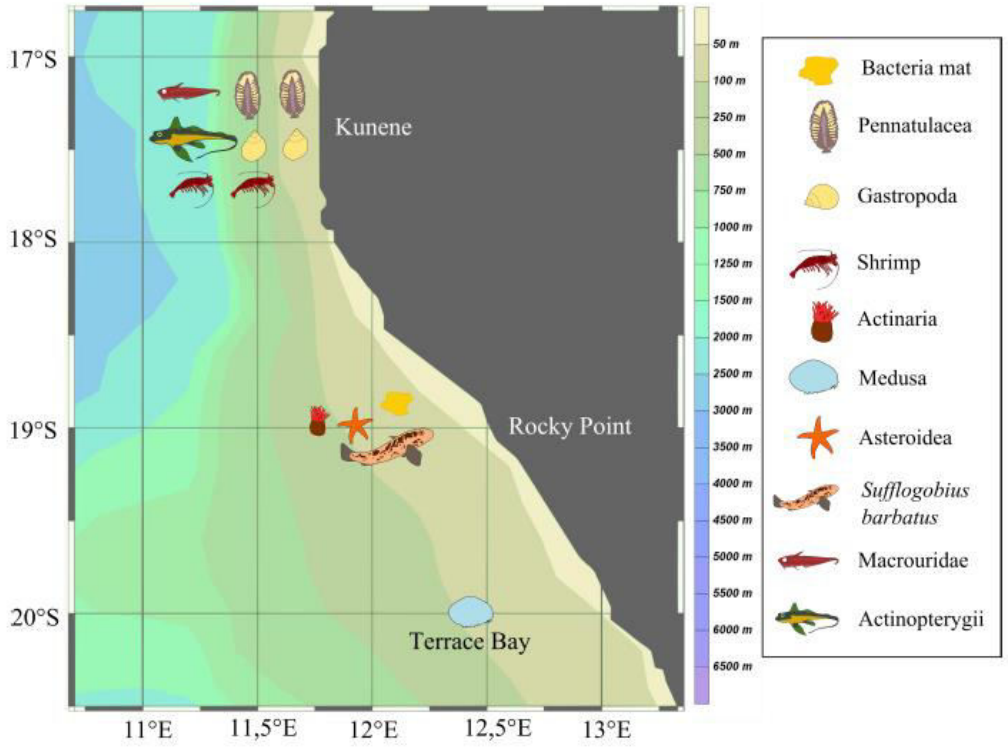


Figure 15: Benthic taxa composition at selected transects along the Northern coast (Mertzen, 2013)

5.3.3 Pelagic Communities

Pelagic refers to all open marine waters, setting them apart from the shore and the benthic zones close to the seabed including plankton, fish, and their main predators, marine mammals (seals, dolphins, and whales), seabirds and turtles. There are various types of plankton, including single-celled bacteria, phytoplankton, zooplankton, and ichthyoplankton. Fish consume plankton, which then is eaten by seabirds, sharks, and seals, which in turn are eaten by larger predators like killer whales. The northern Benguela system experiences three phases of upwelling (quiescent, active, and relaxed upwelling), characterized by different patterns of zooplankton abundance, taxonomic composition, and inshore-offshore distribution (Timonin *et al.*, 2010). Zooplankton abundance is relatively low and there are no significant differences in distribution within inshore and offshore areas. In response to changing upwelling conditions, phytoplankton biomass is highly variable on the Namibian shelf. The phytoplankton is dominated by diatoms, which can adapt to turbulent ocean conditions. A diatom bloom occurs after an upwelling event, whereas a dinoflagellate bloom occurs during a quiescent period because they can grow quickly at low nutrients levels.

High abundances of various fish species, especially those targeted by anglers (galjoen, steenbras, kabeljou, blacktail) however, commercially important pelagic species are mainly found in mixed shoals of various sizes that are generally within 200 meters and sometimes inshore, just beyond the skeleton coast surf zone (Tony *et al*., 2012).

The Namibian coastline is home to several marine mammals such as whales and dolphins and seals. The Namibian coastline is an important foraging and breeding area for cetaceans such as Bottlenose Dolphins, Heaviside's Dolphins, dusky dolphins, and Southern Right Whales (Ashton & Ashton, 2005) and several seal colonies exist in the northern coastal region within the proximities of the project area. Dolphins, whales and seals cover large foraging grounds, and the Northern regions comprise important foraging hotspots of these marine mammals (Ashton & Ashton, 2005; Schusterman, 1981). The Heaviside (*Cephalorhynchus heavisidii*), bottlenose (*Tursiops truncatus*), and dusky (*Lagenorhynchus obscurus*) dolphins occur mainly in the 200 depths along the entire Namibian coast (please find a paper on Namibian dolphin project side) (Ashton & Ashton, 2005). However, host species that migrate between Antarctic feeding grounds, warmer breeding grounds, and other species (humpback whale) with a globally distributed range are also found along coast (Ashton & Ashton, 2005). The Benguela upwelling system is a globally unique cold-water upwelling system as it is bounded in the north and south by warm-water current systems, characterized by high primary production. Thus, cetaceans associated with the Benguela ecosystem such as dusky dolphins and those associated with the warmer subtropical habitat off Angola are likely to be encountered in the survey area.

The northern coast is an important foraging area for leatherback turtle (*Dermochelys coriacea*) and green turtle (*Chelonia mydas*) (Cunningham & van Rooyen, 2020; Elwen & Braby, 2015). The northern Benguela ecosystem has a high density of jellyfish, which are the primary food source for turtles (Elwen & Braby, 2015). It is increasingly recognized as a potential feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Cunningham & van Rooyen, 2020).

The Namibian coastline supports large breeding and foraging populations of seabirds, there are 14 seabird species occurring along the coast (African Penguin, Cape Gannet, Bank Cormorant, Crowned Cormorant, Cape Cormorant, African Black Oystercatcher and Hartlaub’s Gull, Swift Tern and Caspian Tern, Great White Pelicans, flamingos). Most of the seabird species breeding in Namibia feed relatively close inshore (10-30 km). Along Namibia's coast, gannets and

cormorants and Damara Terns are common along the Northern coast region (Molly & Tapio, 2003).

5.4 Socio-Economic Settings

The project site (EPL) is not located within a specific regional jurisdiction; however, it is bordered to its immediate east by the Skeleton Coast National Park which is in the Kunene Region. The project will be supplied with services and infrastructure from the Erongo Region's facilities, mainly in Walvis Bay (for harbour where the exploration vessels will take off from). Therefore, the socio-economic settings presented herein is for the two regions as they are relevant to the project activities.

5.4.1 Demography

A. The Erongo Region

The Erongo Region covers an area of 63,586 km^2, which comprises 7.7% of Namibia's total area of about 823,680 km^2. The Erongo Region stretches from the Central Plateau westwards across the Central-Western Plains and Escarpment to the Central Namibian coast, roughly over a distance between 200 and 350 km. Northwards the stretches from the Ugab River in the north to the Kuiseb River in the south over up to 300 km. On the west it is flanked by the Atlantic Ocean (Erongo Regional Council, 2021).

The total population of the Erongo Region as per the 2011 National Population and Housing Census was recorded at 150 809, of which 70 986 were females and 79 823 males. The population density for the Region was 2.7 people per square kilometres (Namibia Statistics Agency, 2011).

B. The Kunene Region

According to the Kunene Regional Council (2021), Kunene Region is geographically located in the Northwestern part of Namibia and encompasses a range of biomass or landscapes neatly arranged parallel to one another. On the wet is the for-bidding Skeleton Coast. A region of rocks, fog, shipwrecks, and desolation, washed by the waters of the Benguela current, which brings Antarctic cold to desert heat.

The Kunene River in the northern part of the region forms an international boundary with Angola. The Kunene region boarders Omusati region to the east and southeast of the Etosha National Park. In the south, it is bordering the Erongo and Otjozondjupa regions.

The Kunene region covers an area of 115,293km^2 of the total Namibian land. Kunene Region is the second largest region after //Karas region. Kunene region is home to 86,856 inhabitants representing 4% of the Namibian population (Kunene Regional Council, 2021).

According to the Namibia Statistics Agency (2011), the total population of the Kunene Region as (per the 2011 National Population and Housing Census) was recorded at 86 856, of which 43 253 were females and 43 603 males.

5.4.2 Economy

A. Erongo Region

According to Bender (1999), the Coastal Zone of the Erongo Region is predominantly urban, because of the unique character of the landscape, which precludes agriculture. The population is thus concentrated in the urban areas of Walvis Bay, Swakopmund, Arandis and Henties Bay and a few small settlements such as Langstrand and Wlotzkasbaken. The rural population in the coastal area includes a group of Topnaars (approximately 500 persons) residing along the Kuiseb River.

According to the Erongo Regional Council (2015), the economy of the Erongo Region mainly depends on mining, fishing, agriculture, and tourism. The Mining Sector in the Erongo Region has been characterized by the establishment and expansion of several Uranium mines over the past decade due to an increased demand for this energy source. The Erongo Region also accommodates the mining of commodities such as gold, marble, granite, salt, and semi-precious stones.

The fishing industry is the third largest economic sector contributed about 6.6 percent cent to the Gross Domestic Product (GDP). The Region's whole eastern part and certain western parts are characterized by livestock farming on commercial farms in the districts of Karibib, Usakos and Omaruru, and in the communal areas. The Erongo Region further offers some of the most spectacular and popular tourist destinations as well as a variety eco-, wildlife, cultural and adventure tourism opportunities (Erongo Regional Council, 2015).

According to the Namibia Statistics Agency (2011a), the main source of income in households in the Erongo Region comes from farming (3%), wages and salaries (73%), cash remittance (5%), business and non-farming (9%) and pension (8%).

B. Kunene Region

The sources of income in the Kunene Region are derived from farming, business activities, wages and salaries, old-age pension, cash remittances, retirement funds, grants for orphans and vulnerable children (OVCs) and grants for people living with disabilities. The main source of income in the region (41%) is derived from salaries and wages, while the lowest is derived from orphan grants (0,5%). In the urban areas, 53,6% of households reported that their main source of income is derived from wages and salaries, while farming (42,9%) dominated as a source of income in the rural areas (Kunene Regional Council, 2015).

i. The Main Economic Activities

The main industries of employment in the region are found in the Agriculture, Forestry and Fishing sectors (11,283), followed by administrative and support services (1,648), the education sector (1,126) then the wholesale and retail trade and finally repair of motor vehicles (1,59). The Fishing industry is, however, less prevalent in the Region.

One of the crucial components that contributes to the economy of the Region is tourism. According to the Kunene Regional Council (2015), the tourism hotspots are, but not limited to the ones in Opuwo town (i.e., Ovahimba and Ovazemba traditional attires), Kunene River (Epupa Falls), Khorixas (Twyfelfontein– World Heritage Site, the Burned Mountain, Organ Pipes, and the Petrified Forest), Kamanjab (VingerKlip), Sesfontein (Ugab River Mouth, Warmquelle-hot springs, Skeleton Coast) and Epupa (Swartbooi Drift – Dorsland Trekkers).

ii. Mining

Kunene Region offers great opportunities for mineral exploration due to its rock and mountainous formations, which are pivotal for regional economic growth and development. Exploration and discovery of mineral resources is at an advanced stage and if found economically viable, could contribute significantly to the economic growth of the Region (Kunene Regional Council, 2015).

iii. Fisheries and Marine Resources

With regards to the fishing activities in Kunene Region, these are observed at Terrace Bay, Mowe Bay and along the Kunene River. In addition, the Ministry of Fisheries has also established aqua-culture projects in Fransfontein and Okandombo (Kunene Regional Council, 2015).

5.5 Surrounding Land Uses

The EPL is in offshore with the only neighbouring land use onshore east being the Skeleton Coast National Park.

In the immediate east side of the EPL is the Terrace Bay, an angler's paradise offering an exceptional coastal experience inside the famous Skeleton Coast Park. The area is equipped with one of the Namibia Wildlife Resorts accommodation facilities (rest camp) also known as a resort. This resort is located on the coast (directly on the beach), set in an undisturbed and peaceful spot, surrounded by the majestic dunes of the northern Namib Desert (Namibia Wildlife Resorts, 2021).

The typical activities that are carried out at the Bay include sightseeing of Terrace Bay's wildlife diaspora at the Uniab River Delta, hiking, bird watching, spot gaming or witnessing breathtaking sunsets from atop the dunes.

The next chapter is a presentation of how the public was notified and consulted for the ESA.

6 PUBLIC CONSULTATION PROCESS

The Environmental Impact Assessment (EIA) Regulations GN 28-30 (GG 4878) detail requirements for public consultation within a given environmental assessment process (GN 30 S21). Public consultation forms an important component of an Environmental Assessment (EA) process. It provides potential Interested and Affected Parties (I&APs) with an opportunity to comment on and raise any issues relevant to the project for consideration as part of the assessment process. The public consultation process assists the Environmental Assessment Practitioner (EAP) in identifying all potential impacts and to what extent further investigations are necessary. Public consultation can also aid in the process of identifying possible mitigation measures. Public consultation for this project has been done under the EMA and its EIA Regulations.

6.1 Registered Interested and Affected Parties (I&APs)

The Consultant identified relevant and applicable national, regional, and local authorities, local leaders, and other interested members of the public. Pre-identified I&APs were contacted directly,

while other parties who contacted the Consultant after project advertisement notices in the newspapers, were registered as I&APs upon their request. Newspaper advertisements of the proposed offshore exploration activities were placed in two widely read national newspapers in the region (*The Namibian* and *New Era* Newspapers). The project advertisement/announcement ran for two consecutive weeks inviting members of the public to register as I&APs and submit their comments. The list of registered and consulted I&APs is provided in **Appendix D**.

6.2 Communication with I&APs

The public consultation process was conducted according to the requirements of Regulation 21 of the EIA Regulations. However, the complete fulfilment of this Regulation was slightly affected by the COVID-19 Regulations. Regardless, the Environmental Consultant tried all the possible ways to ensure that they reached as many people as possible to get involved in the process. The communication with the interested and affect parties (I&APs) about the proposed project was done through the following means and in this order to ensure that the public is notified and afforded an opportunity to comment on the proposed project activities:

- Registration of pre-identified stakeholders and interested & affected parties (I&APs) and updating the list throughout the environmental assessment process.
- Placement of newspaper adverts in two newspapers, *New Era* and *The Namibian* both on the 22nd and 29th of June 2021 - **Appendix E**, briefly explaining the activity and its locality, inviting members of the public to register as I&APs and submit their comments/concerns.
- A Background Information Document (BID) containing brief information about the proposed facility was compiled (**Appendix F**) and circulated to relevant pre-identified authorities (stakeholders) on 30 June 2021, and upon request to all new registered I&APs.
- A project/public notice was compiled (the clear copy of this public notice is shown in **Figure 16)**, printed in three A3 size posters. The public notice contained public meeting invitation details and were placed at the following places:
    - In Swakopmund at the Erongo Regional Council notice board since the harbour infrastructures to be used by the exploration vessel would be taking off from the Walvis Bay Harbour which falls under the Erongo Region jurisdiction (**Figure 17**).
    - In Opuwo at the Kunene Regional Council notice board (**Figure 18**) because on the onshore eastern side, the EPL borders the Skeleton Coast National Park which falls under the Kunene Region jurisdiction.

- Walvis Bay Municipality notice board (in Walvis Bay – **Figure 19**) because the town houses the harbour infrastructure/facilities which will provide services to the exploration vessel.

- Two slot online public consultation meetings were arranged and the link shared with all registered I&APs a week prior to the meeting date. The meeting slots were scheduled for Thursday, the 15th of July 2021 at 10h30 in the morning and 14h30. However, the meeting was a no-show. The Consultant assumed the meeting was a no-show due to some of the following reasons:
    - Lack of interest in the project because the project is offshore, and most members of the public do not see the need to get involved in.
    - Due to the global pandemic of the coronavirus, people may rather be worried about navigating their lives through the COVID-19 situation and its regulations. Some may have been interested but internet connection or operating electronic devices to join online gatherings/meetings could had been a limiting factor, etc.

ENVIRONMENTAL ASSESSMENT (EA) FOR THE PROPOSED OFFSHORE EXPLORATION ACTIVITIES OF PRECIOUS STONES ON EXCLUSIVE PROSPECTING LICENSE (EPL) NO. 6929 WEST OF THE SKELETON COAST NATIONAL PARK IN THE KUNENE REGION, NAMIBIA: AN APPLICATION FOR THE ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC)

Under the Environmental Management Act (No. 7 of 2007) and its 2012 Environmental Impact Assessment (EIA) Regulations, the public is hereby notified that an application for the Environmental Clearance Certificate (ECC) of the offshore mineral (precious stones) exploration activities will be submitted to the Environmental Commissioner.

Proponent: Linco Investments CC

Environmental Consultant: Excel Dynamic Solutions (Pty) Ltd ("EDS" Namibia)

Type of activity: Offshore Exploration Activities of Precious Stones on Exclusive Prospecting License (EPL) No. 6929

Location & Footprint: The proposed exploration activities of precious stones will be undertaken offshore within the boundaries of EPL 6929. The 77 730-hectare (ha) tenement is located about 400km north of Swakopmund and 200km of southwest of Opuwo along the Skeleton Coast of Namibia parallel to the present shoreline, near Terrace Bay (**please refer to the locality map below**).

The site area (EPL) is located west of the Skeleton Coast Park, a proclaimed nature reserve in the Kunene Region The area lies within water depths of about +/-4 meters below sea level (mbsl) to +80mbsl.

Members of the public are further invited to register as Interested and Affected Parties (I&APs) to comment/raise concerns or receive further information on the Environmental Assessment (EA) process. Registration is to be done with EDS on the contact details below.

A 2-slot Public Consultation Meeting will be held virtually as per the following details:

Date: Thursday, 15 July 2021

Time 1 (Slot 1): 10h30 Please join Zoom Meeting here:

https://zoom.us/j/94885568474?pwd=RDFJTkUwZmFxdEkwTDdpQUNhNmxRZz09

Meeting ID: 948 8556 8474, Passcode: 000706

Time 2 (Slot 2): 14h30 Please Join Zoom Meeting here:

https://zoom.us/j/99608195206?pwd=Tmx2OHp4TXM1bE53V2dCdFY0Z053QT09

Meeting ID: 996 0819 5206, Passcode: 928635

Please feel free to join the meeting using either of the provided links according to your availability (i.e., at whichever slot is suitable for you).

Venue: Due to COVID-19 Regulations and movement restrictions, the meeting will be held virtually (online) with registered and available I&APs.

Registration and comments/concerns/issues should reach EDS before end of business on before or on Friday, 6 August 2021.

Contact Person(s): **Mr. Fredrika Shagama or Ms. Althea Brandt**

Tel: +264 61 259 530, E-mail: public@edsnamibia.com

Excel Dynamic Solutions

Location of EPL 6929 Offshore

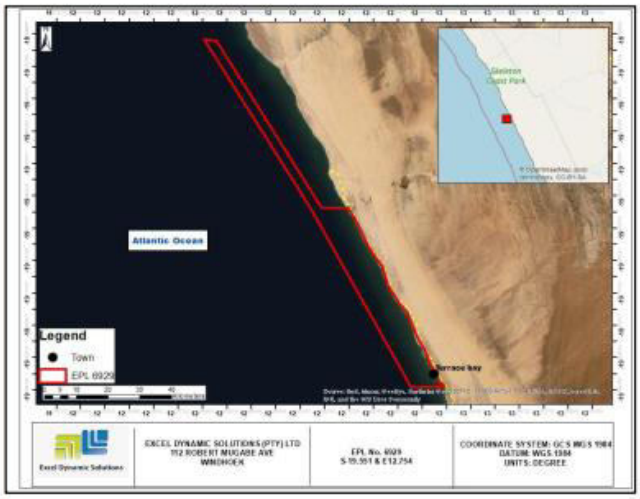
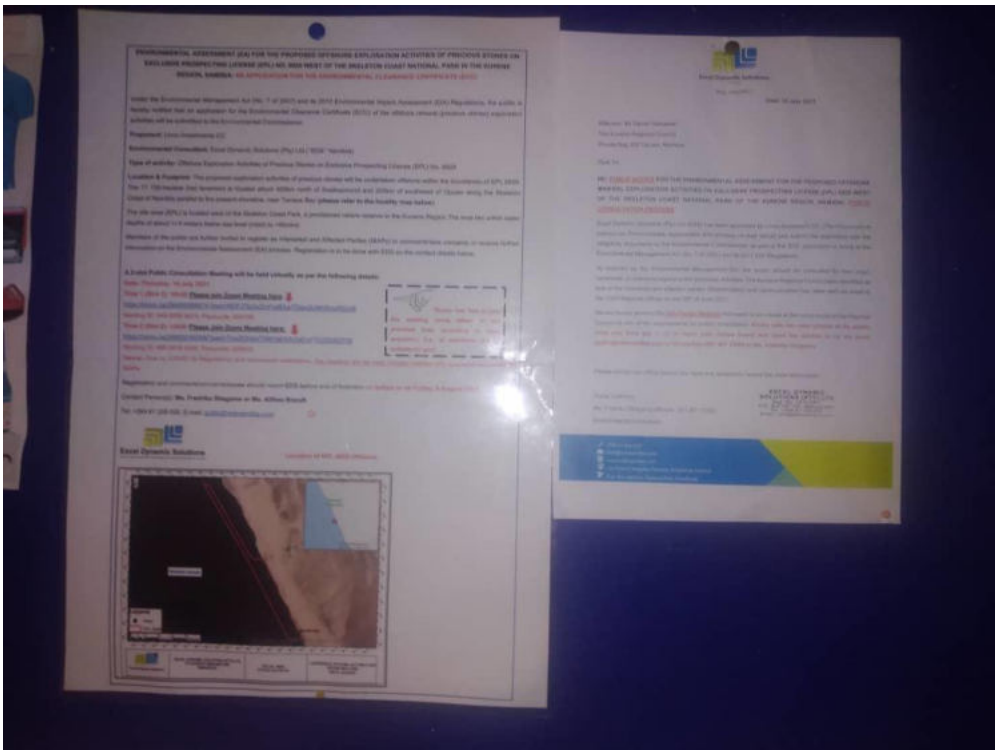


Figure 16: Clear copy of the A3 Public notice with visible details

Figure 17: Public notice placed at the Erongo Regional Council



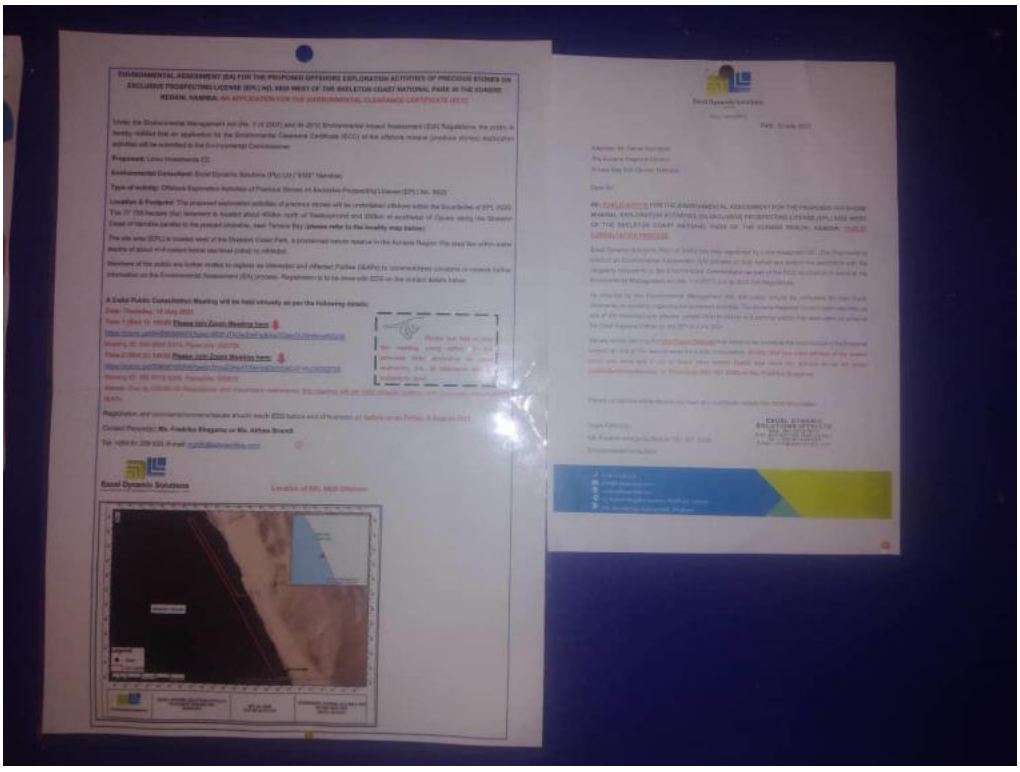


Figure 18: Public notice placed at the Kunene Regional Council

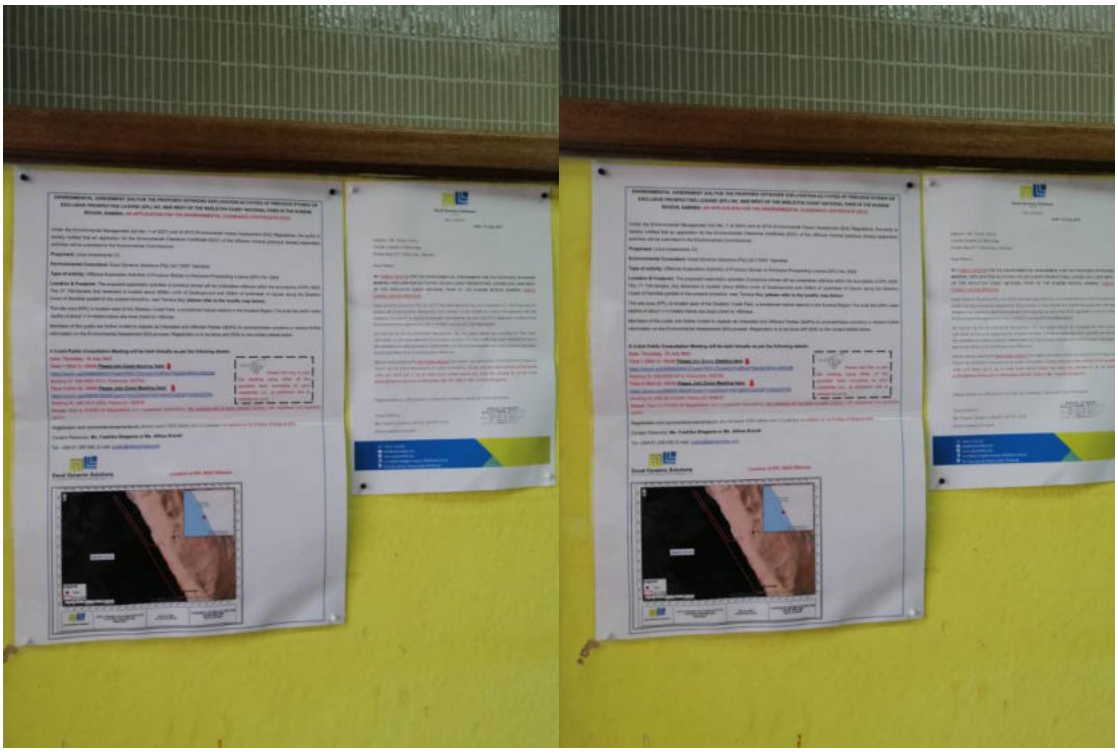


Figure 19: Public notice placed at the Municipality of Walvis Bay

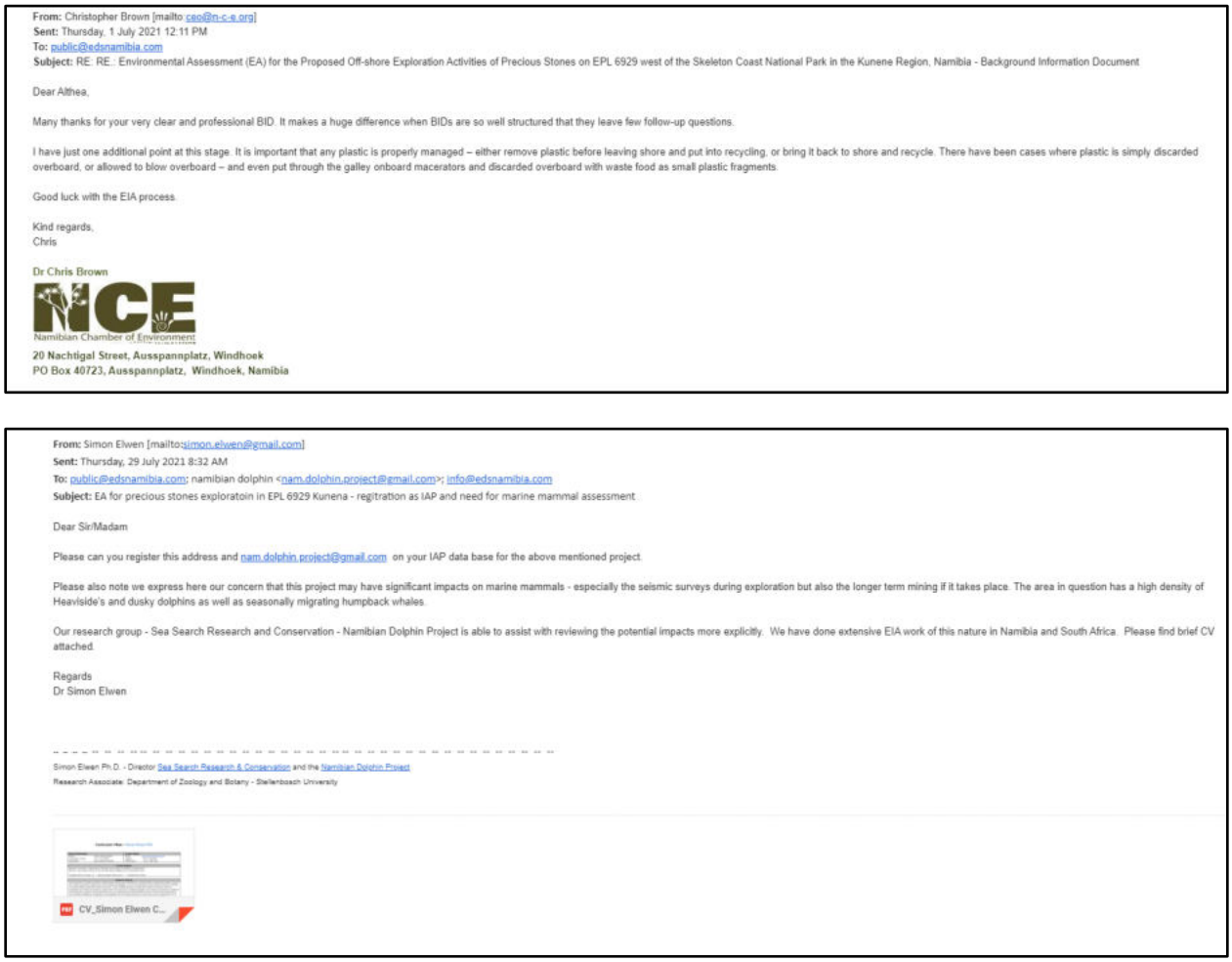
6.3 Public Consultation Feedback

The feedback on the BID was received from two I&APs and this is summarized in **Table 3** below and shown as received in **Figure 20.**

Table 3: Summary of comments received from I&APs on the BID and prior to the public meeting

Commentor, Date & Mode of commenting	Comment/Issue/Suggestion	ESD Response
Dr Christopher Brown (Namibia Chamber of Environment (NCE)), 1 July 2021 (Email)	**Waste management:** it is important that any plastic is properly managed – either remove plastic before leaving shore and put into recycling or bring it back to shore and recycle. There have been cases where plastic is simply discarded overboard or allowed to blow overboard – and even put through the galley onboard macerators and discarded overboard with waste food as small plastic fragments.	The valuable input has been incorporated into the impact identification and assessment sections of this Report and draft EMP.

Dr Simon Elwen (Sea Search Research and Conservation - Namibian Dolphin Project), 29 July 2021 (Email)	Potential significant impacts on marine mammals - especially the seismic surveys during exploration but also the long-term mining if it takes place. The area in question has a high density of Heaviside's and dusky dolphins as well as seasonally migrating humpback whales.	The valuable input has been incorporated into the impact identification and assessment sections of this Report. **A Desktop Benthic Study has been conducted and the Report is attached hereto as Appendix G.**



From: Christopher Brown [mailto ceo@n-c-e.org]
Sent: Thursday, 1 July 2021 12:11 PM
To: public@edsnamibia.com
Subject: RE: RE:. Environmental Assessment (EA) for the Proposed Off-shore Exploration Activities of Precious Stones on EPL 6929 west of the Skeleton Coast National Park in the Kunene Region, Namibia - Background Information Document

Dear Althea,

Many thanks for your very clear and professional BID. It makes a huge difference when BIDs are so well structured that they leave few follow-up questions.

I have just one additional point at this stage. It is important that any plastic is properly managed – either remove plastic before leaving shore and put into recycling, or bring it back to shore and recycle. There have been cases where plastic is simply discarded overboard, or allowed to blow overboard – and even put through the galley onboard macerators and discarded overboard with waste food as small plastic fragments.

Good luck with the EIA process.

Kind regards,
Chris

Dr Chris Brown
Namibian Chamber of Environment
20 Nachtigal Street, Ausspannplatz, Windhoek
PO Box 40723, Ausspannplatz, Windhoek, Namibia

From: Simon Elwen [mailto:simon.elwen@gmail.com]
Sent: Thursday, 29 July 2021 8:32 AM
To: public@edsnamibia.com; namibian dolphin <nam.dolphin.project@gmail.com>; info@edsnamibia.com
Subject: EA for precious stones exploratoin in EPL 6929 Kunena - regitration as IAP and need for marine mammal assessment

Dear Sir/Madam

Please can you register this address and nam.dolphin.project@gmail.com on your IAP data base for the above mentioned project.

Please also note we express here our concern that this project may have significant impacts on marine mammals - especially the seismic surveys during exploration but also the longer term mining if it takes place. The area in question has a high density of Heaviside's and dusky dolphins as well as seasonally migrating humpback whales.

Our research group - Sea Search Research and Conservation - Namibian Dolphin Project is able to assist with reviewing the potential impacts more explicitly. We have done extensive EIA work of this nature in Namibia and South Africa. Please find brief CV attached.

Regards
Dr Simon Elwen

Simon Elwen Ph.D. - Director Sea Search Research & Conservation and the Namibian Dolphin Project
Research Associate: Department of Zoology and Botany - Stellenbosch University

CV_Simon Elwen C...

Figure 20: Comments as received from I&APs

The following chapter entails the potential impacts that are anticipated to be associated with the project activities, their description (for the negative/adverse impacts only), assessment and management/mitigation thereof to minimize their significance to the affected environmental features.

7 IMPACT IDENTIFICATION, ASSESSMENT AND MITIGATION MEASURES

7.1 Identification of Potential Impacts

Offshore exploration activities are usually associated with some potential positive and negative impacts. For an environmental assessment, the focus is mainly placed on the negative impacts. This is done to ensure that these impacts are addressed by providing adequate mitigation measures such that an impact's significance is brought under control, while maximizing the positive impacts of the project. The potential positive and negative impacts that have been identified from the prospecting activities are listed as follow:

Positive impacts:

- Creation of jobs to the locals (primary, secondary, and tertiary employment).
- Helps boost local economic growth.
- Open other investment opportunities.
- Contribution to regional economic development.

Negative impacts:

- Possible destruction of marine faunal and floral habitats as well as removal of nutrients.
- Potential significant impacts on marine mammals - especially the seismic surveys during exploration but also the long-term mining if it takes place. The area in question has a high density of Heaviside's and dusky dolphins as well as seasonally migrating humpback whales.
- Potential marine pollution due to accidental hydrocarbon spills from exploration equipment would impact marine fisheries resources.
- Potential occupational health, safety and security risks associated with mishandling of exploration equipment as well as from accidents or emergencies at sea.

7.2 Impact Assessment Methodology

The Environmental Assessment is primarily a process used to ensure that potential impacts that may occur from project activity are identified and addressed with environmentally cautious approaches and legal compliance. The impact assessment method used for this project is in accordance with Namibia's Environmental Management Legislation (Environmental Management

Act No. 7 of 2007) and its Regulations of 2012, as well as the International Finance Corporation (IFC) Performance Standards.

7.2.1 Impact Assessment Criteria

The identified impacts were assessed in terms of probability (likelihood of occurring), scale/extent (spatial scale), magnitude (severity) and duration (temporal scale) as presented in **Table 4**. To enable a scientific approach to the determination of the environmental significance, a numerical value is linked to each rating scale. This methodology ensures uniformity and that potential impacts can be addressed in a standard manner so that a wide range of impacts are comparable. It is assumed that an assessment of the significance of a potential impact is a good indicator of the risk associated with such an impact. The following process will be applied to each potential impact:

- Provision of a brief explanation of the impact.
- Assessment of the pre-mitigation significance of the impact; and
- Description of recommended mitigation measures.

The recommended mitigation measures prescribed for each of the potential impacts contribute towards the attainment of environmentally sustainable operational conditions of the project for various features of the biophysical and social environment. The following criteria (**Table 4**) were applied in this impact assessment:

Table 4: Impact Assessment Criteria employed to assess the potential negative impacts

Nature	Description	Rating
Extent (Spatial scale)	An indication of the physical and spatial scale of the impact.	**Low (1):** Impact is localized within the site boundary: Site only. **Low/Medium (2):** Impact is beyond the site boundary: Local. **Medium (3):** Impacts felt within adjacent biophysical and social environments: Regional. **Medium/High (4):** Impact widespread far beyond site boundary: Regional **High (5):** Impact extend National or over international boundaries.
Duration	The timeframe, over which the impact is expected to occur, measured in relation to the lifetime of the project.	**Low (1):** Immediate mitigating measures, immediate progress

Nature	Description	Rating
		Low/Medium (2): Impact is quickly reversible, short-term impacts (0-5 years) **Medium (3):** Reversible over time; medium term (5-15 years). **Medium/High (4):** Impact is long-term. **High (5):** Long term; beyond closure; permanent; irreplaceable or irretrievable commitment of resources
Intensity, Magnitude / Severity (Qualitative criteria)	The degree or magnitude to which the impact alters the functioning of an element of the environment. The magnitude of alteration can either be positive or negative	**Medium/low (4):** Low deterioration, slight noticeable alteration in habitat and biodiversity. Little loss in species numbers. **Low (2):** Minor deterioration, nuisance or irritation, minor change in species / habitat / diversity or resource, no or very little quality deterioration.
Probability of occurrence	Probability describes the likelihood of the impacts occurring. This determination is based on previous experience with similar projects and/or based on professional judgment	**Low (1):** Improbable; low likelihood; seldom. No known risk or vulnerability to natural or induced hazards. **Medium/low (2):** Likely to occur from time to time. Low risk or vulnerability to natural or induced hazards. **Medium (3):** Possible, distinct possibility, frequent. Low to medium risk or vulnerability to natural or induced hazards. **Medium/High (4):** Probable if mitigating measures are not implemented. Medium risk of vulnerability to natural or induced hazards. **High (5):** Definite (regardless of preventative measures), highly likely, continuous. High risk or vulnerability to natural or induced hazards.

7.2.2 Impact Significance

After the impact has been assessed, its significance is then determined. The impact significance is determined through a synthesis of the above impact characteristics (in Table 3 above). The significance of the impact "without mitigation" is the main determinant of the nature and degree of mitigation required. Once the above factors (**Table 5**) have been ranked for each potential impact, the impact significance of each is assessed using the following formula:

SP = (magnitude + duration + scale) x probability

The maximum value per potential impact is 100 significance points (SP). Potential impacts were rated as high, moderate, or low significance, based on the following significance rating scale (**Table 5**).

Table 5: Significance rating scale

Significance	***Environmental Significance Points***	***Colour Code***
High (positive)	>60	H
Medium (positive)	30 to 60	M
Low (positive)	<30	L
Neutral	0	N
Low (negative)	>-30	L
Medium (negative)	-30 to -60	M
High (negative)	>-60	H

Positive (+) – Beneficial impact

Negative (-) – Deleterious/ adverse Impact

Neutral – Impacts are neither beneficial nor adverse.

For an impact with a significance rating of high (-ve), mitigation measures are recommended to reduce the impact to a medium (-ve) or low (-ve) significance rating, provided that the impact with a medium significance rating can be sufficiently controlled with the recommended mitigation measures. To maintain a low or medium significance rating, monitoring is recommended for a period to enable the confirmation of the significance of the impact as low or medium and under control.

The assessment of the construction and operational phases is done for pre-mitigation and post-mitigation.

The risk/impact assessment is driven by three factors:

- **Source: The cause or source of the contamination**
- **Pathway: The route taken by the source to reach a given receptor**

- **Receptor: A person, animal, plant, eco-system, property, or a controlled water source. If contamination is to cause harm or impact, it must reach a receptor.**

The potential negative impacts stemming from the proposed activities are described, assessed and management/mitigation measures provided thereof. Further mitigation measures in a form of management action plans are provided in the Draft EMP.

7.3 Assessment of Potential Negative Impacts: Exploration Phase

The main potential negative impacts associated with the exploration phases are identified and assessed below:

7.3.1 Impact on Marine Biodiversity (Shaanika and Mateus, 2021)

Benthic invertebrates such as Cephalopods, some bivalves, echinoderms, and crustaceans have structures called statocysts, which contain a statolith and associated sensory hairs sensitive to low frequencies and are responsive to particle motion in the sound field (Offutt 1970; Budelmann 1988, 1992; Packard *et al*., 1990; Popper *et al*., 2001). Marine invertebrates are mainly susceptible to low frequency sounds ranging between 40Hz - 400 Hz. There is limited information on invertebrate sound detection under field operating conditions, however, lethal, and sub-lethal effects have been observed under experimental conditions where invertebrates were exposed to air guns (McCauley, 1994). Some changes include swimming, metabolic, growth, and reproduction rates reduced, and behaviour changes. Under stress, Manila clams relocate less and remain atop the seafloor with closed off valves (Weilgart, 2018). Due to these responses, the clams were unable to mix the sediment above the surface for feeding, and therefore, prolonged stressor periods may lead to accumulating lactate and further ecosystem functionalities will be affected in the absence of clams (Solan *et al*., 2016).

Phytoplankton and zooplankton are mainly restricted by currents, so they are not able to actively avoid the seismograph, and therefore they are likely to encounter the sound sources. There is no evidence to suggest that seismic surveys affect phytoplankton, and air gun impulses are unlikely to have a significant effect beyond 1m distance (McCauley, 1994).

Fish detect sound in two ways; the ear that is sensitive to sound pressure and the lateral line that detects particle motion. These systems have their own hearing threshold (Tavolga & Wodinsky 1963). The lateral line is sensitive to low frequency (20 - 50 Hz) through the particle velocity component of sound. Low frequency sounds can cause harm to internal organs of larger fish.

Most fish can detect sound from 50 - 1000 Hz (Popper & Fay, 1999; Popper *et al*., 2003) **Chyba! Nenalezen zdroj odkazů.**. Fish can differentiate between sounds sources and conscious of direction of sound, differentiate between biological sound and anthropogenic noise. Fish can be exposed seismic survey without lethal effects. With only localized impacts of swimming bladders and temporary hearing loss (Falk & Lawrence, 1973; Enger, 1981). Most fish will distance themselves from seismic sound sources and only a few animals will be hurt by the seismic sounds (Pulfrich, 2017). Behavioral impacts are often short term and lasting less than the length of the impact and vary from leaving the area, change in depth and these can be observed 5 km from the seismic source (Hassel *et al*., 2004). The ecological significance of seismic effect is expected to be low except in case here they influence reproductive activities. although effect is not well documented, recruitment tend to be affected as fish have been found to cease spawning. This area of interest is an important foraging and spawning area for species such as kop, anchovies, and Steenbras.

Marine seabirds will mainly be affected by seismic sounds as they dive and rest on the water surface. This area of interest is in the foraging range of diving birds such as cormorant, cape gannets and the flight less African penguin. The penguins are most susceptible to seismic sounds due to their flight lessness, they have a hearing range 100 Hz – 15 kHz (Wever *et al*. 1969). Pichegru *et al.,* 2017 however found penguins to strongly avoid their foraging area during seismic activities, when seismic activities occurred within 100 km of their breeding site.

Marine turtles are susceptible to physiological injury, behavioral change and masking of environmental sounds and communications. Turtles' auditory sensitivity frequencies ranges from 60Hz -2000 Hz (Holtz *et al*., 2021; McCauley, 1994; Atlantic G&G Programmatic EIS, 2014). This overlap with the sound produces by most seismic activities, suggesting that turtle could be affected by seismic noise.

Cape fur seals forage within and beyond the continental shelf and are expected to be present in the EPL of interest. Cape Fur seals audiograms have not been specifically studied but, most seals and sea lions can detect sound of below 100 Hz and over 10kHz (McCauley 1994; Atlantic G&G Programmatic EIS, 2014) - **Figure 21**. Seismic sounds can affect seals physiologically, behaviorally and mask biological sounds, and indirect effects on predators and prey. Seals exhibit avoidance and fright behaviour around seismic sound sources Pulfrich, (2017), but their behavior generally resumes normal behaviour as soon as sounds stops. They generally tend to stay in the area. Cape fur seals are relatively insensitive to sound below 1000 Hz, making them relatively tolerant to most seismic activity.

Cetaceans (whales and dolphins) highly dependent on sound for communication, feeding and direction. Cetaceans a use sound frequencies ranging from 7 – 200 kHz, with most whales using frequency range of 7- 22 kHz (found humpback whales in the wild to detect sounds ranging from 10 Hz to 10 kHz at levels of 102), while most dolphins use a relatively higher frequency range of just below 1kHz to over 100 kHz (Atlantic G&G Programmatic EIS, 2014; Popper, 1980) **Chyba! Nenalezen zdroj odkazů.**. Strongly suggesting that cetacean particularly whales (larger toothed whales and baleen whales such as Humpback whale) are susceptible to sound of seismic equipment's (Nowacek *et al*., 2007). Cetaceans suffer physiological injuries and stress (Lien, 1993), behavioral disturbances (Malme *et al*., 1988; Stone, 2003), masking of important environmental sound (Weilgart *et al*., 2007; Di Lorio, 2010) and indirect effects on prey species (Englas *et al*., 1995).

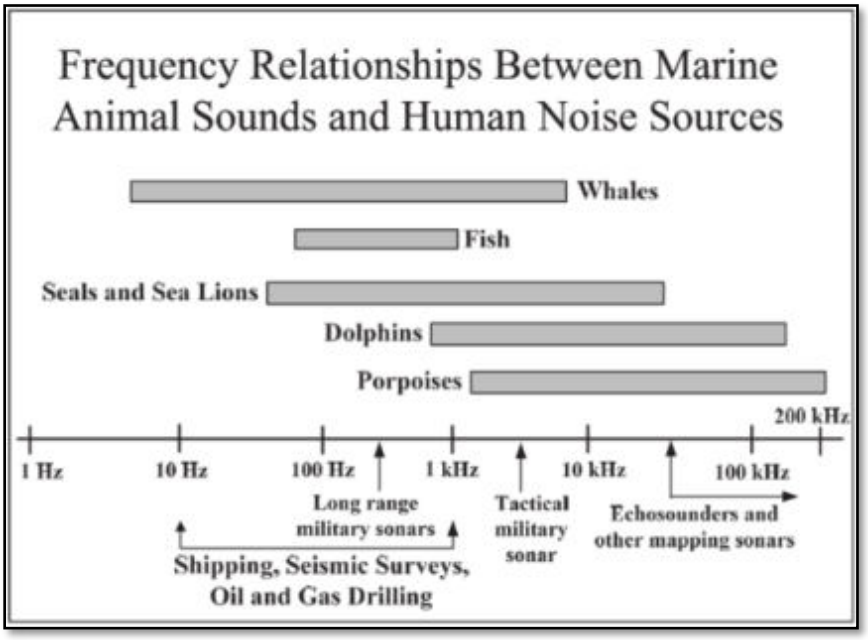


Figure 21: Frequency range of sounds generally produced by different marine animal groups shown relative to major human noise sources ((Atlantic G&G Programmatic EIS, 2014 as cited by Shaanika and Mateus, 2021)

The main threat generated from the geophysical survey will be sound generated by the seismic profiling system, which will be producing less than 12 Hz sound frequency, most of the biodiversity occurring in the EPL 6929 have auditory sensitivity frequencies of over 50Hz and do not overlap with that produced by the seismic profiling system. Cetacean (large toothed and Baleen whales) and fish will potentially be affected by the seismic profiling system.

Under the status, the impact can be of a medium significance rating. With the implementation of appropriate mitigation measures, the rating will be reduced to a low significance rating. The impact to marine biodiversity is assessed below (**Table 6**).

Table 6: Assessment of the impacts of exploration activities on marine biodiversity

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M/H - 4	L/M - 2	L/M - 4	M/H - 4	M – 40
Post mitigation	M/H - 4	L: 1	L - 2	L/M: 3	L: -21

Mitigations and recommendation to minimize the impact on marine biodiversity

- Appoint independent onboard Marine Fauna Observer (MFO) and Passive acoustic monitors (PAM) for the duration of the survey. MFO and PAM should be knowledgeable about the Namibian Marine environment and biodiversity and able to identify seabird, marine mammals, and turtles among other marine fauna. MFO will monitor the presence of marine fauna during day light and the PAM operator should monitor the presence of marine mammals in the water column around the vessel using specialized hydrophones after sunset or during low visibility conditions.
- Adapt The Joint Venture for conservation committee (JNCC) guidelines for minimizing injury to marine mammal from Geophysical survey (seismic survey guidelines) during the survey. (https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4)
- Seismic survey should be avoided during cetacean's migratory seasons (June-November), when they move from the southern oceans to the equator. December to May is the recommended time for the exploration.
- To monitor the impact of the benthic communities. underwater video recording is strongly recommended before, during and after exploration.

7.3.2 Waste Generation (Pollution)

The two significant project phases will be associated with the generation of different waste, ranging from domestic, sewage, general (such as plastics) to hazardous waste. If the generated waste is not disposed of in a responsible way, marine pollution may occur not only within the site boundary but also the surrounding marine environment at large. Improper handling, storage and disposal of hydrocarbon products and hazardous materials for instance may lead to marine water

contamination, in case of spills and leakages. Therefore, the project needs to have appropriate and effective waste management for the operations.

Without any mitigation measures, the general impact of waste generation has a medium significance. The impact will reduce to low significance, upon implementing the mitigation measures. The assessment of this impact is given in **Table 7**.

Table 7: Assessment of waste generation impact

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M/H - 4	L/M - 4	M/H - 4	M - 44
Post mitigation	L - 1	L - 1	L - 2	L/M - 2	L - 8

Mitigations and recommendation to waste management

- The exploration vessel should be equipped with separate waste bins for all waste types (general/domestic, hazardous, etc.).
- Plastic should be removed before leaving shore and put into recycling or bring it back to shore for recycling.
- Plastic or any other waste type should not be discarded overboard or allowed to blow overboard nor put through the galley onboard macerators and discarded overboard with waste food as small plastic fragments.
- Biodegradable and non-biodegradable wastes must be stored in separate containers and collected regularly for disposal at a recognized landfill/dump site on land, upon reaching an agreement with the Municipality of Walvis Bay being the closest from the harbour.
- Workers should be sensitized to dispose of waste in a responsible manner and not to litter on and overboard exploration vessel.
- After each daily works, the Proponent should ensure that all waste types are stacked up and stored into the onboard waste bins and not left on the open spaces of the exploration vessel or thrown into the sea.
- All waste produced on the vessel should be contained until such that time it can be transported to designated waste sites onshore/on land in Walvis Bay.

- Sewage waste should be stored as per the portable chemical toilets' manufacturer's instructions and disposed of at the nearest wastewater treatment facility (in Walvis Bay) on land and not disposed of in the sea/overboard. This will be done to ensure that wastewater do not reach and contaminate seawater.
- Oil spills should be taken care of by ensuring that the vessel is equipped with drip trays for onboard fuel-consuming equipment, if any.
- A penalty system for irresponsible disposal of waste on and overboard area should be implemented.
- The Proponent should develop and prepare countermeasures to contain, clean up, and mitigate the effects of an oil spill on board. This includes keeping spill response procedures
- Washing of equipment contaminated hydrocarbons should take place at a dedicated area (lined) onboard, where contaminants are contained to prevent runoff into marine water resources.

7.3.3 Occupational Health, Safety and Security

The project activities can be associated with some health and safety risks to the workers (exploration crews) when exposed to these. These risks are in terms of accidental injury, owing to either minor (i.e., superficial physical injury) or major (i.e., involving heavy machinery) accidents, possible falling off the exploration vessel and drowning in the sea.

The possible presence of hydrocarbons onboard may result in accidental fire outbreaks. This could pose a safety risk to the project personnel, machinery, and equipment.

If machinery and equipment are not properly stored and packed, there would be risks of this machinery or equipment falling and injure the project personnel.

The impact can be rated as medium significant if no mitigation measures are implemented, but upon implementation, the impact will be of low significance. This impact is assessed in **Table 8** below and mitigation measures provided thereof.

Table 8: Assessment of the impacts of the project activities on health, safety, and security

Mitigation Status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M - 3	M - 3	M - 6	M/H - 4	M – 48
Post mitigation	L/M - 2	L/M - 2	L - 2	L/M - 2	L - 12

Mitigations and recommendation to minimize health, safety and security issues

- As part of their induction, the workers should be provided with an awareness training of the risks of mishandling equipment and materials onboard.
- The Proponent should ensure that the equipment and machinery required and used for exploration are in good condition and well-serviced/maintained to prevent injuries and safety risks stemming from potential malfunctioning of and unstable equipment.
- The exploration crew should include a qualified and experienced medical personnel and occupational health & safety officer to ensure that both minor and major health incidents are properly attended to and in time.
- The exploration vessel should be equipped with a minimum of two first aid kits and two fire extinguishers and respective crew members trained how to administer and use these, respectively.
- The equipment and fuel storage areas onboard should be properly secured to prevent any harm or injury to the project personnel.
- The exploration vessel should be frequently supplied with sufficient personal protective equipment (PPE) to ensure that the crew has an interrupted supply of PPE to ensure safety throughout the exploration activities.
- When operating at different areas of the vessel, employees should be properly equipped with adequate and suitable PPE such as coveralls, masks, gloves, safety boots, earplugs, safety glasses, and hard hats. The PPE should also include the suitable warm clothes to protect the workers/crew against cold sea weather.
- No employee should be allowed to consume alcohol or other intoxicants prior to and during working hours as this may lead to mishandling of equipment which results into injuries and other health and safety risks.

In terms of security aspect:

- All crew members aboard the exploration vessel should be issued with and in possession of Restricted Area Permits (RAPs) in terms of the Diamond Act 13 of 1999 (and the Regulations) from the Ministry of Mines and Energy (MME).
- The Proponent should ensure that these permits are applied for and obtained for every crew member prior to boarding the exploration vessel.

8 RECOMMENDATIONS AND CONCLUSIONS

8.1 Recommendations

The potential impacts (both positive, and negative) that are anticipated from the proposed project activities were identified, described, and assessed. The potential negative impacts of were rated as medium significant and appropriate mitigation measures were recommended for effective implementation and continuous monitoring by the Proponent, their contractors and project related personnel. The aim will be to reduce the potential impacts from medium significance to low in the long run and bring the impact under control throughout the project operations. These management and mitigation measures are provided under chapter 7 of this ESA report, and as management action and monitoring plans in the draft EMP.

The public was consulted as required by the EMA and its 2012 EIA Regulations (Section 21 to 24). This was done via the two newspapers used for this environmental assessment (New Era and the Namibian newspapers in July 2021); A notice for public consultation meeting was sent out. However, on the day of the meeting no one showed up. Three A3 public notices (posters) were placed at three different locations' notice boards. The posters that contained public meeting invitation details were placed at the following places:

- In Swakopmund at the Erongo Regional Council notice board since the harbour infrastructures to be used by the exploration vessel would be taking off from the Walvis Bay Harbour which falls under the Erongo Region jurisdiction
- In Opuwo at the Kunene Regional Council notice board because on the onshore eastern side, the EPL borders the Skeleton Coast National Park which falls under the Kunene Region jurisdiction.
- Walvis Bay Municipality notice board (in Walvis Bay) because the town houses the harbour infrastructure/facilities which will provide services to the exploration vessel.

The findings of this assessment were deemed sufficient and conclude that no further detailed assessments are required to the ECC application.

It is therefore recommended that an Environmental Clearance Certificate be issued for the proposed exploration activities, subject to the following recommendations:

- All required permits, licenses and approvals for the proposed activities should be obtained as required.

- The Proponent complies with the legal requirements governing this type of project and its associated activities.
- All mitigations provided in this Report and the management action plans in the draft EMP should be implemented and monitoring conducted as recommended.
- All the necessary environmental and social (occupational health and safety) precautions provided should be adhered to.
- The monitoring of the implementation of mitigation measures should be conducted, applicable impact's actions taken, reporting done and recorded as recommended in the draft EMP.
- Environmental (EMP) Compliance Monitoring should be conducted on a bi-annual basis by the project Safety, Health and Environmental Officer or an independent Environmental Consultant throughout the exploration phase. Environmental Compliance monitoring reports should be compiled and submitted to the DEAF Portal as per provision made thereon (the MEFT/DEAF's portal).

These recommendations are primarily aimed at improving environmental management, ensuring sustainability and promote harmonious co-existence of the project activities and the host environment.

8.2 Conclusion

The potential positive and negative impacts stemming from the proposed exploration and its associated activities were identified, assessed and mitigation measures made thereof. The mitigation measures recommended in this report and management action plans provided in the draft EMP, can be deemed sufficient to avoid and/or reduce (where impact avoidance impossible) the risks to acceptable levels.

Excel Dynamic Solutions (Pty) Ltd is, therefore, confident that these measures are sufficient, and thus recommends that the Proponent be issued with the Environmental Clearance Certificate (ECC). However, the ECC should be issued on condition that the provided management measures and action plans are effectively implemented and monitored on site.

Monitoring of the environmental components described in the impact assessment should be conducted by the Proponent and applicable Competent Authority. This is to ensure that all potential impacts identified in this study and other impacts that might arise during implementation are properly identified in time and addressed. Lastly, should the ECC be issued, the Proponent

will be expected to be compliant with the ECC conditions as well as legal requirements governing the project and its related activities.

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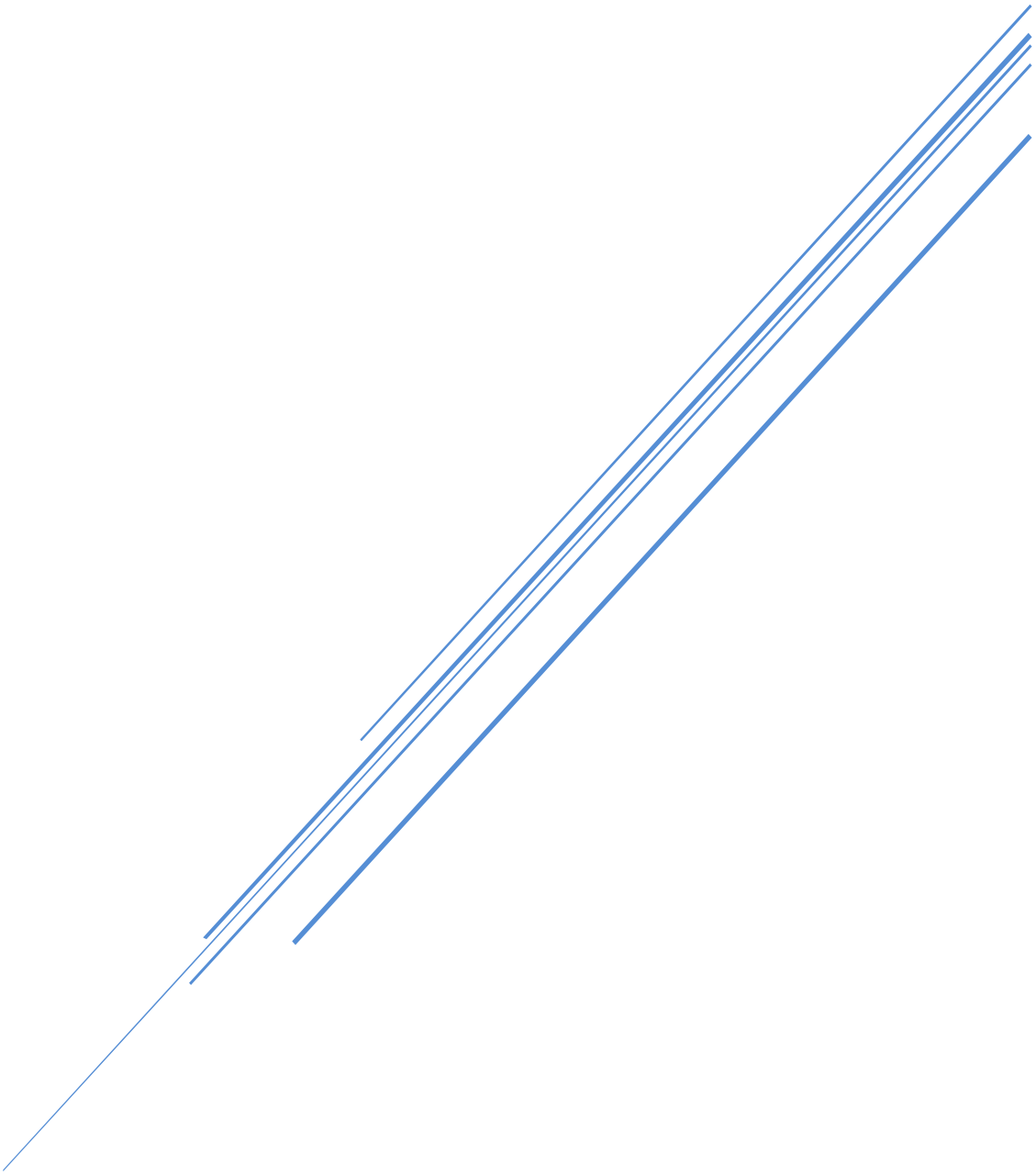
DESKTOP BENTHIC STUDY FOR EPL 6929

By Titus Shaanika and Ndamononghenda Mateus



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1. BASELINE ENVIRONMENT: PHYSICAL ENVIRONMENT

1.1. Climatic and oceanic conditions

This section describes atmospheric and oceanic conditions along the Namibian coast and depended on the availability of literature, emphasis was placed on the Northern coastal region and Möwe Bay (the closest settlement with a weather station to **EPL 6929**) area under some subsections.

1.1.1. Precipitation and Air Temperature

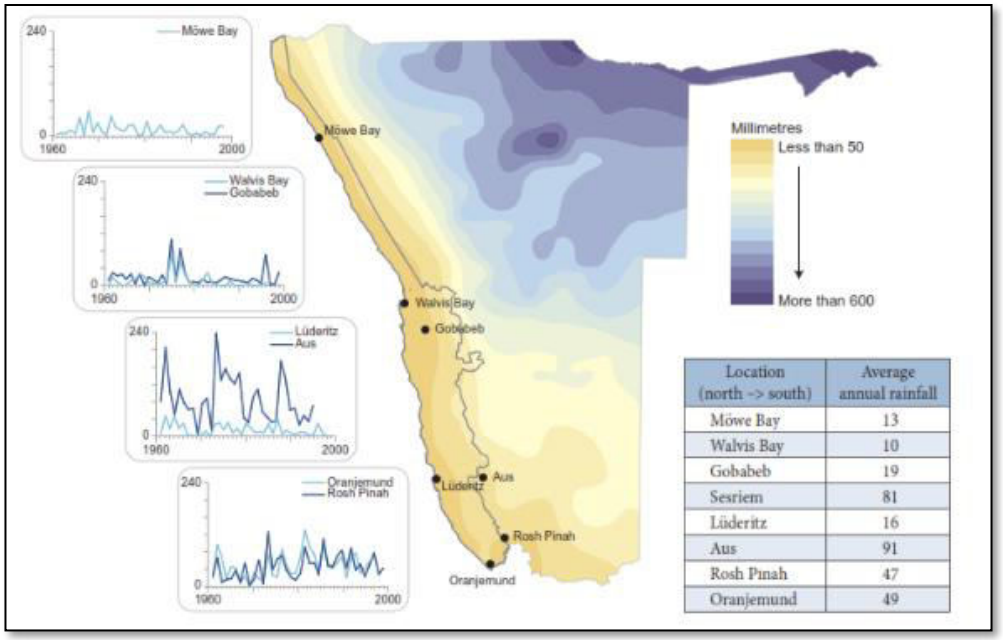
The Namibian coastline is having high humidity percentage, due to the moisture from the adjacent Atlantic Ocean (Mendelsohn *et al.,* 2002). June is the least humid month with a humidity range of 60-80 %, February is the most humid month with a humidity over 90%. This humidity results in fog (Mendelsohn *et al.,* 2002) Figure 14. Rain is seldom recorded, mainly occurring when the moist air from inland overpowers the sea breeze (Mendelsohn *et al.,* 2002). The annual average rainfall along the coast is less than 50 mm, the annual average rainfall at Möwe Bay is 13 mm and 10-15 days of 1mm of rainfall a year has been recorded (Mendelsohn *et al.,* 2002; Robertson *et al.,* 2012) Chyba! Nenalezen zdroj odkazů..

Due to relatively low radiation and sunshine (compared to inland), the temperature along the Namibian coastline is generally less than 20 ˚C (Robertson *et al.,* 2012). With Möwe Bay having an average temperature range of 16-18 ˚C, minimum range of 10-12 ˚C and maximum range of 22- 26 ˚C (Mendelsohn et al., 2002). The highest ever temperature record at Möwe Bay is 40 ˚C and the lowest record is 5 ˚C (Robertson *et al.,* 2012). On average Möwe Bay receives 5 - 6 hours of sunshine per day (Mendelsohn *et al.,* 2002) Chyba! Nenalezen zdroj odkazů..

AVERAGE MAXIMUM AND MINIMUM % RELATIVE HUMIDITY

Place	Maximum	Minimum
Coastline		
Möwe Bay	94	79
Swakopmund	96	69
Walvis Bay	95	73
Lüderitz	91	70
Oranjemund	89	47
Inland		
Uis	76	18
Rössing	79	26
Gobabeb	86	23
Aus	57	17

Figure 1 relative humidity along the Namibian coastline (Robertson et al., 2012)



Location (north -> south)	Average annual rainfall
Möwe Bay	13
Walvis Bay	10
Gobabeb	19
Sesriem	81
Lüderitz	16
Aus	91
Rosh Pinah	47
Oranjemund	49

Figure 2 Average annual rainfall in Namibia and total annual rainfall recorded at four weather stations along the coast (Robertson et al., 2012)

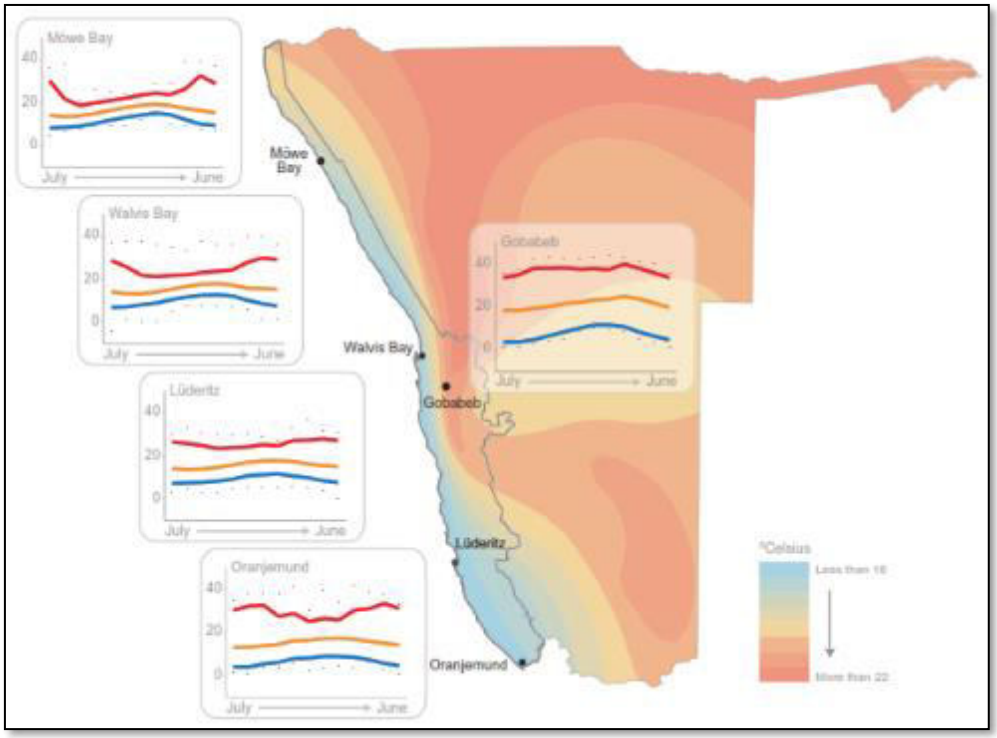
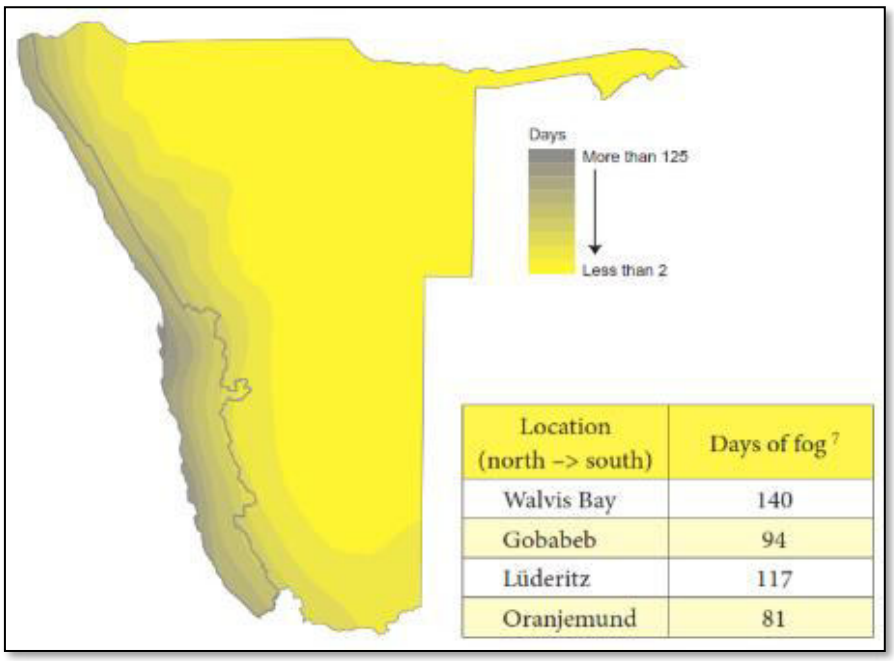


Figure 3 Average temperatures (in °Celsius) across Namibia (Robertson et al., 2012).

1.1.2. Fog

Fog is frequently recorded in the Namib desert, occurring an average of 125 days a year along the Namibian coastline (Robertson *et al*., 2012), the fog occurs due to moist air from the sea cooling due to either radiation, advection, or frontal processes (Spirig *et al.,* 2019). Fog is a vital source of water to the desert flora (Gottlieb *et al.,* 2019) and fauna (Eckardt *et al.,* 2013) Figure 4.



Location (north –> south)	Days of fog [7]
Walvis Bay	140
Gobabeb	94
Lüderitz	117
Oranjemund	81

Figure 4 The average number of fog days per year (Robertson et al., 2012).

1.1.3. Atmospheric Conditions and Wind

Namibia is a situated between 17 degrees and 29 degrees south of the equator (Mendelsohn et al., 2002). Subjecting it to three major Climatic belts, the Intertropical Convergence Zone (ITCZ), the Subtropical High-Pressure Zone, and the temperate zone (Heerden & Hurry, 1992). The ITCZ provides moist air from both the Atlantic and Indian ocean (Heerden & Hurry, 1992). These converges in the low-pressure zone, where warm air rises, condensing and forming water vapour (Heerden & Hurry, 1992). The Subtropical High-Pressure Zone has dry cold air from the Botswana and South African Anti-cyclones and the Temperate zone mainly comes westerly and low-pressure systems and cold front from west to east, the system originates from the southern seas (Heerden & Hurry, 1992) (Mendelsohn *et al.,* 2002).

These three climate belts migrate throughout, from south to north throughout the year in relation to the position of the sun, causing the two distinct seasons in the southern hemisphere, summer (warm) and winter (cold) (Heerden & Hurry, 1992). The ITCZ is dominant during summer and the temperate zone is dominant during winter (Heerden & Hurry, 1992). These belts ultimately influence the weather patterns (Precipitation, wind, sunlight, humidity etc.) over most of Southern Africa including Namibia's Coastline (Robertson *et al.,* 2012).

The wind is the perhaps the defining climatic feature of the Namib desert and inherently of the marine and coastal environment (Tyson & Seely, 1980; Mendelsohn *et al.,* 2002). Southernly wind dominate the entire coastline, blowing at speed of up to 40 km/h. The winds tend to be calmer in the morning and pick up speed at around 14:00 (Robertson *et al.,* 2012).

The wind averages about 20km/h Möwe Bay, peaking around April and May at speeds of 25 km/h, like the entire coastline Möwe Bay is dominated by the southernly wind, with south westerly and south easterly winds also relatively common (Robertson *et al.,* 2012). Möwe Bay is reported to calm 14% of the time (Mendelsohn *et al.,* 2002) Figure 5.

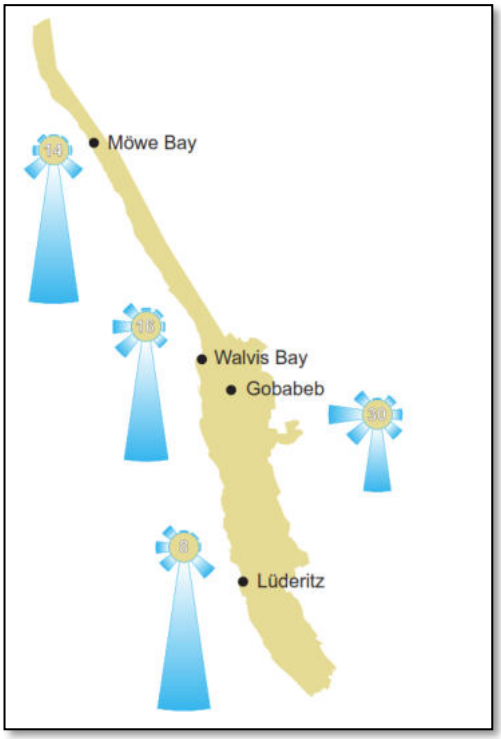


Figure 5 Wind roses for Lüderitz, Walvis Bay, Gobabeb and Möwe Bay. The length of each arm or petal of the rose is proportional to the frequency of wind received from that direction, while the Figure in the middle of the rose is the percentage of time that calm conditions were recorded (Robertson et al., 2012).

1.1.4. Oceanic Currents and Upwelling

The Namibian Ocean is characterized by the Benguela current that flows along the coast northward from the cold southern Atlantic Ocean waters. This current runs from Cape Peninsula (South Africa) to around the Kunene River mouth (between Namibia and Angola).

There is an underwater and counter shore current flowing southwards Benguela current, winds traveling at 360 - 1080 km/h (varies seasonally with varying wind speeds) pushes cold water northwards (Robertson *et al.,* 2012) Figure 7.

The Coriolis (the earth acts on moving objects as it rotates, causing them to deflect anticlockwise in the southern hemisphere) force together with winds from inland pushes surface water offshore (Ekman transport), causing a vacuum that is filled by water from the ocean's depth, this is essentially upwelling. Upwelling provides a lot of nutrients to the Benguela Large Marine Ecosystem Figure 6. There are four main upwelling cells along the Namibian coast namely the Lüderitz cell around Lüderitz (strongest), central Namibian cell around Walvis Bay, Northern Namibian cell near Möwe Bay and the Kunene Cell around the Kunene River mouth (Robertson *et al.,* 2012) Figure 7.

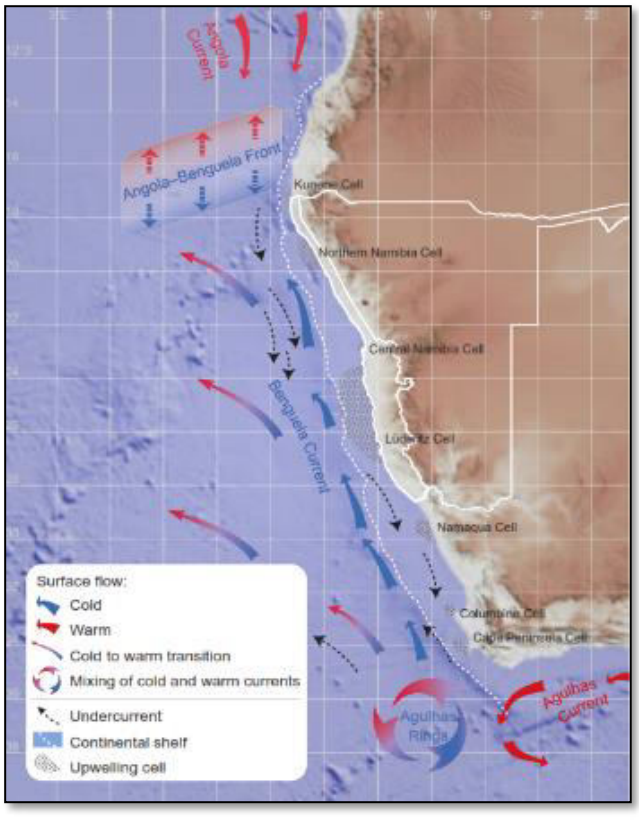


Figure 6 the main features of Benguela current (Robertson et al., 2012)

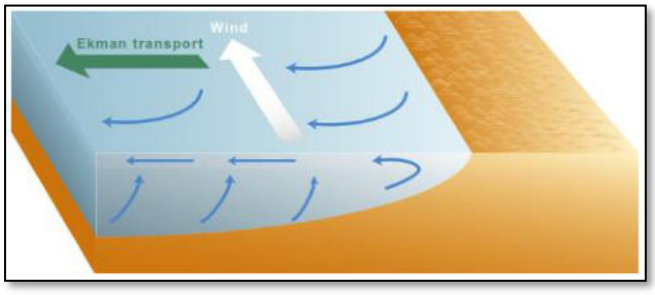


Figure 7 Upwelling along the Namibian coast is driven by wind and Ekman transport (Robertson et al., 2012)

Sea surface temperature (SST) along Namibia's coastline vary throughout the year, coldest during winter (May- November) when the winds are strongest and the Lüderitz cells is dominating the entire coastline, with SST ranging from 13-14 ˚C. From December to April the Central and North coast is warmer, SST ranges from 16-19 ˚C (Robertson *et al.,* 2012) Figure 8.

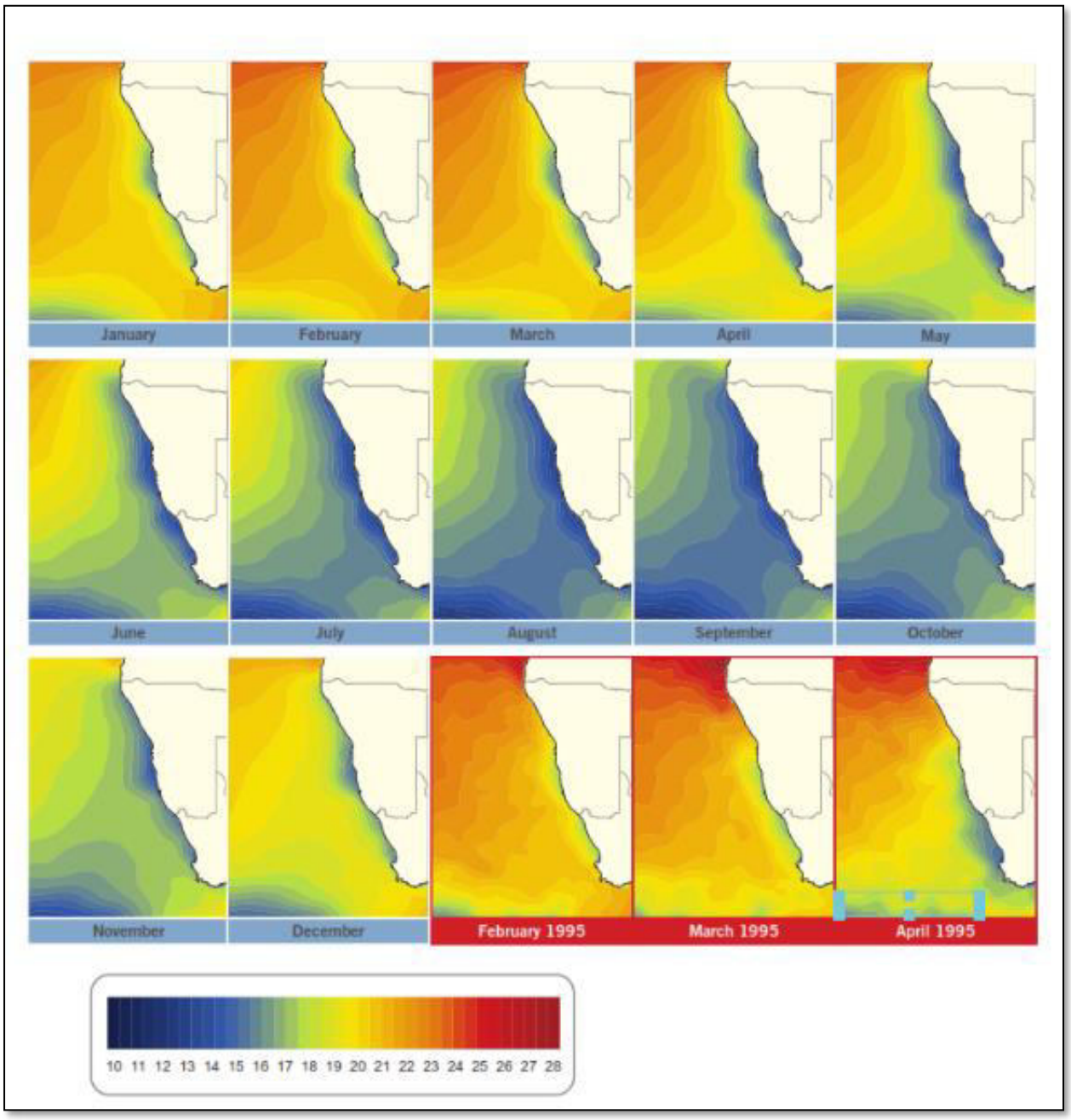


Figure 8 Average temperatures (°Celsius) of the sea surface each month over the period January 1990 to December 2009 . Also shown are surface temperatures for three months during the Benguela-Niño in 1995. (Robertson et al., 2012)

1.1.5. Variability

The Namibian coastal zone does experience unusual weather and climatic condition (Mendelsohn *et al.,* 2002). When the warm water from the Angola pushes southward much longer than usual, in a phenomenon known as Benguela Nino, the ocean SST rises significantly and has adverse impact on marine flora and fauna. These events have been recorded in 1963, 1984 and 1995, causing 8 ˚C increase in SST along Namibia coastline (Robertson *et al.,* 2012) Figure 8.

East winds are a rather common occurrence along the Namibian coastline, but their hot (up to 40 degrees Celsius) and dry (less than 20% humidity) nature, make them a notable weather condition to be aware of as they are a nuisance to the communities of the coastal settlements (Liebenberg-Enslin *et al*., 2017). These winds frequent between April and September, generally setting in the early morning hours and dying out in the afternoon (Robertson *et al.,* 2012). The east wind, essentially sandstorms transport hundreds of tons dust westward over the Atlantic Ocean (Mendelsohn *et al.,* 2002; Liebenberg-Enslin *et al.,* 2017). As the east wind flow toward the ocean the air pressure drops causing the air to heat up as it drops from the interior highlands (1500-2000 m) (Tyson & Seely, 1980; Liebenberg-Enslin *et al*., 2017).

1.2. Geology and Bathymetry

1.2.1. Regional Geology

The oldest rocks along the skeleton coast formed between 1000- 7000 million years ago (Schoeman, 1988). Rocks such as a mica schist, gneiss and granite are part of the Damara sequence (Schoeman, 1988). Möwe Bay has grey granites, cut by grey dolerite dykes and pink feldspar. Between the Hoarusib and Khumib Rivers blue -grey rock surfaces emerge, marked by strands of pink feldspar and white quartz (Schoeman, 1988). Around the Hoanib River gneiss rocks appear as reddish-brown low ridges, running parallel to the coast. Cutting through the Hoanib and Khumib Rivers past the Ogams fountain and through to the Hartmann Valley (Schoeman, 1988).

Between 120- 170 million years as the African and south American continents drifted apart. Vast quantities of lava were spread across the Namib landscape (Schoeman, 1988). These lava floods formed the Etendeka lavas, appearing around Terrace Bay, Möwe Bay, Rocky Point and Cape Frio running parallel to the coast (Schoeman, 1988).

1.2.2. Stratigraphy and Local Geology

Beneath the waves of the Namibian coast the continental shelf width varies, averaging between 100 - 140 km wide. With the narrowest sections occurring northward toward Angola (30 km wide near the Kunene River mouth), The edge of the continental shelf is about 350- 400 meters. The Study area (EPL 6929) falls well within the continental shelf. The EPL area is relatively shallow averaging depths less than 150 meters Figure 9.

Between the Uniab River mouth (20.10 S 13.18 E) south of study area and Khumib River mouth (18.87 S 12.42 E) north of the study area Figure 11. The texture of the benthic sediment ranges from sand, muddy sand, sandy mud, and mud, with sand texture dominating, with patches of muddy texture occurring (Robertson *et al.,* 2012) Figure 10. This texture indicates sediment from river sources (terrigenous sediments) (Robertson *et al.,* 2012), there are two other ephemeral rivers between the Uniab and Khumib Rivers, namely Hoarusib and Hoanib Rivers (Molly & Tapio, 2003) Figure 11Figure 11. Terrigenous sediments dominate most of the inner and shallow area of the continental shelf Figure 12. Diatom sediments also occur, evidence of the highly productive upwelling activities along the Namibian coast (Robertson *et al.,* 2012).

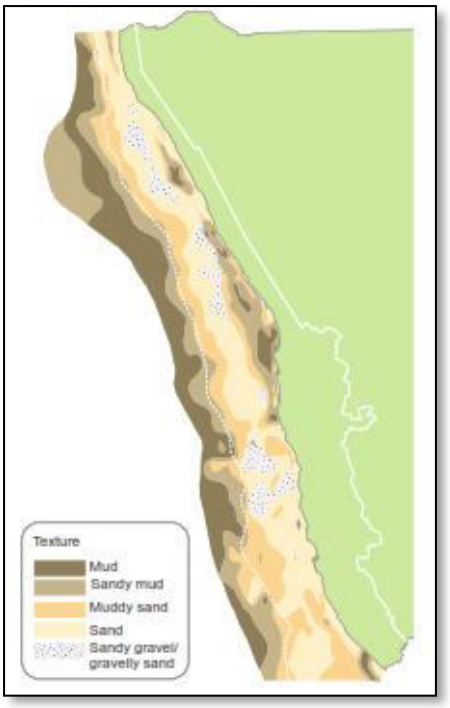


Figure 9 The bathymetry or depths of the ocean between the coastline, continental shelf shown with dotted white line (Robertson et al., 2012)

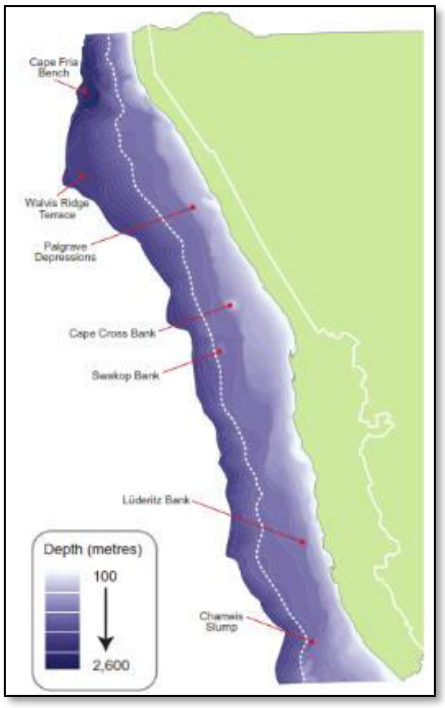


Figure 10 The texture of the surface sediments (Robertson et al., 2012)

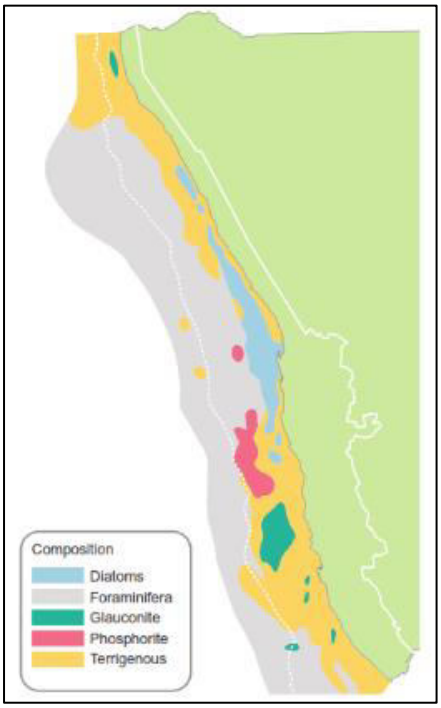


Figure 11 the predominant sedimentary material (Robertson et al., 2012)

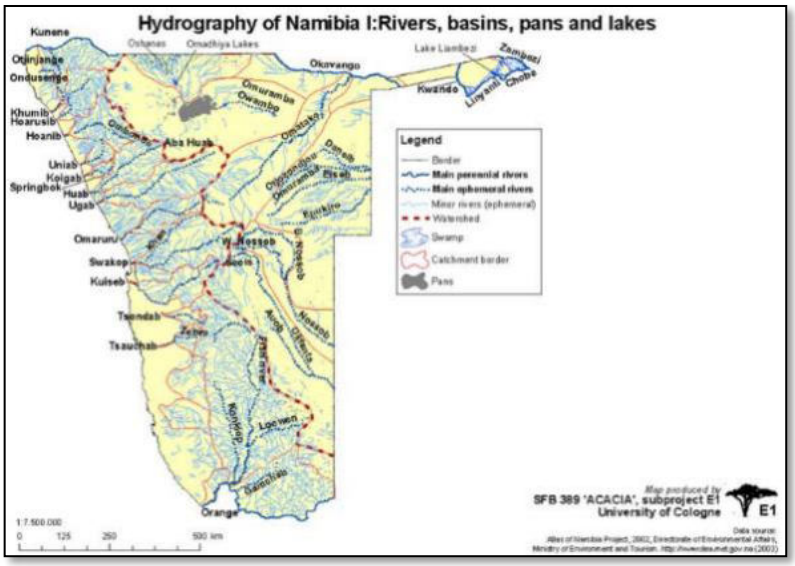


Figure 12 the hydrography and rivers of Namibia

The stratigraphy of the Namibia seabed is made up of 8 layers of varying thickness, this report will focus on the stratigraphy between Walvis Bay and Kunene River mouth as described in *Baby et al.,* 2018. These geological layers are defined by the period they were formed (and are described from newest to oldest).

- The 8th (Late Miocene–Pliocene*)* and 7th (Oligo-Miocene) layers are essentially the seafloor and are continuously being formed. They were formed less than 150 million years ago and have a thickness of less than 50 meters into the earth crust.
- The 6th layer is the Paleocene-Oligocene, which formed between 330- 150 million years ago, and is 50 - 120 meters thick.
- The 5th & 4th (early Turonian -top Maastrichtian) layer is between 467.5 - 330 million years old, and is about 250 - 375 meters thick,
- Cenomanian is the 3rd layer is the which formed between 500-475.5 years ago and is 200 - 325 meters thick.
- The 2nd layer is Albian, between 565 - 475.5 million years old, and is 130-150 meter thick.
- The 1st layer is the late Hauterivian top Aptian, which developed between 653-565 years ago. This sits on the syn and the continental crust.

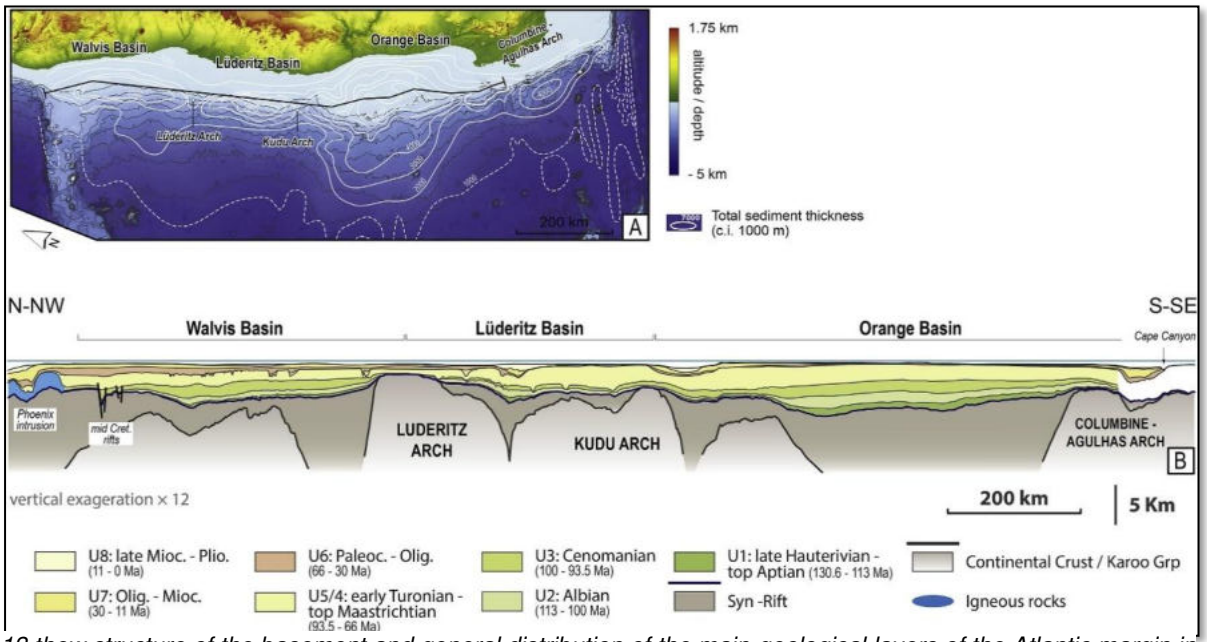


Figure 13 thew structure of the basement and general distribution of the main geological layers of the Atlantic margin in Namibia and south Africa, 1 MA = 5 million years. (Baby et al., 2018).

2. MARINE ECOLOGY: BIOLOGICAL ENVIRONMENT

2.1.1. Coastal and near shore

The coastal and near shore zone includes all ecologically distinct units on or near the coast (intertidal and subtidal zones) as well as the near shore marine environment (up to 30m in depth). The study area falls within the northern Benguela region, a warm temperate Namib province along the Skeleton coast (Bridgeford, 2012). Skeleton coast is a flat, mostly featureless sand inundated coast which consists of two relatively large rocky outcrops at Möwe Bay and Rocky Point as well as some smaller ones at Torra Bay, Terrace Bay, and False Cape Fria (Bridgeford, 2012; Engledow, 1998; Harris *et al*., 2013; Pulfritch, 2017). The coastline encompass about 54% of sandy beaches, 28% is mixed sandy and rocky shores, 16% is rocky shores and the remaining 2% consists of lagoons(Tony, Alice, John, & Roger, 2012).The wind-induced upwelling physical processes highly influence the environment and shape the marine ecology which offers a greater level of habitat heterogeneity.

The marine ecosystems along the northern coast comprise a limited range of habitats that include:

- sandy intertidal and substrates
- intertidal rocky shores and subtidal zones
- The water bodies

The southern African West Coast region general benthic communities are ubiquitous with considerable spatial and temporal variabilities depending on the substratum type, wave exposure, and/or depth zone (Bustamante & Branch, 1996; Engledow, 1998). A few relatively typical species from each of these habitats are described below, focusing on both dominant and commercially important species, as well as potentially sensitive species, that may be affected by the proposed exploration project.

a) Sandy substrate habitats and biota

Zoobenthos refers to the community of animals living on (epibenthic) or burrowing in (benthic) the sediments of a water body. Benthos is classified according to size, microbenthos <0.1mm, meiobenthos 0.1–1mm, macrobenthos >1mm and megabenthos > 10mm. Sandy beaches are dynamic coastal environments, where faunal communities are influenced largely by wave energy, slope, and particle size interactions. The morphodynamics of sandy beaches are mainly classified as dissipative, reflective, or intermediate beaches (Branch & Griffiths, 1988). The dissipative beaches have fine sands, high wave energy, and the rich intertidal faunal communities. Reflective beaches have low wave energy, are coarse-grained, have steep intertidal beach faces, and contain distinct fauna communities. In the intermediate zone between the dissipative and reflective coasts, species composition is extremely variable, depending on food availability (Branch & Griffiths, 1988). Figure 14 below shows the types of sandy beaches along the Namibian coast.

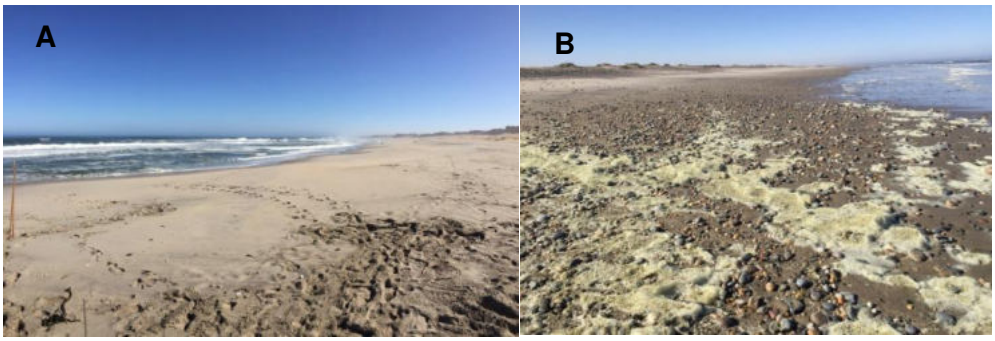


Figure 14 Sandy beach (A) and (B) a medium sized sand, with pebble and cobble deposits beach in the intertidal zone and surf zone off the Namibian coast (photo by Mateus N.L)

The sandy beach fauna distribution assessment along the Namibian coast is based on sporadic studies during the 1980s Tarr *et al*., (1985) and a recent biodiversity surveys (Kreiner *et al*., 2019). The biomass of invertebrates is moderate to high as a significance of the nutrient-rich tidal waters along the coastline. The most abundant taxa along the Namibian shores are insects and spiders associated with washed up kelp wrack, nematodes, platyhelminths (flatworms), amphipods (small shrimp-like crustaceans) and ghost crabs (Tony *et al*., 2012). Zoogeography reflects species distribution patterns, but communities and their composition can change greatly over short distances as physical conditions change (Emanuel *et al*., 1992; Tarr *et al*., 1985). The subtidal substrate benthic soft bottom communities depend primarily on water

depth and sediment size; however, other variables such as current velocity, organic content, and food abundance play a role.

Sandy beach macrofaunal community structure and zonation along the northern coast encompass a wide range of species with tropical affinities around Bosluis Bay and temperate towards Toscanini (Molly & Tapio, 2003; Tarr *et al*., 1985). The distribution of benthic invertebrates along the five beaches off the northern coast, Bosluis Bay (9 species), Angra Fria (10 species), Hoarusib (7 species), Möwe Bay (9 species) and Toscanini (6 species) (Kreiner *et al*., 2019). Relatively low abundance and distribution of isopods, *Excirolana natalensis*, *Tylos granulatus , Excirolana latipes, Eurydice kensleyi and Amphipods, Africorchestia quadrispinosa,* and *Gastrosaccus namibensis* along the sandy beaches inter tidal zones (Kreiner *et al*., 2019).

b) Rocky habitat and biota

i. Inter tidal rocky shores

The northern coast of Namibia is mainly covered in gravel plains and shifting dunes and is bordered to the east by the Namib Desert. The rocky shorelines that occur on the southern African west coast are strongly influenced by sediments and include considerable quantities of sand mixed in with the benthic biota. The species composition of the rocky shore's biota varies significantly based on geography. In sheltered shorelines as compared with exposed shorelines, the species of fauna and flora biomass supported per unit area differ greatly. The Namibian coastline features a variety of benthic habitats along the rocky intertidal shores. The functional classification is based on the trophic status of the taxa residing at the intertidal zone (autotrophs, grazers, rappers, filter feeders, herbivores, and predators) (Harris et al., 2013). Grazers consist mostly limpet species, rappers include limpet species that specifically trap kelp fronds beneath their shells, the filter feeders are particularly mussels and the reef worm *Gunnarea capensis,* mobile predators and scavengers such as carnivorous whelks, anemones, crustose algae and foliose algae which collectively is made up by the articulated (geniculate) coralline algae; corticated algae; ephemeral seaweeds and canopy-forming kelps (Pulfrich & Branch, 2013).

The region along the northern coast near Rocky Point and Möwe Bay is comprised of the project zone. In the exposed shoreline, invertebrates have a much larger biomass than in the sheltered intertidal zone. At Rocky point, the sheltered sites are characterized by gently sloping, irregular rocky/sandy bench stretching along south end of sheltered bay in front of small kelp bed from high shore to low shore mainly bare rock (62%) and sand (21%) zones (Kreiner *et al*., 2019). The sheltered benches at rocky point comprised zones of Granularis, Algal/sand, Pachymenia (Aeodes), Gracilaria/Chondria and Mowe bay zones Littorina, Upper Chthamalus, Lower Chthamalus, Corallina/Pachymenia, Corallina and Argenvillei/kelp. The semi exposed zones consist of Upper Chthamalus, Lower Chthamalus, Mussel/ Chthamalus, Pachymenia and Corallina beds (Kreiner *et al*., 2019). An overlap of the trophic structures of both rocky and sandy shores can be found on mixed shores with fluctuating degree of sand coverage compared to more homogenous shores (Harris *et al*., 2013).

ii. Rocky subtidal reefs

Communities near the subtidal areas often feature dense stands of kelp or eelgrass, as well as numerous types of invertebrates, such as amphipods, polychaete worms, snails, clams, sea urchins, and crabs. Suspended sediment plumes reduce predators and grazers on subtidal reefs and increased biomass of filter feeders and ephemeral green algae possibly due to light reduction (Pulfrich *et al.,* 2003; Dethier *et al*., 1993). The exposed rocky shores along the northern coast of Namibia mainly encompass zones of Littorina/Oxystele, Chthamalus, Mussel/Chthamalus and Algal/Perna communities (Kreiner et al., 2019). At rocky point and Mowe bay, a horizontal platform to mid regions with vertical and sharply lowest areas receiving waves impact typical species found include *Afrolittorina knysnaensis, Chthamalus dentatus, Mytilus galloprovincialis, Bunodactis reynaudi, Chthamalus dentatus, Polysiphonia virgate, Scutellastra granularis, Semimytilus algosus* and *Scutellastra argenvillei* (Kreiner *et al.,* 2019).

2.1.2. Benthic communities

Namibia's shelves have high productivity and mineralization with diverse benthic biomasses and communities adapted for chronic and massive exposure to both organic and inorganic material. This community was studied from different perspectives via baseline studies and monitoring assessments along the Namibian coast. A summary is provided below focusing on the areas near the project area.

The largest proportion of macrofauna abundance and biomass along the west coast constitute of polychaetes, crustaceans and molluscs with inherently patchy distributions reflecting the high natural spatial and temporal variability (Eisenbarth & Zettler, 2016; Mertzen, 2013; Tony *et al*., 2012). Benthic macrofauna abundance decrease from the shelf towards the lower slope along the Namibian coast (Eisenbarth & Zettler, 2016). On the shelf, high biomass of polychaetes, bivalves *Sinupharus galatheae* and the gastropod *Nassarius vinctus* can be found along the northern coast. Similar abundances within the fringe of the project area around Rocky point, the inner shelf comprise relative abundances of colonial marine cnidarians, Pennatulacea, Actinaria, Asteroidia Mertzen, (2013) Figure 15 and in the outer shelf abundance of same taxa were recorded in much higher abundances (Mateus unpublished data). The sulphide-rich (H_2S) seabed sediments off the northern Benguela upwelling system fuels extensive mats of large sulphide-oxidizing bacteria on the seabed, which create detoxified habitat niches and food for the animals living there (Currie *et al*., 2018). High concentrations of H_2S characterize the inner shelf surface sediments between 19°S and 27°S dominated by *Thiomargarita namibiensis* and some species of *Beggiatoacea* (Currie *et al*., 2018).

Along the Southern African west coast, water depth and sediment composition play an important role in determining physical environment and, therefore, the structure of macrofauna biodiversity. Soft-bottom communities are composed of epifauna and bottom-dwelling invertebrates and vertebrates which are in turn dependent on the benthic macrofauna for nutrition. Offshore, this habitat is home to the largest populations of the commercially important deep-sea red crab *Chaceon maritae*, which lives at depths of 300 to 1000m with higher densities in the northern region of Namibia (Pulfrich, 2017; Mateus, n.d.).

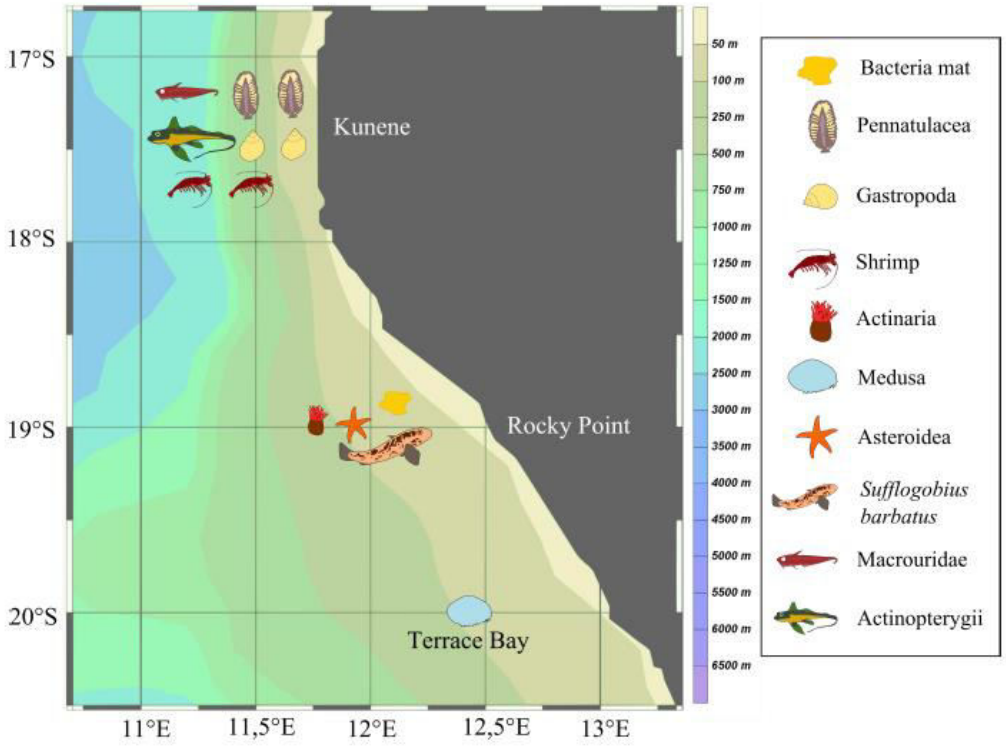


Figure 15 Benthic taxa composition at selected transects along the Northern coast (Mertzen, 2013)

2.1.3. Pelagic communities

Pelagic refers to all open marine waters, setting them apart from the shore and the benthic zones close to the seabed including plankton, fish, and their main predators, marine mammals (seals, dolphins, and whales), seabirds and turtles. There are various types of plankton, including single-celled bacteria, phytoplankton, zooplankton, and ichthyoplankton. Fish consume plankton, which then is eaten by seabirds, sharks, and seals, which in turn are eaten by larger predators like killer whales. The northern Benguela system experiences three phases of upwelling (quiescent, active and relaxed upwelling), characterized by different patterns of zooplankton abundance, taxonomic composition, and inshore-offshore distribution (Timonin *et al.*, 2010). Zooplankton abundance is relatively low and there are no significant differences in distribution within inshore and offshore areas. In response to changing upwelling conditions, phytoplankton biomass is highly variable on the Namibian shelf. The phytoplankton is dominated by diatoms, which can adapt to turbulent ocean conditions. A diatom bloom occurs after an upwelling event, whereas

a dinoflagellate bloom occurs during a quiescent period because they can grow quickly at low nutrients levels.

High abundances of various fish species, especially those targeted by anglers (galjoen, steenbras, kabeljou, blacktail) however, commercially important pelagic species are mainly found in mixed shoals of various sizes that are generally within 200 meters and sometimes inshore, just beyond the skeleton coast surf zone *(*Tony *et al*., 2012).

The Namibian coastline is home to several marine mammals such as whales and dolphins and seals. The Namibian coastline is an important foraging and breeding area for cetaceans such as Bottlenose Dolphins, Heaviside's Dolphins, dusky dolphins, and Southern Right Whales (Ashton & Ashton, 2005) and several seal colonies exist in the northern coastal region within the proximities of the project area. Dolphins, whales and seals cover large foraging grounds and the Northern regions comprise important foraging hotspots of these marine mammals (Ashton & Ashton, 2005; Schusterman, 1981). The Heaviside (*Cephalorhynchus heavisidii*), bottlenose (*Tursiops truncatus*), and dusky (*Lagenorhynchus obscurus*) dolphins are occur mainly in the 200 depth along the entire Namibian coast (please find a paper on Namibian dolphin project side) (Ashton & Ashton, 2005). However, host species that migrate between Antarctic feeding grounds, warmer breeding grounds, and other species(humpback whale) with a globally distributed range are also found along coast (Ashton & Ashton, 2005). The Benguela upwelling system is a globally unique cold-water upwelling system as it is bounded in the north and south by warm-water current systems, characterized by high primary production. Thus, cetaceans associated with the Benguela ecosystem such as dusky dolphins and those associated with the warmer subtropical habitat off Angola are likely to be encountered in the survey area.

The northern coast is an important foraging area for leatherback turtle (*Dermochelys coriacea*) and green turtle (*Chelonia mydas*) (Cunningham & van Rooyen, 2020; Elwen & Braby, 2015). The northern Benguela ecosystem has a high density of jellyfish, which are the primary food source for turtles (Elwen & Braby, 2015). It is increasingly recognized as a potential feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Cunningham & van Rooyen, 2020).

The Namibian coastline supports large breeding and foraging populations of seabirds, there are 14 seabird species occurring along the coast (African Penguin, Cape Gannet, Bank Cormorant, Crowned Cormorant, Cape Cormorant, African Black Oystercatcher and Hartlaub's Gull, Swift Tern and Caspian Tern, Great White Pelicans, flamingos). Most of the seabird species breeding in Namibia feed relatively close inshore (10-30 km). Along Namibia's coast, gannets and cormorants and Damara Terns are common along the Northern coast region (Molly & Tapio, 2003).

3. EVALUATION OF IMPACTS

3.1. Impact on Marine Biodiversity

Benthic invertebrates such as Cephalopods, some bivalves, echinoderms, and crustaceans have structures called statocysts, which contain a statolith and associated sensory hairs sensitive to low frequencies and are responsive to particle motion in the sound field (Offutt 1970; Budelmann 1988, 1992; Packard *et al*., 1990; Popper *et al*., 2001). Marine invertebrates are mainly susceptible to low frequency sounds ranging between 40Hz - 400 Hz. There is limited information on invertebrate sound detection under field operating conditions, however, lethal, and sub-lethal effects have been observed under experimental conditions where invertebrates were exposed to air guns (McCauley, 1994). Some changes include swimming, metabolic, growth, and reproduction rates reduced, and behaviour changes. Under stress, Manila clams relocate less and remain atop the seafloor with closed off valves (Weilgart, 2018). Due to these responses, the clams were unable to mix the sediment above the surface for feeding, and therefore, prolonged stressor periods may lead to accumulating lactate and further ecosystem functionalities will be affected in the absence of clams (Solan *et al*., 2016).

Phytoplankton and zooplankton are mainly restricted by currents, so they are not able to actively avoid the seismograph, and therefore they are likely to encounter the sound sources. There is no evidence to suggest that seismic surveys affect phytoplankton, and air gun impulses are unlikely to have a significant effect beyond 1m distance (McCauley, 1994).

Fish detect sound in two ways; the ear that is sensitive to sound pressure and the lateral line that detects particle motion. These systems have their own hearing threshold (Tavolga & Wodinsky 1963). The lateral line is sensitive to low frequency (20 - 50 Hz) through the particle velocity component of sound. Low frequency sounds can cause harm to internal organs of larger fish. Most fish can detect sound from 50 - 1000 Hz (Popper & Fay, 1999; Popper *et al*., 2003) Figure 16. Fish can differentiate between sounds sources and conscious of direction of sound, differentiate between biological sound and anthropogenic noise. Fish can be exposed seismic survey without lethal effects. With only localized impacts of swimming bladders and temporary hearing loss (Falk & Lawrence, 1973; Enger, 1981). Most fish will distance themselves from seismic sound sources and only a few animals will be hurt by the seismic sounds (Pulfrich, 2017). Behavioral impacts are often short term and lasting less than the length of the impact and vary from leaving the area, change in depth and these can be observed 5 km from the seismic source (Hassel *et al*., 2004). The ecological significance of seismic effect is expected to be low except in case here they influence reproductive activities. although effect is not well documented, recruitment tend to be affected as fish have been found to cease spawning. This area of interest is an important foraging and spawning area for species such as kop, anchovies, and Steenbras.

Marine seabirds will mainly be affected by seismic sounds as they dive and rest on the water surface. This area of interest is in the foraging range of diving birds such as cormorant, cape gannets and the flight less African penguin. The penguins are most susceptible to seismic sounds due to their flight lessness, they have a hearing range 100 Hz – 15 kHz (Wever et al. 1969). Pichegru *et al.,* 2017 however found penguins to strongly avoid their foraging area during seismic activities, when seismic activities occurred within 100 km of their breeding site.

Marine turtles are susceptible to physiological injury, behavioral change and masking of environmental sounds and communications. Turtles' auditory sensitivity frequencies ranges from 60Hz -2000 Hz (Holtz *et al*., 2021; McCauley, 1994; Atlantic G&G Programmatic EIS, 2014). This overlap with the sound produces by most seismic activities, suggesting that turtle could be affected by seismic noise.

Cape fur seals forage within and beyond the continental shelf and are expected to be present in the EPL of interest. Cape Fur seals audiograms have not been specifically studied but, most seals and sea lions can detect sound of below 100 Hz and over 10kHz (McCauley 1994; Atlantic G&G Programmatic EIS, 2014) Figure 16. Seismic sounds can affect seals physiologically, behaviorally and mask biological sounds, and indirect effects on predators and prey. Seals exhibit avoidance and fright behaviour around seismic sound sources Pulfrich, (2017), but their behavior generally resumes normal behaviour as soon as sounds stops. They generally tend to stay in the area. Cape fur seals are relatively insensitive to sound below 1000 Hz, making them relatively tolerant to most seismic activity.

Cetaceans (whales and dolphins) highly dependent on sound for communication, feeding and direction. Cetaceans a use sound frequencies ranging from 7 – 200 kHz, with most whales using frequency range of 7- 22 kHz (found humpback whales in the wild to detect sounds ranging from 10 Hz to 10 kHz at levels of 102), while most dolphins use a relatively higher frequency range of just below 1kHz to over 100 kHz (Atlantic G&G Programmatic EIS, 2014; Popper, 1980) Figure 16. Strongly suggesting that cetacean particularly whales (larger toothed whales and baleen whales such as Humpback whale) are susceptible to sound of seismic equipment's (Nowacek *et al*., 2007). Cetaceans suffer physiological injuries and stress (Lien, 1993), behavioral disturbances (Malme *et al*., 1988; Stone, 2003), masking of important environmental sound (Weilgart *et al*., 2007; Di Lorio, 2010) and indirect effects on prey species (Englas *et al*., 1995).

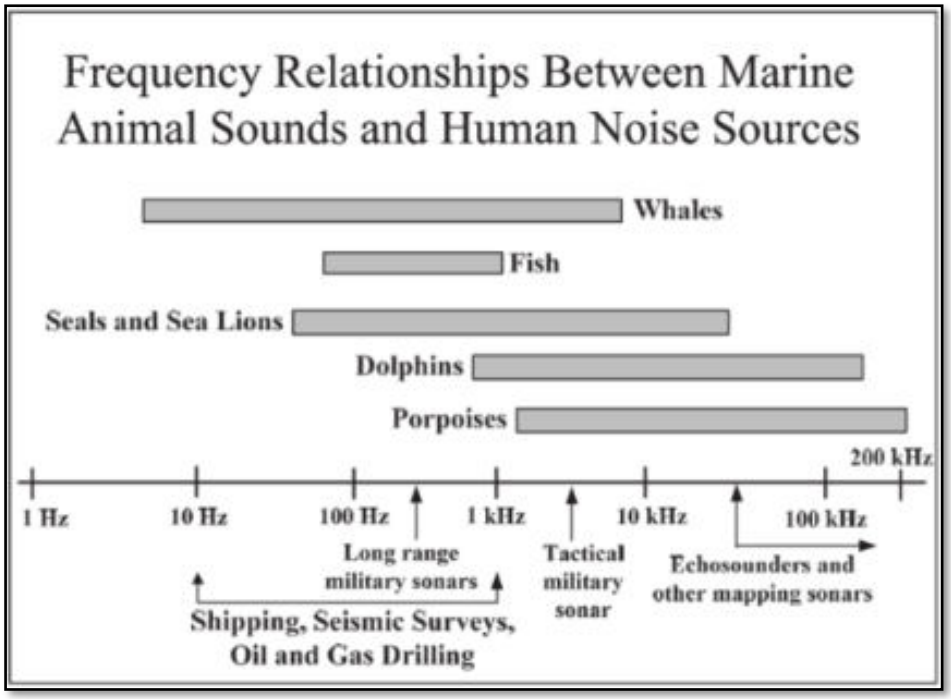


Figure 16 Frequency range of sounds generally produced by different marine animal groups shown relative to major human noise sources ((Atlantic G&G Programmatic EIS, 2014)

The main threat generated from the geophysical survey will be sound generated by the seismic profiling system, which will be producing less than 12Hz sound frequency, most of the biodiversity occurring in the EPL 6929 have auditory sensitivity frequencies of over 50Hz and do not overlap with that produced by the seismic profiling system. Cetacean (large toothed and Baleen whales) and fish will potentially be affected by the seismic profiling system.

Under the status, the impact can be of a medium significance rating. With the implementation of appropriate mitigation measures, the rating will be reduced to a low significance rating. The impact to marine biodiversity is assessed below.

Table 1 Assessment of the impacts of exploration activities on marine biodiversity (ecology)

Mitigation status	Extent	Duration	Intensity	Probability	Significance
Pre mitigation	M/H-4	L/M-2	M/L-4	M-4	M-40
Post mitigation	M/H: -4	L: -1	L: -2	L/M: -3	L: -21

Mitigations and recommendation to minimize the impact on marine biodiversity

- Appoint independent onboard Marine Fauna Observer (MFO) and Passive acoustic monitors (PAM) for the duration of the survey. MFO and PAM should be knowledgeable about the Namibian Marine environment and biodiversity and able to identify seabird, marine mammals, and turtles among other marine

fauna. MFO will monitor the presence of marine fauna during day light and the PAM operator should monitor the presence of marine mammals in the water column around the vessel using specialized hydrophones after sunset or during low visibility conditions.

- Adapt The Joint Venture for conservation committee (JNCC) guidelines for minimizing injury to marine mammal from Geophysical survey (seismic survey guidelines) during the survey. (https://hub.jncc.gov.uk/assets/e2a46de5-43d4-43f0-b296-c62134397ce4)
- Seismic survey should be avoided during cetacean's migratory seasons (June-November), when they move from the southern oceans to the equator. December to May is the recommended time for the exploration.
- To monitor the impact of the benthic communities. underwater video recording is strongly recommended before, during and after exploration.

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