APPENDIX F SPECIALIST STUDIES

The following Specialist Studies have been conducted for the compilation of the Final Environmental Impact Assessment Report.

F1. Fisheries Study

F2. Marine Ecology

F3. Terrestrial Ecology

F4. Maritime Heritage

APPENDIX F1 FISHERIES STUDY

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED METISS SUBSEA CABLE SYSTEM OFF THE EAST COAST OF SOUTH AFRICA

FISHERIES STUDY

Date: March 2019

Prepared for: Environmental Resources Management South Africa (Pty) Ltd

On behalf of the applicant:

Prepared by: Capricorn Marine Environmental (Pty) Ltd

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26 March 2019

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Mr Japp has worked in the field of Fisheries Science and resource assessment since 1987 and has considerable experience in undertaking specialist environmental impact assessments relating to fishing and fish stocks. His work has included environmental economic assessments and the evaluation of the environmental impacts on fishing. Sarah Wilkinson has worked on marine resource assessments, specializing in spatial and temporal analysis (GIS) as well as the economic impacts of fisheries exploitation in the southern African region.

This specialist report was compiled for Environmental Resources Management (ERM) for their use in compiling a Scoping Report and Environmental Impact Assessment (EIA) for the proposed METISS Submarine Cable System off the East Coast of South Africa. We do hereby declare that we are financially and otherwise independent of the Applicant and of ERM.

Dave Japp

Sarah Wilkinson

CONTENTS

ACRONYMS AND ABBREVIATIONS

AoI	Area of Influence
ASN	Alcatel Submarine Networks
BMH	Beach Manhole
CapMarine	Capricorn Marine Environmental (Pty) Ltd
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ERM	Environmental Resources Management
EEZ	Exclusive Economic Zone
GRT	Gross Registered Tonnage
ICCAT	International Convention for the Conservation of Atlantic Tunas
ICPC	International Cable Protection Committee
ICT	Information and Communications Technology
IOTC	Indian Ocean Tuna Commission
ITU	International Telecommunications Union
kg	Kilogram
m	Metre
MLRA	Marine Living Resources Act
METISS	Melting Pot Indianoceanic Submarine System
PLGR	Pre-Lay Grapnel Run
ROV	Remotely Operated Vehicle
SADSTIA	South African Deep-Sea Trawling Industry Association
SAFE (cable)	South Africa Far East
SANHO	South African Navy Hydrographic Office
t	Tonnes
TAC	Total Allowable Catch
TAE	Total Allowable Effort
Tbps	Terabits per second
ToR	Terms of Reference
UNCLOS	United Nations Convention on the Law of the Sea (1982)

EXECUTIVE SUMMARY

The Project involves the installation and operation of the Melting Pot Indianoceanic Submarine System (METISS) in South Africa. METISS is a proposed new subsea fibre optic cable system that will connect Mauritius to South Africa and provide high-speed connectivity of 24 terabytes per second to the global telecommunications network and low latency access to enhance business operations across multiple industries.

METISS is owned by a Consortium of companies comprising Canal+ Télécom, CEB FiberNet, EMTEL, Zeop, SRR (SFR) and TELMA. The Consortium was formed for the purposes of developing the system. The Consortium has contracted ASN and Elettra for the manufacture and installation of the subsea cable system. The Consortium has contracted Liquid Telecom to act as the Landing Party in South Africa responsible for operational aspects in South Africa.

The METISS main cable ('trunk') will run more than 3,200 km from Mauritius to South Africa and spilt at Branching Units off the main trunk to landing sites in Reunion Island and Madagascar.

The system includes a 14 mm to 35 mm diameter subsea cable that will enter the South African EEZ (approximately 370 km from the seashore) and continues through Territorial Waters (approximately 22 km from the seashore), and onto land until it reaches the Cable Landing Station (CLS) at Pipeline Beach in Amanzimtoti, KwaZulu-Natal. As part of the EIA process, an assessment was undertaken of the impact of the proposed Project on the South African fishing industry.

Prior to installation, a detailed survey would be undertaken (using multibeam echosounder, side-scan sonar and sub-bottom profiling to determine the optimal routing of the subsea cable. Immediately prior to installation a clearance operation would be conducted to remove any obstacles from the path of the final subsea cable route where burial is required (the pre-lay grapnel run). Following this, a specialised subsea cable laying vessel would place the cable on the seabed along the predetermined route. In water depths shallower than 1,000 m, the subsea cable would be buried by way of ploughing 1 m deep into the seabed. In nearshore areas, heavier armouring would used to provide additional protection to the subsea cable. In water depths greater than 1,000 m, the subsea cable would not be buried and will be placed on the seabed.

Activities proposed during the pre-installation, installation, and operational phases of the Project were identified as sources of a potential impact on the fishing industry. Fishing vessels would be required to maintain a safe operational distance of 500 m from the Project vessels during the pre-grapnel run and installation of the subsea cable.

Restriction of access to fishing ground could be experienced by the traditional linefish sector, which operates in the nearshore vicinity of the proposed area of influence, the large pelagic longline sector, which operates extensively from a distance of 12 nm (approximately 22 km) from the coastline to the limit of the South African Exclusive Economic Zone, and the KZN crustacean trawl sector, which operates on the Tukela Bank. Due primarily to the temporary duration of the impact, the overall significance on these sectors is assessed to be Negligible.

Once installed, the cable route would be charted by the South African Navy Hydrographic Office and would appear on navigational charts. Cable protection zones and corridors prohibit specified activities posing risks to subsea cables – including fishing, anchoring, and dredging – within fixed geographic areas. Although the subsea cable would be considered protected from damage due to burial at depths shallower than 1,000 m, the entire subsea cable route would be protected with an exclusion zone that would prohibit anchoring and trawling within a distance of 1 nm (approximately 2 km) on either side of the subsea cable. This could result in an impact of potential exclusion to any demersal fishery (ie those that direct fishing effort at the seabed). South African demersal fishery sectors include crustacean-directed trawl, hake-directed trawl and longline and longline trap fisheries for rock lobster. Of the demersal sectors, the project area coincides only with grounds of only the KwaZulu-Natal crustacean trawl fishery. The impact on the sector during the operational phase of the Project is assessed to be of Moderate significance. Mitigation measures could include allowance of overtrawling of the subsea cable inshore of the 600 m depth contour. In this case the resultant impact would be of Negligible significance.

1 INTRODUCTION

The Project involves the installation and operation of the Melting Pot Indianoceanic Submarine System (METISS) in South Africa. METISS is a proposed new subsea fibre optic cable system that will connect Mauritius to South Africa and provide high-speed connectivity of 24 terabytes per second to the global telecommunications network and low latency access to enhance business operations across multiple industries.

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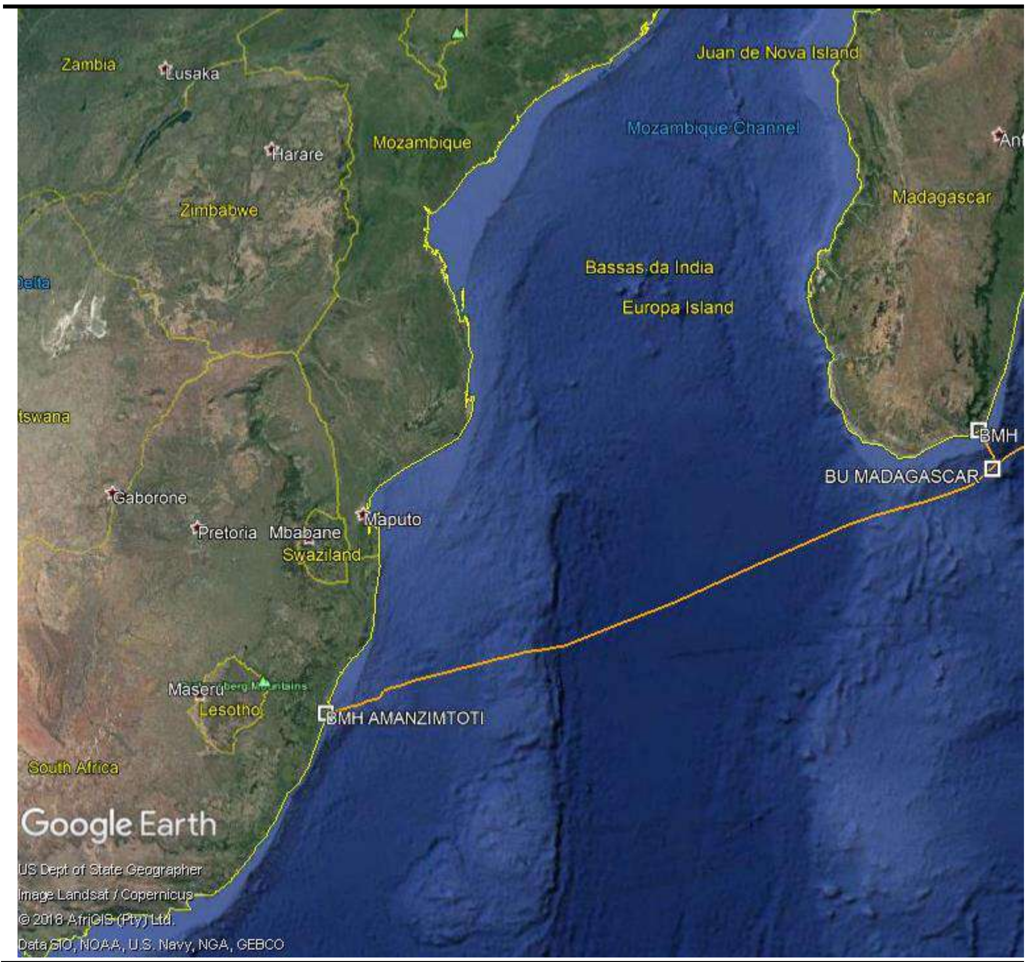
The installation of the subsea cable system is provisionally scheduled to commence in the first quarter of 2020 and is expected to be completed and operational by the end of the third quarter of 2020.

Figure 1.1 Location of the Proposed METISS Subsea Cable System Configuration



Source: ERM, 2019

As the legislation is general, planning, installation and maintenance are performed according to approved and certified International Organization for Standardization (IOS) quality systems. The planning of the route is performed in accordance with industry recognised standards and codes including the International Telecommunications Union (ITU) and International Cable Protection Committee (ICPC).

ASN has appointed Environmental Resources Management (ERM) as the independent Environmental Assessment Practitioner (EAP) for the Environmental Impact Assessment (EIA) process. The EIA Report will set out the anticipated impacts arising from the Project and propose measures on how these might be managed. The EIA Report will inform an environmental authorisation decision to be taken by the Department of Environmental Affairs (DEA). As part of the EIA process, Capricorn Marine Environmental (Pty) Ltd ('CapMarine') has been appointed to undertake an assessment of the impact of the proposed Project on commercial fishing operations.

1.1 *TERMS OF REFERENCE*

The Terms of Reference (ToR) for the current report are to provide an overview of fisheries spatial and temporal catch and effort data and to produce a baseline description of the current commercial fisheries operating within the vicinity of the proposed Project Area of Influence (AoI). Following this, to provide an assessment of the potential impacts of the Project on the existing fisheries and to identify mitigation measures. The specific ToR for the Fisheries Specialist Study are as follows:

- Details of the person who prepared the report, and the expertise of that person to carry out the specialist study or specialised process.
- A declaration that the person is independent.
- An introduction that presents a brief background to the study and an appreciation of the requirements stated in the specific terms of reference for the study.
- A short literature review of existing fisheries spatial and temporal catch and effort data.
- A baseline description of the current commercial fisheries operating within the vicinity of the proposed Project (in territorial waters of South Africa).
- Details of the approach to the study where activities performed and methods used are presented.
- The specific identified sensitivity of fishing sectors related to the proposed Project.
- A map superimposing the proposed cable routing within South African territorial waters (with appropriate buffers), on the spatial distribution of catch and effort expended by each fishing sector.
- A description of the findings and potential implications of such findings on the impact of the proposed Project.
- Suggested mitigation measures and monitoring recommendations.
- A description of any assumptions made and any uncertainties or gaps in knowledge.

2 PROJECT DESCRIPTION

2.1 OVERVIEW

The METISS Subsea Cable System will span more than 3,200 km from Mauritius to South Africa and deliver a boost to bandwidth between the respective countries, providing a connection speed of 24 Terabytes Per Second (TBps).

The Project involves the installation and operation of the system. The main system components include the following:

- Fibre-optic subsea cable
- Repeaters and Branching Units (BU)
- Beach Manhole (BMH)
- System earth
- Cable Landing Station (CLS) (in the case of the Project this will be an existing building)
- Terrestrial fibre optic cable (herein referred to as terrestrial cable)

2.2 PROJECT LOCATION

In South Africa, the Project will involve the installation and operation of a 14 to 35 mm diameter subsea fibre optic cable system, which will run ~3,200 km from South Africa to Mauritius. Branches will split from the main trunk to landing sites located *en route*, including Madagascar and Réunion.

The main trunk of the marine cable will enter South African territorial waters at approximately 30° 0' 51.550″ S, 31° 13' 55.130″ E and follow a 538 km route within the EEZ to a coastal landing site south of Durban on the KwaZulu-Natal coast. The landing site is located south of the Amanzimtoti Beach at approximately 30° 2′ 27.030″ S, 30° 53′ 58.400″ E, and is characterized by a stretch of sandy beach.

At the shore crossing, the buried subsea fibre optics cable will enter a beach manhole where it will connect to the terrestrial portion of the cable. The beach manhole would be located above the high water mark at approximately 30° 2' 24.900" S, 30° 53' 55.700″ E.

The subsea cable route has been designed by route engineers at ASN & Elettra to be the optimum route for the cable, taking into consideration environmental and stakeholder constraints. The subsea cable route has, and will be further engineered to avoid potential hazards, reduce impact to seabed users such as disruption to marine resources and operations, and secure long-term protection of the cable.

The subsea cable route and project design are developed and refined through two main stages:

- Subsea Cable Route Study – detailed review of all factors affecting the routing of the subsea cable, including physical, environmental, socioeconomic, and regulatory aspects
- Subsea Cable Route Survey – surveys of the inshore and deep-water sections of the subsea cable route prior to installation.

Survey data has been acquired across the survey corridor in the order of 500 m, centred on the subsea cable route. The Subsea Cable Route Survey comprised the use of multibeam echosounder, side scan sonar, sub bottom profiling, magnetometer, cone penetrometer tests and core sampling.

Note that full details of the land-based Project components are included in the EIA Report compiled by ERM.

2.3 *CABLE SYSTEM COMPONENTS*

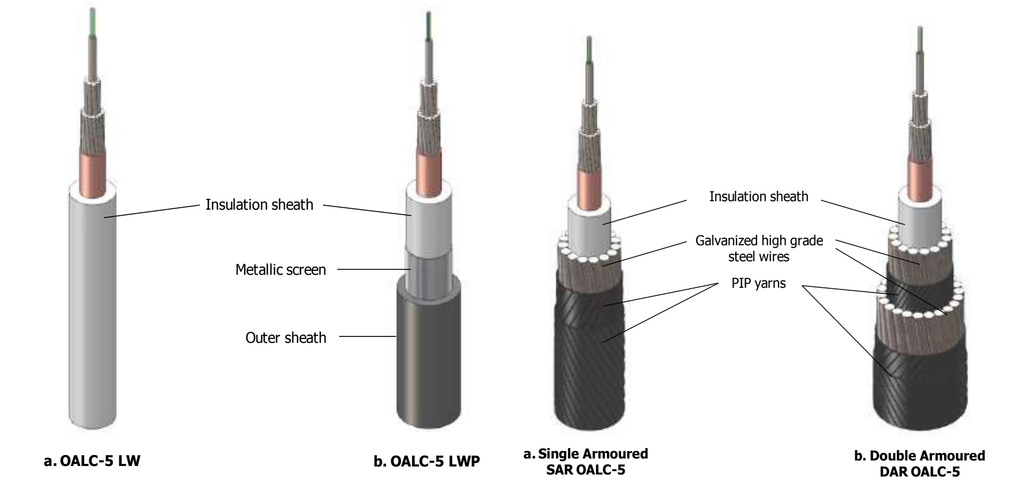
A description of the subsea cable system components is provided below.

The main part of the system is the subsea fibre optic cable which will consist of inner optical fibres encased in polyethylene for strength. The optical fibres are glass fibres that carry light along their length. They are widely used in telecommunication systems because they allow for transmission of data over long distances and at very high speeds. The exterior cable diameter will range from 14 to 35 mm.

The main design function of a subsea cable is to protect the optical fibre transmission path over the service life of the system, including laying, burial, and recovery operations. *Figure 2.1* shows the proposed cable types viz. Lightweight (LW), Lightweight Protected (LWP), Reinforced Single Armour (SAR) and Reinforced Double Armour (DAR). DAR and SAR cable types are normally used in shallow water where cable burial is planned and where the external risk to the cable is considered higher. LWP and LW cable types are normally used in deep water where the cable will be surface laid and the external risk to the cable is considered lower.

The cable type to be used for METISS is the ASN OALC-5 subsea cable, a resilient cable type designed specifically for repeatered systems. A 'repeatered system' is a cable system typically longer than 350 to 400 km. To prevent the optical signal deteriorating from the point of origin to the destination, the signal is boosted approximately every 70 km in a component call a 'repeater'. Power will be provided to the repeaters through electrical connection in the cable. The current is fully shielded by the polyethylene coating.

Figure 2.1 Proposed ASN OALC-5 Cable Types



Source: ERM, 2018

2.4 *PROJECT ACTIVITIES*

The Project phases include:

- Pre-installation and Installation;
- Operation; and
- Decommissioning

2.4.1 *Pre-Installation*

The exact position of the subsea cable is being confirmed on the basis of offshore and nearshore surveying of the seabed. This provides the necessary information for detailed engineering, construction, installation and subsequent maintenance of the cable.

The following survey techniques were used during the survey operations:

Geophysical Survey

- Multibeam Echosounder (MBES) to determine the contours of the seabed and define water depth;
- Sub-bottom profiling to identify the type of sediments and best route for burial of subsea cable; and
- Sidescan sonar to identify obstacles such as deep gullies, rocks, and corals.

Geotechnical Survey (in planned burial areas only)

- Cone Penetrometer Tests (CPTs) to determine the resistivity of the sediment for burial operations; and
- Core Sampling to identify the types of sediment to assist with burial assessment.

The survey has been completed and the data collected are being used to finalize the subsea cable route.

Prior to installation, a clearance operation will be conducted to remove obstacles from the path of the final subsea cable route (as confirmed by the marine survey). Immediately in advance of installation, a Pre-Lay Grapnel Run (PLGR) will take place along the planned subsea cable route where burial is required as a final check of the seabed for items that might interfere with installation or otherwise damage the subsea cable or plough burial equipment. The PLGR is undertaken by the main cable laying vessel or another designated vessel. The operation involves the towing of one or an array of grapnels along the route where burial is required. The vessel proceeds at a rate to ensure that the grapnel maintains continuous contact with the seabed. The grapnel is usually a sliding prong type which can penetrate up to 40 centimetres (cm) into the seabed.

As the vessel moves along the route, the towing tension is monitored and the grapnel is recovered if the tension increased indicating that an obstruction has been hooked. As a matter of routine, the grapnel is recovered and inspected at minimum intervals of 15 km along the route.

Usually a single tow is made along the route but in areas where other marine activity or debris amounts are high, additional runs may be made. All debris recovered from the seabed will be stored on board and disposed of at an appropriate approved land facility once the vessel docks.

2.4.2 Installation

The subsea cable will be installed using a combination of surface lay on the seabed and burial. The subsea cable segment from the BMH on land out to the low water mark will be buried to a target depth of 2.0 m below the soil level, or until bedrock. From the low water mark to approximately 1,000 m water depth in South African waters, the subsea cable will be buried to a target depth of 1.0 m below the seabed. The subsea cable will be buried using various industry standard burial tools including diver jetting and ploughing. In water depths deeper than 1,000 m, the subsea cable will be surface laid on the seabed.

The installation vessel will be a purpose-built subsea cable vessel fully equipped with all the necessary equipment, tools and facilities to safely handle and install, joint, test, and power the submerged plant, including simultaneous lay and plough burial (*Figure 2.2*). The vessel will have sufficient power and dynamic positioning capability to carry out the installation in the expected weather and current conditions.

Marine installation of the subsea cable in South African waters is expected to take approximately 30 days, including shore end operations ie construction of the BMH for approximately five days.

Figure 2.2 *RV Teliri Cable Laying Vessel*

Source: Elettra, 2018

The plough used to bury the subsea cable in the seabed has dimensions of approximately 9 m x 5 m x 5 m (LxHxW) and a submerged weight of 13 tonnes (*Figure 2.3*). The plough is designed to backfill the cable burial trench during operation.

Figure 2.3 *Taurus2 SMD Plough System*

Source: Elettra, 2018

Any subsea cable crossings will require the plough to be raised and the cable will be buried using a Remote Operated Vehicle (ROV) equipped with a jetting system (*Figure 2.4*) in an operation known as Post-Lay Inspection & Burial. The proposed ROV has dimensions of approximately 5 m x 3 m x 2 m (LxHxW).

Figure 2.4 ROV Phoenix II

Source: Elettra, 2018

Crossing existing in-service telecommunications cables, power cables or pipelines will involve surface lay followed by post-lay burial using an ROV in areas of planned burial. All cable owners will be notified in line with International Cable Protection Committee (ICPC) guidelines and where possible, a favourable crossing angle of close to 90 degrees is pursued for all crossings.

No power cable or pipeline crossings have been identified in South African waters. There is one identified in-service fibre optic cable crossing and it is expected to be in an area where the cable is surface laid, at approximately 1,400 m water depth.

Once the subsea cable enters the BMH it is then connected to existing terrestrial infrastructure. The connection to the Terminal Station will be made from the BMH via a terrestrial cable installed through ducts. The subsea cable will then be connected in the BMH to the existing Terminal Station and tested.

Following installation, the subsea cable is expected to be operational for at least 25 years. During operation there may be a potential requirement for maintenance work such as cable repair at fault location due to unexpected damage. These works will be similar in nature to cable installation works described above but for a shorter period of time.

On the approach to the beach (shore end) and the low water mark the subsea cable will be buried using diver jet burial; hand-held jets to bury the cable in the seabed. The expected maximum width of the seabed fluidised by the jet burial is approximately 105 mm either side of the centre line of the proposed cable route (ie 210 mm width) and the subsea cable is buried to a target depth of 1 m. It is expected that the seabed would naturally reinstate to before-work level and condition shortly after completion of the works.

Articulated Pipe may be used as additional protection for the subsea cable from the low water mark to the BMH.

The Articulated Pipe has a maximum external diameter of 130 mm and will be buried on the beach to a target depth of 2.0 m or until bedrock.

2.4.3 Operation of the System

Following installation, the system is expected to be operational for at least 25 years.

Once installed and operational the system will not require routine maintenance. However, subsea cables can be damaged or broken by human activity (fishing trawler gear or ships dragging or dropping anchor) and/or natural events (seismic activity). If the subsea cable is damaged or needs repair, the damaged portion of the cable can be retrieved and repaired or replaced.

For inshore and subsea cable repairs, equipment and methods would be similar to those outlined above but not along the full alignment ie, of smaller scale, with the potential to use smaller equipment such as Remotely Operated Vehicles (ROVs) equipped with injector tool and divers with hand held tools.

The typical process for repair works for shore end and marine works is outlined below:

- Terminal Testing: Testing from cable station terminal, to determine fault location as precisely as possible using optical or electrical characteristics of the cable;
- Initial Inspection: Subsea cable route and seabed will be inspected using Side Scan Sonar, ROV or divers where appropriate to determine the precise fault location and nature if unknown. If the cable is buried, tracking equipment is used;
- Cut faulty subsea cable, buoy off, recover to vessel: If necessary to cut the cable at the fault area, either an ROV or grapnels will be used, or if feasible, divers. Divers use hand-jetting and ROV use a jetting technique to uncover buried cable. Grapnels penetrate the seabed without jetting to pick up, cut and recover the cable. The cable ends will be recovered to the vessel, using diver, ROV or gripper grapnels. While one subsea cable end is repaired on the vessel, the other end will be attached to a rope that is lowered to seabed and this rope will be attached to a buoy to mark its location;
- Cable Splice and Repair: Damaged subsea cable section will be cut out. First one end will be spliced to the spare repair cable section and electrical and optical testing conducted to ensure the integrity of the splice and cables. Then the second subsea cable end will be picked up and spliced back to the repair cable section. Upon completion, the cable integrity will be confirmed through end-to-end electrical and optical testing;
- Replacement of Repaired Subsea Cable: Once the subsea cable has been fully repaired and connected, it will be lowered onto the seabed, along the 'as-laid' subsea cable route. Once the repaired subsea cable is in the 'as-laid' cable route alignment, a diver or ROV will perform an inspection of the repair area, including determining the beginning and ending of unburied subsea cable; and

- Post-Lay Inspection and Burial (PLIB): Should burial at the repair area be necessary, it will be carried out to best endeavours or pre-determined target depth, using diver or ROV jetting up to 2 m. If burial is not possible, other means of protection may be considered such as articulated piping, URADUCT® or other means such as rock dumping. One final diver or ROV inspection will be carried out before repair works are completed.

In the Southern Africa region, there are dedicated repair ships on standby to respond to any emergency repairs.

2.4.4 *Decommissioning*

Decommissioning of the system would usually involve demolition and recovery and removal of terrestrial components. The marine subsea portion of the subsea cable could be recovered and removed along certain segments if required, and abandonment in place along others. The METISS subsea cable system, will not however, be removed.

The subsea portion of the cable is likely be retired in place, as per current global industry practice.

The following steps shall be undertaken for decommissioning:

- To ensure that due consideration is given to all alternatives a detailed evaluation of facilities decommissioning options will be carried out. The evaluation will consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environmental options for the decommissioning of the cable and associated infrastructure.
- A risk assessment will also be conducted to ensure that nothing which could be constituted as a hazard for other users of the area or for the environment in general will be left at the site. The site will be left in a safe and environmentally acceptable condition.
- The appropriate authorities shall be consulted and notified of the system status (including if the system is retired in place).

A detailed Project Decommissioning Plan will be developed as the Project nears the end of its lifetime. .

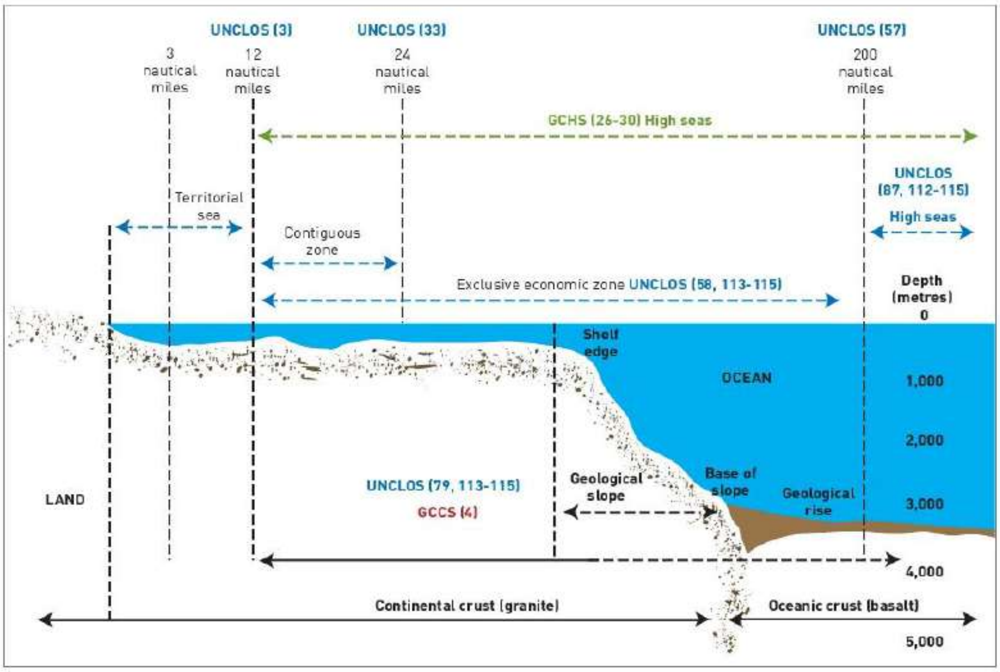
3 RELEVANT LEGISLATURE

The International Convention for the Protection of Submarine Cables (1884) is the foundation of modern international law for subsea cables as contained in the Geneva Conventions on the High Seas 1958 (Articles 26–30) and Continental Shelf 1958 (Article 4) and in the United Nations Convention on the Law of the Sea (1982) (UNCLOS).

Coastal states exercise sovereign rights and jurisdiction in the EEZ and on the continental shelf for the purpose of exploring and exploiting their natural resources, but other states enjoy the freedom to lay and maintain subsea cables in the EEZ and on the continental shelf. In the territorial sea, coastal states may establish conditions for cables or pipelines entering these zones (UNCLOS, Article 79(4)). At the same time, the laying and maintenance of subsea cables are considered reasonable uses of the sea and coastal states benefit from them. Outside of the territorial sea, the core legal principles applying to international cables can be summarized as follows (UNCLOS, Articles 21, 58, 71, 79, 87, 112-115 and 297(1)(a)):

- The freedoms to lay, maintain and repair cables outside of territorial seas, including cable route surveys incident to cable laying (the term laying refers to new cables while the term maintaining relates to both new and existing cables and includes repair) (Nordquist et al., 1993, p. 915);
- The requirement that parties apply domestic laws to prosecute persons who endanger or damage cables wilfully or through culpable negligence;
- The requirement that vessels, unless saving lives or ships, avoid actions likely to damage cables;
- The requirement that vessels must sacrifice their anchors or fishing gear to avoid injury to cables;
- The requirement that cable owners must indemnify vessel owners for lawful sacrifices of their anchors or fishing gear;
- The requirement that the owner of a cable or pipeline, who in laying or repairing that cable or pipeline causes injury to a prior laid cable or pipeline, indemnify the owner of the first laid cable or pipeline for the repair costs; and
- The requirement that coastal states along with pipeline and cable owners shall not take actions which prejudice the repair and maintenance of existing cables.

Figure 3.1 Legal boundaries of the ocean from territorial sea to exclusive economic zone and onto the high seas



Source: D. Burnett in UNEP-WCMC, 2009

Under UNCLOS and the earlier 1884 International Convention for the Protection of subsea cables, if a mariner damages a cable and the damage could be avoided by taking reasonable care as a prudent seaman, then the person causing the damage is liable. If a mariner damages a subsea cable with fishing gear or an anchor, when he could have seen that cable on a chart and avoided it, he may be liable for the damage. In addition to civil liability for damages, the mariner may face criminal sanctions for culpable negligence or wilful injury to a subsea cable.

International law also requires that a vessel that has gear or an anchor caught on a subsea cable is required to sacrifice the gear or anchor to avoid injury to the cable. Provided the mariner was not negligent in contacting the subsea cable in the first place, the mariner is entitled to indemnity for the cost of the sacrificed gear or anchor by the owners of the subsea cable. To claim indemnity for the sacrifice, the mariner should file within 24 hours of arrival in port a declaration setting forth the circumstances of the sacrifice with the subsea cable owner, if known, or the local government maritime authorities like the coast guard. In the case of a valid sacrifice, the cable owner may be required to pay the indemnity for the sacrificed gear or anchor.

4 APPROACH AND METHODOLOGY

4.1 DESCRIPTION OF POTENTIAL IMPACTS ON FISHERIES

Exclusion Zone

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part A, Rule 10), a vessel that is engaged in the laying of a subsea cable is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way of the operation. A safety zone of 500 m is enforced around the cable-laying vessel during operations.

Once installed, a subsea cable is protected by a 1 nm exclusion zone on either side of the cable and it is an offence for any anchoring or trawling within this zone. The proposed Project therefore presents an impact on the fishing industry via exclusion to the demersal trawl or longline operations.

4.2 ASSESSMENT METHODOLOGY

The proposed Project's potential significant impacts on commercial fishing are evaluated in this study. The assessment was focused on the marine portions of the Project and the effects caused by exclusion of fishing during the subsea cable laying operations and on the exclusion of anchoring and trawling during within 1 nm to either side of the subsea cable during the operational phase. The shore-based activities of the Project were not considered to be applicable for assessing impacts to commercial fishing and were not included in this analysis.

The spatial distribution of catch was mapped at an appropriate resolution for each fishing sector (based on the fishing method and resulting area covered by fishing gear). The proposed routing of the subsea cable was mapped and a spatial buffer of 500 m to either side of the cable route was applied to indicate the temporary exclusion of fishing vessels during the subsea cable-laying operations. A buffer of 1 nm to either side of the subsea cable was used to map the permanent area of exclusion to trawling and anchoring surrounding the installed cable (applicable to demersal fishing operations only). This area was mapped and the spatial overlap expressed as a percentage of fishing ground available to each sector. This measurement was used as an indication of the relative extent of the impact on each fishery where an overlap of less than 10% was considered to be local in extent and an overlap of greater than 10% was considered to be regional in extent. The average annual catch taken within the impacted area was used to calculate the amount of catch (also expressed as a percentage of overall total landings) that would potentially be lost.

For each impact, the TYPE (direct, indirect, induced or cumulative), DURATION (time scale), EXTENT (spatial scale), SCALE and FREQUENCY were described. These criteria were used to determine the MAGNITUDE (Negligible, Small, Medium or Large) of the impact. The overall SIGNIFICANCE of the impact was a function of the consequence and the MAGNITUDE of the impact and the SENSITIVITY (Low, Medium or High) of the receptor. Practical mitigation and optimisation measures that can be implemented effectively to reduce or enhance the significance of impacts were identified. The impact significance was re-rated assuming the effective implementation of mitigation measures.

The methodology followed for this assessment was provided by ERM and is defined below.

4.2.1 *Impact Identification and Characterisation*

An 'impact' is any change to a resource or receptor caused by the presence of a project component or by a project-related activity.

Impacts can be negative or positive.

Impacts are described in terms of their characteristics, including the impact type and the impact spatial and temporal features (namely extent, duration, scale and frequency). Terms used in this EIA Report are described in *Table 4.1* below.

Table 4.1 Impact Characteristics (ERM, 2018)

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the project (in terms of cause and effect).	**Direct** - Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptor. **Indirect** - Impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment (eg viability of a species population resulting from loss of part of a habitat as a result of the project occupying the seabed). **Induced** - Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project **Cumulative** - Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.
Duration	The time period over which a resource / receptor is affected.	**Temporary** – impacts that are predicted to last for a period of less than 3 years **Short term** - impacts that are predicted to last for a period of less than 5 years. **Long term** - impacts that will continue for the life of the Project, but cease when the Project stops operating. **Permanent** - impacts that exceed the life of the Project.

Extent	The reach of the impact (i.e. physical distance an impact will extend to)	**On-site** – impacts that are limited to the Project site. **Local** - impacts that are limited to the Project site and adjacent areas. **Regional** - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems **National** - impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. **Trans-boundary/International** - impacts that affect internationally important resources such as areas protected by international conventions or impact areas outside of South Africa.
Scale	Quantitative measure of the impact (eg the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.

4.2.2 *Determining Impact Magnitude*

Once impacts are characterised they are assigned a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the extent, duration, scale and frequency.

Magnitude (from small to large) is a continuum. Evaluation along the continuum requires professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is noted. Magnitude designations for negative effects are: Negligible, Small, Medium and Large.

The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a Negligible magnitude.

In the case of impacts resulting from unplanned events, the same resource/ receptor-specific approach to concluding a magnitude designation is used. The likelihood factor is also considered, together with the other impact characteristics, when assigning a magnitude designation.

Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

Large Magnitude Impact affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measureable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A High magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

Medium Magnitude Impact affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A Moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.

Small Magnitude Impact affects a specific area, system, aspect (physical), group of localised individuals within a population (biological) and at sufficient magnitude to result in a small increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) over a short time period (one plant/animal generation or less, but does not affect other trophic levels or the population itself), and localised area.

Negligible Magnitude Impact is one where the area of the impact to the resource/receptor (including people) is immeasurable, undetectable or within the range of normal from natural background variations.

Determining Magnitude for Socio-economic Impacts

For socio-economic impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The quantitative elements are included into the assessment through the designation and consideration of scale and extent of the impact.

4.2.3 *Determining Receptor Sensitivity*

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered. Where the receptor is biological or cultural (ie the marine environment or a coral reef), its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. For socio-economic impacts, the degree of sensitivity of a receptor is defined as the level of resilience (or capacity to cope) with sudden social and economic changes. The sensitivity of receptor is designated either low, medium or high (*Table 4.2*).

Table 4.2 Socio-Economic Sensitivity Criteria (ERM, 2018)

Sensitivity	Low	Medium	High
Criteria	Those affected are able to adapt with relative ease and maintain pre-impact status.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Those affected will not be able to adapt to changes and continue to maintain-pre impact status.

4.2.4 *Assessing Significance*

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in *Table 4.3*.

Table 4.3 Impact Significance (ERM, 2018)

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/importance designations that enter into the matrix. *Table 4.4* provides a context for what the various impact significance ratings signify.

Table 4.4 Context of Impact Significances (ERM, 2018)

An impact of **Negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
An impact of **Minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
An impact of **Moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
An impact of **Major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the project.

4.2.5 *Mitigation Potential and Residual Impacts*

A key objective of an EIA process is to identify and define socially, environmentally and technically acceptable and cost effective measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in *Table 4.5*.

The priority is to first apply mitigation measures to the source of the impact (ie to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

Table 4.5 Mitigation Hierarchy (ERM, 2018)

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
Abate on Site: add something to the design to abate the impact (eg pollution control equipment).
Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site (eg traffic measures).
Repair or Remedy*:* some impacts involve unavoidable damage to a resource (eg material storage areas) and these impacts require repair, restoration and reinstatement measures.
Compensate in Kind; Compensate through Other Means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg financial compensation for degrading agricultural land and impacting crop yields).

As required by the South African EIA Regulations (NEMA, as amended in 2017) the following additional items were considered in the assessment of impacts and risks identified:

- The degree to which the impact and risk can be reversed (this is rated on a scale of High, Medium, or Low);
- The degree to which the impact and risk may cause irreplaceable loss of resources (this is rated on a scale of High, Medium, or Low).

This will inform the residual impact significance.

4.2.6 *Residual Impact Assessment*

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

4.2.7 *Cumulative Impacts*

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact. How the impacts and effects are assessed is strongly influenced by the status of the other activities (eg already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet operating; and
- Projects that are a realistic proposition but are not yet built.

4.2.8 *Assessing Significance of Risks for Accidental Events*

The methodology used to assess the significance of the risks associated with accidental events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing control and mitigation measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects.

Definitions used in the assessment for likelihood and consequence are set out in *Table 4.6*.

Table 4.6 Risk Significance Criteria for Accidental Events (ERM, 2018)

Likelihood: Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables: • Low: the event or incident is reported in the telecommunication industry, but rarely occurs; • Medium: the event or incident does occur but is not common; and/or • High: the event or incident is likely to occur several times during the project's lifetime. **Consequence:** The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in accidental events is similar to significance (magnitude x sensitivity) of planned events and is classified as either a: • Minor consequence: impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required; • Moderate consequence: impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or • Major consequence: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in *Table 4.7* is used to determine the risk significance for accidental events. The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 4.7 Accidental Events Risk Significance (ERM, 2018)

Risk Significance Rating				
	Likelihood	Low	Medium	High
Consequence	Minor	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of accidental events occurring. However, the mitigation strategy to minimise the risk of the occurrence of accidental events is outlined in *Table 4.8*.

Table 4.8 Mitigation Strategy for Accidental Events (ERM, 2018)

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through: • Reducing the likelihood of the event ie, preventative maintenance measures, emergency response procedures and training; • Reducing the consequence; and • A combination of both of these. **Recovery/remediation:** includes contingency plans and response • Emergency Response Plans;and Tactical Response Plans.

4.3 *DATA SOURCES*

Catch and effort data were sourced from the Department of Agriculture, Forestry and Fisheries (Branch: Fisheries) (DAFF) record for the years 2000 to 2016. All data were referenced to a latitude and longitude position and were redisplayed on a 10x10 minute grid. Additional information was obtained from the Marine Administration System from DAFF and from the *South Africa, Namibia and Mozambique Fishing Industry Handbook 2017 (45th Edition).*

4.4 *ASSUMPTIONS, UNCERTAINTIES & GAPS IN KNOWLEDGE*

The study is based on a number of assumptions and is subject to certain limitations, which should be acknowledged when considering information presented in this report. The validity of the findings is not expected to be affected by these assumptions and limitations:

- The fisheries dataset used in this report was derived from DAFF and is the official record of national commercial catch and effort. These data are derived from logbooks that are completed by skippers, and it is assumed that there will be a proportion of erroneous data due to mistakes in the capturing of these data into electronic format. The proportion of erroneous data is estimated to be up to 10% of the total dataset and would be primarily related to the accurate recording or transcription of the fishing position (latitude and longitude). Where obvious errors in the reporting of fishing positions were identified these were excluded from the analysis. There is also a possibility that catch and effort is under-reported, which presents a potential gap in knowledge in the current assessment.
- The magnitude and significance of the impact of a proposed subsea cable is difficult to ascertain. Based on the description provided for the current Project, the subsea cable would be protected from damage by trawling (and other fishing operations) through burial to a depth of 1.0 m. This action is implemented to reduce the risk of damage to the subsea cable rather than a mitigation of the impact of loss of ground to fishermen. The exclusion corridor would be charted and the cable routing would not be considered to be over-trawlable. Therefore, the current assessment is based on the assumption that demersal fishing activity would be excluded along the entire length of the proposed subsea cable route whereas, in practice, fishing could take place in areas where the cable has been buried.

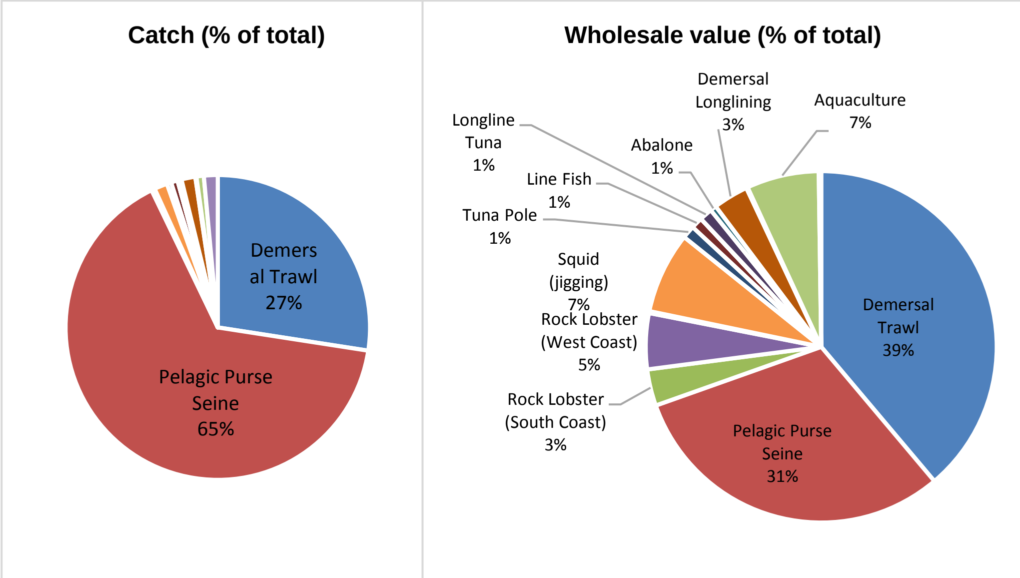
5 *DESCRIPTION OF THE BASELINE ENVIRONMENT*

5.1 *OVERVIEW OF SOUTH AFRICAN FISHERIES*

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

Approximately 14 different commercial fisheries sectors currently operate within South African waters. *Table 5.1* lists these along with ports and regions of operation, catch landings and number of active vessels and rights holders (2016). *Figure 5.1* indicates the proportional volume and value of catch landed by each of these sectors (2016). Primary fisheries in terms of economic value and overall tonnage of landings are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*) and the pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The traditional line fishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi)* and other reef fish. Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank, South Coast and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast. In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of the landed catch.

Figure 5.1 *Pie chart showing percentage of landings by weight (left) and wholesale value (right) of each commercial fishery sector as a contribution to the total landings and value for all commercial fisheries sectors combined (2016).*



Source: CapMarine 2018, modified from DAFF.

- Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. These ports also have significant infrastructure for the processing of anchovy into fishmeal as well as canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip and Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors. There are more than 230 small-scale fishing communities on the South African coastline, ranging in size from small villages to towns (DAFF, 2016).

Table 5.1 South African offshore commercial fishing sectors, landings, number of rights holders, wholesale catch value and target species (DAFF Fisheries Economic Section, 2017)

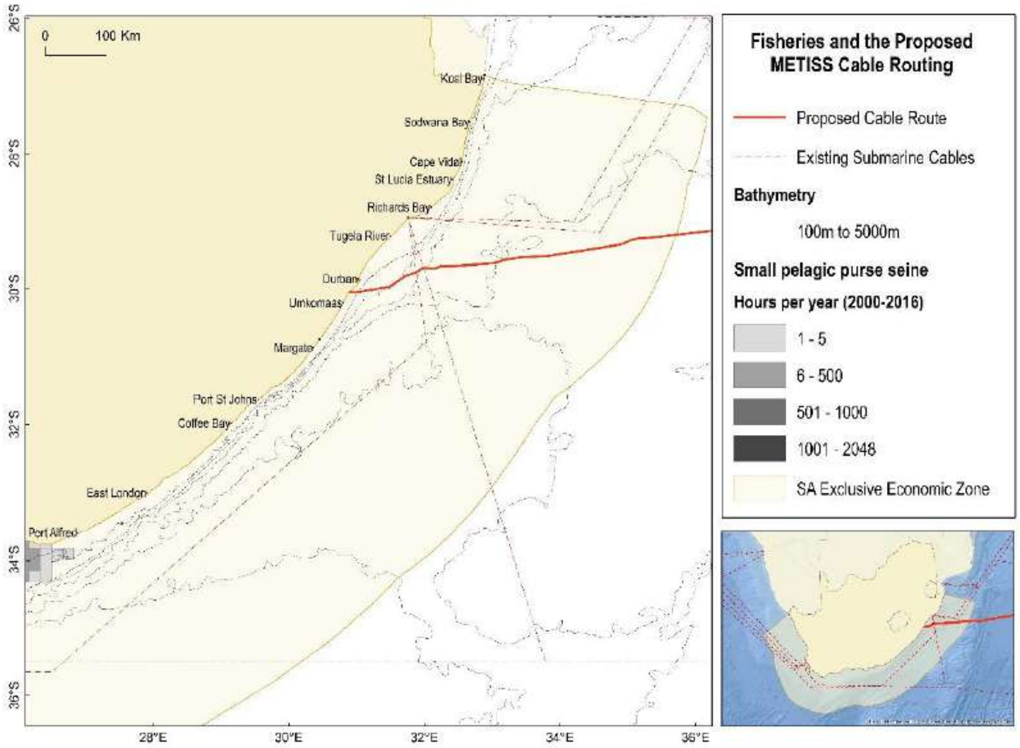
Sector	Areas of Operation	Main Ports in Priority	No. of Rights Holders (Vessels)	Landed Catch (tons)	Wholesale Value (R'000)	Target Species
Small pelagic purse-seine	West, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	111 (101)	399 612	3210924	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	50 (45)	151 456	3927000	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay	18 (31)	6 956	131793	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*Merluccius capensis*), juvenile horse mackerel (mackerel (*Trachurus capensis*)
Mid-water trawl	West, South Coast	Cape Town, Port Elizabeth	34 (6)	9 674		Adult horse mackerel (*Trachurus capensis*)
Demersal longline	West, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	146 (64)	9 027	338600	Shallow-water hake (*Merluccius capensis*)
Large pelagic longline	West, South, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	30 (31)	7 492	123367	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius*), southern bluefin tuna (*T. maccoyii*)
Tuna pole	West, South Coast	Cape Town, Saldanha	170 (128)	2 809	124009	Albacore tuna (*T. alalunga*)
Traditional line fish	West, South, East Coast	All ports, harbours and beaches around the coast	422 (450)	6 445	109763	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii*), geelbek (*Atractoscion aequidens*), kob (*Argyrosomus japonicus*), yellowtail (*Seriola lalandi*), Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	13 (12)	735	351196	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	240 (105)	1 033	537516	*Jasus lalandii*
KwaZulu-Natal prawn trawl	East Coast	Durban, Richards Bay	6 (5)	181	17859	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Port Elizabeth, Port St Francis	92 (138)	8 500	781908	Squid/chokka (*Loligo vulgaris reynaudii*)
Gillnet	West Coast	False Bay to Port Nolloth	162 (N/a)	634	10433	Mullet / harders (*Liza richardsonii*)
Beach seine	West, South, East Coast	N/a	28 (N/a)	1 600		Mullet / harders (*Liza richardsonii*)
Oysters	South, East Coast	N/a	145 pickers	42	3300	Cape rock oyster (*Striostrea margaritaceae*)
Seaweeds	West, South, East	N/a	14 (N/a)	6 172	23566	Beach-cast seaweeds (kelp, *Gelidium* spp and *Gracilaria* spp
Abalone	West Coast	N/a	N/a (N/a)	86	59500	Abalone / "perlemoen" (*Haliotis midae*)

5.2 SMALL PELAGIC PURSE-SEINE

The pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whiteadii*) is the largest South African fishery by volume (tons landed) and the second most important in terms of economic value. The abundance and distribution of these small pelagic species fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km. The majority of the fleet of 101 vessels operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast.

The eastern-most extent of fishing activity ranges to Algoa Bay and there is therefore no spatial overlap between the proposed cable route and grounds fished by the sector (see *Figure 5.2*). There is no impact expected on the small pelagic purse-seine fishery as a result of the proposed Project.

Figure 5.2 Spatial distribution of national fishing effort expended by the purse-seine fishery targeting small pelagic species in relation to the proposed cable route.



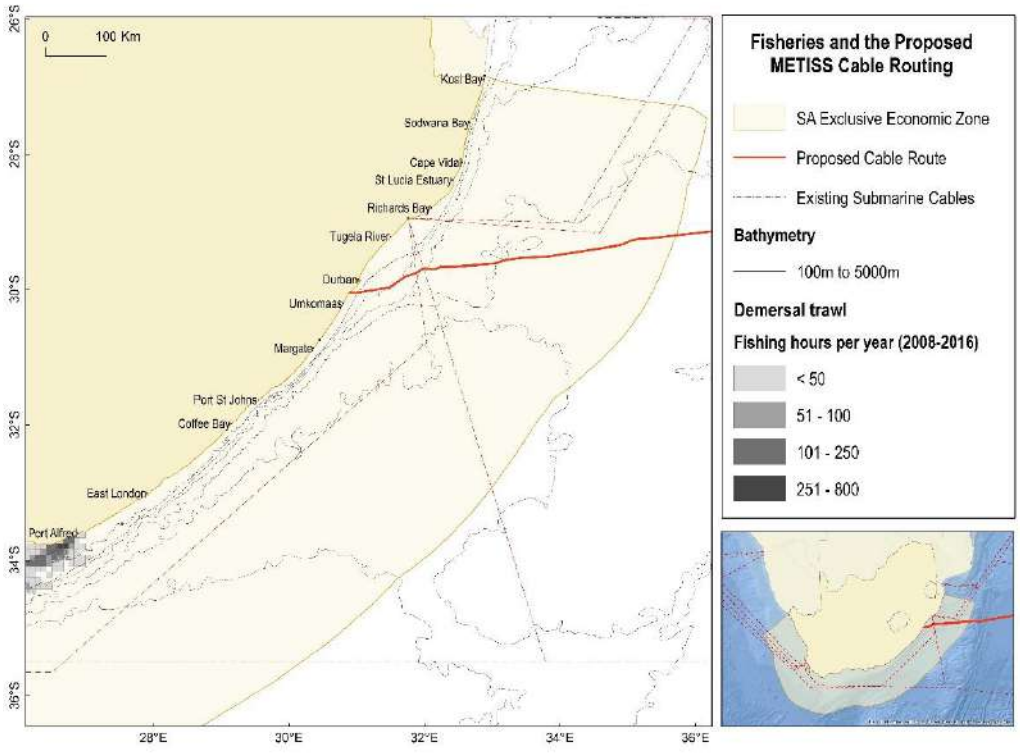
Source: CapMarine 2018.

5.3 DEMERSAL TRAWL

The primary fisheries in terms of highest economic value are the demersal (bottom) trawl and longline fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The demersal trawl fishery comprises an offshore and inshore fleet, which differ primarily in terms of vessel capacity and the areas in which they operate. Approximately 45 offshore vessels operate from most major harbours on both the West and South Coasts. Trawlers target fish at a water depth range of 300 m to 1,000 m and fishing grounds extend in an almost continuous band along the shelf edge from the Namibian maritime border in the north to Port Elizabeth in the East. The inshore fleet comprises approximately 30 vessels which operate off the South Coast from the harbours of Mossel Bay and Port Elizabeth. Inshore grounds are located on the Agulhas Bank and extend eastward towards the Great Kei River. Sole is targeted at a water depth range of between 50 m and 80 m, while hake is targeted at depths of between 100 m and 160 m.

Figure 5.3 shows the distribution of fishing activity in relation to the proposed cable route. As there is no spatial overlap with grounds fished by the sector there is no impact expected on the demersal trawl sector.

Figure 5.3 ***Spatial distribution of national fishing effort expended by the trawl sector targeting demersal species in relation to the proposed cable route.***



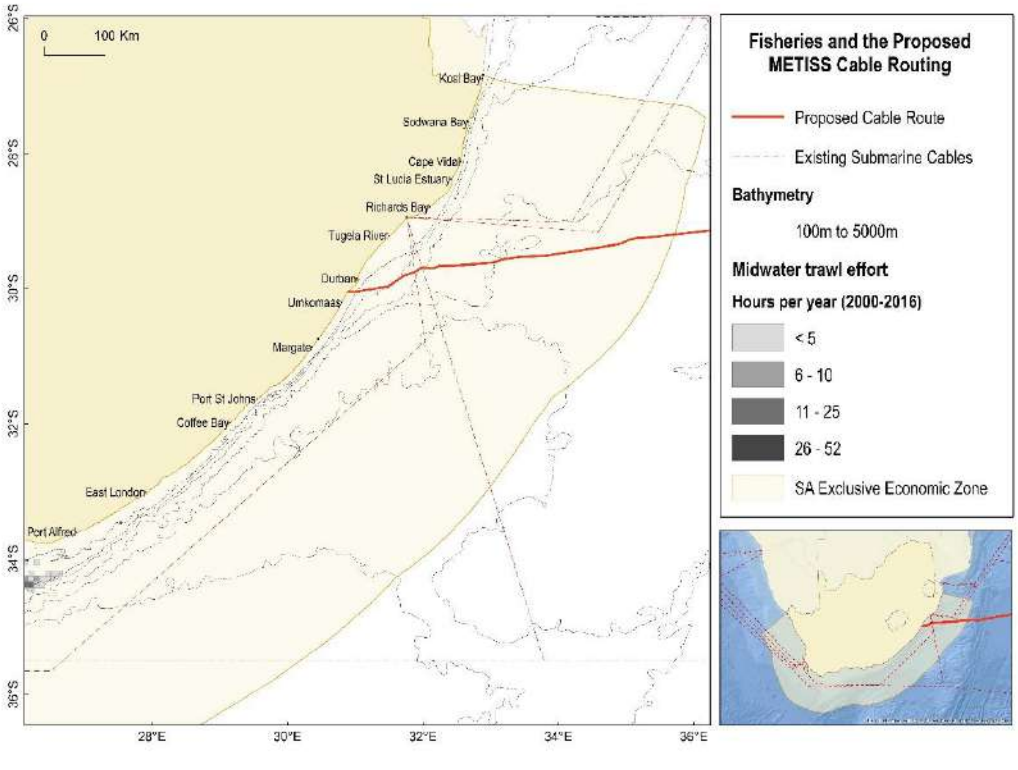
Source: CapMarine 2018.

5.4 MID-WATER TRAWL

Adult horse mackerel (*Trachurus trachurus capensis*) is targeted by mid-water trawl, which is defined in the Marine Living Resources Act (No. 18 of 1998) (MLRA) as any net which can be dragged by a fishing vessel along any depth between the seabed and the surface of the sea without continuously touching the bottom. The fishery operates predominantly on the Agulhas Bank, where shoals are found in commercial abundance. The spatial extent of mid-water trawl activity is relatively limited when compared to that of demersal trawling. Until recently, fishing was restricted by permit condition to the area eastward of 20°E where fishing grounds are condensed into three areas. The first lies between 22 °E and 23 °E at a distance of approximately 70 nm (130 km) offshore from Mossel Bay and the second extends from 24 °E to 27 °E at a distance of approximately 30 nm offshore. The third area lies to the south of the Agulhas Bank 21 °E and 22 °E. These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. From 2017, DAFF has permitted experimental fishing to take place westward of 20°E in response to sustained low catch rates recorded off the South and East Coasts.

The eastern-most extent of fishing activity ranges to approximately 27°E and therefore does not coincide with the proposed cable route (see *Figure 5.4*). There is no impact expected on the mid-water trawl fishery as a result of the proposed Project.

Figure 5.4 Spatial distribution of national fishing effort expended by the midwater trawl sector targeting horse mackerel in relation to the proposed cable route.



Source: CapMarine 2018.

5.5 *Demersal Longline*

Like the demersal trawl fishery, the target species of the long-line fishery is the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay. Fishing grounds are similar to those targeted by the hake-directed trawl fleet. Off the West Coast, vessels target fish along the shelf break from Port Nolloth (15°E, 29°S) to the Agulhas Bank (21°E, 37°S). Lines are set parallel to bathymetric contours and to a maximum depth of 1,000 m, in places.

As there is no spatial overlap with grounds fished by the sector there is no impact expected on the demersal longline sector.

5.6 *Large Pelagic Longline*

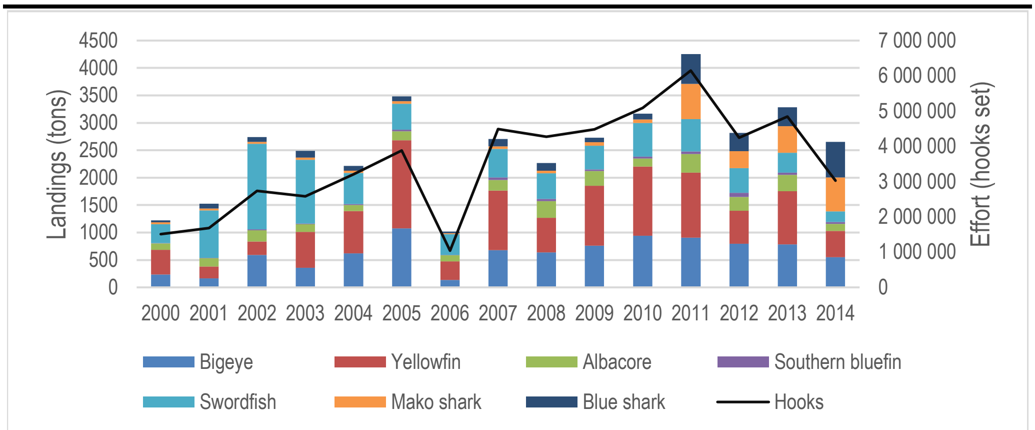
Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African Exclusive Economic Zone (EEZ) by the pelagic longline and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). Tuna, tuna-like species and billfishes are migratory stocks and are therefore managed as a "shared resource" amongst various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). In the 1970s to mid-1990s the fishery was exclusively operated by Asian fleets (up to 130 vessels) under bilateral agreements with South Africa. From the early 1990s these vessels were banned from South African waters and South Africa went through a period of low fishing activity as fishing rights issues were resolved. Thereafter a domestic fishery developed and 50 fishing rights were allocated to South Africans only. These rights holders now include a small fleet of local longliners although the fishery is still undertaken primarily with Japanese vessels fishing in joint ventures with South African companies. There are currently 30 commercial large pelagic fishing rights issued and 21 vessels active in the fishery. During the period 2000 to 2014, the sector landed an average catch of 4,527 tons and set 3.55 million hooks per year. Catch by species and number of active vessels for each year from 2005 to 2014 are given in *Table 5.2*. Total catch and effort figures reported by the fishery for the years 2000 to 2014 are shown in *Figure 5.5*.

The fishery operates year-round with a relative increase in effort during winter and spring (see *Figure 5.6*). Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE (Punsly and Nakano, 1992).

Table 5.2 ***Total catch (t) and number of active domestic and foreign-flagged vessels targeting large pelagic species for the period 2005 to 2014 (Source: DAFF, 2016)***

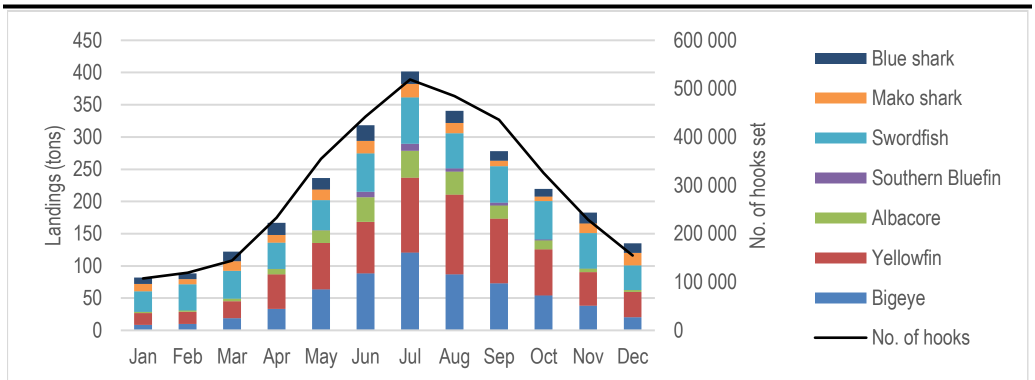
Year	Bigeye tuna	Yellowfin tuna	Albacore	Southern bluefin tuna	Swordfish	Shortfin mako shark	Blue shark	Number of active vessels	
								Domestic	Foreign-flagged
2005	1077.2	1603.0	188.6	27.1	408.1	700.1	224.6	13	12
2006	137.6	337.3	122.9	9.5	323.1	457.1	120.7	19	0
2007	676.7	1086.0	220.2	48.2	445.2	594.3	258.5	22	12
2008	640.3	630.3	340.0	43.4	397.5	471.0	282.9	15	13
2009	765.0	1096.0	309.1	30.0	377.5	511.3	285.9	19	9
2010	940.1	1262.4	164.6	34.2	527.7	590.5	311.6	19	9
2011	906.8	1181.7	338.7	48.6	584.4	645.2	541.6	16	15
2012	822.0	606.7	244.6	78.8	445.3	313.8	332.6	16	11
2013	881.8	1090.7	291.1	50.9	471.0	481.5	349.0	15	9
2014	543.8	485.8	113.8	31.2	223.1	609.6	573.4	16	4

Figure 5.5 ***Inter-annual variation of catch landed and effort expended by the large pelagic longline sector over the period 2000 to 2014.***



Source: CapMarine 2018.

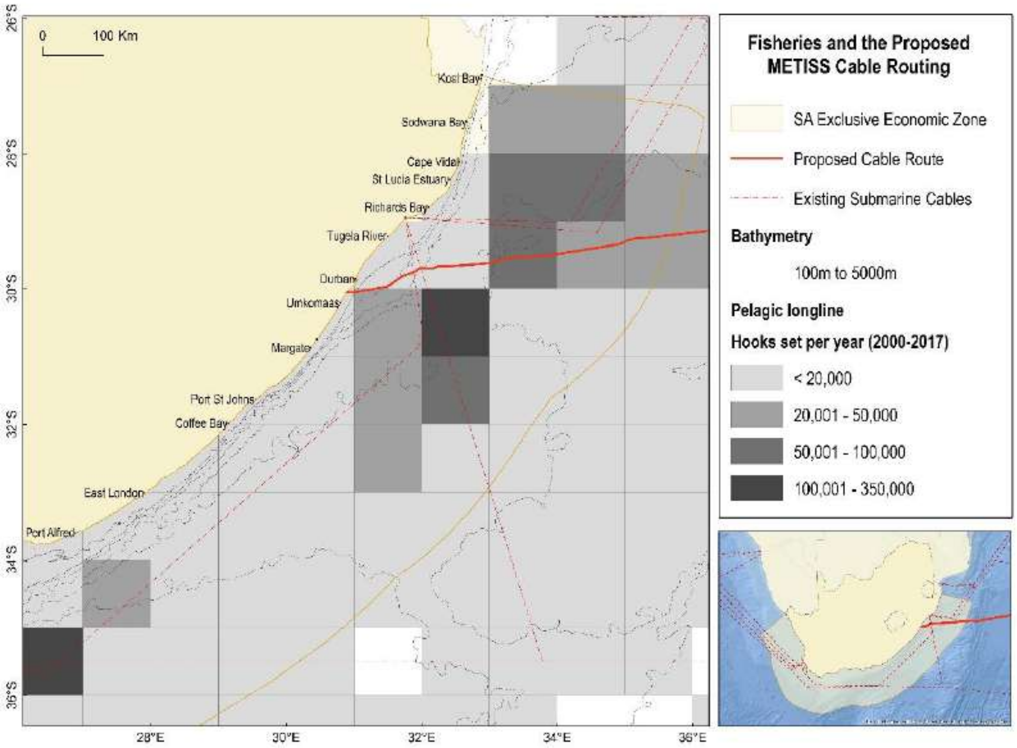
Figure 5.6 ***Monthly variation of catch and effort recorded by the large pelagic longline sector (average figures for the period 2000 to 2014).***



Source: CapMarine 2018.

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. As indicated in *Figure 5.7*, the proposed subsea cable route coincides with the spatial distribution of pelagic longline fishing effort. The impact of the proposed project activities on the sector will be assessed further in Section 6.

Figure 5.7 ***Spatial distribution of national fishing effort expended by the longline sector targeting large pelagic species in relation to the proposed cable route.***



Source: CapMarine 2018.

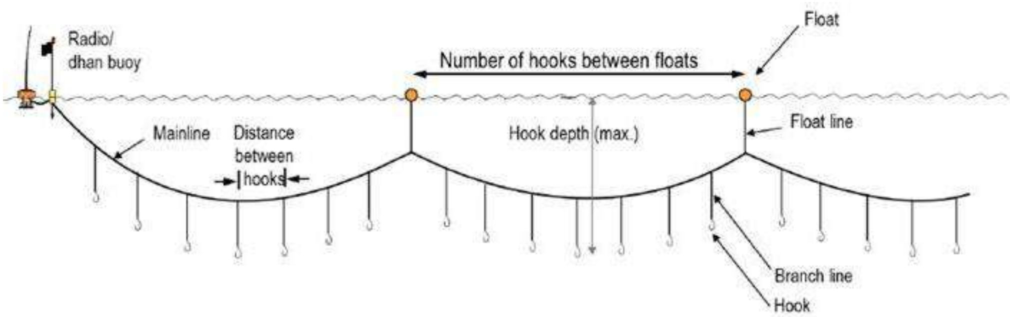
Tuna are targeted at thermocline fronts, predominantly along and offshore of the shelf break. Vessels set a drifting monofilament mainline of up to 100 km length which is suspended from surface buoys and marked at each end. Between radio buoys the mainline is kept near the surface or at a certain depth by means of ridged hard-plastic buoys, (connected via a "buoy-lines" of approximately 20 m to 30 m). The buoys are spaced approximately 500 m apart along the length of the mainline. Up to 3,500 hooks are attached to the mainline on branch lines, (droppers), which are clipped to the mainline at intervals of 20 m to 30 m between the ridged buoys. The main line can consist of twisted tarred rope (6mm to 8mm diameter), nylon monofilament (5mm to 7.5mm diameter) or braided monofilament (~6mm in diameter). A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. During hauling, vessel manoeuvrability is severely restricted. In the event of an emergency, the line may be dropped and hauled in at a later stage.

See *Figure 5.7* for a photograph of a typical surface longline vessel, *Figure 4.8* for typical gear configuration and *Figure 4.9* for gear components used by the fishery.

Figure 5.8 ***Photograph of a typical large scale tuna longline vessel***

Source: CapMarine 2017.

Figure 5.9 ***Typical configuration of surface longline gear targeting tuna, swordfish and shark species.***



Source: IOTC Ross Observer Manual, 2015.

Figure 5.10 ***Photographs showing marker buoys (left), radio buoys (centre) and monofilament branch lines (right)***

Source: CapMarine 2015.

5.7 *TRADITIONAL LINEFISH*

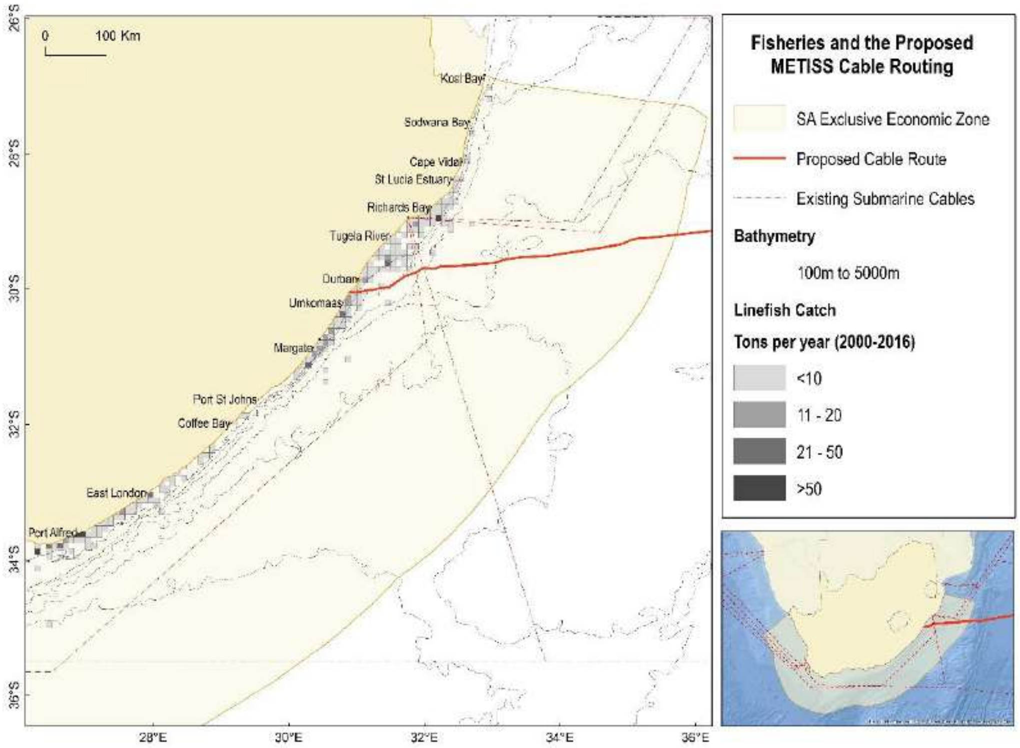
The traditional line fishery is the country's third most important fishery in terms of tonnage landed and economic value. It is a long-standing, nearshore fishery based on a large assemblage of different species using hook and line, but excludes the use of longlines. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*) while other species such as Cape bream (hottentot) (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)* and yellowtail (*Seriola lalandi)* are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). *Table 5.3* lists the catch of important linefish species for the years 2002 to 2016.

Table 5.3 Annual catch of linefish species (t) from 2002 to 2016 (DAFF, 2018)

	snoek	yellowtail	kob	carpenter	slinger	hottentot seabream	geelbek	santer	Total catch
2002	3837	242	392	231	101	79	315	48	
2003	4532	329	272	177	88	106	513	48	
2004	7278	883	360	228	184	254	672	87	
2005	4787	739	324	184	169	168	580	84	
2006	3529	310	400	159	192	87	419	79	
2007	2765	478	421	265	157	128	448	84	11841
2008	5223	313	358	226	194	120	403	82	
2009	6322	330	442	282	186	184	495	66	14109
2010	6360	171	419	263	180	144	408	69	13688
2011	6205	204	312	363	214	216	286	62	12530
2012	6809	382	221	300	240	160	337	82	11855
2013	6690	712	157	481	200	173	263	84	9142
2014	3863	986	144	522	201	192	212	74	6849
2015	2045	594	121	519	175	142	238	68	4421
2016	1643	474	133	690	211	209	246	65	4289

The traditional line fishery is a boat-based activity and has since December 2000 consisted of 3450 crew operating from about 450 commercial vessels. The number of rights holders in 2017 is 425 with 2,550 allowable crew (rights are valid until 31 December 2020). The crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3,000 km coastline, of which 50 species may be regarded as economically important. To distinguish between line fishing and longlining, line fishers are restricted to a maximum of 10 hooks per line. Target species include resident reef-fish, coastal migrants and nomadic species. Annual catches prior to the reduction of the commercial effort were estimated at 16,000 tons for the traditional commercial line fishery. Almost all of the traditional line fish catch is consumed locally. The fishery is widespread along the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast (see *Figure 5.11*).

Figure 5.11 ***Spatial distribution of fishing effort expended by the traditional linefish sector in relation to the proposed cable route.***



Source: CapMarine 2018.

Effort is managed geographically with the spatial effort of the fishery divided into three zones. Zone A extends from Port Nolloth to Cape Infanta, Zone B extends from Cape Infanta to Port St Johns and Zone C covers the KwaZulu-Natal region. *Table 5.4* lists the annual Total Allowable Effort (TAE) and activated effort per linefish management zone from 2006 to 2012.

Table 5.4 ***Annual Total Allowable Effort (TAE) and activated effort per linefish management zone from 2006 to 2012 (DAFF, 2016)***

Total TAE boats (fishers). Upper limit: 455 boats or 3450 crew			Zone A: Port Nolloth to Cape Infanta		Zone B: Cape Infanta to Port St Johns		Zone C: KwaZulu-Natal (Sikombe River to Ponto da Ouro)	
Allocation	455 (3182)		301 (2136)		103 (692)		51 (354)	
Year	Allocated	Activated	Allocated	Activated	Allocated	Activated	Allocated	Activated
2006	455	385	301	258	103	78	51	49
2007	455	353	301	231	103	85	51	37
2008	455	372	301	239	103	82	51	51
2009	455	344	300	222	104	78	51	44
2010	455	335	298	210	105	82	51	43
2011	455	328	298	207	105	75	51	46
2012	455	296	298	192	105	62	51	42

Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing vessels of between 4.5 m and 11 m in length generally range up to a maximum offshore distance of about 70 km, although fishing at this outer limit is sporadic. The spatial distribution of line-fishing effort coincides with inshore areas the proposed cable routing and the impact of the proposed project activities on the sector will be assessed further in section 6.

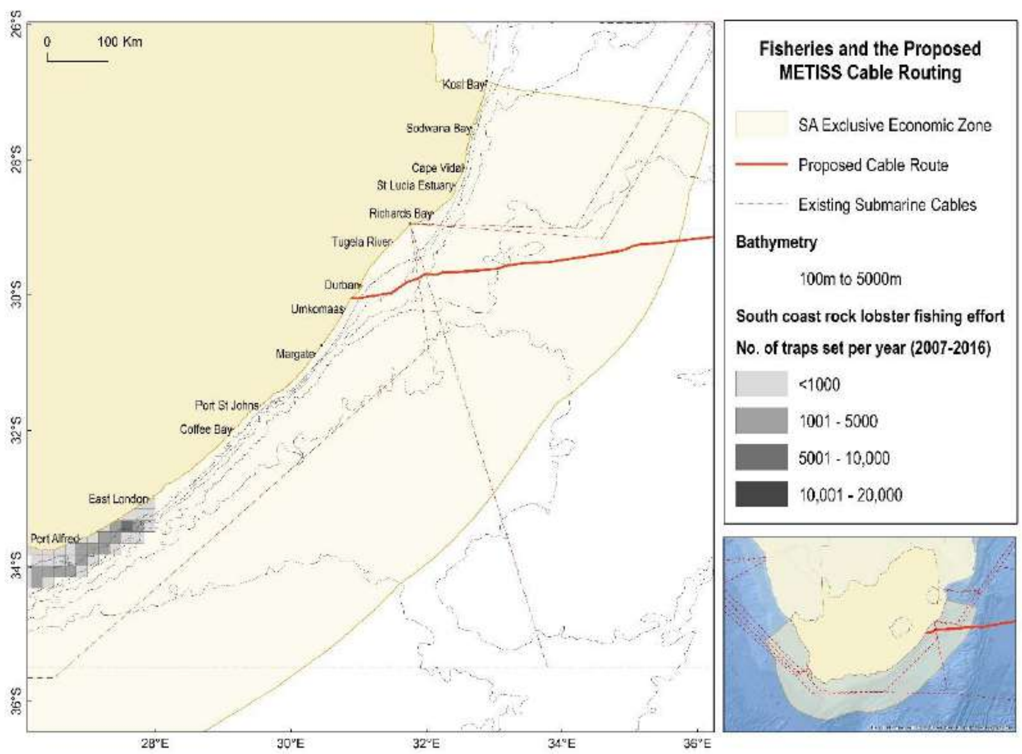
5.8 SOUTH COAST ROCK LOBSTER

The South Coast rock lobster fishery is a deep-water long-line trap fishery. Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2,000 traps per day in sets of 100 to 200 traps per line. They will set between ten lines and 16 lines per day, each of which may be up to 2 km in length. Each line is weighted to lie along the seafloor and will be connected at each end to a marker buoy at the sea surface. Vessels are large, ranging from 30 m to 60 m in length. Those that have on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch will remain at sea between seven and 10 days before discharging at port. The fishery operates year-round with comparatively low activity during October. There are currently seven vessels operating within the fishery which landed a total lobster tail weight of 345 t in 2015/6.

South Coast Rock Lobster (*Palinurus gilchristi*) occurs on the continental shelf of the South Coast between depths of 50 m and 200 m. The stock is fished in commercially viable quantities in two areas off the South Coast, the first is on the Agulhas Bank approximately 200 km offshore and the second is within 50 km of the shoreline between Mossel Bay and East London. The fishery is restricted from operating far offshore by the Agulhas Current, but would be expected to operate within the proposed survey area west of East London and inshore of the 200 m bathymetric contour. *Figure 5.12* shows grounds fished in relation to the proposed cable routing.

The spatial distribution of fishing effort does not coincide with the proposed cable routing and there is no impact expected on the sector.

Figure 5.12 ***Spatial distribution of national fishing effort expended by the trap fishery for south coast rock lobster in relation to the proposed cable route.***



Source: CapMarine 2018.

5.9 *SQUID JIG*

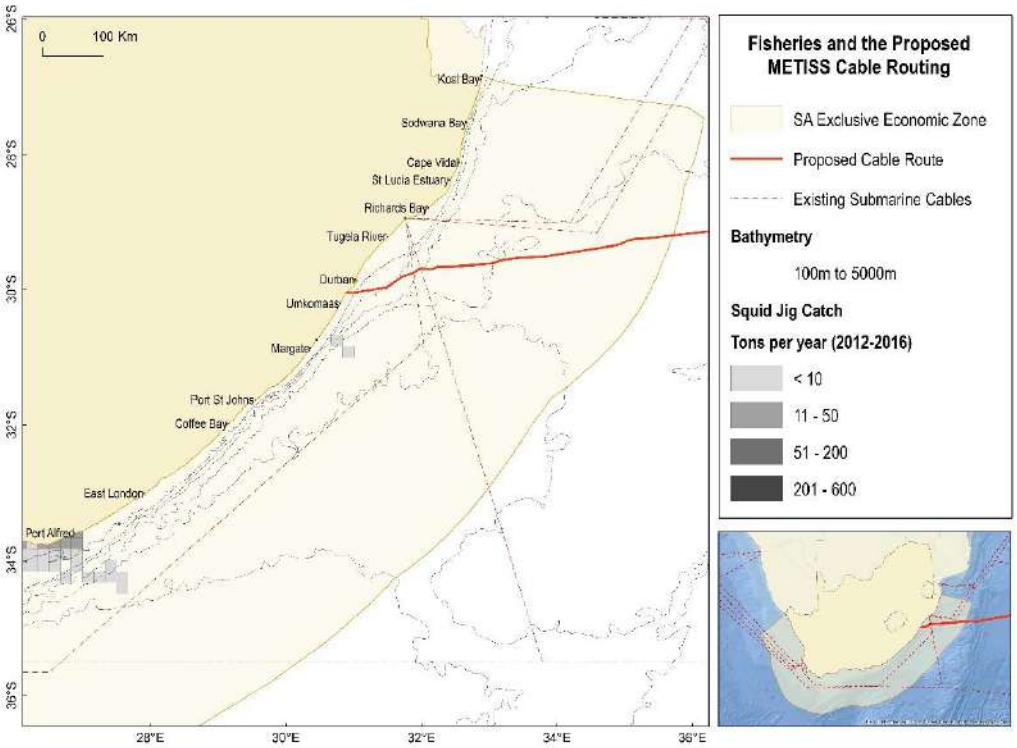
Chokka squid (*Loligo vulgaris reynaudii*) is distributed from the border of Namibia to the Wild Coast. It occurs extensively on the Agulhas Bank out to the shelf edge, increasing in abundance towards the eastern boundary of the South Coast, especially between Plettenberg Bay and Algoa Bay (Augustyn 1990; Sauer et al. 1992; Augustyn et al. 1994). Along the South Coast adult squid is targeted in spawning aggregations on shallow-water fishing grounds extending from Plettenberg Bay to Port Alfred between 20 m and 130 m depths (Augustyn 1990; Downey 2014). The most important spawning grounds are between Plettenberg Bay and Algoa Bay (Augustyn 1990), these having been linked to specific spawning habitat requirements (Roberts & Sauer 1994; Roberts 2005). Spawning aggregations are a seasonal occurrence reaching a peak between September and December (Augustyn et al. 1992).

The method of fishing involves hand-held jigs and bright lights which are used to attract squid at night. A squid jig is defined as a lure like object with a row or number of rows of barbless "hooks" at one end and an "eye" at the opposite end. Jigging operations involve the use of one or more jigs attached to a handline at the "eye" of the jig and moved up and down in a series of short movements in the water (Squid Permit Condition, DAFF).The catch is frozen at sea or at land-based facilities at harbours between Plettenberg Bay and Port Alfred.

Vessels predominantly operate out of Cape St Francis and Port Elizabeth harbours. *Figure 5.13* shows the distribution of fishing effort in relation to the proposed cable route.

As fishing grounds do not coincide with the route the sector is not expected to be impacted by the proposed Project.

Figure 5.13 Spatial distribution of national fishing effort expended by squid jig fishery in relation to the proposed cable route.



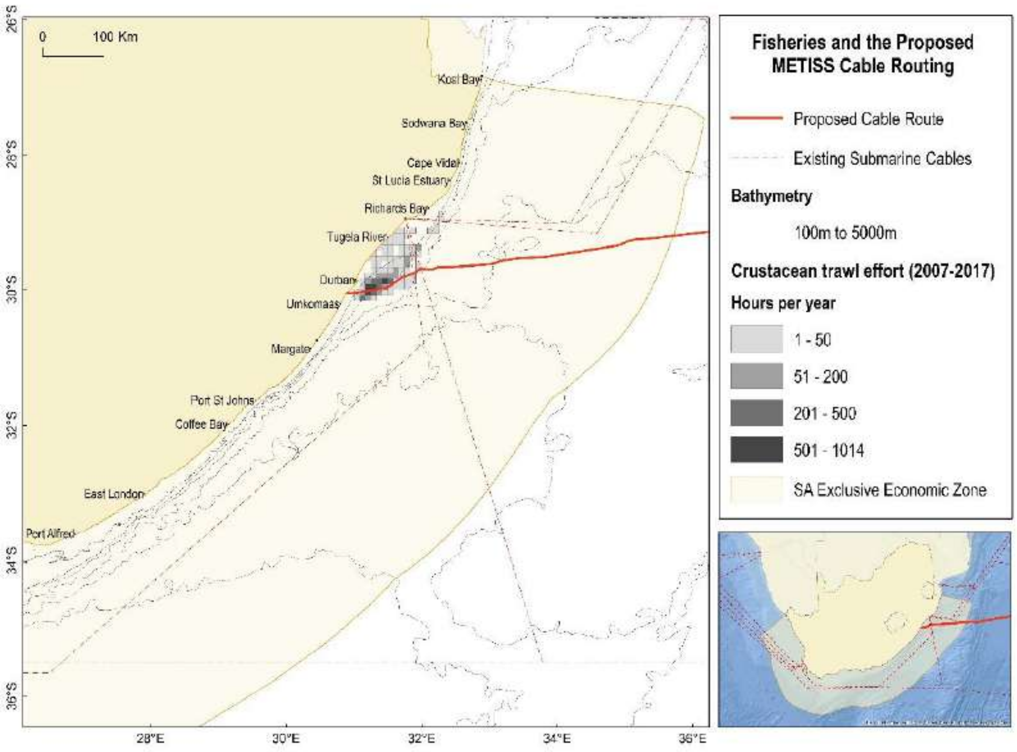
Source: CapMarine 2018.

5.10 *CRUSTACEAN TRAWL*

South Africa's crustacean trawl fishery operates exclusively within the province of KwaZulu-Natal (KZN). Also referred to as the KwaZulu-Natal prawn trawl sector, the fishery comprises two components; a shallow-water (5-40 m) fishery on the Thukela Bank and at St Lucia in an area of roughly 500 km^2, and a deep-water fishery (100-600 km) between Cape Vidal in the north and Amanzimtoti in the south. *Figure 5.14* shows the location of fishing grounds which coincides with the proposed cable route. The impact of the proposed project activities on the sector will be assessed further in Section 6.

In combination, the shallow- and deep-water fisheries operate over an area of approximately 1,700 km^2 along the edge of the continental shelf. The inshore and offshore sectors differ not only according to the fishing grounds in which they operate but also according to their targeted species and gear types.

Figure 5.14 Spatial distribution of fishing effort expended by the crustacean trawl sector in relation to the proposed cable route.



Source: CapMarine 2018.

The inshore fishery is based on white prawns (*Fennereopenaeus indicus*), tiger prawns (*Penaeus monodon*) and brown prawns (*Metapenaeus monoceros*) which occur on the shallow water mud banks along the north east coast of KZN.

There are few areas within the habitat distribution of penaeid prawns that are suitable for trawling due to the steep slope of the continental shelf on the East Coast. The shelf widens between Durban and Richards Bay to form the Tugela Bank – a muddy/sandy area relatively sheltered from the fast-flowing Agulhas current. The inshore fishery operates on the Tugela Bank in water depths of up to 50 m and within 10 nautical miles of the shore. There is a seasonal closure of the Tugela Bank grounds in order to minimize high bycatch levels, therefore trawlers operate only within these inshore grounds during the period March to August. During summer months activity shifts northwards towards St Lucia, where the fishery targets bamboo prawns (*Penaeus japonicus*) in addition to the previously-mentioned species. The prawn species on which the inshore fishery is based are fast-growing and are dependent on estuarine environments during the early phase of their life cycle. As juveniles they recruit onto the mud banks where they mature and reproduce. The catch composition within the fishery typically comprises 20% prawn species, while approximately 10% of the remainder of the catch is also retained for its commercial value and includes crab, octopus, squid, cuttlefish and linefish. The remainder of the catch is discarded.

The deep-water fishery operates between water depths of 100 m and 600 m from Amanzimtoti in the south to Cape Vidal in the north, covering approximately 1,700 km^2 along the edge of the continental shelf. The boundary between the delimitation of offshore and inshore fisheries is about seven nautical miles from the shore. Offshore trawling takes place year-round. Targeted species include pink (*Haliporoides triarthus*) and red prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), red crab (*Chaceon macphersoni*) and deep-water rock lobster (*Palinurus delagoae*). Catches are packed and frozen at sea and landed at the ports of Richards Bay or Durban.

The fishery is managed using a Total Applied Effort (TAE) strategy, which limits the number of vessels permitted to fish on the inshore and offshore grounds. Currently there are five vessels operating within the inshore grounds and two vessels restricted to working in the offshore grounds. The fleet comprises steel-hulled vessels ranging in length from 25 – 40 m and up to a Gross Registered Tonnage (GRT) of 280 tons. All are equipped with GPS, echosounders, radar and VHF/SSB radio. Most vessels are single otter trawlers, deploying nets from the stern or side at a speed of two to three knots. Trawl net sizes range from 25 m to 72 m footrope length, with a minimum mesh size of 60 mm. The duration of a typical trawl is four hours. Trip lengths range from three to four weeks and vessels may carry a crew of up to 20.

Table 5.5 below lists the catch by species group of the prawn trawl fishery from 2000 to 2016. Annual and monthly catch and effort for the deep-water sector over the period 1990 to 2012 is shown in *Figure 5.16* and *Figure 5.17*, respectively.

Figure 5.15 Photograph of a typical crustacean trawl vessel.

Source: Oceanographic Research Institute

Table 5.5 Annual Total Annual catch of the KZN prawn trawl fishery (t) (DAFF, 2016).

		Total catch (t)						
		Inshore fishery	Offshore fishery				Both fisheries	
Year	TAE (no. of permits)	Shallow-water (all prawns)	Deep-water (all prawns)	Langoustine	Red crab	Rock lobster	Landed by-catch	Total catch
2000		107	142	76	53	10	34	422
2001		63	103	80	54	8	4	313
2002		93	102	56	28	9	10	298
2003		29	162	60	40	5	91	387
2004		40	116	42	24	4	82	308
2005		33	140	42	31	4	88	339
2006		21.3	123	49	31	4.7	47	276
2007	7	17.6	79.2	53.2	24.1	5.3	46.9	226.3
2008	7	9.2	104.6	31.4	17.0	4.7	34.9	201.8
2009	7	7.7	196.7	59.8	20.9	9.7	53.4	267.8
2010	7	7.3	172	51.2	23.2	22	69.4	345.1
2011	7	9.6	150.1	79.2	19.7	22.7	63.2	344.5
2012	7	7.6	153.4	81.6	21.6	18.5	71.4	354.1
2013	7	1.7	103.3	61.5	12.0	8.1	34.4	221.0
2014	7	0.3	149.6	56.2	11.5	4.9	25.2	247.7
2015		0	118.0	72.8	55.9	6.3	48.1	301.1
2016		0	115.0	32.5	42.5	4.3		

Figure 5.16 Annual catch and effort for the deep-water trawl fishery (1990 to 2012)

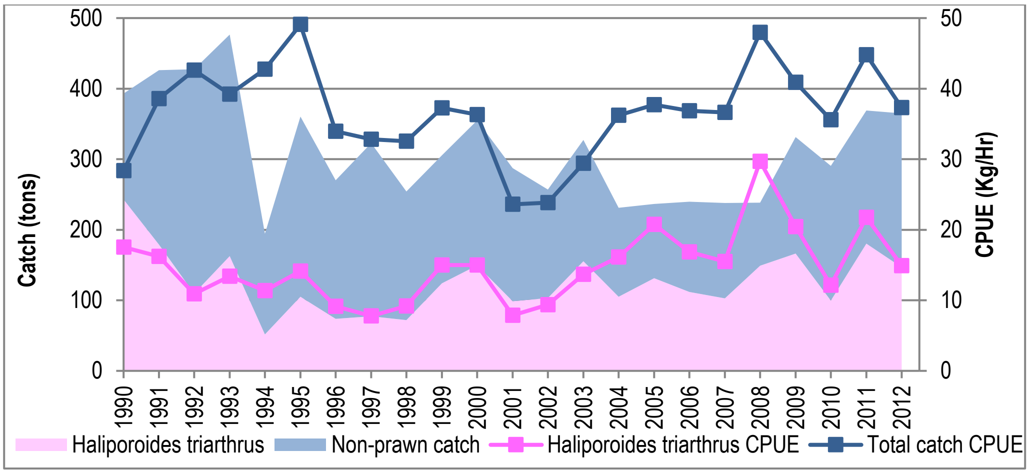
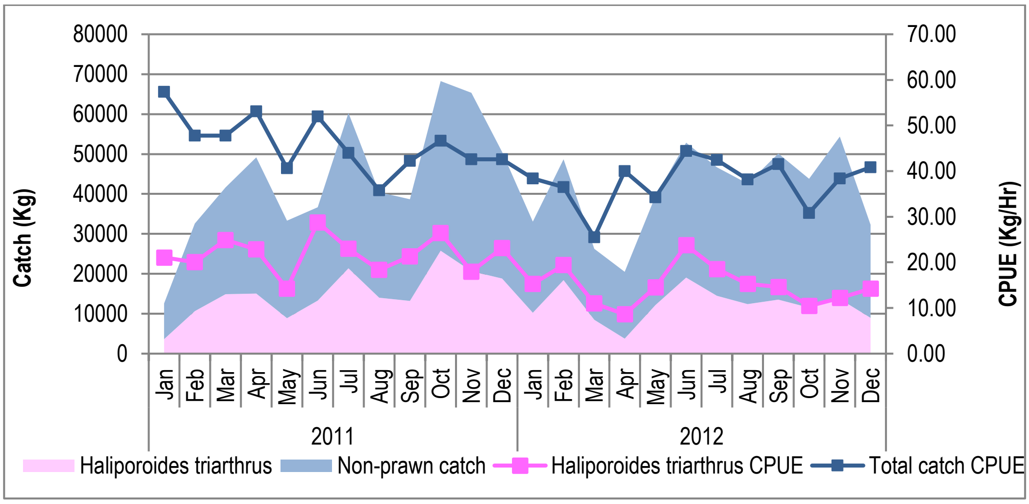


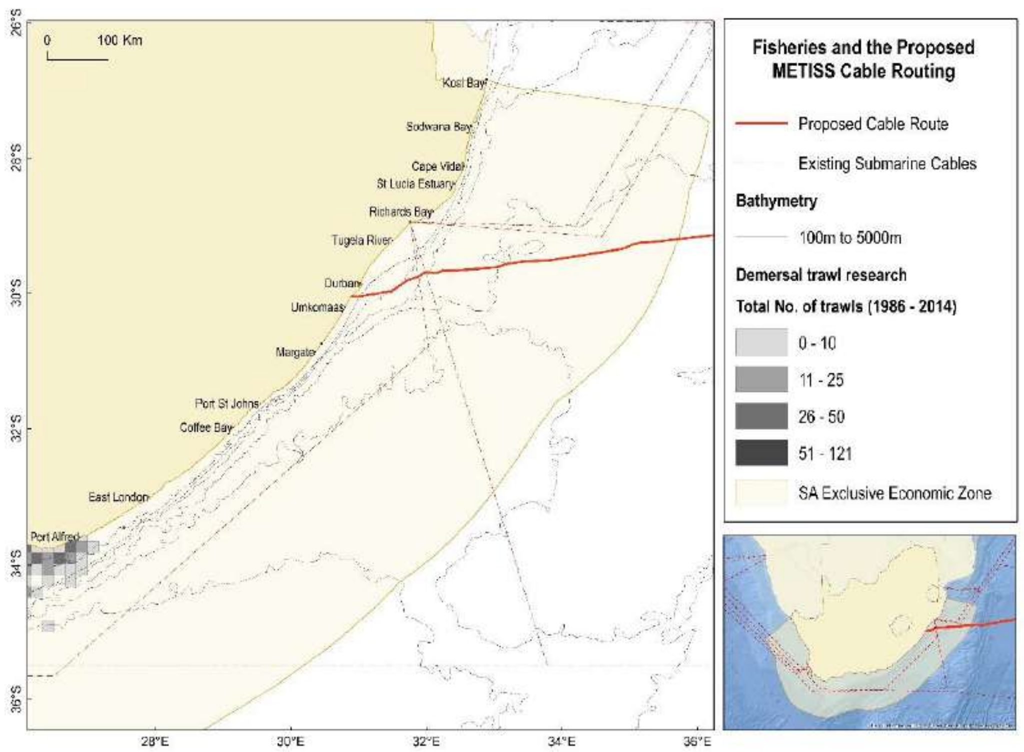
Figure 5.17 Monthly catch and effort for the deep-water trawl fishery (1990 to 2012)



5.11 *FISHERIES RESEARCH*

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DAFF in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January. The survey of the Southeast coast (20°E – 27°E longitude) takes place in April/May. Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1,000 m isobath. *Figure 5.18* shows the distribution of research trawls undertaken in relation to proposed cable route. As fishing grounds do not coincide with the route the sector is not expected to be impacted by the proposed Project.

Figure 5.18 Spatial distribution of trawling effort expended during research surveys undertaken by DAFF to ascertain biomass of demersal fish species. Effort is shown in relation to the proposed cable route.



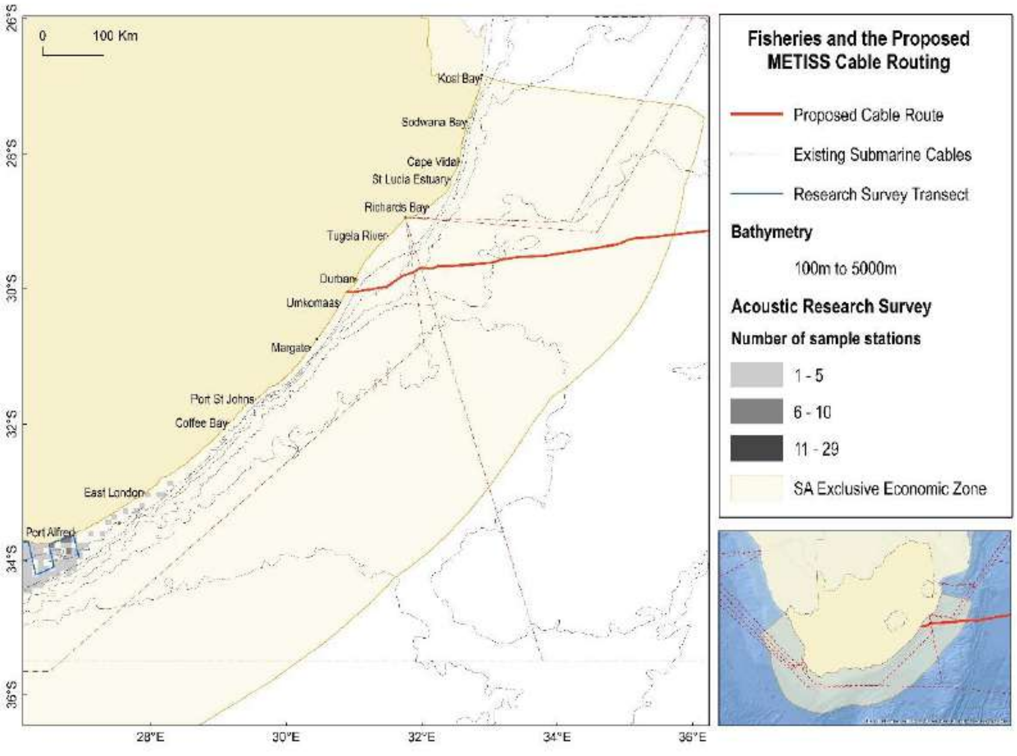
Source: CapMarine 2018.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December.

The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DAFF survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east. *Figure 5.19* shows the location of sampling tracks undertaken in relation to proposed cable route.

As these do not coincide with the route the sector is not expected to be impacted by the proposed Project

Figure 5.19 Spatial distribution of sampling tracks for acoustic surveys of the biomass of small pelagic species undertaken in 2013 in relation to the proposed cable route.



Source: CapMarine 2018.

6 IMPACT DESCRIPTION AND ASSESSMENT

6.1 DESCRIPTION OF THE SOURCE OF IMPACT

Project activities proposed during pre-installation, installation, and operational phases were identified as sources of a potential impact on the fishing industry. Fishing vessels would be required to maintain a safe operational distance of 500 m from the Project vessel during the pre-grapnel run and installation of the cable. The exclusion zone would be temporary during installation. Once installed, the subsea cable route would be charted by the South African Navy Hydrographic Office. An exclusion zone of 1 nm (1.852 km) would permanently be enforced around the cable routing. This would be marked into navigational charts and vessels would not be permitted to trawl or anchor within a distance of 1 nm (1.852 km) to either side of the cable.

6.2 DESCRIPTION OF THE ENVIRONMENTAL ASPECTS

Historically, commercial fishing has accounted for more than 40 percent of all subsea cable faults worldwide (CSRIC, 2014). Commercial fishing-related damage is most often caused by bottom-tending fishing gear such as trawl nets and dredges, but it is also cause by longlines anchored to the seabed and pot and trap fisheries using grapnels for gear retrieval. A description of gear used by selected South African demersal fishing sectors is included in Appendix 1, to illustrate the associated risks to subsea cables posed by each of these sectors.

Research indicates that when a trawl crosses a communications subsea cable lying on the seabed, more than 90% of such crossings do not result in cable damage (Wilson, 2006) as trawls are designed to pass over seabed obstacles[1]. For the current Project, the cable will be buried to a target depth of 1.0 m in waters shallower than 1,000 m, thus protection will be provided against snagging by trawl gear (in particular trawl doors which dig into the top sediment layer of the seabed). Where burial is not possible, either due to seabed obstructions, hard ground or at depths greater than 1,000 m, the subsea cable will laid directly on the seabed. If a piece of fishing gear or anchor hooks or snags a subsea cable, there would be a likelihood of damage to the cable. Subsea cable damage by bending, crushing and stretching can occur long before the cable breaks. Subsea cable s are at risk of damage, therefore, where anchors, grapnels or other equipment are used to drag for lost or unmarked gear. In nearshore areas, the subsea cable will be protected against potential damage by heavy armouring.

[1] This figure is averaged across different types of trawling gear, including "light" gear which may not necessarily make heavy contact with the seabed. Demersal trawl configurations used by the South African offshore trawl fleet do include trawl doors of up to 3 tons each which make 'heavy' contact with the sea bed.

6.3 DESCRIPTION OF THE POTENTIAL IMPACT DURING INSTALLATION PHASE

The following impacts on fisheries as a result of the presence of Project vessels during the pre-installation and installation phases of the Project:

6.3.1 *Loss of catch*

Fishermen are required by law to maintain a safe operational distance of 500 m from the Project vessel during the pre-grapnel run and installation of the subsea cable. The exclusion zone would be temporary in duration (it would exist only for the duration of installation activities) and transitory (ie the exclusion zone surrounding the Project vessel would move as the vessel moves). The affected area was considered to be a zone extending 500 m on either side of the proposed subsea cable route. This may result in a loss in catch where traditional fishing grounds coincide with this route.

6.4 DESCRIPTION OF THE POTENTIAL IMPACT DURING OPERATIONAL PHASE

The following impacts on fisheries as a result of the laying and long-term establishment of the subsea cable have been identified:

6.4.1 *Loss of catch*

Fishermen are required by law to take reasonable care to avoid damaging subsea cables. This means in practice not fishing near known subsea cable locations, which are indicated on navigational charts. The requirement that fishermen avoid conduct likely to break subsea cables is established in the United Nations Convention on the Law of the Sea (UNCLOS), as well as in South African legislation where subsea cables are marked by an exclusion zone of one nautical mile (nm) on either side of the cable routing within which trawling and anchoring is prohibited. A trawler would be required to “fly” its gear so as to avoid contact with the subsea cable – this refers to shortening the trawl warps and hauling the gear up off the ground until clear of the obstruction. These days precision placement of the gear is possible even at depth due to the sensors attached to the gear. Therefore, the impact to fisheries would equate to exclusion from fishing ground and an associated loss in catch over the time that gear is lifted off the seabed. In the event that several subsea cables are present in close proximity, there is the potential of a cumulative impact where the ground between the exclusion zones may become unfishable due to the distance required to raise and lower fishing gear.

6.4.2 *Safety of fishing vessels*

In the event that trawling gear snags a subsea cable, lifting the cable can be much more dangerous than pulling free from other seabed obstructions. When the winch is engaged the tension in the trawl warp increases as more cable is lifted from the seabed.

The tension in the warps could build up rapidly to a point which would capsize the vessel. Most capsizes of this type are due to human error, and a well-designed vessel should have adequate resistance against capsizing. The combined winch and engine power of a modern trawler are capable of exerting considerable tension in the warp which in turn acts as a downward force on the towing block. This is frequently positioned above the vessel centre of gravity. If the load is also applied to one side then the vessel has the means of creating enough force to capsize itself (Drew and Hopper, 1996).

6.4.3 Damage to fishing gear

In areas where the subsea cable is not buried (any areas of rocky ground, and at depths greater than 1,000 m) the cable would be exposed and vulnerable to snagging by demersal longline and trawling gear. If this were to occur, besides the potential for damage to the subsea cable, snagging could result in the loss of fishing gear.

6.5 SENSITIVE RECEPTORS

All fishing vessels would be required to maintain a safe operational distance from the Project vessels during the pre-grapnel run and installation of the subsea cable. Thus the sensitive receptors during the Pre-Installation and Installation Phases of the Project would potentially be any fishing sector.

The sensitive receptors during the Operational Phase of the Project would be those fishing sectors that would be excluded from anchoring or trawling within the 1 nm (1.852 km) protection corridor surrounding the subsea cable i.e. those that direct fishing effort at the seabed. The relevant South African demersal fishery sectors include hake-directed trawl and longline and longline trap fisheries for rock lobster.

6.6 PROJECT CONTROLS AND INDUSTRY OBJECTIVES

Most of the larger companies operating in the submarine cable industry typically work to standards and quality management systems set by the International Organization for Standards under the ISO 9000 and ISO 9001 schemes. In addition, the International Cable Protection Committee (ICPC) publishes recommendations on key issues such as subsea cable routing, cable protection and cable recovery that are available to anyone on request. Although their observance is not mandatory, these recommendations are designed to facilitate quality improvement and are often cited by third parties as examples of best practice in the industry (ICPC, 2009).

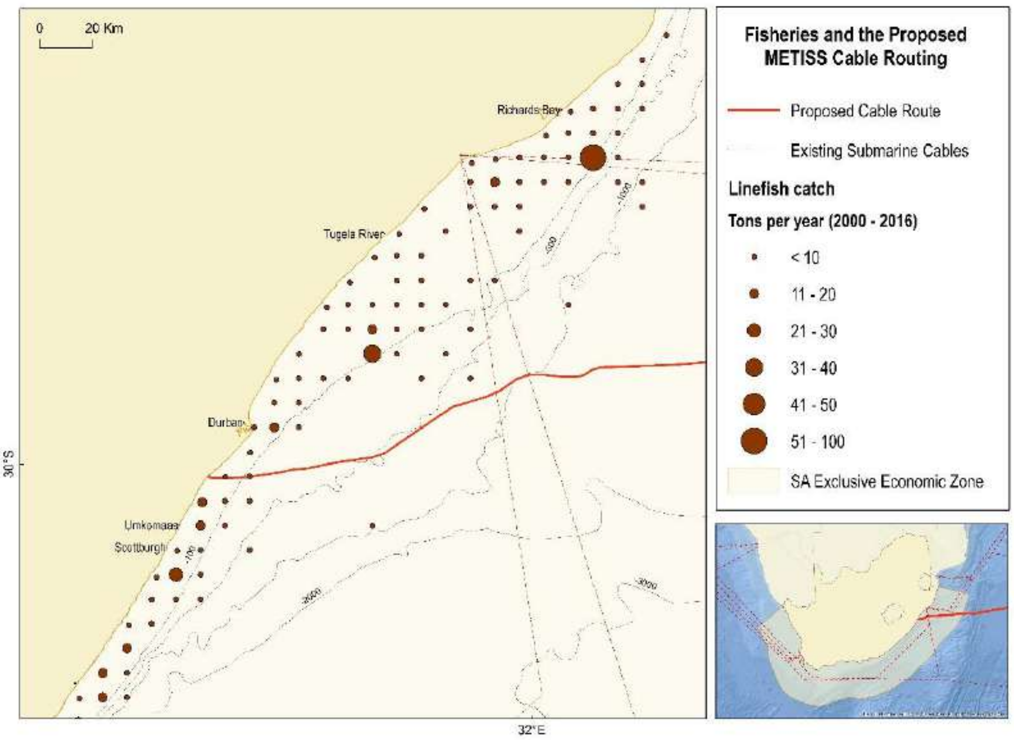
6.7 IMPACT ASSESSMENT

The spatial distribution of fishing effort of each sector in relation to the proposed subsea cable route is provided in Section 5.

6.7.1 *Installation Phase*

Sectors that could be affected during a temporary 500 m radius exclusion to fishing ground during the pre-installation and installation phases of the Project include the KZN crustacean trawl sector, traditional linefish sector and the large pelagic longline sector. The presence of the subsea cable laying vessel would present a direct but temporary impact which would be local in extent (vessels would transit along the survey or cable route). The scale of the impact on all sectors is considered to be small as the affected area covers a low proportion of fishing ground available to each of these sectors. The magnitude of the impact is considered to be small and the impact is considered to be of overall Negligible significance (see *Table 6.1*).

Figure 6.1 Spatial distribution of fishing effort expended by the traditional linefish sector in relation to the proposed cable route.



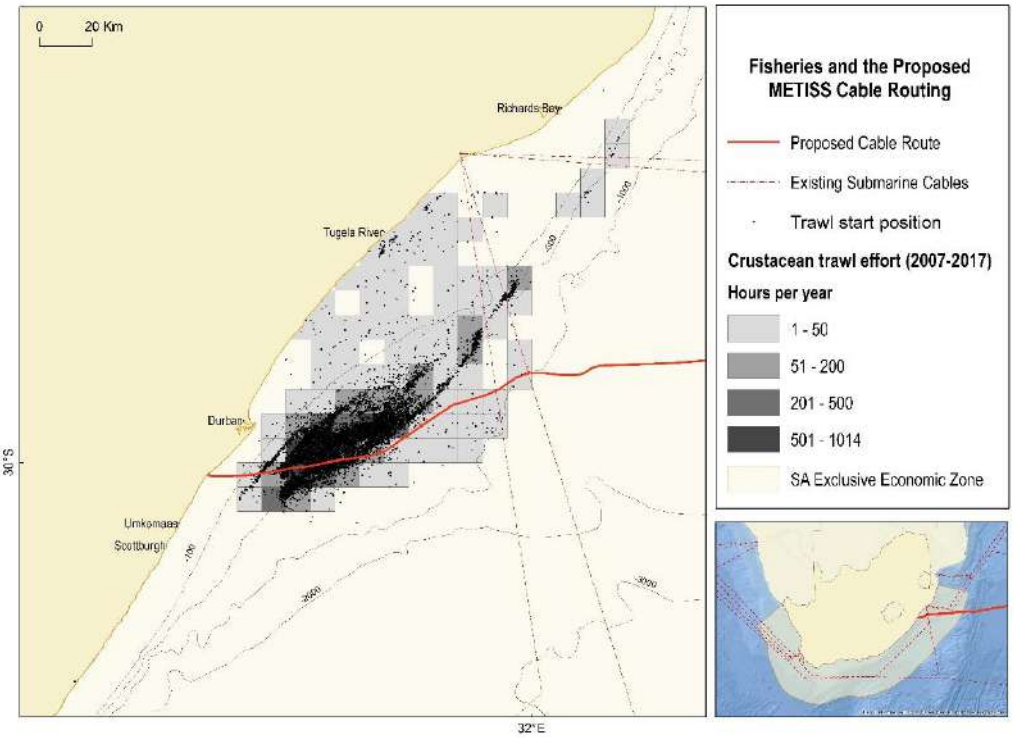
Source: CapMarine 2018.

6.7.2 *Operational Phase*

The demersal fisheries (ie those that direct fishing effort at the seabed) that could be affected by exclusion to fishing during the Operational Phase of the Project include the KZN crustacean trawl, hake-directed trawl and longline and longline trap fisheries for rock lobster. The proposed cable route does not; however, coincide with fishing grounds for the demersal trawl and longline sectors or the rock lobster trap fishery and therefore no impact expected on these sectors either during the operational phase of the Project.

The proposed subsea cable route coincides with grounds fished by the deep-water prawn trawl fishery (see *Figure 6.2*). Over the period 2007 to 2017, a total of 828 trawls crossed the proposed cable route. This is equivalent to 5.2% of the total number of trawls conducted by the sector. With burial of the subsea cable in water depths of less than 1,000m, normal trawling operations would be unaffected during the operational phase of the Project as fishing activity is directed in waters shallower than 600 m. The magnitude of the impact on the sector is considered to be small, the sensitivity of the receptor is assessed to be High and the overall significance of the impact is assessed to be Moderate (see *Table 6.2*). Mitigation measures could include allowing overtrawling of the subsea cable inshore of the 600 m depth contour. The resultant impact would be of Negligible significance.

Figure 6.2 ***Spatial distribution of crustacean-directed trawling effort in relation to the proposed cable route.***



Source: CapMarine 2018.

6.8 MITIGATION MEASURES

Mitigation measures include the burial of the cable to a depth of 1.0 m in waters shallower than 1,000 m. No additional mitigation measures are considered necessary.

Table 6.1 Impact on fishing sectors during the installation phase of the proposed Project.

Exclusion to Fishing Ground during Pre-Installation and Installation Phases of the Project		
Large Pelagic Longline		
Characteristic	**Impact**	**Residual Impact**
Extent	Local	Local
Duration	Temporary	Temporary
Scale	Small	Small
Reversibility	High (Fully Reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity of the Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**
Traditional Linefish		
Characteristic	**Impact**	**Residual Impact**
Extent	Local	Local
Duration	Temporary	Temporary
Scale	Small	Small
Reversiblity	High (Fully Reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**
Crustacean Trawl		
Characteristic	**Impact**	**Residual Impact**
Extent	Local	Local
Duration	Temporary	Temporary
Scale	Small	Small
Reversibility	High (Fully Reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

Table 6.2 *Impact on the Crustacean Trawl fishing sector during the operations phase of the proposed Project.*

Exclusion from Fishing Ground during Operational Phase of the Project		
Characteristic	**Impact**	**Residual Impact**
Extent	Local	Local
Duration	Long-term	Long-term
Scale	5.2% of total national effort was expeded within the affected area (2007 – 2017)	
Reversibility	High (Fully Reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High	Low
Significance of Impact	**Moderate**	**Moderate**

6.9 CUMULATIVE IMPACT

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact. *Table 6.3* below lists the existing, approved and proposed Projects, the impacts of which have previously been assessed with regards to the fishing industry. The significance of the impact of the current Project proposal on affected sectors is not expected to increase the overall significance of cumulative impacts on any fisheries sectors.

Table 6.3 *Identification of other proposed Projects that may contribute to a cumulative impact on fishing sectors.*

Identified sources of potential cumulative impact on fisheries
Operational
Exclusion areas in place around wellheads and subsea pipelines within Licence Block 9
Exploration well drilling in Licence Block 11B/12B planned to take place in December 2018
Aproved but not operational
Seismic survey (2D) within Exploration Rights Areas held by Silverwave (Pty) Ltd
Exploration and well appraisal within Licence Block 9 by PetroSA (Pty) Ltd
Proposed and pending approval
IOX Cable System
Seismic survey (3D) proposed by Sungu Sungu Oil (Pty) Ltd within Pletmos Licence Area
Exploration well drilling within Exploration Right 236 by ENI South Africa B.V.

7 CONCLUSIONS

Fishermen are required by law to take reasonable care to avoid damaging subsea cables. Those sectors at risk of snagging cables include demersal fisheries, in particular, those that fish via trawl and longline. The demersal longline fishery deploys gear that anchors to the seabed. In the unlikely event of gear breaking, grapnel hooks may be used to retrieve lost lines and these could potentially snag and damage an exposed section of cable. With regards to demersal trawling operations, trawl doors pose a reasonably high risk of snagging.

As a means of protection against human activities, including fishing, the subsea cable would be buried to a depth of 1 m in waters shallower than 1,000 m; however, the subsea cable may be exposed on the seabed in some areas unsuitable for burial, eg rock or highly mobile sand. Despite burial in some places, protection along the entire cable routing would be afforded by a legal cable protection zone of 1 nm to either side of the subsea cable. National legislation prohibits trawling or anchoring within 1 nm on either side of the subsea cable and this would affect fishing sectors that trawl or set longline gear on the seabed. The subsea cable routing and exclusion corridor would be published in official notices to mariners and nautical charts, which are distributed by the navy hydrographic office.

With regards to the South African fishing industry this would present an impact to demersal fisheries where the areas of operation of these sectors coincides with the proposed subsea cable route. In practical terms, normal fishing operations would be disrupted and fishing activity would be displaced into adjacent grounds, or through the lifting ground gear (in the case of trawling) off the seabed whilst transiting over the subsea cable. This could result in a loss of catch. In the event that gear were to foul a cable, the gear may be damaged or lost completely. Any catches contained in nets would likely be lost. At worst, there would be a risk to the vessel of capsizing if an attempt were made to lift the cable in order to free fishing gear.

The potential effects of the proposed Project activities on each of the sectors were evaluated.

Sectors that could be affected during a temporary exclusion to fishing ground during the pre-installation and installation phase of the Project include the KZN prawn trawl, traditional linefish sector, and the large pelagic longline sector, which operates extensively from a distance of 12 nm from the coastline to the limit of the South African Exclusive Economic Zone. Due to the temporary nature of the activity, and the very low level of overlap between the affected area and overall extent of fishing grounds, the impact is considered to be of negligible significance.

Sectors that are considered most vulnerable to the long-term impact of an exclusion zone that would surround an installed subsea cable would be any demersal fishery; however, the project area of influence coincides only with ground fished by the KZN crustacean trawl sector.

The impact expected to result during the Operational Phase of the Project (i.e. the exclusion corridor around the cable route) is expected only to affect the KZN crustacean trawl sector. The significance of the impact is assessed to be Moderate.

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9 APPENDIX 1: DESCRIPTION OF FISHING GEAR CONFIGURATIONS THAT POSE A RISK TO SUBSEA CABLES

Historically, commercial fishing has accounted for more than 40 percent of all submarine cable faults worldwide (CSRIC, 2014). Commercial fishing-related damage is most often caused by bottom-tending fishing gear such as trawl nets and dredges, but it is also cause by longlines anchored to the seabed and pot and trap fisheries using grapnels for gear retrieval. A description of gear used by the South African hake-directed trawl and longline sectors is presented below to indicate the associated risks posed to subsea cables.

9.1 DEMERSAL TRAWL

The offshore trawl fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 80 m in length (see *Figure 9.1*). The configuration of trawling gear is similar for both freezer and wetfish vessels (see *Figure 9.2*).

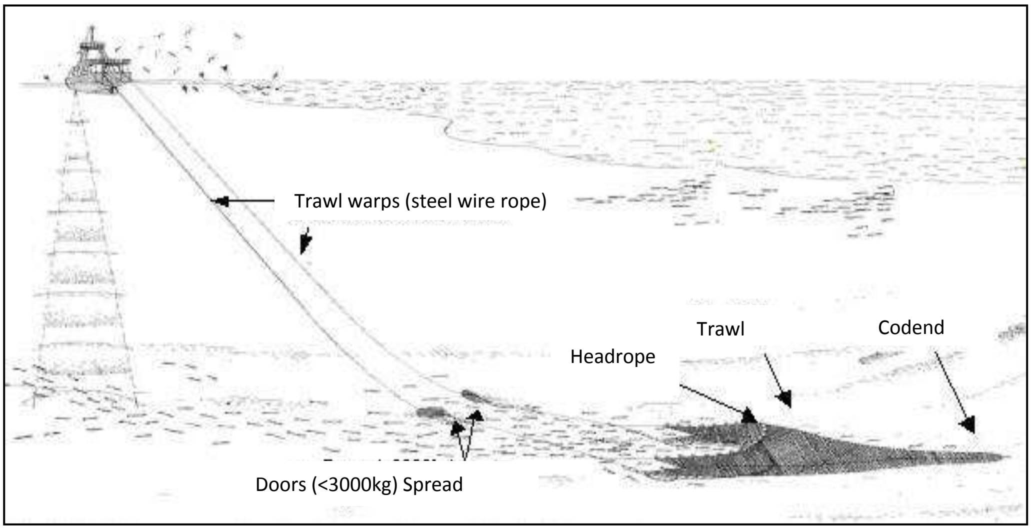
Figure 9.1 ***Photograph of a freezer (left) and wetfish (right) trawler vessel currently active in the offshore South African demersal trawl fleet.***

Trawl gear is deployed astern of the vessel and the main elements of the gear include:

- Steel trawl warps up to 32 mm diameter - in pairs up to 3 km long when towed;
- A pair of trawl doors (500 kg to 3 tons each);
- Net footropes which may have heavy steel bobbins attached (up to 24" diameter; maximum 200 kg) as well as large rubber rollers ("rock-hoppers"); and

- Net mesh (diamond or square shape) is normally wide at the net opening whereas the bottom end of the net (or cod-end) has a mesh size minimum limit of 110 mm (stretched).

Figure 9.2 Schematic diagram showing the typical gear configuration used by offshore trawlers to target demersal species.



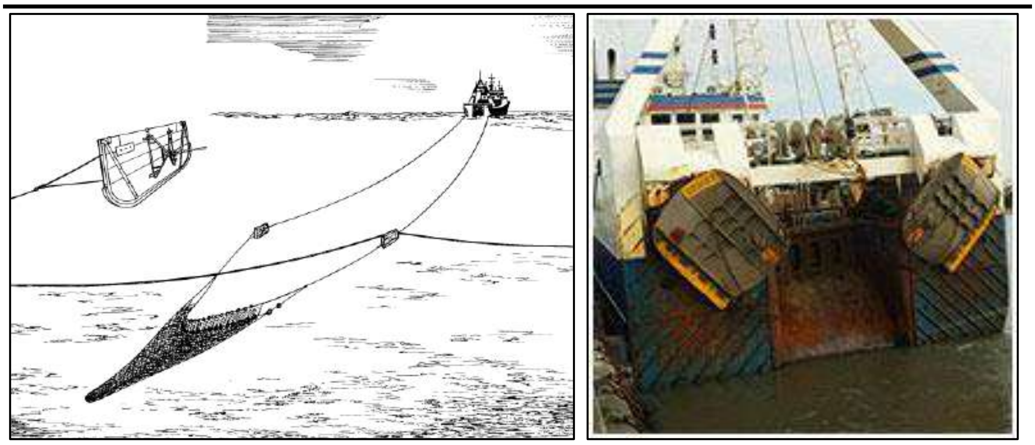
Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening. Bottom contact is made by the footrope and by long cables and bridles between the doors and the footrope. Behind the trawl doors are bridles connecting the doors to the wings of the net (to the ends of the footrope and headrope). A headline, bearing floats and the weighted footrope (that may include rope, steel wire, chains, rubber discs, spacers, bobbins or weights) maintain the vertical net opening. The "belly", "wings" and the "cod-end" (the part of the net that retains the catch) may contact the seabed.

There is a wide range of ground gear configurations used with different companies, vessels and skippers using different combinations that have varied over time, in different grounds and with different fishing strategies relating to market demands. The intention in demersal hake trawling is to have the ground gear in close contact with the seafloor surface and to skim over it rather than to dig into the ground although trawl doors often penetrate up to 150 mm into the seafloor on soft grounds. Footrope protection such as the use of wire in the footrope, bound ropes along the footrope, the addition of rubber disks or rollers (large rollers are considered rock hoper gear or rubber or steel bobbins at regular intervals along the footrope is required, particularly for fishing in hard or irregular ground.

Vessels towing on smooth bottom for species which live in contact with the seabed often use tickler chains ahead of the footrope which cause bottom dwellers to jump or swim up and be captured by the net. On smooth bottom, fishermen often keep their ground gear in close, continuous contact with the bottom. Some degree of seabed penetration is likely and this may increase the chances of fouling a cable. On rocky bottom, trawl gear is more often rigged to keep light bottom contact. Light contact in such areas might not decrease the chances of fouling a cable, since cables are more likely to be exposed on top of the seabed or spanning between rocks. There is also the risk of a door bouncing over a rock, landing hard and penetrating the seabed to strike a cable. Although some footropes have rollers, the rubber discs of rockhopper gear are not designed to roll. They may become cut or torn and this increases the risk of snagging on a cable.

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

Figure 9.3 ***Schematic diagram showing otter trawl snagging cable (left) and photograph of trawl doors stowed astern of vessel.***



Source: ICPC Ltd (left) and CapMarine (right)

Trawl doors

Trawl doors keep the gear on or near the bottom and provide horizontal spread for the net. In most bottom fisheries the intention is to have the door and the footrope skim along in contact with the seabed without digging into it. When a door strikes a cable, damage to the cable is likely. The damage is more severe if the door snags the cable and exerts a pulling or lifting force. Doors with curved front edges and doors designed to ride with the front corner off the bottom are less likely to snag on cables and other seabed obstacles. In the 1970's the International Cable Protection Committee funded research to develop and spread the use of doors with curved forward edges. Some fishermen weld additional plates on the bottom of the door to increase its weight or protect against wear. Unless the front edge of the weight blends smoothly with the door, this can cause it to snag more on objects such as cables. See *Figure 9.4* for photographs of trawl doors.

Figure 9.4 ***Photographs of trawl doors typically used as part of ground gear in the South African demersal trawl fleet.***

Photo credit: Dr K. Sink, South African National Biodiversity Institute

Bobbins

In the context of trawling, bobbins refer to the spherical weights that are added to the footrope to protect the footrope, raise it off the ground and allow the net to roll along the seabed. In South Africa, round wooden bobbins were used in the 1950's with hollow banded steel and solid rubber bobbins used from the 1960s. Solid rubber bobbins may be heavier than steel bobbins (*Figure 9.5*) which are usually hollow although some skippers make holes in steel bobbins to increase the weight of their ground gear by allowing water to fill the hollow bobbins. Permit conditions stipulate an upper limit of 750 mm diameter and 200 kg for bobbins.

Figure 9.5 ***Photographs of solid rubber (left) and steel (right) bobbins typically used as part of ground gear in the South African demersal trawl fleet.***

Photo credit: Dr K. Sink, South African National Biodiversity Institute

Rubber discs

Rubber discs (also referred to as rollers or cookies) refer to the circular rubber disks, wheels, rollers or plates of varying sizes (usually 75 to 600 mm in diameter) that are used along the footrope. An entire footrope can be "wrapped" with small rubber disks but larger disks (rockhopper gear) are usually spaced at regular intervals along the footrope with rubber spacers or disks in between the larger disks or rollers.

Rockhopper gear

Rockhopper gear refers to moulded rubber disks larger than 250 mm in diameter which is designed to work on very hard seabed (see *Figure 9.6* for an example of a footrope with large diameter rubber discs). Rockhopper gear in South Africa is not designed to roll over the seabed but rather to raise the belly of the net slightly off rocky grounds. Early research showed that a fish trawl of 26 m headline length with ground gear consisting of 6 m of 350 mm diameter rubber wheels in the centre, and two 4.5 m wing sections of 90 mm diameter rubber discs, had the ability to traverse hard ground with boulders up to 2 m in height, and to physically displace boulders up to 1 m diameter when towed by a 22 m trawler with a 200 hp main engine (Main and Sangster, 1979 in Sink, 2012). Local skippers report that the main function of both bobbin and rockhopper gear is gear protection in rough ground. Many local skippers report that rockhopper gear is usually preferable to bobbin gear because it is less risky (less chance of snagging) and less dangerous on deck. Rockhopper gear is being increasingly used over bobbin gear, particularly in deep water.

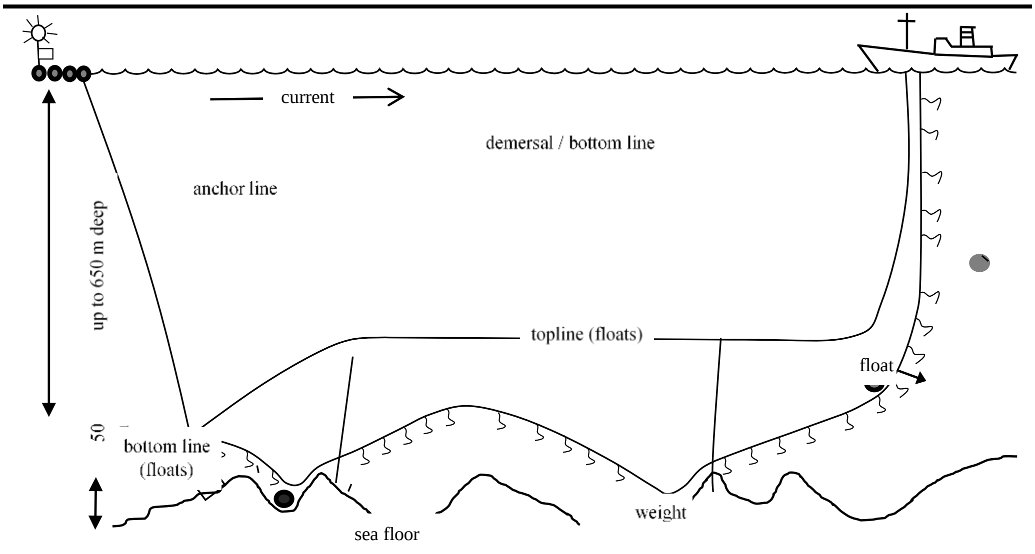
Figure 9.6 ***Photographs of a footrope with large diameter rubber discs comprising "rockhopper gear" typically used as part of ground gear in the South African demersal trawl fleet.***

Photo credit: Dr K. Sink, South African National Biodiversity Institute

9.2 *DEMERSAL LONGLINE*

A demersal longline vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor (see *Figure 9.7*). Steel anchors, of 40 kg to 60 kg, are placed at the ends of each line to anchor it, and are marked with an array of floats. If a double line system is used, top and bottom lines are connected by means of dropper lines. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom line breaks at any point along the length of the line. Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete.

Figure 9.7 ***Schematic diagram showing the typical configuration of demersal (bottom-set) gear used by longline vessels to target demersal species.***



Source: CapMarine

9.3 *SOUTH COAST ROCK LOBSTER TRAP (LONGLINE)*

The South Coast rock lobster fishery is a deep-water long-line trap fishery. Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2 000 traps per day in sets of 100 to 200 traps per line. They will set between ten lines and 16 lines per day, each of which may be up to 2 km in length. Each line is weighted to lie along the seafloor and will be connected at each end to a marker buoy at the sea surface. Vessels are large, ranging from 30 m to 60 m in length.

It is common practice for a vessel to tow a grapnel (a hook-like anchor or length of chain with several prongs) across the bottom to find and lift lost gear. Internationally, incident reports between cables and stationary fishing gear have occurred due to grapnels snagging cables and a number of cable faults caused by longlines have been reported. The force generated in trying to clear a snagged longline has been estimated at up to 4 tonnes.

Figure 9.8 Photograph of cable damaged by a grapnel intended to retrieve fish traps from 1800 m depth.

Source: Tyco Telecommunications) (US) Inc.

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED METISS SUBMARINE CABLE SYSTEM OFF THE EAST COAST OF SOUTH AFRICA

Specialist:	Capricorn Marine Environmental (Pty) Ltd		
Contact person:	Sarah Wilkinson		
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Project Consultant:	ERM – Environmental Resources Management		
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E-mail:	Reinett.Mogotshi@erm.com		

4.2 The specialist appointed in terms of the Regulations_

I, Sarah Wilkinson, declare that -- General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

CapMarine
Capricorn Marine Environmental (Pty) Ltd
VAT no: 4590215309
Reg.no: 2004/004844/07

Signature of the specialist:

Capricorn Marine Environmental (Pty) Ltd
Name of company (if applicable):

04 March 2019
Date:

Contents of this report in terms of Regulation GNR 982 of 2014	Cross-reference in this report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 3
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	p. i
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 4.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6.8
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4.1 to 4.2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6
(g) an identification of any areas to be avoided, including buffers;	N/a
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.4
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6
(k) any mitigation measures for inclusion in the EMPr;	Section 6.7
(l) any conditions for inclusion in the environmental authorisation;	N/a
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/a
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 7
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/a
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/a
(q) any other information requested by the competent authority.	N/a

APPENDIX F2 MARINE ECOLOGY

PROPOSED INSTALLATION
OF THE ASN AFRICA METISS SUBSEA CABLE SYSTEM,
AMAMZIMTOTI, KWAZULU-NATAL, SOUTH AFRICA

Marine Ecology Assessment

Prepared for:

Environmental Resources Management Southern Africa Pty Ltd

ERM

On behalf of

March 2019

PISCES

ENVIRONMENTAL SERVICES (PTY) LTD

PROPOSED INSTALLATION
OF THE ASN AFRICA METISS SUBSEA CABLE SYSTEM,
AMAMZIMTOTI, KWAZULU-NATAL, SOUTH AFRICA

MARINE ECOLOGY ASSESSMENT

Prepared for

ERM Southern Africa (Pty) Ltd

Prepared by

Andrea Pulfrich
Pisces Environmental Services (Pty) Ltd

March 2019

PISCES ENVIRONMENTAL SERVICES (PTY) LTD

Contact Details:

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TABLE OF CONTENTS

ABBREVIATIONS and UNITS

CBD	Convention of Biological Diversity
CCA	CCA Environmental
CITES	Convention on International Trade in Endangered Species
cm	centimetres
cm/sec	centimetres per second
CMS	Centre for Marine Studies
CMS	Convention on Migratory Species
CSIR	Council for Scientific and Industrial Research
dB	decibell
DEA	Department of Environmental Affairs
E	East
EBSA	Ecologically or Biologically Significant marine Areas
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
ENE	east-northeast
GIS	Global Information System
gC/m^2	grams Carbon per square metre
ha	hectares
HDD	Horizontal Directional Drilling
Hz	Herz
IDZ	Industrial Development Zone
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
km	kilometre
km^2	square kilometre
KZN	KwaZulu-Natal
MPA	Marine Protected Area
m	metres
m^2	square metres
mg/m^3	milligrams per cubic metre
ml	millilitre
mm	millimetre
m/sec	metres per second
m^3/sec	cubic metres per second
NE	northeast
NNE	north-northeast
ppt	parts per thousand
ROV	Remotely Operated Vehicle
S	south
SANBI	South African National Biodiversity Institute
S&EIR	Scoping and Environmental Impact Report

SSW	south-southwest
SW	southwest
WSW	west-southwest
µPa	micro Pascal
°C	degrees Centigrade
percent	percent
~	approximately
<	less than
>	greater than

GLOSSARY

Benthic	Referring to organisms living in, or on, the sediments of aquatic habitats (lakes, rivers, ponds, etc.).
Benthos	The sum total of organisms living in, or on, the sediments of aquatic habitats.
Benthic organisms	Organisms living in, or on, sediments of aquatic habitats.
Biodiversity	The variety of life forms, including the plants, animals and micro-organisms, the genes they contain and the ecosystems and ecological processes of which they are a part.
Biomass	The living weight of a plant or animal population, usually expressed on a unit area basis.
Biota	The sum total of the living organisms of any designated area.
Bivalve	A mollusc with a hinged double shell.
Community structure	All the types of taxa present in a community and their relative abundance.
Community	An assemblage of organisms characterized by a distinctive combination of species occupying a common environment and interacting with one another.
Dilution	The reduction in concentration of a substance due to mixing with water.
Ecosystem	A community of plants, animals and organisms interacting with each other and with the non-living (physical and chemical) components of their environment
Environmental impact	A positive or negative environmental change (biophysical, social and/or economic) caused by human action.
Epifauna	Organisms, which live at or on the sediment surface being either attached (sessile) or capable of movement.
Habitat	The place where a population (*eg,* animal, plant, micro-organism) lives and its surroundings, both living and non-living.
Infauna	Animals of any size living within the sediment. They move freely through interstitial spaces between sedimentary particles or they build burrows or tubes.
Macrofauna	Animals >1 mm.
Macrophyte	A member of the macroscopic plant life of an area, especially of a body of water; large aquatic plant.
Meiofauna	Animals <1 mm.
Marine environment	Marine environment includes estuaries, coastal marine and nearshore zones, and open-ocean-deep-sea regions.

Pollution	The introduction of unwanted components into waters, air or soil, usually as result of human activity; *eg,* hot water in rivers, sewage in the sea, oil on land.
Population	The total number of individuals of the species or taxon.
Pseudofaeces	Pseudofaeces production is a process of particle selection whereby less nutritious particles are rejected and the quality of the ingested material improved proportionately.
Recruitment	The replenishment or addition of individuals of an animal or plant population through reproduction, dispersion and migration.
Sediment	Unconsolidated mineral and organic particulate material that settles to the bottom of aquatic environment.
Species	A group of organisms that resemble each other to a greater degree than members of other groups and that form a reproductively isolated group that will not produce viable offspring if bred with members of another group.
Subtidal	The zone below the low-tide level, *ie,* it is never exposed at low tide.
Surf-zone	Also referred to as the 'breaker zone' where water depths are less than half the wavelength of the incoming waves with the result that the orbital pattern of the waves collapses and breakers are formed.
Suspended material	Total mass of material suspended in a given volume of water, measured in mg/ℓ.
Suspended matter	Suspended material.
Suspended sediment	Unconsolidated mineral and organic particulate material that is suspended in a given volume of water, measured in mg/ℓ.
Taxon (Taxa)	Any group of organisms considered to be sufficiently distinct from other such groups to be treated as a separate unit (*eg,* species, genera, families).
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Turbidity	Measure of the light-scattering properties of a volume of water, usually measured in nephelometric turbidity units.
Vulnerable	A taxon is vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Dr Andrea Pulfrich of Pisces Environmental Services (Pty) Ltd. Andrea has a PhD in Fisheries Biology from the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany.

As Director of Pisces since 1998, Andrea has considerable experience in undertaking specialist environmental impact assessments, baseline and monitoring studies, and Environmental Management Programmes / Plans relating to marine diamond mining and dredging, hydrocarbon exploration and thermal/hypersaline effluents. She is a registered Environmental Assessment Practitioner and member of the South African Council for Natural Scientific Professions, South African Institute of Ecologists and Environmental Scientists, and International Association of Impact Assessment (South Africa).

This specialist report was compiled on behalf of ERM Southern Africa (Pty) Ltd (ERM) for their use in preparing a Scoping and Environmental Impact Report (S&EIR) for the proposed installation of the METISS Subsea Cable System, off the East Coast of South Africa. I do hereby declare that Pisces Environmental Services (Pty) Ltd is financially and otherwise independent of the Applicant and ERM.

Dr Andrea Pulfrich

1. GENERAL INTRODUCTION

The Project involves the installation and operation the Melting Pot Indianoceanic Submarine System (METISS) in South Africa. METISS is a proposed new subsea fibre optic cable system that will connect Mauritius to South Africa and provide high-speed connectivity of 24 terabytes per second to the global telecommunications network and low latency access to enhance business operations across multiple industries.

METISS is owned by a Consortium of companies comprising Canal+ Télécom, CEB FiberNet, EMTEL, Zeop, SRR (SFR) and TELMA. The Consortium was formed for the purposes of developing the system. The Consortium has contracted ASN and Elettra for the manufacture and installation of the subsea cable system. The Consortium has contracted Liquid Telecom to act as the Landing Party in South Africa responsible for operational aspects in South Africa.

The METISS main cable ('trunk') will run more than 3,200 km from Mauritius to South Africa and spilt at Branching Units off the main trunk to landing sites in Reunion Island and Madagascar. The system includes a 14 mm to 35 mm diameter subsea cable that will enter the South African EEZ (approximately 370 km from the seashore) and continues through Territorial Waters (approximately 22 km from the seashore), and onto land until it reaches the Cable Landing Station (CLS) at Pipeline Beach in Amanzimtoti, KwaZulu-Natal. As part of the EIA process, an assessment was undertaken of the impact of the proposed Project on the South African fishing industry. The subsea cable will land to the south of Amanzimtoti Pipeline Beach. The landing location is approximately 30° 2' 27.030" S, 30° 53' 58.400" E.

The installation of the subsea cable system is provisionally scheduled to commence in the first quarter of 2020 and is expected to be completed and operational by the end of the third quarter of 2020.

1.1. Scope of Work

This specialist report was compiled as a desktop study on behalf of ERM, for inclusion in the S&EIR and for developing an EMPr for the proposed installation of the subsea cable system off Amamzimtoti on the East Coast of South Africa.

The terms of reference for this study are:

- Details of the person who prepared the report, and the expertise of that person to carry out the specialist study or specialised process
- A declaration that the person is independent.
- An introduction that presents a brief background to the study and an appreciation of the requirements stated in the specific terms of reference for the study.
- A short literature review of existing secondary data
- A baseline description of the marine and coastal environment within the vicinity of the proposed Project (in territorial waters of South Africa)
- Details of the approach to the study where activities performed and methods used are presented.
- A description of the findings and potential implications of such findings on the impact of the proposed Project.
- Suggested mitigation measures and monitoring recommendations.

- A description of any assumptions made and any uncertainties or gaps in knowledge

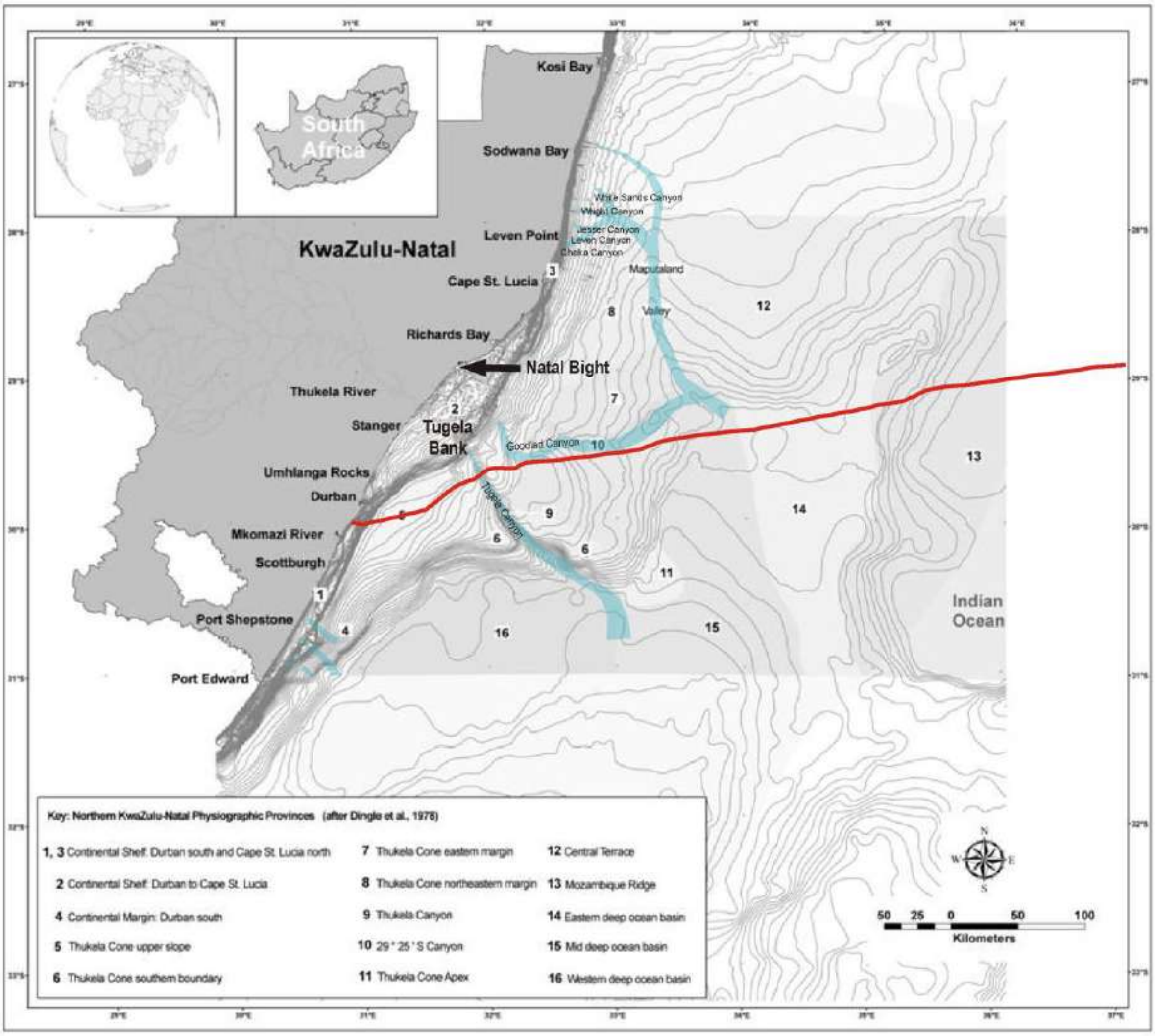


Figure 1: The Integrated marine GIS bathymetric contour dataset for KwaZulu-Natal after Young (2009) illustrating submarine canyons (blue shading) and the subsea cable route (red line). The northern Natal physiographic provinces after Dingle *et al*, (1987) are also shown. (Adapted from Harris *et al*, 2012).

1.2. Approach to the Study

As determined by the terms of reference, this study has adopted a 'desktop' approach. Consequently, the description of the natural baseline environment in the Marine Study Area is based on a review and collation of existing information and data from the scientific literature, internal reports and the Generic Environmental Management Programme Report (EMPr) compiled for oil and gas exploration in South Africa (CCA & CMS 2001). The information for the identification of potential impacts on benthic communities was drawn from various scientific publications, and information sourced from the Internet. The sources consulted are listed in the Reference chapter.

All identified marine impacts are summarised, categorised and ranked in appropriate impact assessment tables, to be incorporated in EMPr Addendum and EIA Report.

2. DESCRIPTION OF THE PROPOSED PROJECT

2.1. Project Location

The project involves the installation and operation of a 14 to 35 mm diameter subsea fibre optic cable system, the main trunk of which will run ~3,200 km from South Africa to Mauritius. Branches will split from the main trunk to landing sites located *en route*, including Madagascar and Réunion.

In South Africa, the Project will involve the installation and operation of a 14 to 35 mm diameter subsea fibre optic cable system, which will run ~3,200 km from South Africa to Mauritius. Branches will split from the main trunk to landing sites located en route, including Madagascar and Réunion.The main trunk of the marine cable will enter South African territorial waters at approximately 30° 0' 51.550" S, 31° 13' 55.130" E and follow a 538 km route within the EEZ to a coastal landing site south of Durban on the KwaZulu-Natal coast. The landing site is located south of the Amanzimtoti Beach at approximately 30° 2' 27.030" S, 30° 53' 58.400" E, and is characterized by a stretch of sandy beach.

At the shore crossing, the buried subsea fibre optics cable will enter a beach manhole where it will connect to the terrestrial portion of the cable. The beach manhole would be located above the high water mark at approximately 30° 2' 24.900" S, 30° 53' 55.700" E.

2.2. Installation Phase

The installation of the cable would involve two main phases, namely:

- A **pre-lay grapnel run**, which is conducted immediately in advance of cable installation to remove any obstacles from the path of the final subsea cable route. The operation involves the towing of one or an array of grapnels by the main cable laying vessel, or another designated vessel, along the route where burial is required. The grapnel is towed at a rate that ensures it maintains contact with the seabed and can penetrate up to 40 cm into unconsolidated sediments. As a matter of routine, the grapnel is recovered and inspected at intervals of ~15 km along the route. Usually a single tow is made along the route, although in areas where other marine activity or seabed debris are high, additional runs may be required.
- **Subsea cable installation**, which is undertaken by a specialised cable laying vessel that places the cable on the seabed along the predetermined route. At depths beyond 1,000 m, bottom currents are such that the cable can be placed directly on the seabed without the need for burial. At depths shallower than 1,000 m, a trench 0.9 – 1.5 m deep is excavated in the unconsolidated sediments by a specialised subsea cable plough to receive the cable. The foot print of the plough is limited to the area in which the four plough skids and the plough share, which is approximately 0.2 m wide, are in contact with the seabed. The plough itself is 5 m wide, with a submerged weight of 13 tonnes. The plough is designed to backfill the cable burial trench during operation. Heavier armouring around the cable is also used to provide additional protection, particularly in areas of uneaven or rocky seabed. A jet trencher deployed from a remotely operated vehicle (ROV) may also be used in some areas of burial.

[1.] The route would be determined during a pre-installation survey involving a desk-top Subsea Cable Route Study followed by detailed geophysical surveys of the seabed along the proposed subsea cable route.

In the littoral zone (<15 m) to the landing point on the beach, the cable will be installed through 'direct shore end operation'. This involves floating the shore end cable directly from the main cable installation vessel to the beach landing point using buoys and assisted by small boats and divers. The sections of the cable crossing the low water mark and the beach will be buried in the seabed using diver-operated hand-held jets. The expected maximum width of the seabed fluidised by the jet burial is approximately 210 mm with burial to a target depth of 1.0 m. Where burial cannot be achieved[2], or where additional cable protection is required, an articulated split-pipe may be used to maximise cable security.

- The **shore-crossing** of the cable segment from the low water mark to the beach man hole will involve trenching of the beach sediments to a target depth of 2 m below the beach level, or until bedrock is reached. The beach excavation will typically be carried out using tracked backhoe diggers and hand tools.

Table 1: Summary of Cable Installation Activities revalent to the marine environment.

Conditions/Environment	Installation Method
Water depth > 1,000 m	• In water depths more than 1,000 m, where the risk of external threat is considered lower, the subsea cable (14 to 35 mm) will be installed on the surface of the seabed, with the subsea cable conforming to the contours of the seabed.
Water depth 20 to 1,000 m	• The subsea cable (14 to 35 mm) will be buried below the seabed in water depths less than 1,000 m to a target burial depth of 1 m • The plough used to bury the cable has dimensions of approximately 9 m x 5 m x 5 m (L x H x W) and a submerged weight of 13 tonnes. The plough is designed to backfill the cable burial trench during operation.
Shore end (beach) and low water mark sections (<20 m water depth)	• The shore end (beach) and low water mark sections of the subsea cable will be buried using the diver jet burial technique; which includes hand-held jets to bury the subsea cable in the seabed. The expected maximum width of the seabed fluidised by the jet burial is approximately 105 mm either side of the centre line of the proposed subsea cable route (ie, 210 mm width) and the subsea cable is buried to a target depth of 1 m. The seabed can be expected to naturally reinstate shortly after completion of the works. • Articulated pipe will be used as additional protection for the subsea cable from the LWM to the BMH. The articulated pipe has a maximum external diameter of 130 mm and will be buried on the beach to a target depth of 3 m or until bedrock.
Beach Manhole (BMH)	• Excavation of a pit on the shore line above the high-water mark, followed by construction of a concrete bunker (typically up to 5 m x 5 m x 2 m) with ducts seaward for the subsea cable entry.
Subsea cable route installation alternative 1 – trenching only	• The installation of the beach section by trench will entail digging of a trench (to a depth of 1 m to 3 m below the soil level, or until bedrock using a backhoe digger and hand tools) along the existing beach access pathway, down to the beach into the intertidal zone. • Trenching and backfilling will entail the excavation and deposition of approximately 5 cubic metres of material per metre of trench. It should be noted that all excavated material will be reused to fill in the trench.

System Earth (beach-plate)	• Excavation of a pit adjacent to the BMH to a depth of approximately 5 m for burial of electrodes connected via an Earth Return Cable in the BMH.

2.3. Operations

Once installed and operational the subsea cable will not require routine maintenance, although cable repair may be required as a result of physical damage (either anthropogenic or natural) or failure. To effect repairs on deep sea cables, the damaged subsea cable is cut at the seabed and each end separately bought to the surface, whereupon a new section is spliced in. Dedicated repair ships are on standby to respond to any emergency repairs.

2.4. Decommissioning

The subsea cable is expected to be operational for at least 25 years.

Decommissioning of the system would usually involve demolition and recovery and removal of terrestrial components. The marine subsea portion of the subsea cable could be recovered and removed along certain segments if required, and abandonment in place along others. The METISS subsea cable system, will not however, be removed.

The subsea portion of the cable is likely be retired in place, as per current global industry practice.

The following steps shall be undertaken for decommissioning:

- To ensure that due consideration is given to all alternatives a detailed evaluation of facilities decommissioning options will be carried out. The evaluation will consider environmental issues in conjunction with technical, safety and cost implications to establish the best practicable environmental options for the decommissioning of the cable and associated infrastructure.
- A risk assessment will also be conducted to ensure that nothing which could be constituted as a hazard for other users of the area or for the environment in general will be left at the site. The site will be left in a safe and environmentally acceptable condition.
- The appropriate authorities shall be consulted and notified of the system status (including if the system is retired in place).

A detailed Project Decommissioning Plan will be developed as the Project nears the end of its lifetime. This is done in accordance with a Decommissioning Plan, details of which will be provided in this EIA Report. Details regarding the decommissioning of the terrestrial portion of the cable will also be included in the Decommissioning Plan.

3. DESCRIPTION OF THE BASELINE MARINE ENVIRONMENT

The Project Area comprises the various biophysical receptors that may be affected by the Project activities.

The descriptions of the physical and biological environments focus primarily on the area between Port Shepstone and Richard's Bay on the KwaZulu-Natal (KZN) coast. The summaries presented below are based on information provided in the Generic EMPRs for Oil and Gas Prospecting off the Coast of South Africa (CCA & CMS 2001) and more recent scientific studies undertaken in the general area.

3.1. The Physical Environment

3.1.1 Bathymetry and Sediments

The orientation of the coastline along the East Coast is relatively uniform, and north-northeast trending. A significant topographical feature is the Natal Bight, a coastal indentation between Cape Vidal and Durban, which is sheltered from the main force of the southward flowing Agulhas Current. The majority of the East Coast region has a narrow continental shelf and a steep continental slope. A prominent feature on the continental shelf is the Thukela Bank located along the KwaZulu-Natal coast between 28° 30' S and 30° 20' S. Here the continental shelf widens to 50 km offshore, the maximum width reached along the East Coast (Lutjeharms *et al,* 1989), and the continental slope is more gentle (Martin & Flemming 1988). To the south, the continental margin descends into the Natal Valley, while to the north-eastwards it develops into the Central Terrace.

The Thukela Bank is interrupted by two canyons; the large and prominent Thukela Canyon and the smaller Goodlad Canyon (also referred to as 29°25' S). A further canyon, referred to as the 'Durban Canyon' (SANBI GIS database) is located east of Durban, with an additional five canyon heads reported between the 50 m and 300 m contour to the south of the Bank between Port Shepstone and Port Edward where the continental shelf narrows and the continental margin descends into the Natal Valley (Harris *et al,* 2012). The Thukela Canyon is an example of a large submarine canyon restricted to the mid-lower continental slope. Unlike those off the Greater St Lucia Wetland Park (GSLWP) further north, this canyon lacks connection to the upper continental slope and shelf. The canyon head is located at ~600 m depth with the thalweg ending in the Natal Valley at ~2,800 m (Wiles *et al,* 2013). Sporadic high relief basement outcrops occur in the canyon head, with terraces developing along the western canyon wall beyond depths of ~1,500 m. With increasing distance from the continental shelf, and increasing depth, the canyon increases in width and relief. Information on the Goodlad Canyon is sparse. It is reported to start as a small 20 m deep valley (Martin & Flemming 1988) deepening to 250 m while becoming a 50 km wide, shallow valley at a depth of 1,400 m. It emerges from the Thukela Bank at 2,320 m (Goodlad 1986). The gradient of the canyon walls are less steep than those of the Thukela Canyon and limited tributaries occur (Young 2009). No information specific to the canyon off Durban or the southern canyons could be sourced.

These Canyons therefore differs significantly in morphology from those in northern KwaZulu-Natal, where coelacanths have been reported. Firstly, the canyon heads lack the amphitheatre-shaped head morphology.

Secondly, they are located at far greater depth than the Sodwana canyons and lack connectivity to the shelf, and finally, they show no significant tributary branches (Wiles *et al*, 2013). Although terraces are present and may provide shelter in the form of caves and overhangs, they occur at depths (>1,500 m) well beyond those at which coelacanths have been recorded to date.

The Thukela Bank is the major sedimentary deposition centre of the KZN continental shelf, being characterised by fluvial deposits of Thukela River and Mgeni River origin. Sediment dispersal in the Bight is controlled by the complex interaction of shelf morphology, the Agulhas Current, wave regime, wind-driven circulation, sediment supply and the presence of the semi-permanent gyre. The seabed is thus sedimentary in nature but varies in the degree to which it is consolidated (CBD 2013; see also Green & MacKay 2016). North of Durban, the shelf region is dominated by terrigenous sand (0.063 – 2 mm), with patches of gravel (>2 mm) occurring throughout the area. Areas on the mid-shelf contain sediments comprising up to 60 percent terrigenous mud. Two large mud depo-centres are found off the Thukela River mouth, while a smaller one is located off St Lucia. These mud depo-centres are a rare environment along the east coast of South Africa, comprising only about 10 percent of the shelf area (Demetriades & Forbes 1993). The muds and their associated elevated organic contents provide habitat to a unique fauna dominated by benthic and deposit feeders that favour muddy sediments and turbid waters. Despite being primarily a soft-sediment habitat, low profile beachrock outcrops (Fennessy 1994a, 1994b; Lamberth *et al*, 2009) occur just offshore of the 50 m contour off Durban and around the 200 m contour off Richard's Bay.

South of Durban, sand dominates both the inshore and offshore surficial sediments, although a substantial gravel component is present on the middle and outer shelf to as far as Port St Johns, occurring as coarse lag deposits in areas of erosion or non-deposition. Traces of mud are present on most areas of the shelf, although significant mud depo-centres are absent. The Agulhas Current and/or waves affect the sediment bedform patterns on the KZN continental shelf. North and south of the Thukela Bank, the Agulhas Current generates active dune fields at the shelf edge (Flemming & Hay 1988). In contrast, sediments on the shelf area of the Thukela Bank to a depth of 100 m are affected mostly by wave action (CSIR 1998; Green & MacKay 2016). South of the Ilovo River the inner shelf comprises sand sheets, while sand ribbons and streamers occur on the mid-shelf comprises, with gravel pavements dominating the outer shelf.

The outer shelf is dominated by gravels of shell-fragment and algal-nodule origin (Heydorn *et al*, 1978). Outer shelf sediments are influenced solely by the strong Agulhas Current, forming large-scale subaqueous dunes with a southwesterly transport direction. Subaqueous dunes in the inner and mid shelf are prone to current reversals (Uken & Mkize 2012).

3.1.2 Benthic Habitats

The proposed subsea cable route crosses a number of benthic habitats (see Figure 2 and Figure 3a and 4b). The seabed communities along the inshore portions (<500 m) of the proposed subsea cable route fall within the Natal photic and sub-photic biozones, which extend from the low water mark to the shelf edge.

These biozones lie within the 'minimal protected category' (1 – 5 percent) and a number of the benthic habitats on the Thukela Bank and continental shelf off the East Coast are defined as 'Vulnerable' or 'Endangered' as existing Marine Protected Areas (MPAs) are insufficient for conserving marine habitats and their associated biodiversity (Lombard *et al,* 2004; Sink *et al,* 2012).

Cumulative impacts and the lack of biodiversity protection has resulted in some of the coastal habitat types along the east coast being assigned a threat status of 'critically endangered' and 'vulnerable' (Lombard *et al,* 2004; Sink *et al,* 2012) (Table 2). Using the SANBI benthic and coastal habitat type GIS database (Figure **3**a and 4b), the threat status of the benthic habitats within the broader project area, and those potentially affected by proposed subsea cable route, were identified (Table 2). Five benthic habitats rated as 'vulnerable' are affected by the proposed cable routing, namely Natal Canyon, Natal Sandy Inshore, Natal Sandy Shelf, Natal Shelf Reef and Natal-Delagoa Intermediate Sandy Coast. All other habitats affected by the cable routing are considered 'least threatened'.

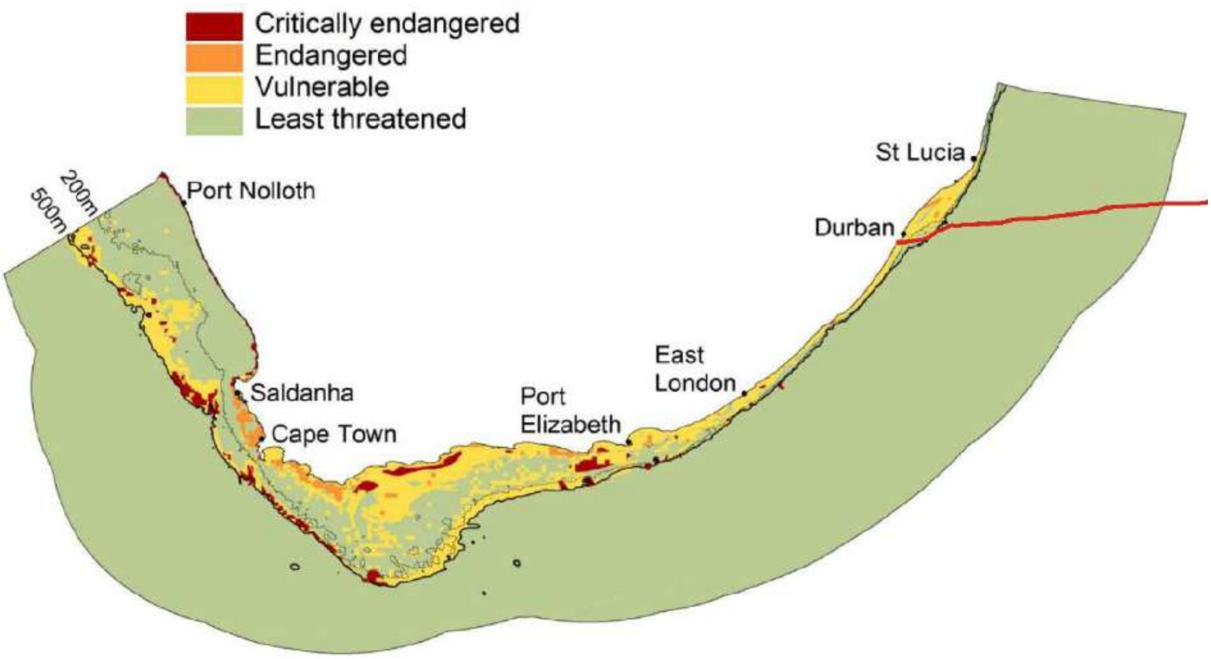


Figure 2: Ecosystem threat status for coastal and offshore benthic habitat types on the South African East Coast in relation to the proposed subsea cable route (red line) (adapted from Sink *et al,* 2012).

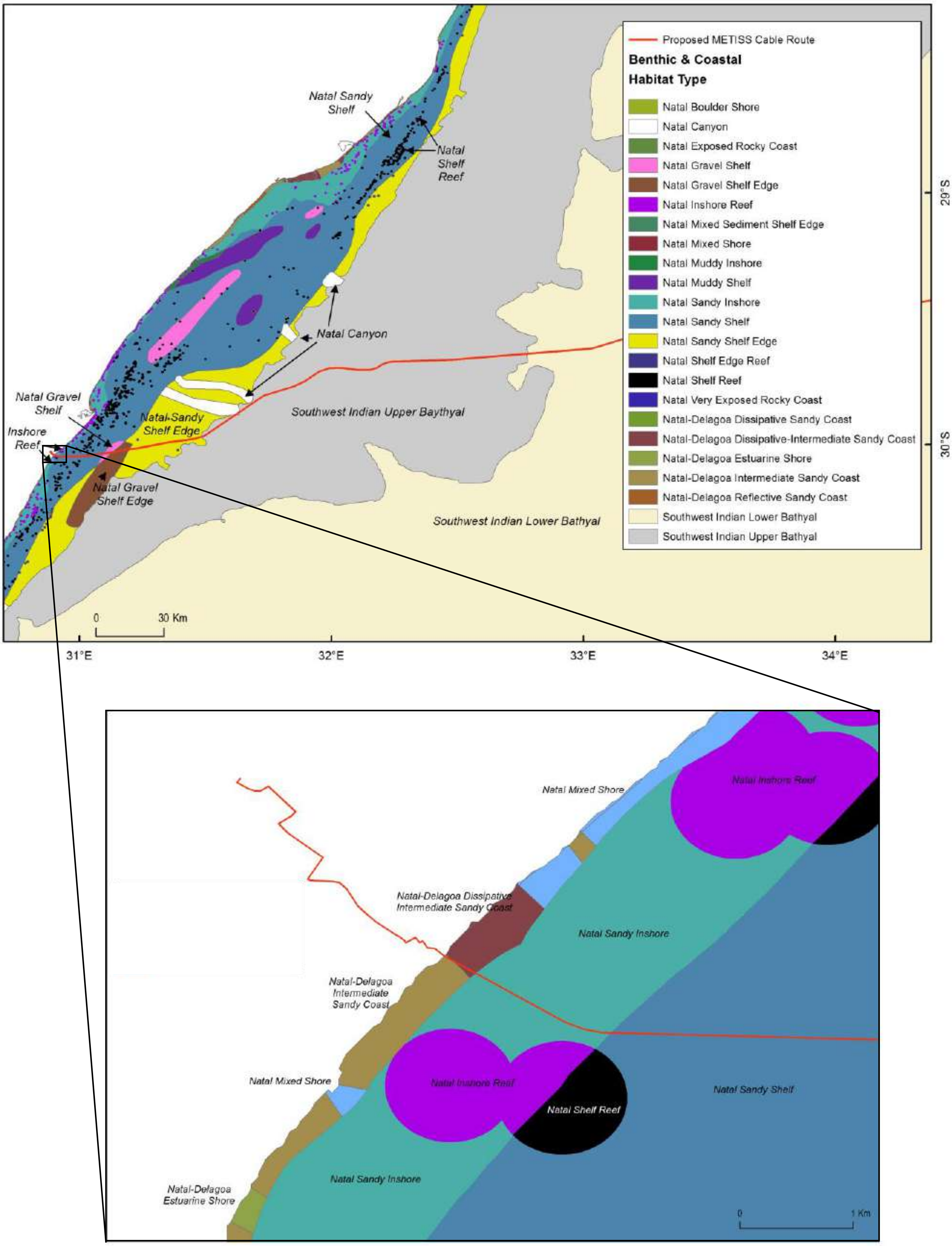


Figure 3: Benthic and coastal habitat types on the continental shelf of the general project area. Insert provides details of the inshore habitat types on the continental shelf. The habitats affected by the proposed cable routing are identified in Table 3 (adapted from Sink *et al*, 2012).

Table 2: Ecosystem threat status for marine and coastal habitat types in the broader project area (adapted from Sink *et al*, 2012). Assuming trenching is implemented for the cable's shore crossing, those habitats potentially affected by the proposed subsea cable route are shaded.

Habitat Type	Threat Status	Total Size (km^2)
Natal Boulder Shore	Critically Endangered	2.58
Natal Canyon	Vulnerable	483.1
Natal Estuarine Shore	Least Threatened	0.49
Natal Exposed Rocky Coast	Least Threatened	75.04
Natal Gravel Shelf	Least Threatened	1,097.29
Natal Gravel Shelf Edge	Least Threatened	773.52
Natal Inshore Gravel	Least Threatened	0.22
Natal Inshore Reef	Endangered	245.29
Natal Mixed Sediment Shelf	Least Threatened	1.79
Natal Mixed Sediment Shelf Edge	Least Threatened	29.17
Natal Mixed Shore	Vulnerable	157.2
Natal Muddy Inshore	Endangered	52.99
Natal Muddy Shelf	Endangered	501.86
Natal Muddy Shelf Edge	Least Threatened	61.8
Natal Sandy Inshore	Vulnerable	1,236.45
Natal Sandy Shelf	Vulnerable	6,348.09
Natal Sandy Shelf Edge	Least Threatened	2,412.8
Natal Shelf Edge Reef	Least Threatened	17.59
Natal Shelf Reef	Vulnerable	522.89
Natal Very Exposed Rocky Coast	Least Threatened	4.23
Natal-Delagoa Dissipative Sandy Coast	Least Threatened	3.97
Natal-Delagoa Dissipative-Intermediate Sandy Coast	Least Threatened	153
Natal-Delagoa Intermediate Sandy Coast	Vulnerable	198.38
Natal-Delagoa Reflective Sandy Coast	Vulnerable	49.91
Southwest Indian Upper Bathyal	Least Threatened	84,965.89
Southwest Indian Lower Bathyal	Least Threatened	218,081.26

3.1.3 Water Masses and Circulation

The oceanography of this coast is almost totally dominated by the warm Agulhas Current that flows southwards along the shelf edge (Schumann 1998) (Figure 4). The Agulhas Current forms between 25° and 30° S, its main source coming from recirculation in a South-West Indian Ocean subgyre. Further contributions to the Agulhas Current come from the Mozambique Current and the East Madagascar Current in the form of eddies that act as important perturbations to the flow (Lutjeharms 2006). It flows southwards at a rapid rate following the shelf edge along the East Coast, before retroflecting between 16° and 20° E (Shannon 1985). It is a well-defined and intense jet some 100 km wide and 2,300 m deep (Schumann 1998; Bryden *et al*, 2005). Current speeds of 2.5 m/s or more have been recorded (Pearce *et al*, 1978).

Where it meets the northern part of the Thukela Bank near Cape St Lucia, the inertia of the Agulhas Current carries it into deep water. This generates instability in the current (Gill & Schumann 1979) resulting in meanders and eddies (Pearce *et al,* 1978; Guastella & Roberts 2016; Roberts *et al,* 2016). Three eddy types have been identified in the Agulhas Current (Gründlingh 1992):

- Type I meanders that comprise smaller shear/frontal features to a depth of at least 50 m, which dissipate over a period of days.
- Type II meanders comprising the large clockwise loops generated within the Natal Bight. Of these the extremely transient Natal Pulse occurs when meanders move the southward flow offshore, enabling sluggish and occasional northward flow to develop close inshore (Schumann 1988; Roberts *et al,* 2016). The larger Natal Gyre is a clockwise circulation cell that extends from Durban to Richard's Bay, resulting in northward flow inshore (Pearce 1977a, 1977b). The Natal Gyre, however, is temporally and spatially variable (CSIR 1998; Roberts *et al,* 2016), being affected by a number of Type I disturbances (Gründlingh 1992). More recently, Guastella & Roberts (2016) identified that the Durban Eddy, a meso-scale, lee-trapped cold-core feature, which develops in the south between Durban and Sezela causing strong north-eastward flow inshore, is present off Durban approximately 55 percent of the time, with an average lifespan of 8.6 days, and inter-eddy periods of 4 to 8 days. Combined with the southerly flow on the outer shelf, the effect is the development of a semi-permanent cyclonic circulation ('swirl') over the entire southern bight.
- Type III meanders, which are the larger meanders that originate north of St Lucia.

South of Durban, the continental shelf again narrows and the Agulhas Current re-attaches itself as a relatively stable trajectory to the coast, until off Port Edward it is so close inshore that the inshore edge (signified by a temperature front) is rarely discernible (Pearce 1977a). At Port St Johns, however, there exists a semi-permanent eddy, which results in a northward-flowing coastal current and the movement of cooler water up the continental slope onto the centre of the very narrow shelf (Roberts *et al,* 2010). Further south, when the Agulhas Current reaches the wider Agulhas Bank, where the continental slopes are weaker, it starts to exhibit meanders, shear edge eddies and plumes of warm surface waters at the shelf edge, before retroflecting eastwards as the Agulhas Return Current to follow the Subtropical Convergence (Lutjeharms 2006) (Figure 4).

In common with other western boundary currents, a northward (equatorward) undercurrent — termed the Agulhas Undercurrent — is found on the continental slope of the East Coast at depths of between 800 m and 3,000 m (Beal & Bryden 1997).

As the Agulhas Current originates in the equatorial region of the western Indian Ocean its waters are typically blue and clear, with low nutrient levels and a low frequency of chlorophyll fronts. On the Thukela Bank, however, nutrient concentrations are characterised by short-term temporal variations, but are higher than in areas where the continental shelf is narrower (Carter & d'Aubrey 1988). This is attributed in part, to the topographically induced upwelling that occurs in the area as a result of the bathymetric arrangement of the Natal Bight (Gill & Schumann 1979; Schumann 1986; Lutjeharms *et al,* 1989). Recently, however, Roberts & Nieuwenhuys (2016) identified that upwelling in the northern KZN Bight is common, and that almost all major and minor cold-water intrusions coincided with upwelling-favourable north-

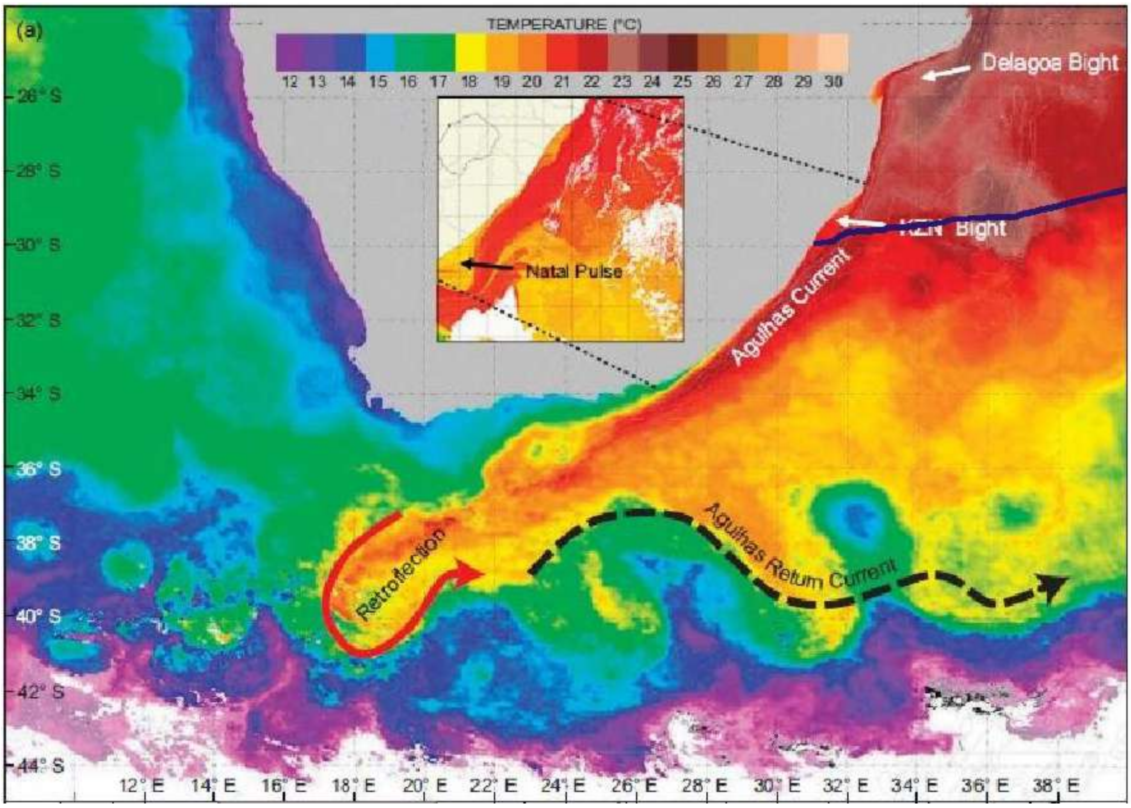


Figure 4: The predominance of the Agulhas current in the oceanography of the subsea cable route (blue line) (adapted from Roberts *et al,* 2010).

easterly winds that simultaneously force a south-westerly coastal current. Major upwelling events last for 5-10 days, whereas shorter duration events persist for 1-2 days. Wind-driven upwelling also occurs in the inner bight between Richards Bay and Port Durnford. Furthermore, the canyons of northern bight may also play a role in enhancing upwelling. Upwelling has also been reported in the southern bight 'swirl'. The cold nutrient-rich upwelled waters are a source of bottom water for the entire Natal Bight (Lutjeharms *et al,* 2000a, b). However, from all other perspectives, the Bight may be considered a semi-enclosed system (Lutjeharms & Roberts 1988) as the strong Agulhas Current at the shelf edge forms a barrier to exchanges of water and biota with the open ocean.

The surface waters are a mix of Tropical Surface Water (originating in the South Equatorial Current) and Subtropical Surface Water (originating from the mid-latitude Indian Ocean). Surface waters are warmer than 20°C and have a lower salinity than the Equatorial Indian Ocean, South Indian Ocean and Central water masses found below. Surface water characteristics, however, vary due to insolation and mixing (Schumann 1998). Seasonal variation in temperatures is limited to the upper 50 m of the water column (Gründlingh 1987), increasing offshore towards the core waters of the Agulhas Current where temperatures may exceed 25° C in summer (21° C in winter) (Schumann 1998). Further offshore of the core waters temperatures again decrease.

3.1.4 Winds and Swells

The main wind axis off the KZN coast is parallel to the coastline, with north-north-easterly and south-south-westerly winds predominating for most of the year (Schumann & Martin 1991) and with average wind speeds around 2.5 m/s (Schumann 1998) (Figure 5).

In the sea areas off Durban, the majority of swells are from the South and South-southwest, with the largest attaining >7 m. During summer and autumn, some swells also arrive from the east (Figure 6). The less regular weather patterns affecting the East Coast (eg, low pressure cells present NE of Durban, cut-off low pressure cells and tropical cyclones) strongly influence the wave climate, resulting in swells in excess of 10 m (Hunter 1988; Schumann 1998). The giant waves (>20 m high) that are at times encountered within the Agulhas Current (Heydorn & Tinley 1980), arise from the meeting of the south-westerly swells and the southerly flowing Agulhas Current, and may be a navigation hazard at times.

3.1.5 Nutrients

Nutrient inputs on the Thukela Banks are thought to originate from a combination of an upwelling cell off Richards Bay, the Thukela River, and a cyclonic lee eddy off Durban. The marine nutrients are derived from a topographically-induced upwelling cell just south of Richards Bay (Gill & Schumann 1979; Schumann 1988; Lutjeharms *et al,* 1989). The cold nutrient-rich upwelled waters are a source of bottom water for the entire Natal Bight (Lutjeharms *et al,* 2000a, b). The region is generally oligotrophic, with nutrients (silicates, phosphates and nitrates) occurring in very low concentrations in the upper mixed layer, increased below the pycnocline (Muir *et al,* 2016). Nutrient levels show temporal and spatial variability, with elevated levels typically occurring near the Thukela River mouth (Barlow *et al,* 2015; de Lecea *et al,* 2015; van der Molen *et al,* 2016). The cyclonic eddy incorporates enrichment, retention and concentration mechanisms, and together with the upwelling and elevated phytoplankton production in the north of the Bight (Lutjeharms *et al,* 2000b), creates the necessary conditions for enhanced survivorship of early larvae and juveniles of pelagic spawners (Beckley & van Ballegooyen 1992; Hutchings *et al,* 2003).

River discharge also has profound effect on physical, chemical and biological processes in coastal waters, and in KZN the effect of catchment-derived nutrient supply onto the Thukela Banks is thought to be pronounced given that nutrient supply from upwelling events is limited (Lamberth *et al,* 2009; Scharler *et al,* 2016). The importance of localised fluvial processes (under normal flow, reduced flow and flood events) in driving marine food webs has recently received much research attention (DWAF 2004; Lamberth *et al,* 2009; Turpie & Lamberth 2010). Nutrient inputs into the coastal environment through river runoff is predicted to stimulate phytoplankton and zooplankton production, and ultimately the larval, juvenile and adult fish that depend on them as a food source. Proposed impoundments on the Thukela River may thus have cascade effects on ecosystem functioning of the Thukela Banks, with far-reaching consequences for the sustainability of local fisheries.

The turbid, nutrient-rich conditions are also important for the life-history phases (breeding, nursery and feeding) of many demersal and pelagic species. The area harbours the only commercial shallow-water prawn trawl fishery in the country and is thus of considerable socio-economic importance to KZN.

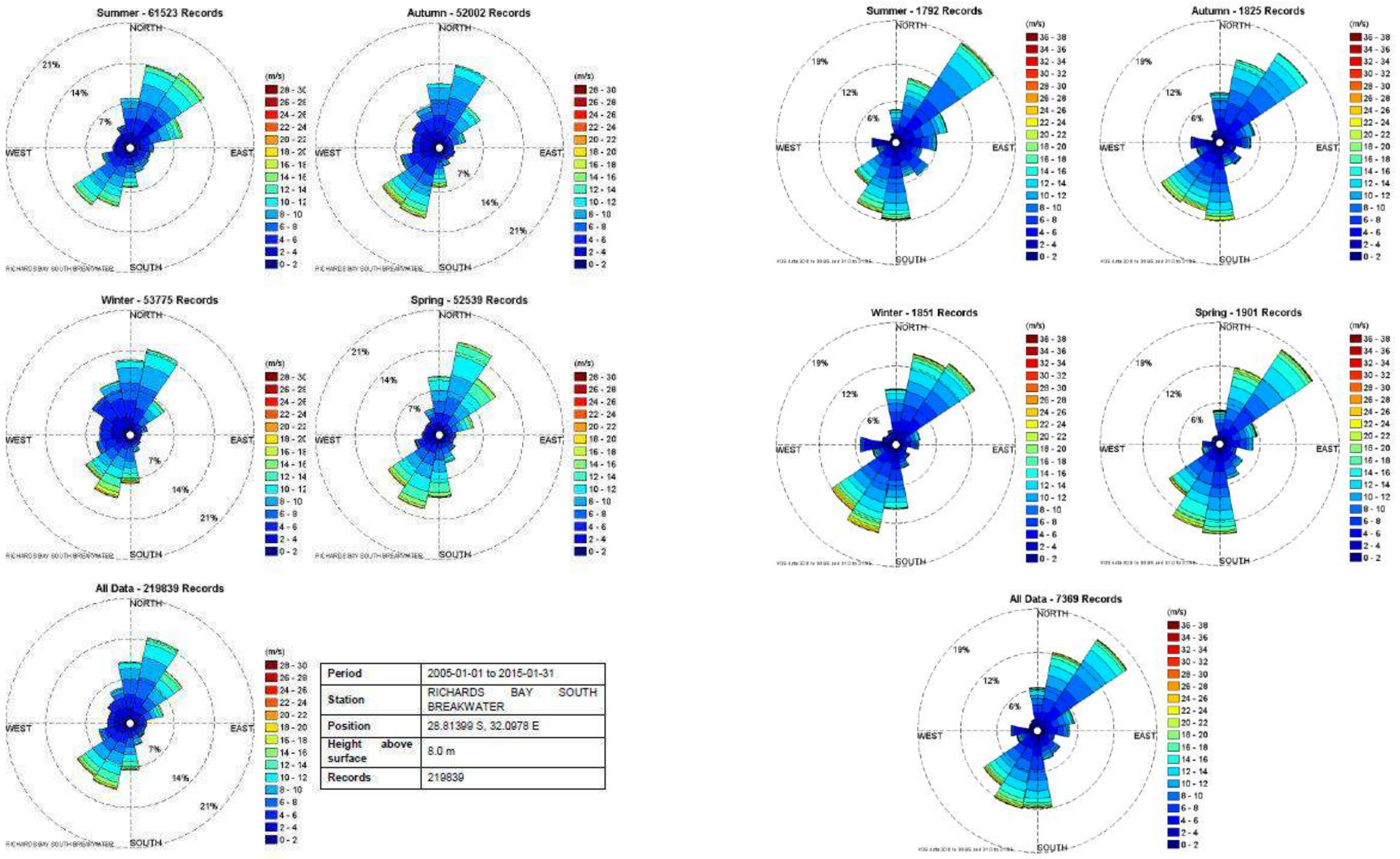
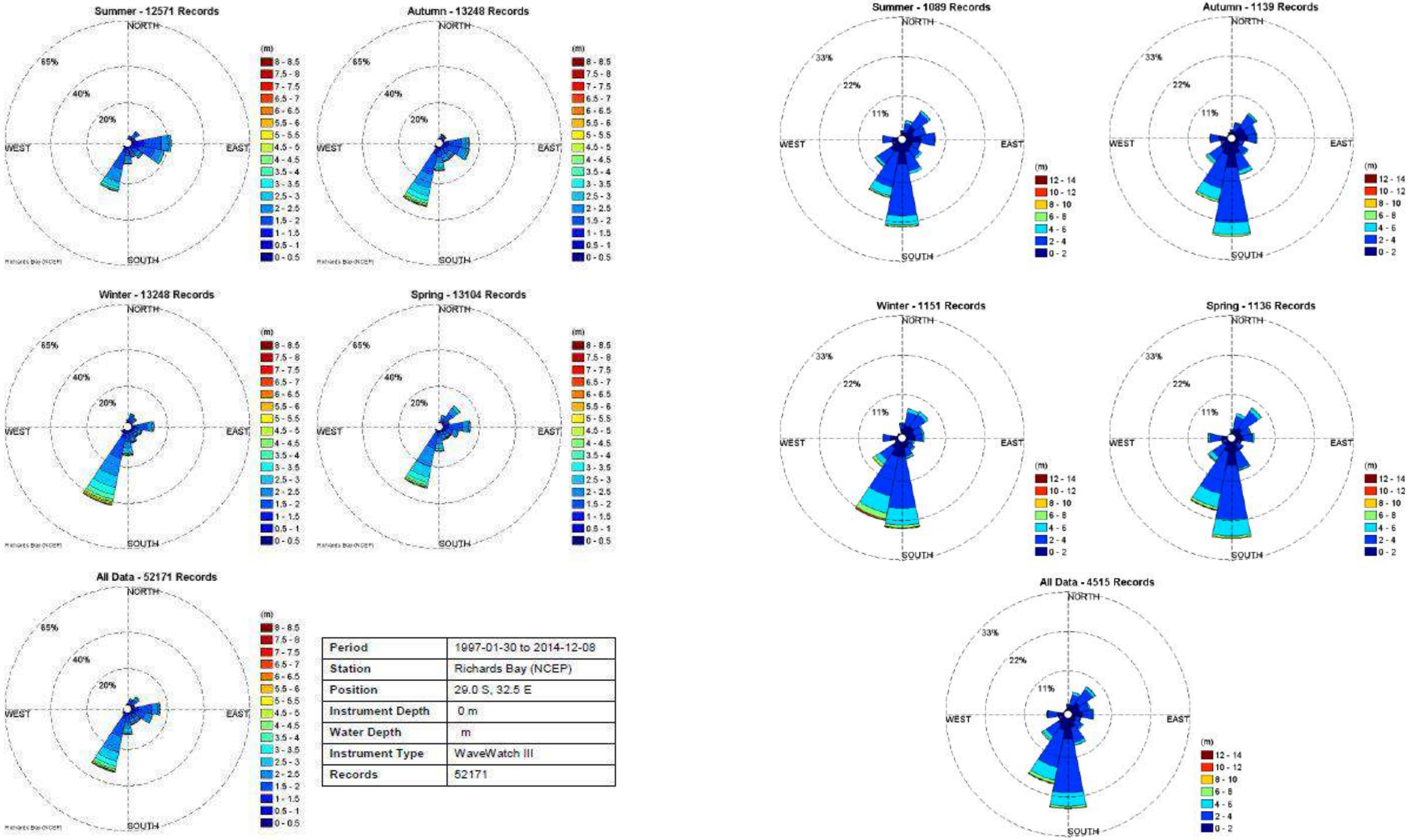


Figure 5: VOS Wind Speed vs Wind Direction for Richards Bay breakwater (28.8°S and 32.1° E) (left) and Port Shepstone (30.0° to 30.9° S and 31.0° to 31.9° E) (1960-02-15 to 2012-04-13; 7,369 records) (right) (from CSIR).



Period	1997-01-30 to 2014-12-08
Station	Richards Bay (NCEP)
Position	29.0 S, 32.5 E
Instrument Depth	0 m
Water Depth	m
Instrument Type	WaveWatch III
Records	52171

Figure 6: VOS Wave Height (Hmo) vs Wave Direction for a deepwater location offshore of Richards Bay (29.0°S and 32.5° E) (left) and for Port Shepstone (30.0° to 30.9° S and 31.0° to 31.9° E) (1960-02-15 to 2012-04-13; 4,515 records) (right) (from CSIR).

3.2. The Biological Environment

Biogeographically The subsea cable route falls into the Natal and West Indian Offshore bioregion (Figure 7) (Lombard *et al,* 2004). The inshore area comprises the Thukela Banks, whereas the offshore areas comprise deepwater benthic habitats and the water body. Due to limited opportunities for sampling, information on the pelagic and demersal communities of the shelf edge, continental slope, and upper and lower bathyal are very poorly known (Griffiths *et al,* 2010). Consequently, much of the information on the baseline environment provided below relates to the inshore (<50 m) and continental shelf (<200 m) regions, which fall within the Natal Bioregion (Figure 7).

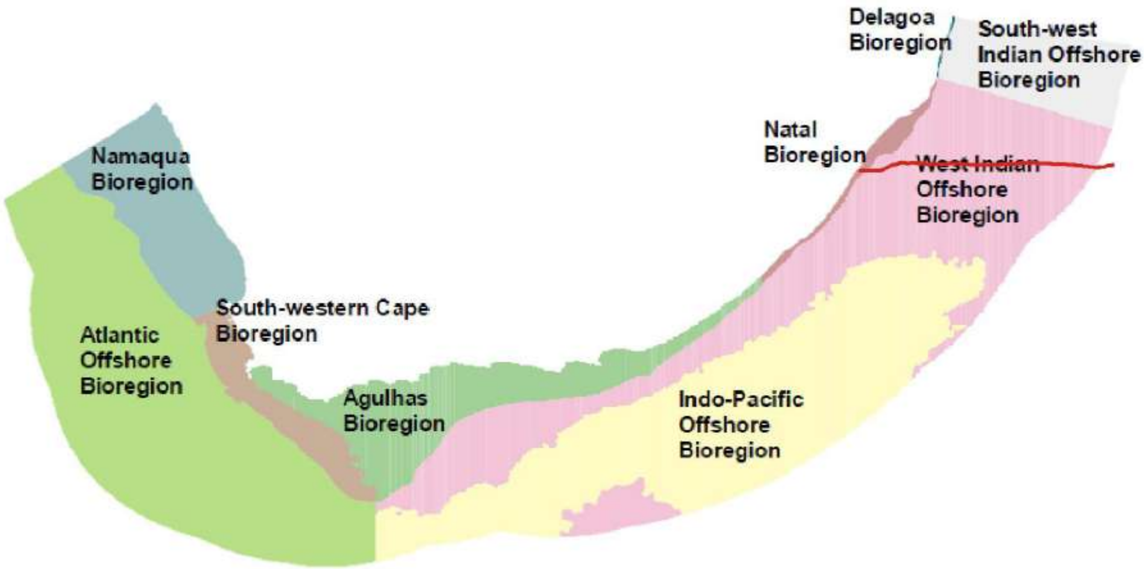


Figure 7: The South African inshore and offshore bioregions in relation to the subsea cable route (red line) (adapted from Lombard *et al,* 2004).

The benthic communities within these habitats are generally ubiquitous throughout the southern African East Coast region, being particular only to substratum type and/or depth zone. They consist of many hundreds of species, often displaying considerable temporal and spatial variability. The biological communities 'typical' of each of these habitats are described briefly below, focusing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed Project.

3.2.1 Plankton

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity in KwaZulu-Natal inshore areas, with chlorophyll a concentrations ranging between 0.03 and 3.88 µg/l (Carter & Schleyer 1988; see also Coetzee *et al,* 2010). Further offshore, the pelagic environment is characterised by very low productivity, with the low variability in water-column temperature resulting in very low frequency of chlorophyll fronts. Phytoplankton, zooplankton and ichthyoplankton abundances are thus expected to be extremely low. In contrast, on the Thukela Bank, short-term increases in productivity are associated with localised upwelling (Oliff 1973; Muir *et al*, 2016; Barlow *et al*, 2015), with phytoplankton being confined to the upper 100 m of the water column (Muir *et al*, 2016). The distribution of phytoplankton and photosynthesis in the bight are, however, driven by temperature and irradiance, rather than nutrients (Barlow *et al*, 2013; Lamont & Barlow 2015). Continental shelf waters support greater and more variable concentrations of zooplankton biomass (Figure 8) than offshore waters (Beckley & Van Ballegooyen 1992), with species composition varying seasonally (Carter & Schleyer 1988). Copepods represent the dominant species group in shelf waters (Carter & Schleyer 1988), although chaetognaths are also abundant (Schleyer 1985). Zooplankton productivity appears associated with nutrient peaks from both the Durban Eddy as well as upwelling off Richards Bay (Pretorius *et al*, 2016), but dependence on nutrients derived from organic matter of marine origin (de Lecea *et al*, 2015) as well as terrestrial origin (de Lecea *et al*, 2013, 2016) has been demonstrated.

Similarly, primary productivity along the Eastern Cape Coast is comparatively low, with mean *chlorophyll a* concentrations averaging between 1-2 mg/m^3 over the whole year in the top 30 m of the water column. *Chlorophyll a* concentrations vary seasonally, being minimal in winter and summer (<1 – 2 mg/m^3), and maximal (2 - 4 mg/m^3) in spring and autumn (Brown 1992). Along the eastern half of the South Coast phytoplankton concentrations are usually higher than on the Agulhas Bank further west, comprising predominantly large cells (Hutchings 1994). This eastwards increase in *chlorophyll a* concentrations determines the increase in the biomass of mesozooplankton from ~0.5-~1.0 g C/m^2 in the west to ~1.0-~2.0 g C/m^2 further east. Dense swarms of euphausiids dominate this zooplankton component, and form an important food source for pelagic fishes (Cornew *et al*, 1992; Verheye *et al*, 1994).

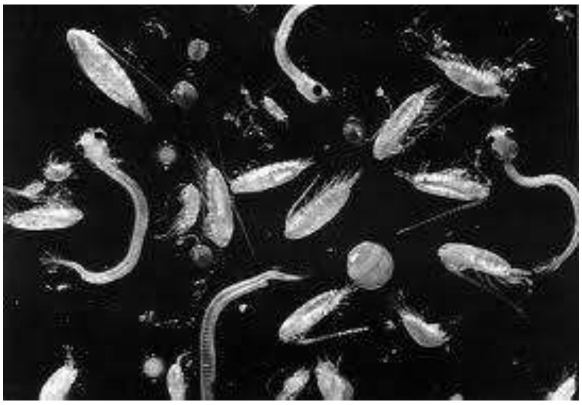


Figure 8: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells on the Thukela Bank.

Pilchard (*Sardinops sagax*) eggs occur in inshore waters (< 50 m) along the Eastern Cape and the southern KwaZulu-Natal coast with the onset of the 'sardine run' between May and July (Anders 1975; Connell 1996). The sardine and other clupeid eggs persist in inshore waters throughout winter – spring, before disappearing in early summer as the shoals break up and move northwards and further offshore (Connell 2010). Recent evidence suggests that the inshore areas of the KZN coast may also function as a nursery area for these small pelagic species during the winter months (Connell 2010; Coetzee *et al*, 2010) as freshwater flows from the large rivers serve as cues for spawning and the recruitment of juveniles (Lamberth *et al*, 2009). Anchovy (*Engraulis encrasicolus*) eggs were reported in the water column during December as far north as St Lucia (Anders 1975).

Numerous other linefish species (eg, squaretail kob and various sciaenids (snapper, sin croaker, beareded croaker)) use the Thukela Banks as a nursery area due to suitable food sources and protection from predators in the turbid water (Fennesy 1994a). For example, juvenile squaretail kob and snapper kob are seasonally abundant as a bycatch in the shallow-water prawn fishery from January to March, before moving from their feeding areas on the trawling grounds to low reef areas where their diet changes to include more teleosts (Fennessey 1994a). The Thukela Banks also serve as a nursery area for the endangered scalloped hammerhead shark, slinger and black mussel cracker (CBD 2013), and five species of dasyatid rays (Fennessy 1994b). The Banks serve as a spawning area for (amongst others) bull shark, sand tiger shark, black mussel cracker and king mackerel, as a spawning and migration route for sardine ('sardine run') (Haupt 2011; Harris *et al,* 2011; Sink *et al,* 2011; Ezemvelo KZN Wildlife 2012; CBD 2013). Numerous linefish species (eg, dusky kob *Argyrosomus japonica*, elf *Pomatomus saltatrix*, seventy-four *Polysteganus undulosus*, steenbras *Petrus rupestrus*, black musselcracker *Cymatoceps nasutus*, white musselcracker *Sparodon durbanensis*, silverbream *Rhabdosargus holubi* and strepie *Sarpa salpa* leervis *Lichia amia*, geelbek *Atractoscion aequidens* and garrick *Lichia amia*) undertake spawning migrations along the inshore areas of the coast into KwaZulu-Natal waters during the winter months (Van der Elst 1976, 1981; Griffiths 1988; Garret 1988). Many of the species listed have been identified as either 'threatened' or listed as priority species for conservation due to over-exploitation (Sink & Lawrence 2008).

Following spawning during spring and summer (November to April), the eggs and larvae of these linefish species are subsequently dispersed southwards by the Agulhas Current (Connell 2010) (Figure 9), with juveniles occurring on the inshore Agulhas Bank (Van der Elst 1976, 1981; Garret 1988). Ichthyoplankton likewise is confined primarily to inshore waters (<200 m), with larval concentrations varying between 0.005 and 4.576 larvae/m^3. Concentrations, however, decrease rapidly with distance offshore (Beckley & Van Ballegooyen 1992). The subsea cable route traverses the major linefish spawning and migration routes, and ichthyoplankton abundance is likely to show strong spatial and temporal variability.

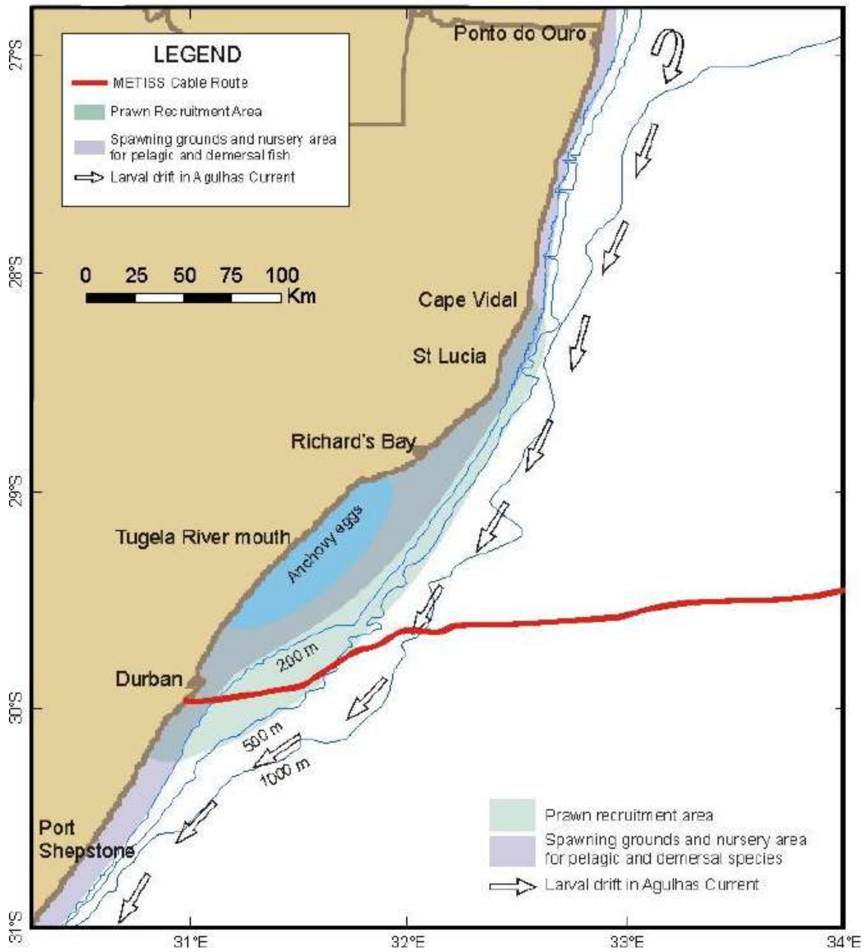


Figure 9: Major fish spawning, nursery and recruitment areas along the KwaZulu-Natal coast in relation to the METISS subsea cable route (red line).

3.2.2 Soft-sediment Benthic Macro- and Meiofauna

The benthic biota of unconsolidated marine sediments constitutes invertebrates that live on (epifauna), or burrow within (infauna), the sediments, and are generally divided into megafauna (animals >10 mm), macrofauna (>1 mm) and meiofauna (<1 mm). While some species live at the water/sediment interface, others burrow into the sediment, usually to depths not exceeding 30 cm. The community structure of benthic biota is shaped by the prevailing physical (abiotic) conditions such as sediment grain size, temperature, salinity, turbidity and currents. Further shaping is derived from biotic factors such as predation, food availability, larval recruitment and reproductive success.

The proposed subsea cable route crosses a number of benthic habitats (see

Figure 2 and Figure 3a and 4b). The seabed communities along the inshore portions of the proposed cable route fall within the Natal photic and sub-photic biozones, which extend from the low water mark to the shelf edge. The benthic habitats within these zones, and their vulnerability, were presented in Table 2.

Intertidal Beaches

The beaches in central and northern KZN comprise coarse grained sediments (Jackson & Lipschitz 1984) and are typically exposed to high wave energy. The KZN sandy beaches are dominated by intermediate beaches (44.39 percent) and rock (33.05 percent), with approximately equal proportions of dissipative (10.80 percent) and reflective (9.12 percent) beaches (Harris 2008; 2012). In the area south of Durban to the southern KZN border (and thus corresponding to the shore crossing site for the cable), Harris (2008) reports that the beaches of all types are much shorted, and are dominated by reflective beach states, with rocks more prevelant than elsewhere. For the 200 km stretch of coastline around Durban, Harris *et al,* (2014) reported an average of 13 invertebrate macrofaunal species of which 5 are southern African endemics. In contrast, Barbosa & Defeo (2015) give an average species richness range of 2-10 species for the KZN coastline. The macrofaunal assemblages are characterised by tropical crustaceans (*eg,* ghost crabs *Ocypode* spp, and mole crabs *Emerita austroafricana* and *Hippa adactyla*) (Dye *et al,* 1981) (Figure 10), with gastropods and isopods being comparatively poorly represented (Wooldridge *et al,* 1981). The polychaete *Scolelepis squamata* and isopod *Excirolana natalensis* are also commonly found (Harris 2008). However, as many as 47 percent of the species recorded were only found at a single site suggesting that some of the invertebrate macrofauna could be considered relatively rare (eg, *Glycera natalensis*, *Bullia mozambicensis*) (Harris 2012; Harris *et al,* 2014).

Subtidal Macrobenthos

The naturally high spatial and temporal variability for these factors in subtidal regions results in seabed communities being both patchy and variable. The offshore soft-sediment habitat characterising the Thukela Banks is home to a unique fauna dominated by benthic and deposit feeders that favour muddy sediments and turbid waters. In particular, the seabed in the nearshore areas off the KwaZulu-Natal coast tends to be patchy in terms of sediment composition, with significant sediment movement being frequently induced by the typically dynamic wave and current regimes (Fleming & Hay 1988). Consequently, the benthic macrofauna of inshore regions will be adapted to typically harsh conditions and frequent disturbance. Further offshore where near-bottom conditions are more stable, the macrofaunal communities will primarily be determined by sediment characteristics and depth.

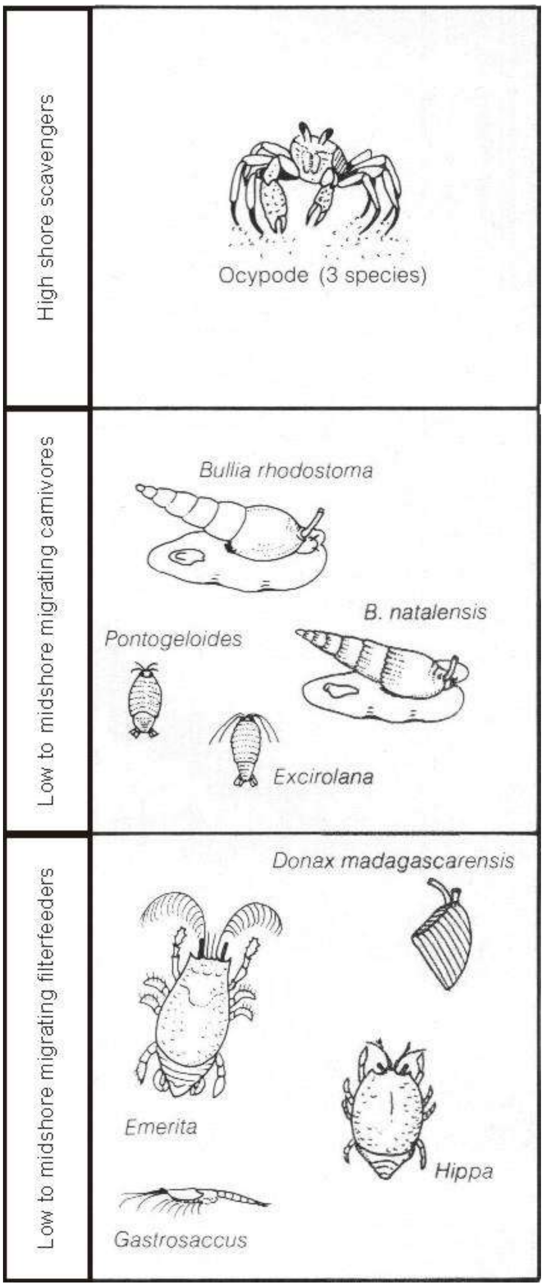


Figure 10: Schematic representation of the East Coast intertidal zonation on sandy beaches (adapted from Branch & Branch 1981).

Typical components of the macrobenthos on the continental shelf are polychaete worms, crustaceans, molluscs, and echinoderms a variety of. Typical species reported by CSIR (2009) from nearshore sediments off Richard's Bay include the amphipods *Urothoe* (various species), *Mandibulophoxus stimpsoni* and *Cunicus profundus*, anthurid and arcturid isopods, the bivalves *Macra* spp., *Modiolus* spp. and *Tellina* spp., the gastropods *Bullia similis* and *Oliva caroliniana*, and a wide variety of polychaete species including *Glycera* sp., *Lumbrineris* sp., *Nephtys* spp., *Orbinia* spp. and *Prionospio* sp. (Figure 11). The meiobenthos includes the smaller species such as nematode worms, flat worms, harpacticoid copepods, ostracods and gastrotriches. Some of the meiofauna are adept at burrowing while others live in the interstitial spaces between the sand grains.

Figure 11: Benthic macrofaunal genera commonly found in nearshore sediments include: (top: left to right) *Ampelisca, Prionospio, Bullia similis*; (middle: left to right) *Modiolus sirahensis, Orbinia, Tellina*; (bottom: left to right) *Nephtys*, hermit crab, *Urothoe*. (Not to scale).

Long-term studies in the Richard's Bay area (Connell *et al,* 1985, 1989; McClurg *et al,* 1999, 2000, 2001, 2002, 2003, 2004; McClurg & Blair 2005, 2006, 2007, 2008; CSIR 2007, 2009) have identified that the benthic macrofaunal communities have a low diversity and abundance, particularly on sandy inshore substrates (CSIR 2009). On the outershelf (80-100 m depth) off Richards Bay, the abundance and diversity of macrobenthic individuals was lowest, being dominated by surface deposit feeders (Untiedy & Mackay 2016). Further offshore where sediments tend to be muddier, diversity and abundance typically increases (CSIR 2009). Similar surveys undertaken off Durban, and on the KwaZulu-Natal continental shelf in general, have yielded much richer communities (McClurg 1998). For example, Untiedy & Mackay (2016) found that on the Thukela Banks, the habitat complexity of the midshelf (60 – 80 m depth) resulted in the community off the Thukela River supporting high macrobenthic abundance, with abundance an diversity decreasing further offshore on the carbon-rich, muddy, outer shelf. Functionally, the community on the midshelf was dominated by interface- and deposit-feeding fauna, while further offshore deposit feeders dominate. On the midshelf between Thukela and Durban, where poorly sorted, coarse sands dominate due to influences from the Durban Eddy, assemblages were abundant, rich and specific to the habitat (MacKay *et al,* 2016). The midshelf off the southern bight (Durban region and within the immediate project area) was most species rich, with suspension feeders contributing most to the abundance of the macrobenthic communities (Untiedy & Mackay 2016).

The benthic fauna of the continental slope and beyond into the abyss are very poorly known, largely due to limited opportunities for sampling. Due to the lack of information on benthic macrofaunal communities beyond the shelf break, no description can be provided for the deeper portions (Lower Bathyal) along the subsea cable route. However, with little sea floor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of such habitats, with polychaete worms, molluscs, echinoderms and a variety of crustaceans typical of the infauna. The meiobenthos includes the smaller species such as nematode worms, flat worms, harpacticoid copepods, ostracods and gastrotriches. Some of the meiofauna are adept at burrowing while others live in the interstitial spaces between the sand grains. Also associated with soft-bottom substrates are demersal communities that comprise bottom-dwelling invertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source.

A number of larger crustacean species form the basis for a small multispecies trawl fishery on the Thukela Bank and the shallow-water mud banks along the northeast coast of KZN. The species in question include various penaeid prawns, particularly *Fenneropenaeus indicus* (white prawn), *Metapenaeus monoceros* (brown prawn) and *Penaeus monodon* (tiger prawn) (Figure 12, left), as well as pink and red prawns (*Haliporoides triarthrus* and *Aristaeomorpha foliacea*), langoustines (*Metanephrops mozambicus* and *Nephropsis stewarti*) and red crab (*Chaceon macphersoni*). Most of the prawn species are fast-growing and short-lived (~1 year), and dependent on estuarine environments (eg, Amatigkula and Thukela River mouths, St Lucia) during the early phase of their life cycle. Juveniles move out of estuaries in January and start recruiting onto the mud banks (and into the fishery) from February onwards, where they subsequently mature and reproduce (Wilkinson & Japp 2010). Abundance of these crustaceans varies seasonally and for shallow water species is strongly dependent on recruitment from estuarine nursery areas and river discharges (M&CM 2007). Prolonged closure of estuary mouths due to reduced river flow thus has important implications for the recruitment success of these crustacean. The shallow-water penaeid prawns typically occur on unconsolidated sandy to muddy sediments in <50 m depth on the Thukela and St Lucia Banks, whereas the deep-water species occur at depths between 360-460 m.

Figure 12: The tiger prawn *Panaeus monodon* (left) occur on shallow-water mud banks along the KwaZulu-Natal coast, whereas the Natal deep-sea rock lobster *Palinurus delagoae* (right) occurs on mud and rubble at depths of 100-600 m (Photos: platinum-premium.com; visualsunlimited.photoshelter.com).

Other deep-water crustaceans that may occur along the proposed subsea cable route are the shovel-nosed crayfish (*Scyllarides elisabethae*) and the Natal deep-sea rock lobster (*Palinurus delagoae*)(Figure 12, right). The shovel-nosed crayfish occurs primarily on gravelly seabed at depths of around 150 m, although it is sometimes found in shallower water. Its distribution range extends from Cape Point to Maputo. The Natal rock lobster similarly occurs on open areas of mud and rubble at depths of 100-600 m (Groeneveld & Melville-Smith 1995). Larvae settle offshore with juveniles and adults migrating inshore as they age. This species primarily occurs north of Durban. Other rock lobster species occurring on the east coast include the East Coast rock lobster (*Palinurus homarus*) and the painted spiny lobster (*Palinurus versicolor*), all of which, however, are typically associated with shallow-water reefs (Branch *et al,* 2010).

The deep-water rock lobster (*Palinurus gilchristi*) occurs on rocky substrate in depths of 90 - 170 m between Cape Agulhas and southern KwaZulu-Natal. Larvae drift southwards in the Agulhas Current, settling in the south of the Agulhas Bank before migrating northwards again against the current to the adult grounds (Branch *et al,* 2010).

3.2.3 Reef Communities

The intertidal and shallow subtidal reefs along the East Coast of South Africa support a wide diversity of marine flora and fauna and a relatively high percentage of endemic species (Turpie *et al,* 2000, Awad *et al,* 2002).

Intertidal Rocky Shores

Rocky intertidal habitats comprise less than one third of the KZN coastline (Jackson & Lipschitz, 1984), most of which are regularly inundated by sand. Rocky intertidal shores on the southern African East Coast can be divided into five zones on the basis of their characteristic biological communities (Figure 13). Tolerance to the physical stresses associated with life in the intertidal, as well as biological interactions such as herbivory, competition and predation interact to produce these five zones. The biological zones, however, also correspond roughly to zones based on tidal heights. East Coast rocky intertidal fauna is comparatively diverse, with assemblages characterised by more tropical species. These are described briefly below (Branch & Branch 1981, Branch *et al,* 2010):

Supralittoral fringe – Littorina zone - The supralittoral fringe, is the uppermost part of the shore most exposed to air, thus perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny gastropods *Afrolittorina africana*, *Littoraria glabra* and *Echinolittorina natalensis*, and the tufted algae *Bostrychia tenella* (Rhodophyta) constituting the most common macroscopic life.

Upper midlittoral – Upper Balanoid zone - The upper midlittoral is characterised by a dense band of the Natal rock oyster *Saccostrea cuccullata*, which gives way to a mixed community of brown mussel *Perna perna*, various barnacles (*eg,* volcano barnacle *Tetraclita serrata,* eight-shell barnacle *Octomeris angulosa*) and limpets such as *Helcion concolor*, *Cellana capensis,* and various species of false limpet *Siphonaria* spp.

Lower midlittoral – Lower Balanoid zone - On the lower shore, biological communities are characterised by several species of zoanthids, urchins, sponges and upright coralline algae.

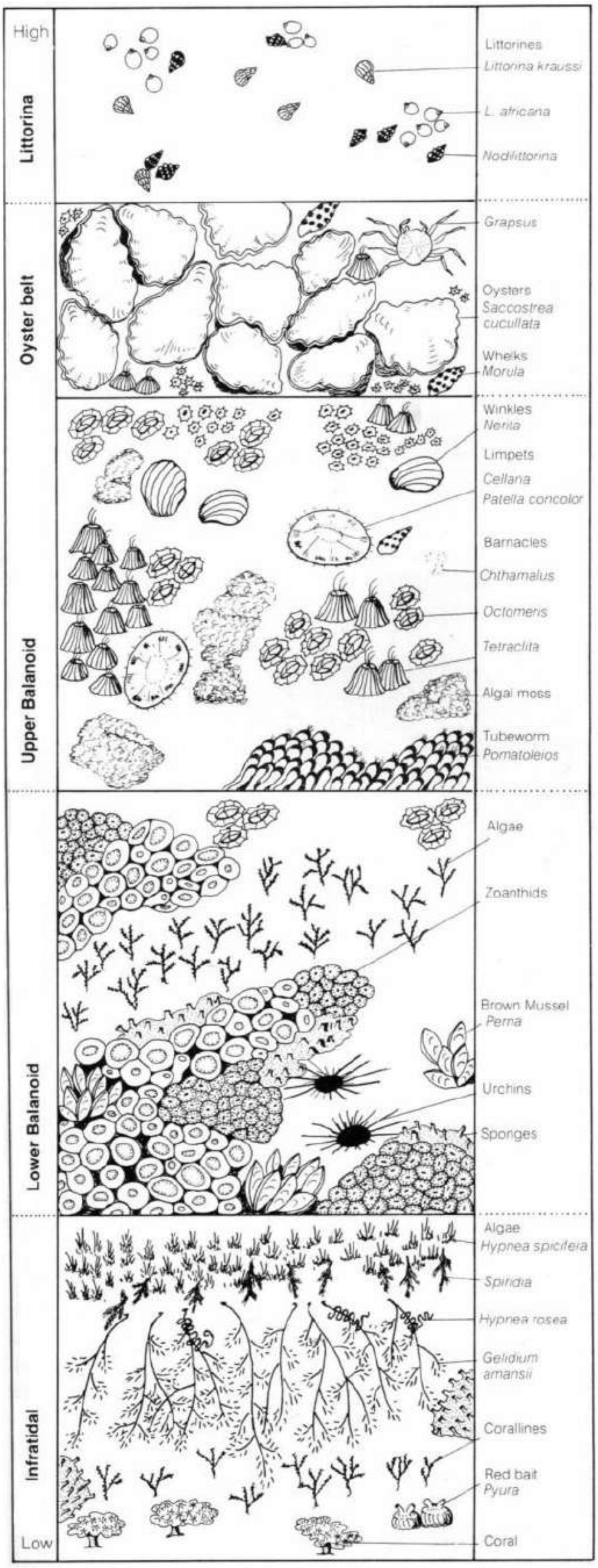


Figure 13: Schematic representation of the East Coast intertidal zonation on rocky shores (adapted from Branch & Branch 1981).

Sublittoral fringe - The well-marked sublittoral fringe is characterised by dense algal beds, which include species such as *Hypnea specifera*, *Spyridia hypnoides* and *Callithamnion stuposum*. In the extreme low-shore, where wave action is strongest the algal communities include various species of coralline algae, *Gelidium amansii* and *Plocamium corallorhiza*. Fauna in the low shore are relatively sparse being represented primarily by urchins and octopus.

Subtidal Reefs

The subtidal shallow reefs of the East Coast range from rich, coral-encrusted sandstone reefs in the north to the more temperate rocky reefs further south (Figure 14). The subsea cable route passes through an area of high deep reef density of shallow corals. The Maputaland Coral Reef system, which extends from Kosi Bay to Leven Point (27°55'40"S, 32°35'40"E) and constitute the southernmost coral-dominated reefs of Africa (UNEP-WCMC 2011) lie well to the north of the subsea cable route. South of the iSimangaliso Wetland Park (St Lucia) reef habitat is provided by rock outcrops, although both hard and soft corals still occur. Known reefs inshore of the 200 m depth contour on the Thukela Bank were mapped by Turpie & Lamberth (2010) and Harris *et al,* (2012). Both reef types (ie, coral and rock outcrops) are characterised by diverse invertebrate and ichthyofaunal biota of Indo-Pacific origin (Figure 15, left). The invertebrate benthic communities associated with hard substrata boast a high diversity of hard and soft corals, sponges, tunicates and bivalve molluscs. Mobile benthic organisms associated with the reefs include a wide variety of echinoderms (urchins, starfish and sea cucumbers), gastropod molluscs and crustaceans. The coral reef habitat also provides shelter and a food source for the highly diverse Indo-Pacific reef fish community.

Both the shallow coral-dominated reefs off Sodwana Bay and the sandstone reefs off Durban and the KZN South Coast are popular amongst divers for their wealth of invertebrate and fish diversity.

In recent years there has also been increasing interest in deep-water corals and sponges because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths exceeding 150 m. Some coral species form reefs while others are smaller and remain solitary. Corals and sponges add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al,* 1997; MacIssac *et al,* 2001). Their frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead frameworks. The canyons and feeder valleys on the shelf edge host a diversity of sponges, black corals, gorgonians, alcyonarian soft corals and stylasterine lace corals, which support a diverse epifauna including basket- and brittlestars, winged oysters and other molluscs (Sink *et al,* 2006). These invertebrates establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current. The occurrence of such potentially vulnerable marine ecosystems (ie deep water corals) in the METISS subsea cable route is unknown.

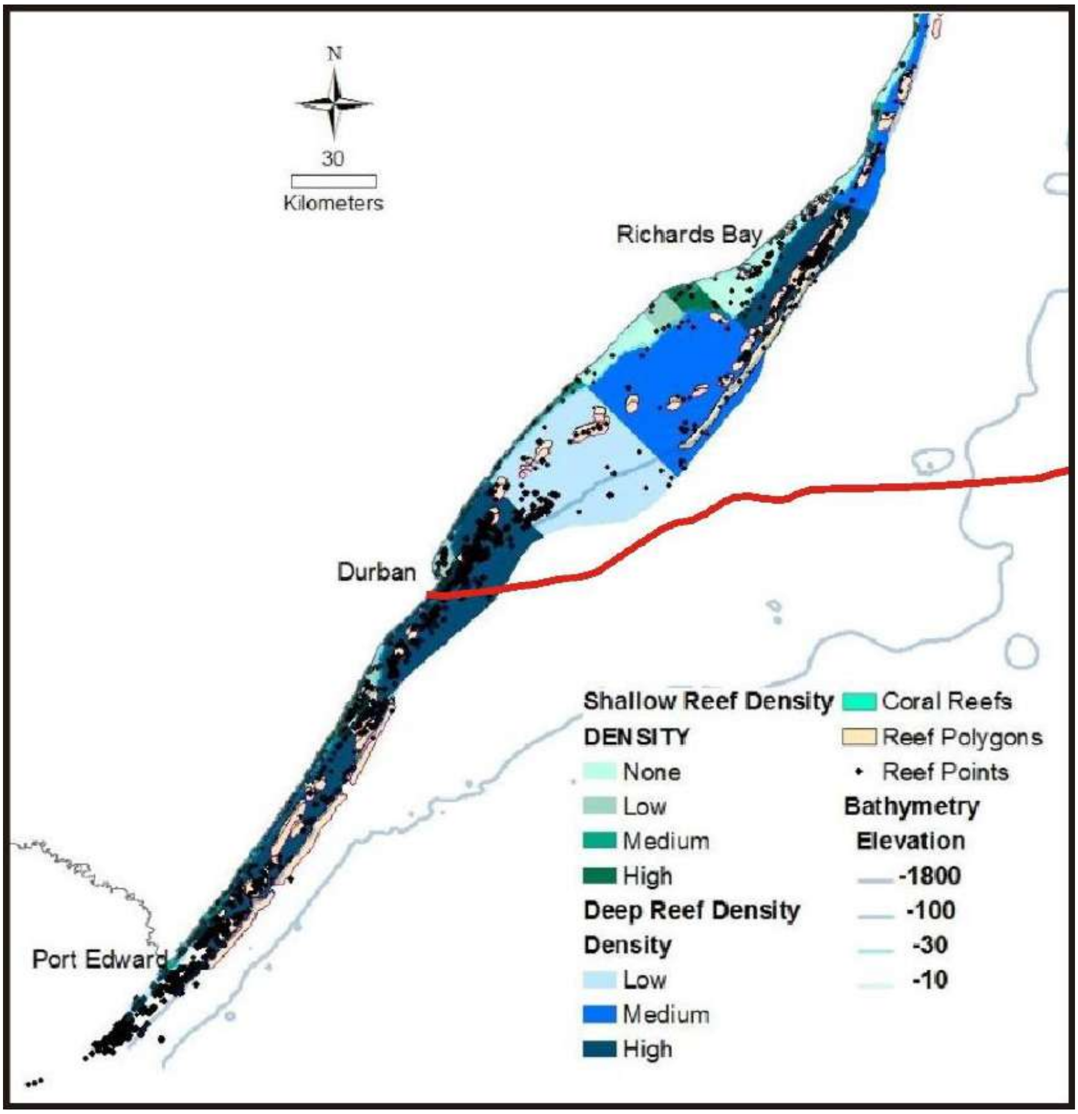


Figure 14: Reefs in KwaZulu-Natal inshore of ~ 200 m depth in relation to the subsea cable route (red line) (adapted from Harris *et al*, 2012).

Figure 15: The reefs in KwaZulu-Natal are characterized by highly diverse invertebrate benthic communities and their associated fish fauna (Left, photo: www.sa-venues.com). The annual 'sardine run' attracts a large number of pelagic predator, which follow the shoals along the coast (Right, photo: www.sea-air-land.com).

3.2.4 Pelagic Invertebrates

Pelagic invertebrates that may be encountered along the subsea cable route include the giant squid *Architeuthis* sp., a deep dwelling species usually found near continental and island slopes all around the world's oceans (Figure 16). Giant squid could thus potentially occur along the subsea cable route, although the likelihood of encounter is extremely low. Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1,000 m.

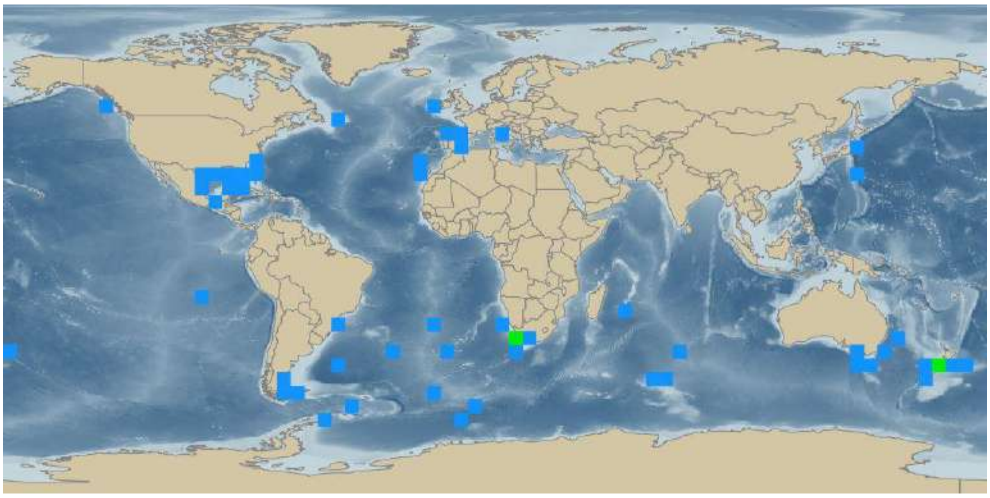


Figure 16: Distribution of the giant squid (http://iobis.org). Blue squares <5 records, green squares 5-10 records.

3.2.5 Pelagic and Demersal Fish

Pilchards (*Sardinops sagax*) are a small pelagic shoaling species typically found in shelf water between 14 °C and 20 °C. Spawning occurs on the Agulhas Bank during spring and summer (November to April). During the winter months of June to August, the penetration of northerly-flowing cooler water along the Eastern Cape coast and up to southern KZN effectively expands the suitable habitat available for this species, resulting in a 'leakage' of large shoals northwards along the coast in what has traditionally been known as the 'sardine run'. Other pelagic shoaling species 'running' with the sardines but often occupying different depths in the water column include anchovy *Engraulis encrasicolus,* West Coast round herring *Etrumeus whiteheadi*, East Coast round herring *Etrumeus teres* and chub mackerel *Scomber japonicus* (Coetzee *et al,* 2010). The cool band of inshore water is critical to the 'run' as the sardines will either remain in the south or only move northwards further offshore if the inshore waters are above 20 °C. The shoals can attain lengths of 20-30 km and are typically pursued by Great White Sharks, Copper Sharks, Common Dolphins (Figure 15, right), Cape Gannets and various other large pelagic predators (www.sardinerun.co.za; O'Donoghue *et al,* 2010a, 2010b, 2010c). Recent studies have indicated that the annual 'sardine run' constitutes a migration to localised upwelling centres inshore of the Agulhas Current (East London and Cape St Lucia) that provide a favourable temperate spawning environment for these small pelagic fish species during and subsequent to their annual migration along the East Coast (Beckley & Hewitson 1994; Coetzee *et al,* 2010). The sardine run occurs along the continental shelf and therefore crosses the inshore sections of the proposed subsea cable route.

Catch rates of several important species in the recreational shoreline fishery of KZN have been shown to be associated with the timing of the 'sardine run' (Fennessey *et al,* 2010). Other pelagic species that migrate along the KZN south coast include elf/shad (*Pomatomus saltatrix*), geelbek (*Atractoscion aequidens*), yellowtail (*Seriola lalandi*), kob (*Argyrosomus* sp.), seventy-four (*Cymatoceps nasutus*), strepie/karanteen (*Sarpa salpa*), Cape stumpnose (*Rhabdosargus holubi*), red steenbras (*Petrus rupestrus*), poenskop (*Cymatoceps nasutus)* and mackerel (*Scomber japonicus*), which are all regular spawners within KZN waters (Van der Elst 1988; Hutchings *et al,* 2003). Both the Thukela Bank, as well as the many estuaries along the KZN coastline, serve as important nursery areas for many of these species. From an ecological perspective, the Thukela Banks are thought by some to function as an estuary, as freshwater flows from the large rivers are likely to provide cues for spawning and the recruitment of juveniles that use the bank as a nursery area (Lamberth *et al,* 2009).

A wide variety of demersal fishes and megabenthic invertebrates have been recorded in experimental trawls off Richards Bay (CSIR 2009) and between the Mlalazi River and Durban (Fennessy 2016) (Figure 17). Long-term datasets shows wide spatio-temporal variability in the diversity and abundance of trawl catches over the years (CSIR 2009). Similar variability has been reported from other regions of the world, and it appears to be an inherent feature of demersal fish and megabenthic invertebrate communities from near-shore soft-sediment habitats (Otway *et al,* 1996). Similarly, a high diversity of pelagic Teleosts (bony fish) and Chondrichthyans (cartilaginous fish) is associated with the numerous inshore reefs and shelf waters and can be expected to occur along the inshore sections of the subsea cable route. Many of the fishes are endemic to the Southern African coastline and form an important component of the commercial and recreational linefisheries of KZN (Table 3).

Figure 17: A trawl sample taken 7 km off Richards Bay showing the wide variety of demersal fish and megabenthic invertebrates occurring in nearshore areas (CSIR 2009).

Fennessy (2016) reports on demersal fish communities across the KZN Bight to depths of 575 m. Species composition was structured mainly by depth (with diversity increasing with depth), substratum type (which in turn influences invertebrate macrofaunal community structure) and proximity to the Thukela River. The Thukela River itself was particularly influential species composition on the adjacent Thukela Bank that harbours a unique community. The fish communities were dominated by the Sparidae (five species), Triglidae (four species), Acropomatidae (three species), Macrouridae (eight species). Information on other neritic and demersal fish and megabenthic invertebrates beyond 600 m depth is lacking.

Table 3: Some of the more important linefish species landed by commercial and recreational boat fishers along the East Coast (adapted from CCA & CMS 2001).

Common Name	Species Name
Demersal teleosts	
Blue hottentot	*Pachymetopon aeneum*
Cape stumpnose	*Rhabdosargus holubi*
Dageraad	*Chrysoblephus christiceps*
Englishman	*Chrysoblephus anglicus*
Mini kob	*Johnius dussumieri*
Natal stumpnose	*Rhabdosargus sarba*
Poenskop/Musselcracker	*Cymatoceps nasutus*
Pompano	*Trachinotus africanus*
Red steenbras	*Petrus rupestris*
Red stumpnose	*Chrysoblephus gibbiceps*
River bream	*Acanthopagrus berda*
Rockcod	*Epinephalus spp.*
Santer	*Cheimerius nufar*
Scotsman	*Polysteganus praeorbitalis*
Slinger	*Chrysoblephus puniceus*
Snapper salmon	*Otolithes ruber*
Spotted grunter	*Pomadasys commersonnii*
Squaretail kob	*Argyrosomus thorpei*
White steenbras	*Lithognathus lithognathus*
Pelagic species	
Elf	*Pomatomus saltatrix*
Garrick/leerfish	*Lichia amia*
Geelbek	*Atractoscion aequidens*
Green jobfish	*Aprion virescens*
King mackerel	*Scomberomorus commerson*
Kob	*Argyrosomus spp*
Kingfish species	*Caranx* spp.
Queenfish	*Scomberoides commersonianus*
Queen mackerel	*Scomberomorus plurilineatus*
Tenpounder	*Elops machnata*
Wahoo	*Acanthocybium solandri*
Yellowtail	*Seriola lalandi*
Chondrichthyans	
Bronze whaler shark	*Carcharhinus brachyurus*
Dusky shark	*Carcharhinus obscurus*
Hammerhead shark	*Sphyrna* spp.
Sandshark	Rhinobatidae
Milkshark	*Rhizoprionodon acutus*
Skates	Rajiformes
Stingray	Dasyatidae

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters along the subsea cable route are the large migratory pelagic species, including various tunas (Figure 18, left), billfish (Figure 18, right) and sharks (Figure 19), many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing. Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, where the fins are removed and the remainder of the body discarded.

Figure 18: Large migratory pelagic fish such as longfin tuna (left) and blue marlin (right) occur in offshore waters (photos: www.samathatours.com; www.osfimages.com).

Table 4: Some of the more important large migratory pelagic fish likely to occur in the offshore regions of the East Coast. The Global IUCN Conservation Status and NEMBA listing are also provided.

Common Name	Species	IUCN Conservation Status	NEMBA Marine TOPS
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*	Critically Endangered	
Bigeye Tuna	*Thunnus obesus*	Vulnerable	
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	
Frigate Tuna	*Auxis thazard*	Least concern	
Eastern Little Tuna/Kawakawa	*Euthynnus affinis*	Least concern	
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	
Billfish			
Blue Marlin	*Makaira nigricans*	Vulnerable	
Striped Marlin	*Kajikia audax*	Near Threatened	
Sailfish	*Istiophorus platypterus*	Least concern	
Swordfish	*Xiphias gladius*	Least concern	
Black Marlin	*Istiompax indica*	Data deficient	
Pelagic Sharks			

Common Name	Species	IUCN Conservation Status	NEMBA Marine TOPS
Great Hammerhead Shark	*Sphyrna mokarran*	Endangered	Endangered
Scalloped Hammerhead	*Sphyrna lewini*	Endangered (SWIO subpop.)	Endangered
Smooth Hammerhead	*Sphyrna zygaena*	Vulnerable	
Pelagic Thresher Shark	*Alopias pelagicus*	Vulnerable	
Bigeye Thresher Shark	*Alopias superciliosus*	Vulnerable	
Common Thresher Shark	*Alopias vulpinus*	Vulnerable	
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Vulnerable	
Dusky Shark	*Carcharhinus obscurus*	Vulnerable	
Great White Shark	*Carcharodon carcharias*	Vulnerable	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	
Longfin Mako	*Isurus paucus*	Vulnerable	
Whale Shark	*Rhincodon typus*	Endangered	Vulnerable
Blue Shark	*Prionace glauca*	Near Threatened	
Tiger Shark	*Galeocerdo cuvier*	Near Threatened	Protected

Two species likely to be encountered along the subsea cable route are singled out for further discussion, namely the great white shark *Carcharodon carcharias* (Figure 19, left) and the whale shark *Rhincodon typus* (Figure 19, right). Both species have a cosmopolitan distribution and although not necessarily threatened with extinction, the great white shark is described as 'vulnerable' and the whale shark as 'endangered' in the IUCN Red listing, and are listed in Appendix II (species in which trade must be controlled in order to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and Appendix I and/or II of the Bonn Convention for the Conservation of Migratory Species (CMS). The great white shark and whale shark are both also listed as 'vulnerable' in the List of Marine Threatened or Protectes Species (TOPS) as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA).

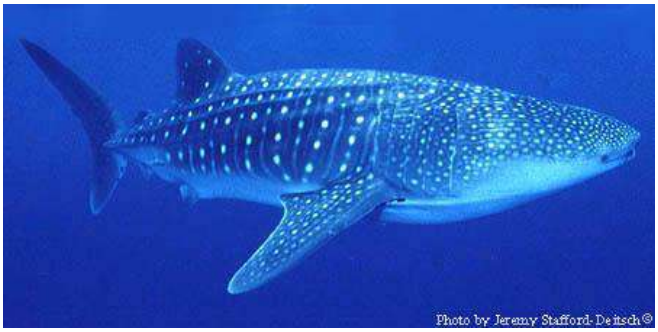


Figure 19: The great white shark *Carcharodon carcharias* (top left) and the whale shark *Rhincodon typus* (bottom right) (photos: www.flmnh.ufl.edu).

The great white shark is a significant apex predator along the South African south and east coasts, and was legislatively protected in South Africa in 1991 in response to global declines in abundance. Long-term catch-per-unit-effort data from protective gillnets in KwaZulu-Natal, however, suggest a 1.6 percent annual increase in capture rate of this species following protection, although high interannual variation in these data lessen the robustness of the trend (Dudley & Simpfendorfer 2006).

White sharks migrate along the entire South African coast, typically being present at seal colonies during the winter months, but moving nearshore during summer (Johnson *et al,* 2009). Recent research at Mossel Bay into the residency patterns of white sharks revealed that male sharks display low site fidelity, often rapidly moving in an out of the area. Females in contrast, display high site fidelity and may remain resident in the area for up to two months (Koch & Johnson 2006). Great white sharks are, however, capable of transoceanic migrations (Pardini *et al,* 2001; Bonfil *et al,* 2005; Koch & Johnson 2006), with recent electronic tag data suggesting links between widely separated populations in South Africa and Australia and possible natal homing behaviour in the species. Although during transoceanic migrations they appear to spend most of the time just below the sea surface, frequent deep dives to a much as 980 m are made whilst *en route*. Long-distance return migrations along the South African coast are also frequently undertaken (Figure 20), particularly by immature individuals (Bonfil *et al,* 2005). These coastal migrations, which are thought to represent feeding-related events, potentially traverse the proposed subsea cable route.

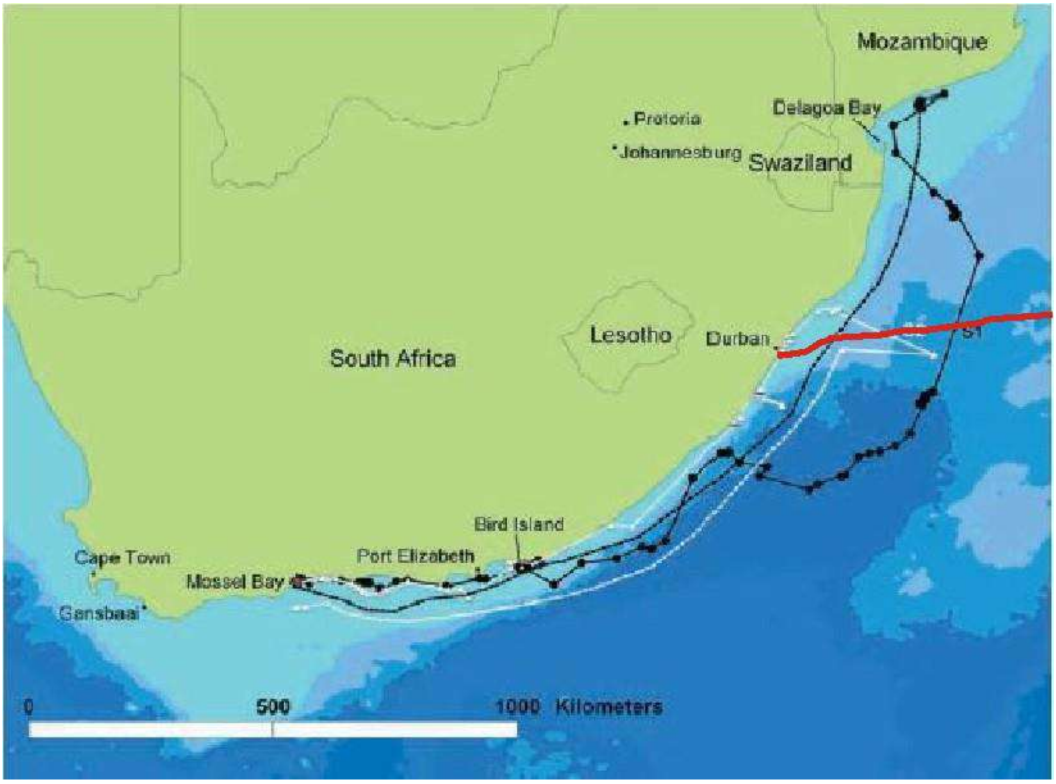


Figure 20: Long-distance return migrations of two tracked great white sharks along the South African coast in relation to the subsea cable route (red line). The black trace shows a migration from 24 May – 2 November 2003; the white trace shows a migration from 31 May – 1 October 2004 (adapted from Bonfil *et al,* 2005)

Whale sharks are regarded as a broad ranging species typically occurring in offshore epipelagic areas with sea surface temperatures of 18–32°C (Eckert & Stewart 2001). Adult whale sharks reach an average size of 9.7 m and 9 tonnes, making them the largest non-cetacean animal in the world. They are slow-moving filter-feeders and therefore particularly vulnerable to ship strikes (Rowat 2007). Although primarily solitary animals, seasonal feeding aggregations occur at several coastal sites all over the world, those closest to the project area being off Sodwana Bay in the Greater St. Lucia Wetland Park, Tofo Reef near Inhambane in Mozambique, Nosy Be off the northwest coast of Madagascar, and the Tanzanian islands of Mafia, Pemba, and Zanzibar (Cliff *et al,* 2007). Off the KZN coast, whale shark abundance in nearshore waters increases in late October-early November, with most animals moving in a northwards direction, possibly *en route* to the aggregation area around Ponta Tofo in Mozambique, where numbers peak between November and May.

Satellite tagging of whale sharks has revealed that individuals may travel distances of tens of 1,000s of kms (Eckert & Stewart 2001; Rowat & Gore 2007; Brunnschweiler *et al,* 2009). Recently the movements of a whale shark tagged in southern coastal Mozambique were monitored crossing the Mozambique Channel, passing the southern tip of Madagascar and into the Madagascar Basin. Although the fish spend most time in the upper 25 m of the water column while on the continental shelf, once in deep water, the occurrence of dives into mesopelagic and bathypelagic zones increased, with dives to a depth of 1,286 m being recorded. These dives were thought to represent search behaviour for feeding opportunities on deep-water zooplakton (Brunnschweiler *et al,* 2009). While there is a possibility of whale sharks migrating across and along the subsea cable route, the likelihood of an encounter is relatively low.

3.2.6 Coelacanths

Location, History and Distribution

For over four decades the Comores Archipelago was assumed to be the only natural habitat of the living Africa coelacanth *Latimeria chalumnae*, with their distribution restricted to depths of ~120-300 m on relatively sediment-poor, steep volcanic (basalt) dropoffs with caves.

The discovery by SCUBA divers of a group of coelacanths in the relatively shallow waters (90–140 m depth) of a submarine canyon off the Greater St Lucia Wetland Park (GSLWP) World Heritage Site in November 2000 (Venter *et al,* 2000), however, demonstrated that the fish were not confined only to the Comoros Islands. Since then captures have been made in bottom trawl and deep-set gillnets off Kenya (De Vos & Oyugi 2002) and Tanzania (Nyandwi 2006; Benno *et al,* 2006). In Tanzania, 21 confirmed catches were made between September 2003 and July 2005 (with a further 8 reported since), mostly from the outer reefs south of Tanga area in the north of the country (Benno *et al,* 2006). Although the habitats in which these specimens were caught are ill-defined, simple bathymetric surveys have suggested that the bottom profile in the Tanga region consists of a series of 10–15-m-high terraces between 70–140 m depth (Benno *et al,* 2006) whereas in the south, submarine depressions interpreted as canyons have been observed at depths of 400 m (Nyandwi 2010).

In contrast, those fish caught off East London (1938), Mozambique (1991: Bruton *et al,* 1992), Madagascar (1995: Heemstra *et al,* 1996; also 1997, 2001 along with other rumored and newly reported Madagascar catches, some of them from canyons) and Kenya (2001: De Vos & Oyugi 2002) were reported to have been captured over predominantly sandy, low-relief seabed. Assuming that steep dropoffs with caves are the required habitat for the species, these catches were thought to be drifters swept away from the Comores by the strong currents typical of the African East Coast.

Schartl *et al,* (2005) suggested that the scattered groups of African coelacanths probably originate from a single remote population, possibly the Comoros or other, unknown habitats in the Indian Ocean. Recent genetic studies, however, suggest that the coelacanths from Northern Tanzania and Kenya are genetically distinct from the population in southern Tanzania and the Comores (Nikaido *et al,* 2011).

Coelocanth Discoveries from Other Areas

Coelacanth discoveries have also been made in Indonesia, but genetic tissue analyses have revealed that these are a separate species, *Latimeria menadoensis*. The first Indonesian coelacanths were similarly caught by deep-set shark gillnets off a volcanic island famed for its steep coral reef dropoffs into over 2,000 m depth (Erdmann 2006). Subsequent, submersible dives found the fish in caves within steep carbonate rocks (Fricke *et al,* 1991; Fricke & Hissmann 2000; Fricke *et al,* 2000), thus resembling the habitats of their African counterparts.

Habitat Requirements and Characteristics

From the pioneering studies in the Comoros by Hans Fricke and associates using the submersible *Jago*, it was predicted that coelacanths have a narrow habitat-tolerance range, namely :

- They require caves and overhangs in steep dropoffs in which to shelter,
- They are sensitive to temperatures above 21°C,
- Being slow swimmers (~5 cm/s), they avoid strong currents,
- They require water with a high oxygen concentration, and
- They emerge from their cave shelters at night to hunt, typically in deeper water.

Following the coelacanth discovery off the GSLWP, numerous bathymetric and submersible surveys were undertaken between 2002 and 2004 as part of the African Coelacanth Ecosystem Project (ACEP) thus providing opportunities to compare the ecological requirements, lifestyle and activity patterns of coelacanths from different areas, and to investigate genetic similarities and differences between and within populations. Together with the discoveries of coelacanths from other areas, the surveys revealed that coelacanths :

- appear to be more widely distributed than originally thought,
- are more tolerant of variations in temperature, oxygen, light and depth than initially perceived,
- exhibit a broader tolerance range of different structural habitats than concluded from Comoran data, and on the East African coast appear to favour submarine canyons, but
- are not necessarily present where these conditions are met, suggesting that the population size in the GSWLP may be lower than formerly predicted.

The results of the studies conducted as part of the ACEP are summarised below.

Bathymetry and Geolomorphology

Multibeam bathymetric surveys were undertaken off the Maputaland coast, with the objective of defining potential coelacanth habitats within submarine canyons in the area (Ramsay & Miller 2006). A total of 23 submarine canyons, including six mature-phase (large, steep-sided features breaching the continental shelf), 17 youthful-phase (smaller, deepwater features occurring near the continental margin) and numerous incipient (shallow linear depressions on the seafloor) canyons that run approximately perpendicular to the shore, were identified along the northern KwaZulu-Natal coastline. The canyon heads breach the relatively narrow (2-4 km) shelf at depths of 90-120 m, and their thalwegs (bottoms) have depths of several hundred metres. The northern margins of the canyon heads are typically steeper and more stable than the southern margins. Stratified sedimentary rock outcrops occur as cliffs and intermittent sandy terraces at depths of between 40-130 m. Dissolution of the sedimentary rock during geological periods of lower sea level resulted in the formation of caves and overhangs below the steep canyon edge (~100 m depth) and along the canyon walls down to 160 m (Ramay & Miller 2006). In terms of canyon morphology, the terraces located at 110 -130 m below current sea level are thought to be optimal coelacanth habitats. In contrast, canyons occurring in close proximity to active subaqueous dune fields are thought to be suboptimal habitats for coelacanths, as excessive sediment movement is expected to result in slumping along unstable canyon margins, with the erosive effect of sediments likely having a negative impact on coelacanth populations through destruction of their preferred cave habitats.

Despite these canyon habitats in the GSLWP differing considerably from those of the volcanic Comoros, overhangs and caves occur in both areas, providing sheltered habitats for coelacanths to occupy during the day. The caves in the canyon edge and walls vary in size and shape; some larger caves penetrate >6 m horizontally into the slope and may be several metres wide and high, while others are lower and less spacious. Cave entrances are typically as wide as the main compartment, with smaller chambers in the ceiling or walls occurring on occasion. The roofs and walls of the caves are of karstic carbonate rock characterized by a rugged surface with sharp ledges and grooves, while the cave floors are rocky or sandy, and sometimes covered with soft silt (Hissmann *et al,* 2006).

Data from the Comoros, which indicated that coelacanths live in deep cool water, led to an initial expectation that coelacanths in the Maputaland canyons would be numerous, assuming that those found in the shallow canyon heads were representative of a deeper, more extensive population. However, the coelacanths sighted off Sodwana were confined to the narrow belt (90–140 m depth) in the canyons where caves, overhangs or broken boulder areas offering shelter were abundant. Coelacanths occurred singly or in groups of up to seven individuals in the caves, and although they showed site fidelity, they appear to use several different caves within their home range. The sizes of home ranges in the canyons off the GSLWP have not been defined, but individuals are known to move the 4 km distance between the Jesser and Wright canyons in the Sowdana Cayon complex (Hissman *et al,* 2006). In the Comoros, a home range might extend for about eight kilometres. Some of the Sodwana coelacanths are known to be resident within the canyon habitat for at least four years. Aggregations of these fish in caves are not thought to be a seasonal occurrence.

Green *et al,* (2006) used pre-existing bathymetric data sets and geo-referenced charts to identify further potential canyons on the southeast African continental shelf and slope. They concluded that further coelacanth habitats could be expected on the continental shelf off the Port Shepstone–Port St Johns stretch of coastline (the expected southernmost limit to coelacanth distribution) and on the outer shelf area between Olumbe and Porto Amelia, and Pemba, Nacala, Mossuril and Vilanculos in northern Mozambique. These areas are characterised by a high density of submarine canyons, and based on the regional geological setting, good cave development in the canyon heads is expected. Although off Tanzania submarine canyons seem to be less well developed, the sparse data identified canyon features off Mtwara, Lindi and Mchinga. In Madagascar, submarine canyons occur off the west coast at Toliara (where a coelacanth was found) and north of Morondava. Submarine canyons are more prevalent on the Madagascan east coast with examples occurring at Antsiranana and Ankerika, between Ambohitralanana and Masoala and between Fenerive and Ankirihiry (north of Toamasina).

Physical Requirements

The Agulhas Current consitutes a confluence of flows from the Mozambique Channel and southern Madagascar. Satellite imagery suggests that from its position further offshore in the Delagoa Bight, it shifts towards the coast near Ponto do Ouro, becoming fully formed in the vicinity of Sodwana Bay and propagating south-westwards as cyclonic and anti-cyclonic eddies. The narrow shelf area of the Maputaland coast is thus characterised by a stong, dominant, southward current, which commonly reaches 0.5-0.75 m/s. On occasions, however, the Agulhas current can be moved away from the shelf by the formation of cyclonic eddies, which induce shelf-edge upwelling (Roberts *et al,* 2006).

Current velocities off Sodwana, however, decrease rapidly with depth, but also exhibit horizontal velocity gradients along the shelf edge. The vertical velicity structure observed along the slope ranged from 20-80 cm/s in the 100-140 m depth zone at which coelacanths occur (Roberts *et al,* 2006). Within the submarine canyons themselves, submersible and Trimix dives have detected weak or the relative absence of currents beyond 50 m depth and near the seabed. The presence of a layer of silt on ledges along canyon walls, and occurrence of fragile glass sponges on steep cliffs, were also indicative of low current velocities near the seabed (Hissmann *et al,* 2006; Sink *et al,* 2006). These calm seabed conditions would enable the coelacanths, which are sluggish fish, to migrate easily within and between canyons. Current velocities measured in coelacanth habitats in the Comoros (Hissmann *et al,* 2000) ranged from 4.9 cm/s at ~160 m to 3.1 cm/s at 270 m. Under these conditions coelacanths were able to leave their caves at night to slowly swim along the volcanic slopes for distances of up to 10 km, before returning to their caves.

The normal temperature range for coelacanths in the Comoros, South Africa and Indonesia is 15-20°C. The upper threshold limit for coelacanths is thought to be 22–23°C (Fricke *et al,* 1991), although fish have been sighted resting in caves at a temperature above 24°C. The optimum temperature for oxygen uptake in coelacanths is 15°C (Hughes & Itazawa 1972), with higher temperatures resulting in respiratory distress. The Sodwana coelacanths would thus be expected to occur at depths beyond 200 m, but as there appear to be fewer adequate shelters beyond 140 m, their occurrence within caves in the 90-140 m depth range may be due to a necessity to remain quiescent in order to keep metabolic rate and oxygen consumption low

(Roberts *et al,* 2006). South African coelacanths can tolerate a (tidally induced) temperature range of 6°C within a single day. Off the Maputaland coast, the 16 – 20°C isotherms typically lie at between 100-140 m depth, which is ~100 m shallower than in the Comoros (200-300 m). The shallowest depth at which a coelacanth has been recorded was at 54 m, below an overhang in a deep reef complex on the shelf south of Diepgat Canyon (Hissmann *et al,* 2006; Roberts *et al,* 2006) south of Sodwana Bay. This occurrence was, however, coincident with a significant upwelling event, when temperatures at this depth decreased to 17–19°C (Roberts *et al,* 2006).

Surface dissolved oxygen levels off the GSLWP were found to be in the order of 3.6 ml/l. A shallow oxygen minimum (a characteristic found throughout most of the South-West Indian Ocean) occurred at between 100-250 m depth, where levels dropped to 3.2 ml/l. Immediately below this oxygen minimum layer, concentrations increased again to resemble those at the surface before declining with depth to 3.2 ml/l at 1,000 m. The minimum oxygen layer thus correspondes with the depths at which the Sodwana coelacanths occur (Roberts *et al,* 2006; Hissmann *et al,* 2006). Off the Comoros, the shallow oxygen minimum of 2.9 ml/l occurs between 200-320m, which likewise corresponds to depths at which coelacanths occur there.

Potential Food Sources

Coelacanths are nocturnal drift hunters, feeding opportunistically on benthic, epibenthic and mesopelagic fish and cuttlefish found in their deep reef and volcanic slope habitats. No attempts of coelacanths feeding on species considered potential prey have been observed off Sodwana, although the density and diveristy of fish at the canyon edges and within the caves was high (Hissmann *et al,* 2006). Transmitter tracking experiments off Sodwana indicated nocturnal activity between 70 – 130 m which was at or above the depth of the daytime refuges, and the depth at which potential prey species were most abundant. Comoran coelacanths in contrast are most active between 200 m to 300 m depth, which is below their resting depth. Larger coelacanths off the Comoros regularly traverse the 100-500 m depth range with the deepest record at almost 700 m. This is in response to increasing abundance of bentho-pelagic and nocturnally active prey with depth (Fricke & Hissmann 2000).

Submersible and Trimix dives in the Sodwana submarine canyons have identified at least 54 species of fish from 18 taxa (Heemstra *et al,* 2006a; Sink *et al,* 2006). An additional 94 fish species are known from depths of 100-200 m along the KwaZulu-Natal coast (Heemstra *et al,* 2006a). The abundance of planktivorous species (fusiliers and lutjanids) along the canyon margins are indicative of the topographic upwelling that drives primary production in the canyon habitat. Other shoaling and commercially important sparids such as slinger, *Chrysoblephus puniceus*, Englishman, *Chrysoblephus anglicus*, Scotsman, *Polysteganus praeorbitalis*, and blueskin, *P. caeruleopunctatus*, as well as large predatory fish, including serranids, were also reported (Sink *et al,* 2006). These fish are all thought to consitute potential prey for coelacanths. The known coelacanth habitat in South Africa thus supports a greater density of large, transient and resident fish than their habitat in the Comoros, where the distribution of prey species has been cited as a factor limiting the distribution and abundance of the coelacanth (Bruton & Armstrong 1991; Fricke & Plante 1988; Fricke & Hissmann 2000). The biomass of fish in the Sodwana canyon habitat is estimated to be three to four times higher than in similar coelacanth habitat in the Comoros (Heemstra *et al,* 2006b). Comprehensive lists of known and potential prey species off the Comoros and Sodwana are provided in Heemstra *et al,* (2006a; 2006b).

Coelacanth Morphology and Behaviour

Coelacanths are large, lobe-finned fish that grow up to 1.8 m in length, can weigh 95 kg and may live as long as 60 years. Unique anatomical feature of coelacanths include:

- the retention of a notochord, a hollow, fluid-filled tube underlying the spinal cord and extending the length of the body. In most other vertebrates this is replaced by the vertebral column early in embryonic development. The fluid in the notochord is a low viscosity lipid, under slight pressure, and similar to the lipids that fill the sinuses and organs of the fish's body.
- the presence of a rostral organ in the snout that is part of the electrosensory system to help in the location of prey;
- an intracranial joint in the skull that allows the anterior portion of the cranium to swing upwards, greatly enlarging the gape of the mouth;
- vertebrae that are incompletely formed or totally lacking bony centra;
- an oil-filled gas bladder, which together with the lipid-filled body provides buoyancy and enables the animal to undertake considerable vertical movement in the water column;
- a braincase containing only 1.5 percent brain tissue, the remainder being filled with fat; and
- well-developed eyes with reflecting tapita to enhance night vision.

Coelacanths are ovoviparous, giving birth to as many as 26 live pups which develop from eggs in the oviduct, feeding off a large yolk sac until birth (Smith *et al,* 1975). The gestation period estimated at 3 years, which would be the longest known in vertebrates (Froese & Palomares 2000). Although their reproductive behaviour is poorly known, recent data suggest that coelacanths have a monogamous mating system and that individual relatedness is not important for mate choice (Lampert *et al,* 2013).

Coelacanths typically occur singly or in groups, congregating in caves and under overhangs during the day, with as many as 14 fish reported crowded together in a single cave. Although several individuals occupy overlapping home ranges, no aggressive encounters between individiuals have been observed. A single fish may frequent several caves within its home range, and three individuals were sighted within the same home range over a period of two years. After sunset, the fish leave their caves and drift slowly, 1-3 metres off the bottom, presumably looking for food. During their nightly foraging swims, they have been observed to perform head-stands, with the body in a vertical position, the head near the bottom, holding this position for a few minutes at a time. This behaviour is thought to be used when scanning the bottom for prey with their rostal organs. (http://scienceinafrica.com/old/index.php?q=2002/ february/coela.htm).

METISS Subsea Cable Route in perspective

Within the South African EEZ, the subsea cable route crosses the head of the Thukela Canyon and follows the southern edge of the Goodlad Canyon. The Thukela Canyon is an example of a large submarine canyon restricted to the mid-lower continental slope. Unlike those off the GSLWP, this canyon lacks connection to the upper continental slope and shelf. The canyon head is located at ~600 m depth with the thalweg ending in the Natal Valley at ~2,800 m (Wiles *et al,* 2013). Sporadic high relief basement outcrops occur in the canyon head, with terraces developing along the western canyon wall beyond depths of ~1,500 m. With increasing distance from the continental shelf, and increasing depth, the canyon increases in width and relief. The Thukela Canyon therefore differs significantly in morphology from those in northern KwaZulu-Natal, where coelacanths have been reported. Firstly, the canyon head lacks the amphitheatre-shaped head morphology. Secondly, it is located at far greater depth to the Sodwana canyons, and finally, it shows no significant tributary branches (Wiles *et al,* 2013). Although terraces are present and may provide shelter in the form of caves and overhangs, they occur at depths (>1,500 m) well beyond those at which coelacanths have been recorded to date.

Information on the Goodlad (29°25' S) Canyon is sparse. It is reported to start as a small 20 m deep valley (Martin & Flemming 1988) deepening to 250 m while becoming a 50 km wide, shallow valley at a depth of 1,400 m. It emerges from the Thukela Cone at 2,320 m (Goodlad 1986). The gradient of the canyon walls are less steep than those of the Thukela Canyon and limited tributaries occur (Young 2009).

Other than the study by Roberts *et al,* (2006) on the Maputaland Coast, there are currently no data available on temperature or dissolved oxygen on, or beyond the shelf edge. Extrapolating these temperature and dissolved oxygen data to the Thukela Canyon region suggests that temperatures in the canyon heads at depths of 600 m the are likely to be <10°C, with dissolved oxygen concentrations of <3.4 ml/l. Although the oxygen concentrations would be suitable for coelacanths, the declining water temperatures beyond 600 m depths are well below the known tolerance for coelacanths (15°C). Together with the fact that these canyons lack connectivity to the shelf, and suitable food sources are likely to be limited at those depths, this suggests that the Thukela and Goodlad Canyons are unlikely to offer suitable habitat for coelacanths.

Conclusions and Data Gaps

As they are considered to be rare fish, coelacanths are in Appendix I (Endangered Species) of CITES, which prohibits international trade in specimens. In the IUCN Red listing and List of Marine TOPS as part of the NEMBA, they are listed as 'critically endangered'. Coelacanths are given additional protection in South Africa, Comoros and Indonesia by specific legislation. A coelacanth MPA is currently also being developed in Tanzania. In South Africa, coelacanths are given additional protection by specific legislation, which protect all coelacanths in South African waters, and tightens the control of diving in coelacanth habitats in the St Lucia and Maputaland Marine Protected Areas (MPAs) (DEAT *et al,* 2004).

Despite the substantial contributions by Fricke and his team of research in the Comoros and Indonesia and the research focus on coelacanths off the KwaZulu Natal Coast over the past decade, several of the fundamental questions related to evolutionary life history, ecology, physiology, behavioural adaptations, demographics and interactions with both the physical and biological environments in which coelacanths live remain either unanswered or only partially answered. In particular, questions regarding population structure, site fidelity, migration patterns and feeding are awaiting comprehensive answers from further detailed studies. A sound understanding of the relationship between coelacanths and their physical, chemical and biological environment is a prerequisite to an informed management and conservation strategy for this species (Ribbink & Roberts 2006).

3.2.7 Turtles

Five species of sea turtles occur along the East Coast of South Africa; the green turtle (Chelonia mydas), olive ridley (Lepidochelys olivacea), leatherback (Dermochelys coriacea) (Figure 21, left), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*)(Figure 21, right). Green turtles are non-breeding residents often found feeding on inshore reefs. They nest mainly along the coast of Mozambique and on both Europa and Tromelin Islands (Lauret-Stepler et al, 2007). Hawksbills also occur on inshore reefs but nest along the coastlines of Madagascar and the Seychelles (Mortimer 1984). Olive ridleys are infrequent visitors to South African waters and nest throughout the central and northern regions of Mozambique (Pereira et al, 2008). Leatherback turtles inhabit the deeper waters of the Atlantic Ocean and are considered a pelagic species. They travel the ocean currents in search of their prey (primarily jellyfish) and may dive to over 600 m and remain submerged for up to 54 minutes (Hays et al, 2004; Lambardi et al, 2008). They come into coastal bays and estuaries to mate, and lay their eggs on the adjacent beaches. Loggerheads tend to keep more inshore, hunting around reefs, bays and rocky estuaries along the African East Coast, where they feed on a variety of benthic fauna including crabs, shrimp, sponges, and fish. The Thukela Bank serves as an important feeding area for this globally vulnerable turtle species. In the open sea their diet includes jellyfish, flying fish, and squid (www.oceansafrica.com/turtles.htm).

Figure 21: Leatherback (left) and loggerhead turtles (right) occur along the East Coast of South Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

Loggerheads and leatherbacks nest along the sandy beaches of the northeast coast of KwaZulu-Natal, South Africa, as well as southern Mozambique during summer months. These loggerhead and leatherback nesting populations are the southern-most in the world (Nel *et al,* 2013). Even though these populations are smaller (in nesting numbers) than most other populations, they are genetically unique (Dutton *et al,* 1999; Shamblin *et al,* Submitted) and thus globally important populations in terms of conservation of these species.

Loggerhead and leatherback females come ashore to nest from mid-October to mid-January each year. They crawl up the beach and deposit an average of ~100 (loggerheads) or ~80 (leatherback) eggs in a nest excavated with their hind flippers. The eggs incubate for two months and hatchlings emerge from their nests from mid-January to mid-March.

The mean hatching success for loggerheads (73 percent) and leatherbacks (76 percent) on the South African nesting beaches (de Wet 2013) is higher than reported at other nesting sites globally. Nevertheless, eggs and emerging hatchlings are nutritious prey items for numerous shoreline predators, resulting in the mean emergence success and hatchling success being slightly lower than the hatching success. However, emergence and hatchling success for both species is similarly higher in South Africa than reported at other nesting beaches as mortality is largely limited to natural sources due to strong conservation presence on the nesting beach, which has reduced incidents of egg poaching and female harvesting to a minimum (Nel 2010). The production of both loggerhead and leatherback hatchlings is thus remarkably high in South Africa, making the nesting beaches in northern KZN some of the most productive (relative to nesting numbers) in the world.

Those hatchlings that successfully escape predation on their route to the sea, enter the surf and are carried ~10 km offshore by coastal rip currents to the Agulhas Current (Hughes 1974b). As hatchlings are not powerful swimmers they drift southwards in the current. Hatchlings and juveniles may therefore be encountered along the inshore sections of the subsea cable route, but abundances are expected to be low. During their first year at sea, the post-hatchlings feed on planktonic prey items (Hughes 1974a), with their activities largely remaining unknown (Hughes 1974a). After ~10 years, juvenile loggerheads return to coastal areas to feed on crustaceans, fish and molluscs and subsequently remain in these neritic habitats (Hughes 1974b). In contrast, leatherbacks remain in pelagic waters until they become sexually mature and return to coastal regions to breed. Loggerheads reach sexual maturity at about 36 years of age whereas leatherbacks reach maturity sooner, at approximately 15 years (Tucek *et al,* Submitted). It has been estimated that only 1 to 5 hatchlings survive to adulthood (Hughes 1974b; de Wet 2013).

Sea turtles are highly migratory and travel extensively throughout their entire life cycle. Adult turtles migrate thousands of kilometres between foraging and breeding grounds, returning to their natal beaches (Hughes 1996; Papi *et al,* 2000; Schroeder *et al,* 2003) by using geomagnetic (Lohmann *et al,* 2007) and olfactory cues (Grassman *et al,* 1984), hearing (Wyneken & Witherington 2001) as well as vision (Witherington 1992) to find their way back to the beach. The Maputaland loggerheads appear to use the higher sulphide concentrations along that particular stretch of coast as a chemical cue for nesting (Brazier 2012). Post-nesting females and hatchlings use natural ambient light to orientate towards the ocean (Bartol & Musick 2002). Artificial light, however, acts as deterrents for nesting females (Witherington 1992; Salmon 2003; Brazier 2012) and brightly lit beaches thus have reduced female emergences. In contrast, hatchlings are attracted to light even if the source is inland and may consequently suffer higher mortality rates due to desiccation and increased predation (Witherington & Bjorndal 1991; Salmon 2003).

Satellite tracking of female loggerhead and leatherback turtles during inter-nesting periods revealed that loggerheads remained close to the shore (within the boundaries of the iSimangaliso Wetland Park) between nesting events (Figure 22), whereas leatherbacks travelled greater distances (more than 300 km) and beyond the borders of the MPA. Consequently, a southward extension of the MPA was proposed in order to include a greater portion of the core range of inter-nesting leatherbacks and provide better protection.

The southward and offshore extention of the iSimangaliso Wetland Park MPA was one of the network of MPAs approved by Cabinet on 24 October 2018. The inshore sections of the subsea cable route lie well south of the inter-nesting migrations for leatherbacks.

Female turtles do not nest every year due to the high energetic costs of reproduction (Wallace & Jones 2008). During this remigration interval they travel thousands of kilometres (particularly leatherbacks) with ocean currents in search of foraging grounds (Luschi *et al,* 2003a; Luschi *et al,* 2003b). Turtles marked with titanium flipper tags have revealed that South African loggerheads and leatherbacks have a remigration interval of 2 – 3 years, migrating to foraging grounds throughout the South Western Indian Ocean (SWIO) as well as in the eastern Atlantic Ocean. They follow different post-nesting migration routes (Hughes *et al,* 1998; Luschi *et al,* 2006), with loggerheads preferring to stay inshore whilst travelling northwards to foraging grounds along the southern Mozambican coastline or crossing the Mozambique Channel to forage in the waters off Madagascar (Figure 23). In contrast, leatherbacks move south with the Agulhas Current to deeper water in high-sea regions to forage (Hughes *et al,* 1998; Luschi *et al,* 2003b; Luschi *et al,* 2006), with some individuals following the Benguela Current along the west coast of South Africa, as far north as central Angola (Figure 24, de Wet (2013)). Both species are thus likely to be encountered along the subsea cable route.

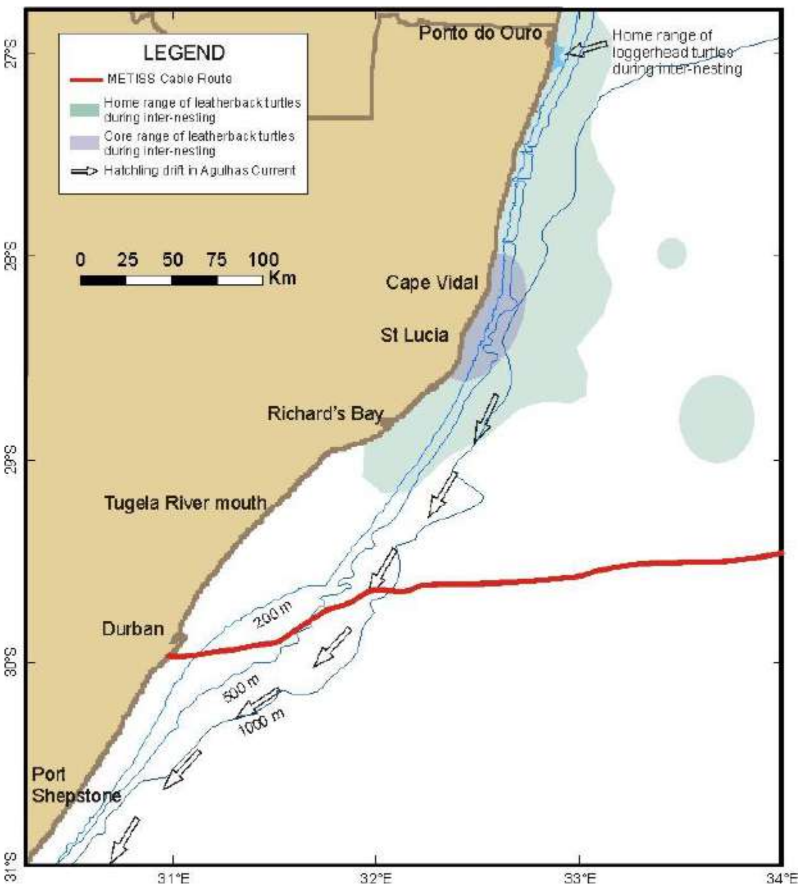


Figure 22: The home and core ranges of loggerheads and leatherbacks during inter-nesting relative to the subsea cable route (red line) (Oceans and Coast, unpublished data).

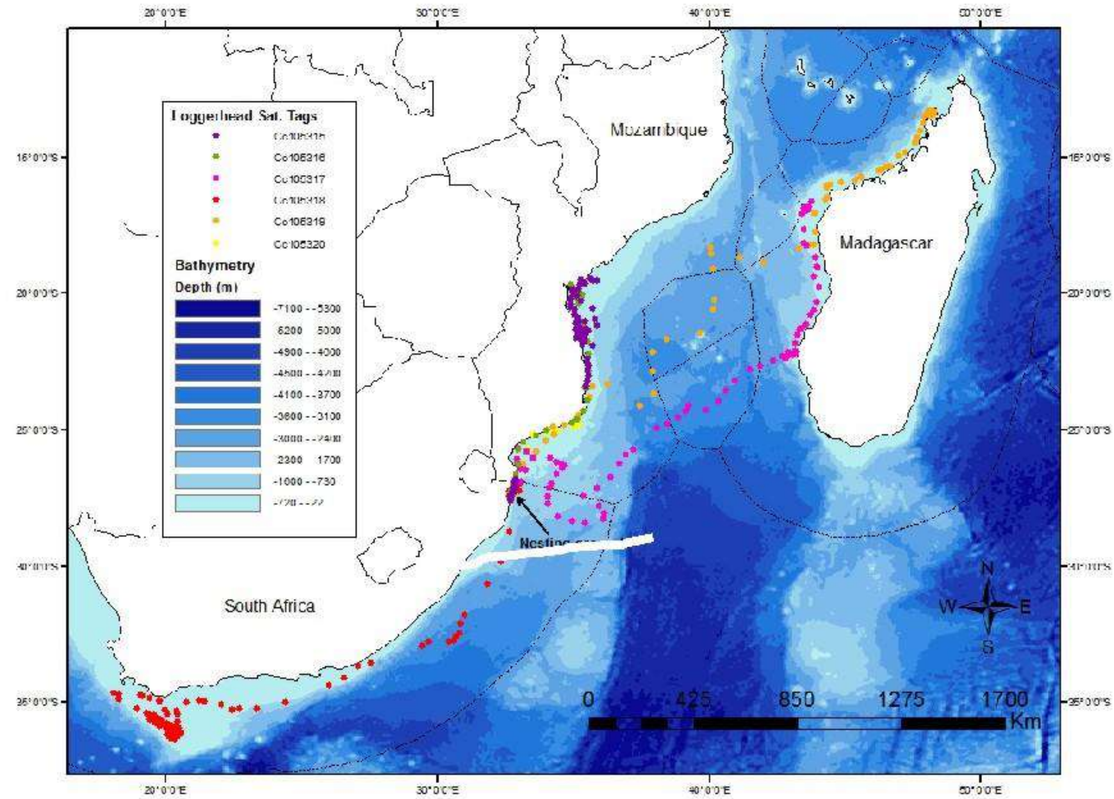


Figure 23: Spatial distribution of satellite tagged loggerhead females (2011/2012; Oceans and Coast, unpublished data) in relation to the subsea cable route (white line).

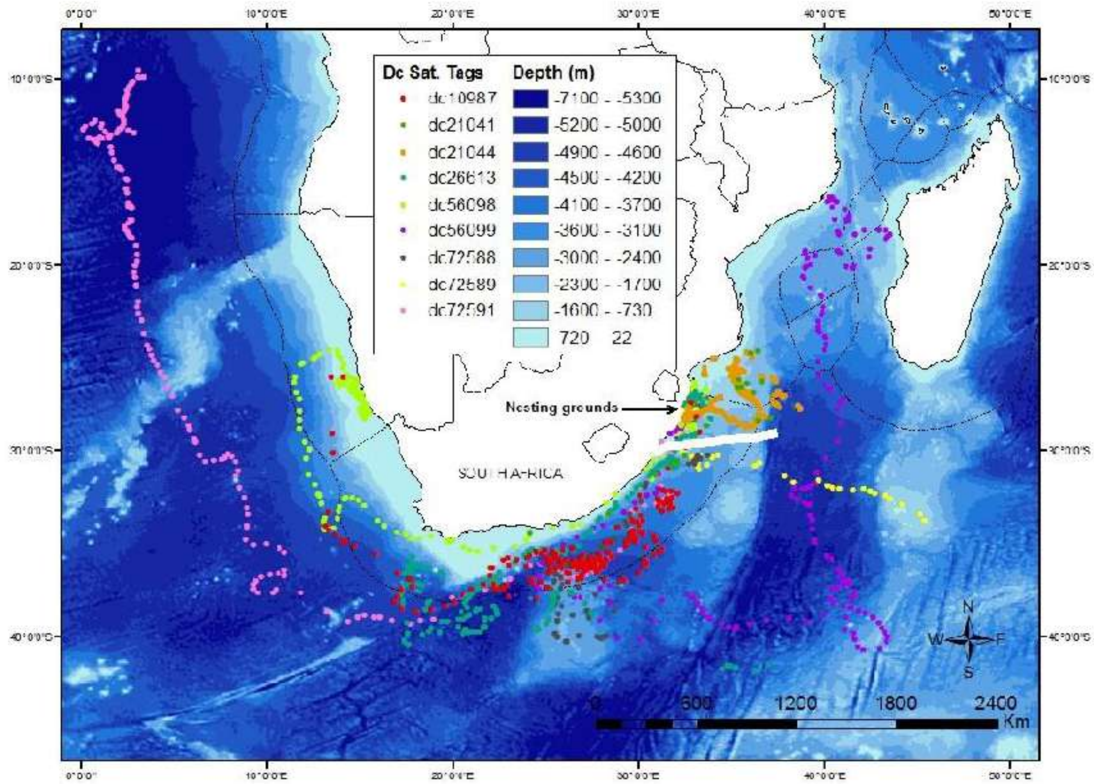


Figure 24: The post-nesting distribution of nine satellite tagged leatherback females (1996 – 2006; Oceans and Coast, unpublished data) in relation to the subsea cable route (white line).

The South African nesting populations of loggerhead and leatherback sea turtles have been actively protected since 1963 when an annual monitoring and conservation programme was established (Hughes 1996). During the more than 50 years of sea turtle conservation the loggerhead nesting population has increased exponentially from ~ 80 to approximately 700 individuals. The leatherback nesting population showed an initial increase from ~20 to approximately 80 individuals and has remained relatively stable over the last few decades. This conservation programme is considered a global success story and has inspired the inception and persistence of numerous other programmes (Hughes 2012). Nonetheless, the extensive migrations undertaken by these species not only exposes them to threats such as becoming incidental bycatch in commercial and artisanal fisheries but makes protecting them from such potential threats very difficult.

In the IUCN Red listing, the hawksbill turtle is described as 'Critically Endangered', the green turtle is 'Endangered' and Leatherback, Loggerhead and Olive Ridley are 'Vulnerable' on a global scale. The most recent conservation status, which assessed the species on a sub-regional scale, is provided in Table 5.

Table 5: Global and Regional Conservation Status of the turtles occurring off the South African coastline showing variation depending on the listing used.

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

NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered

DD – Data Deficient UR – Under Review * - not yet assessed

Leatherback Turtles are thus in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). As a signatory of CMS, South Africa has endorsed and signed two sister agreements specific to the conservation and management of sea turtles (these are the Africa-Atlantic and Indian Ocean South East Asia Memoranda of Understanding). South Africa, as a nation, is therefore committed to the protection of all species of sea turtles occupying its national waters, whether they are non-resident nesters (loggerhead and leatherback turtles) or resident foragers (hawksbill and green turtles; Oceans and Coast, unpublished data). In addition to sea turtle habitat and physical protection in the St. Lucia and Maputaland Marine Reserves, turtles in South Africa are protected under the Marine Living Resources Act (1998).

3.2.8 Seabirds

Twenty-nine seabird species occur commonly along the KwaZulu-Natal coast (Table 6). As the East Coast provides few suitable breeding sites for coastal and seabirds, only three species (Grey-headed gull, Caspian tern and Swift tern) (Figure 25) breed regularly along the coast (CSIR 1998). Many of the river mouths and estuaries along the East Coast, however, serve as important roosting and foraging sites for coastal and seabirds birds, especially those at St Lucia and Richards Bay (Underhill & Cooper 1982; Turpie 1995).

Figure 25: Typical plunge-diving seabirds on the East Coast are the Swift Tern (left) and the Cape Gannet (right) (Photos: www.johanngrobbelaar.co.za; www.oceanwideimages.com).

In the offshore environment along the subsea cable route, the birds most likely to be encountered are the pelagic migrant species such as albatross, petrels and shearwaters. Encounter rates are likely to be higher during winter months and during the inshore sardine 'run', when many of the pelagic species come inshore to follow the shoals northwards up the coast (O'Donoghue *et al*, 2010a, 2010b, 2010c). Coastal species may be encountered along the inshore sections of the subsea cable route.

Table 6: Resident and fairly-common to common visiting seabirds present along the KwaZulu-Natal coast (from CSIR 1998).

Species name	Common name	Status
Diomedea exulans	Wandering albatross	Non-breeding winter visitor. Most abundant off continental shelf
Diomedea cauta	Shy albatross	Non-breeding winter visitor
Diomedea melanophris	Blackbrowed albatros	Non-breeding winter visitor
Diomedea chlororhynchos	Yellownosed albatross	Non-breeding winter visitor
Macronectes giganteus	Southern giant petrel	Non-breeding winter visitor
Macronectes halli	Northern giant petrel	Non-breeding winter visitor
Daption capense	Pintado petrel	Non-breeding visitor, mainly in winter
Pterodroma macroptera	Greatwinged petrel	Non-breeding winter visitor
Pterodroma mollis	Softplumaged petrel	Non-breeding visitor, mainly in winter
Pachyptila vittata	Broadbilled prion	Non-breeding visitor, mainly in winter
Procellaria aequinoctialis	Whitechinned petrel	Non-breeding visitor, mainly in winter

Species name	Common name	Status
Calonectris diomedea	Cory's shearwater	Summer visitor
Puffinus gravis	Great shearwater	Summer vagrant
Puffinus griseus	Sooty shearwater	Non-breeding visitor, mainly in winter
Hydrobates pelagicus	European storm petrel	Non-breeding visitor, mainly in summer
Oceanodroma leucorhoa	Leach's storm petrel	Summer vagrant (NEMBA: Critically Endangered)
Oceanites oceanicus	Wilson's storm petrel	Non-breeding visitor, common year round
Morus capensis	Cape gannet	Common, follows 'sardine run'
Stercorarius parasiticus	Arctic skua	Summer visitor from Palaearctic
Catharacta skua	Antarctic skua	Present all year, more abundant in winter
Larus dominicanus	Kelp gull	Year-round visitor from South & West Coast
Larus cirrocephalus	Greyheaded gull	Coastal breeding resident
Hydroprogne caspia	Caspian tern	Coastal breeding resident
Sterna bergii	Swift tern	Coastal breeding resident
Sterna paradisaea	Arctic tern	Summer visitor from Palaearctic
Sterna sandvicensis	Sandwich tern	Summer visitor from Palaearctic
Sterna bengalensis	Lesser crested tern	Visitor to the coast, mainly in summer
Sterna albifrons	Little tern	Palaearctic migrant, common in summer
Sterna hirundo	Common tern	Summer visitor from Palaearctic

3.2.9 Marine Mammals

The marine mammal fauna of the East Coast comprise between 28 and 38 species of cetaceans (whales and dolphins) known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (Table 7) (Findlay 1989; Findlay *et al*, 1992; Ross 1984; Peddemors 1999; Best 2007), with seals occurring only occasionally in the form of vagrant Cape fur seals (*Arctocephalus pusillus pusillus*) (CSIR 1998). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) based on historic whaling records, and information on smaller cetaceans being particularly poor. Table 7 lists the cetaceans likely to be found along the subsea cable route within South African waters. Of the 36 species listed, the Blue Whale is 'critically endangered', the Indian Ocean humpback dolphin, fin whale and sei whale are considered 'endangered' and the Ifafi-Kosi Bay sub-population of the Indo-Pacific bottlenose dolphin, Sperm whale and Bryde's whale (inshore population) are considered 'vulnerable' in the South African Red List Assessment (Child *et al*, 2016). Altogether 11 species are listed as 'data deficient' in the SA Red List Assessment underlining how little is known about cetaceans, their distributions and population trends.

Table 7: Cetaceans occurrence off the East Coasts of South Africa, their seasonality and likely encounter frequency with cable-laying operations (adapted from Best 2007). IUCN Conservation Status is based on the SA Red List Assessment (2014) (Child *et al*, 2016). The Global IUCN Conservation Status is also provided.

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.	IUCN Conservation Status	Global IUCN Status
Delphinids							
Common bottlenose dolphin	*Tursiops truncatus*	Yes	Yes	Year round	Monthly	Least Concern	Least Concern
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*-Ifafa-Kosi Bay subpopulation	Yes		Year round	Occasional	Vulnerable	
	Tursiops aduncus-Ifafa-False Bay subpopulation	Yes		Year round	Weekly	Near threatened	
	Tursiops aduncus-Seasonal subpopulation	Yes		Year round	Monthly	Data Deficient	Data Deficient
Common (short-beaked) dolphin	*Delphinus delphis*	Yes	Yes	Year round	Monthly	Least Concern	Least Concern
Common (long-beaked) dolphin	*Delphinus capensis*	Yes		Year round	Monthly	Least Concern	Data Deficient
Fraser's dolphin	*Lagenodelphis hosei*		Yes	Year round	Occasional	Least Concern	Least Concern
Pan tropical Spotted dolphin	*Stenella attenuata*	Yes	Yes	Year round	Occasional	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*		Yes	Year round	Occasional	Least Concern	Least Concern
Spinner dolphin	*Stenella longirostris*	Yes		Year round	Occasional	Data Deficient	Least Concern
Indian Ocean humpback dolphin	*Sousa chinensis*	Yes		Year round	Monthly	Endangered	Vulnerable
Long-finned pilot whale	*Globicephala melas*		Yes	Year round	<Weekly	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*		Yes	Year round	<Weekly	Least Concern	Least Concern
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Occasional	Least Concern	Data Deficient
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Monthly	Least Concern	Near threatened
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	Year round	Occasional	Least Concern	Least Concern
Pygmy killer whale	*Feresa attenuata*		Yes	Year round	Occasional	Least Concern	Least Concern

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.	IUCN Conservation Status	Global IUCN Status
Sperm whales							
Pygmy sperm whale	*Kogia breviceps*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Dwarf sperm whale	*Kogia sima*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*		Yes	Year round	Occasional	Vulnerable	Vulnerable
Beaked whales							
Cuvier's	*Ziphius cavirostris*		Yes	Year round	Occasional	Least Concern	Least Concern
Arnoux's	*Berardius arnouxii*		Yes	Year round	Occasional	Data Deficient	Not assessed
Southern bottlenose	*Hyperoodon planifrons*		Yes	Year round	Occasional	Least Concern	Least Concern
Hector's	*Mesoplodon hectori*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Strap-toothed whale	*Mesoplodon layardii*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Longman's	*Mesoplodon pacificus*		Yes	Year round	Occasional	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Blainville's	*Mesoplodon densirostris*		Yes	Year round	Occasional	Data Deficient	Data Deficient
Baleen whales							
Antarctic minke	*Balaenoptera bonaerensis*	Yes	Yes	AMJJASO	Monthly	Least Concern	Near Threatened
Dwarf minke	*Balaenoptera acutorostrata*	Yes		Year round	Occasional	Least Concern	Least Concern
Fin whale	*Balaenoptera physalus*		Yes	MJJASON	Occasional	Endangered	Vulnerable
Antarctic Blue whale	*Balaenoptera musculus intermedia*		Yes	MJJASON	Occasional	Critically Endangered	Endangered
Sei whale	*Balaenoptera borealis*		Yes	MJJASON	Occasional	Endangered	Endangered
Bryde's (inshore)	*Balaenoptera brydei (subspp)*	Yes		Year round	Occasional	Vulnerable	Data Deficient
Pygmy right	*Caperea marginata*	Yes		Year round	Occasional	Least Concern	Least Concern
Humpback	*Megaptera novaeangliae*	Yes	Yes	AMJJASOND	Daily	Least Concern	Least Concern
Southern right	*Eubalaena australis*	Yes		MJJASOND	Occasional	Least Concern	Least Concern

The distribution of whales and dolphins on the East Coasts can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 – 1,000 m), making this the most species-rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide-ranging across 1,000s of kilometres. The most common species along the subsea cable route (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin (Figure 26, left), Indo-pacific humpback dolphin (Figure 26, right), short-finned pilot whale and humpback whale (Figure 27, left).

Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins). Due to large differences in their size, sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

Figure 26: Toothed whales that occur on the East Coast include the Bottlenose dolphin (left) and the Indian Ocean humpback dolphin (right) (Photos: www.fish-wallpapers.com; www.shutterstock.com).

Mysticete (Baleen) whales

The majority of baleen whales fall into the family Balaenidae. Those occurring in the offshore waters of the East Coast include the blue, fin, sei, minke, dwarf minke, inshore Bryde's, Pygmy Right, Humpback and Southern Right. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. These species show some degree of migration when *en route* between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, eg, minke and blue whales) or bimodal (usually May-July and October-November, eg, fin whales), reflecting a northward and southward migration through the East Coast area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at different distances from the coast, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below.

Southern right whales (*Eubalaena australis*)

The Southern African population of Southern right whales (Figure 27, right) historically extended from Southern Mozambique (Maputo Bay) (Banks *et al,* 2011) to Southern Angola (Baie dos Tigres) and is considered a single population within this range (Roux *et al,* 2015). Winter concentrations have been recorded along the Southern and Eastern Coasts of South Africa as far north as Maputo Bay, with the most significant concentration currently on the South Coast between Cape Town and Port Elizabeth. They typically occur in coastal waters off the South Coast between June and November, although animals may be sighted as early as April and as late as January. They migrate to the southern African sub-region to breed and calve, inhabiting shallow coastal waters in sheltered bays (90 percent were found <2 km from shore; Best 1990; Elwen & Best 2004). While in local waters, southern rights are found in groups of 1-10 individuals, with cow-calf pairs predominating in inshore nursery areas. From July to October, animals aggregate and become involved in surface-active groups, which can persist for several hours.

The most recent abundance estimate for this population (2017), estimated the population at ~6,116 individuals including all age and sex classes, which is thought to be at least 30 percent of the original population size with the population growing at ~6.5 percent per year since monitoring began (Brandaõ *et al,* 2018). Although the population is likely to have continued growing at this rate overall, there have been observations of major changes in the numbers of different classes of right whales seen; notably there has been a significant decrease in the number of adults without calves seen in near-shore waters since 2009 (Roux *et al,* 2015, Vinding *et al,* 2015). A large resurgence in numbers of right whales along the South African coast in 2018 and analysis of calving intervals suggests that these 'missing whales' are largely a result of many animals shifting from a 3 year to 4 year calving intervals (Brandao *et al,* 2018). The reasons for this are not yet clear but may be related to broadscale shifts in prey availability in the Southern Ocean, as there has been a large El Niño during some of this period.

Southern right whales will pass across the subsea cable route in July and August and again on their southward migration in October/November. Disturbance during these times should be avoided, especially due to the recent unexplained decline in numbers.

Figure 27: The humpback whale (left) and the southern right whale (right) migrate along the East Coast during winter (Photos: www.divephotoguide.com; www.aad.gov.au).

Humpback whales (*Megaptera novaeangliae*)

Humpback whales (Figure 27, left) are known to migrate between their Antarctic feeding grounds and their winter breeding grounds in tropical waters. The main winter concentration areas for Humpback whales on the African east coast include Mozambique, Madagascar, Kenya and Tanzania on the east coast. During this migration they use subtropical coastal areas as important migratory corridors (Best 2007). Although they have a cosmopolitan distribution (Best 2007) they exhibit a distinct seasonality in occurrence along the South African east coast. This species can be observed between May and February, with peak sightings in June and November/December (Banks 2013). These peaks correspond to the northward migration, as animals pass along the coast *en-route* to their breeding grounds off Mozambique and Madagascar, and the southward migration when they migrate back to their Southern Ocean feeding grounds. Cow-calf pairs can be seen closer to the coast during the southward migration than groups without calves. Humpback whales utilise the relatively protected bays along the South-East Coast of South Africa to rest during their migration.

Three principal migration routes for Humpbacks in the south-west Indian Ocean have been proposed. On the first route up the East Coast, the northern migration reaches the coast in the vicinity of Knysna continuing as far north as central Mozambique. The second route approaches the coast of Madagascar directly from the south, possibly *via* the Mozambique Ridge. The third, less well established route, is thought to travel up the centre of the Mozambique Channel to Aldabra and the Comore Islands (Findlay *et al,* 1994; Best *et al,* 1998).

The population of humpback whales that migrate along the coast and across the subsea cable route likely belong to breeding stock C, one of two populations that occur off southern Africa (IWC 1998). Their migration stream along the East Coast of South Africa has been shown to begin at, or near, Knysna in the west (23° E) from where they travel inshore of the Agulhas current to the breeding grounds off Mozambique (Best *et al,* 1998; Banks 2013). A study conducted in Plettenberg Bay and Knysna, well to the south of the project area, calculated the width of the migration stream to extend a minimum of 16.5 km offshore of the Robberg peninsula (Banks 2013), with anecdotal reports from sailing and fishing vessels operating in the area reporting humpback whales at least 40 km from the coast.

Humpbacks have a bimodal distribution off the East oast, most reaching southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December and as late as February (Banks 2013). The calving season for Humpbacks extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al,* 2010). Off Cape Vidal whale abundances peak around June/July on their northward migration, although some have been observed still moving north as late as October. Southward moving animals on their return migration were first seen in July, peaking in August and continuing to late October (Findlay & Best 1996a, 1996b). More recent analysis of occurrence data from Plettenberg Bay/Knysna indicate a shift in temporal occurrence by 2 months in the last 100 years; with the northward migration starting later (end of May) and the southbound migration extending into late February (Banks 2013).

The most current estimated population size for the C1 population is 7,035 (CI 5,742 – 8,824) individuals, thought to indicate a post-whaling recovery to approximately 80 percent of pre-exploitation levels (IWC 2010). This estimate is, however, given with caution and may be an overestimate of the level of recovery (Banks 2013) and new information on the linkage between various sub-populations suggests this may need revision. The highest concentrations of humpback whales along the nearshore sections of the subsea cable route can be expected in June - July and October - December.

Sei whales (*Balaenoptera borealis*)

Sei whales migrate through South African waters, where they were historically hunted in relatively high numbers, to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers on the east coast highest in June (on the northward migration), and with a second larger peak in September. All whales were caught in waters deeper than 200 m with most deeper than 1,000 m (Best & Lockyer 2002). This species is thus likely to occur off the shelf edge along the subsea cable route. Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

Fin whales (*Balaenoptera physalus*)

Fin whales were historically caught off the East Coast of South Africa, with a unimodal winter (June-July) peak in catches off Durban. However, as northward moving whales were still observed as late as August/September, it is thought that the return migration may occur further offshore. Some juvenile animals may feed year-round in deeper waters off the shelf (Best 2007). There are no recent data on abundance or distribution of fin whales off Southern Africa.

Blue whales (*Balaenoptera musculus*)

Blue whales were historically caught in high numbers off Durban, showing a single peak in catches in June/July. Sightings of the species in the area between 1968-1975 were rare and concentrated in March to May (Branch *et al,* 2007) and only from far offshore (40-60 nautical miles). However, scientific search effort (and thus information) in pelagic waters is very low. The chance of encountering the species along the subsea cable route is considered low.

Minke whales

Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*) and the dwarf minke whale (*B. acutorostrata* subsp.); both species occur off the East coast (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than ~50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year-round. Off Durban, Antarctic minke whales were reported to increase in numbers in April and May, remaining at high levels through June to August and peaking in September (Best 2007).

The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S.

Dwarf minke whales have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean in summer months. Dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa, particularly on the East Coast during the 'sardine run' (O'Donoghue *et al,* 2010a, 2010b, 2010c). Historic whaling records indicate that off Durban they were taken mainly between April and June. Both species are generally solitary and densities along the subsea cable route are likely to be low.

Minke whales are present year-round, with a large portion of this population consisting of small, sexually immature animals that primarily occur beyond 30 nautical miles from the coast during summer and autumn.

Pygmy right whales

The smallest of the baleen whales, the pygmy right whale, occurs along the southern African East Coast to as far north as 30°S. There are no data on the abundance or conservation status of this species, but it was not subjected to commercial whaling, so the population is expected to be near to original numbers. Sightings of this species at sea are rare (Best 2007) due in part to their small size and inconspicuous blows. Density along the subsea cable route is likely to be low.

Bryde's whales (*Balaenoptera brydei* spp.)

Two types of Bryde's whales are recorded from South African waters - a smaller neritic form which recent research indicates is a subspecies of the larger pelagic form described as *Balaenoptera brydei* (Olsen 1913; Penry 2010). The migration patterns of Bryde's whales differ from those of all other baleen whales in the region as they are not linked to seasonal feeding or breeding patterns (Best 1977). The inshore population is unique in that it is resident year-round on the Agulhas Bank, with a few individuals undertaking occasional seasonal excursions up the East Coast in winter during the annual sardine migration. Sightings over the last two decades suggest that the distribution of this population off the South African South Coast has shifted eastwards, most likely in response to a shift in their prey distribution (Best 2001, 2007; Penry *et al,* 2011). This is a small population (~600 individuals), which is possibly decreasing in size; an abundance estimate of 150 – 250 individuals was calculated for Bryde's whales using the Plettenberg Bay/Knysna area in 2005-2008 (Best *et al,* 1984; Penry 2010). The recent South African National Red Data list assessment has also reclassified this population as 'Vulnerable' (Penry *et al,* 2016). Its current distribution implies that it is highly likely to be encountered along the subsea cable route throughout the year, with peak encounter rates in late summer and autumn (Mar – May) (Penry *et al,* 2011; Melly *et al,* in press).

The offshore population of Bryde's whale occurs predominantly on the West Coast, beyond the continental shelf (>200 m depth), and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best 2001). Its seasonality within South African waters is thus contrary to most of the balaenopterids, with abundance on the West Coast highest in January-February. This population of Bryde's whales is unlikely to be encountered along the subsea cable route.

Odontocetes (toothed) whales

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales.

Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Those in the region can range in size from 1.9 m long (Spinner dolphin) to 17 m (bull sperm whale).

Sperm whales (*Physeter macrocephalus*)

All information about sperm whales in the southern African subregion results from data collected during commercial whaling activities prior to 1985 (Best 2007). Sperm whales are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters usually >1,000 m, but occasionally come inshore on the shelf into depths of 500-200 m (Best 2007). Seasonality of catches off the East Coast suggest that medium- and large-sized males are more abundant during winter (June to August), while female groups are more abundant in summer (December - February), although animals occur year round (Best 2007). Although considered relatively abundant worldwide (Whitehead 2002), no current data are available on density or abundance of sperm whales in African waters. They are likely to be the most frequently encountered large cetacean off the shelf edge along the subsea cable route. Sperm whales feed at great depth, during dives in excess of 30 minutes, making them difficult to detect visually. The regular echolocation clicks made by the species when diving, however, make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).

There are almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of eastern South Africa. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1,000 - 2,000 m depth (see various species accounts in Best 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.


Figure 28: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org).

Humpback dolphins (*Sousa chinensis*)

Humpback dolphins (Figure 26, right) occur along the South African South and East Coasts, from Danger Point in the Western Cape to Mozambique, Tanzania, Kenya, the Comoros Islands and the western coast of Madagascar.

Due to the recent recognition of the Western Indian Ocean population as a separate species, their conservation status is internationally regarded as 'vulnerable' and within South Africa as 'endangered', and the species is accepted to be South Africa's most endangered marine mammal. Overall, it is expected that the distribution of the species in the Indian Ocean is not continuous, but rather consists of many subpopulations that should be regarded as separate management units (Durham 1994; Karczmarski 1996; Keith 1999; Karczmarski *et al,* 2000).

Humpback dolphins are coastal animals, preferring water depths less than 20 m and are usually observed within 500 m from shore, predominantly within 10 km of river mouths (Melly 2011; Koper *et al,* 2016). This is similar to findings from the early 1990s, where 87 percent of sightings were observed within 400 m of land, and almost all the sightings were in waters less than 15 m deep (Karczmarski 1996; Karczmarski *et al,* 2000). Localised populations on the South Coast are concentrated around shallow reefs, whereas those off Richard's Bay appear to prefer large estuarine systems. It appears that the species is more closely associated with estuaries and rivers than other inshore cetaceans. The species is caught accidentally in the shark nets, with 3 animals being killed on average annually, most of which are caught in Richard's Bay (S. Plön, pers com.).

Seasonal movements and migrations are not characteristic of the species, but sightings rate and group size appear to increase between January and April, and again in September. The population off KZN is estimated at 160 individuals, with that for South Africa numbering no more than 1,000. Recent studies on the South Coast have indicated a decrease in sightings by approximately 50 percent and a reduction in mean group sizes from 7 to 4 individuals in the last decade (Greenwood 2013; Koper *et al,* 2016). Several hypotheses have been suggested as likely reasons for the decline: a decrease in prey availability, prolonged disturbance from whale and dolphin watching tourism and other marine recreation, coastal development and sustained pollution that contaminates the prey on which this species depends.

Due to their limited spatial distribution (restricted to shallow, coastal areas) this species is likely to occur only along the nearshore sections of the subsea cable route.

Indo-Pacific Bottlenose dolphins (*Tursiops aduncus*)

The Indo-Pacific bottlenose dolphin (Figure 26, left) occurs throughout coastal and shallow offshore waters of the temperate and tropical regions of the Indian Ocean and South-West Pacific. The species inhabits waters less than 50 m deep between the Mozambique border in the east and False Bay in west (Ross 1984; Ross *et al,* 1987). It is found year-round in the coastal habitat in the inshore sections of the proposed subsea cable route, with peak sightings being recorded in April/May (autumn) and October/November (spring) in Algoa Bay (Melly *et al,* in press).

Although their distribution is essentially continuous from Cape Agulhas eastwards to southern Mozambique, the Indo-Pacific bottlenose dolphin seems to have 'preferred areas' along the KZN coast (Ross *et al,* 1987; Ross *et al,* 1989; Cockcroft *et al,* 1990, 1991). Areas in which it is more frequently encountered are about 30 km apart, and are thought to correspond to discrete home ranges. Genetic assessments have identified a resident population North of Ifafa (KZN coast, listed as 'vulnerable'), a resident population south of Ifafa (listed as 'near threatened'), as well as a migratory population South of Ifafa ('data deficient'), which appears to undertake seasonal migrations into KZN waters in association with the 'sardine run' (Natoli *et al,* 2008; Cockcroft *et al,* 2016).

On average, 15 animals die annually as bycatch in the shark nets set along the KZN coast to protect bathers. Little is known about the offshore form of the species, and nothing about their population size or conservation status. They sometimes occur in association with other species, such as pilot whales or false killer whales (Best 2007) and are likely to be present year-round in waters deeper than 200 m.

Indo-Pacific bottlenose dolphins are often seen in large groups of 10s to 100s of animals (Saayman *et al,* 1972; Ross 1984; Melly 2011) with calves seen year-round along the South-East Coast (Cockcroft & Peddemors 1990; Best 2007). Due to their shallow habitat preferences, they may be encountered along the nearshore sections of the subsea cable route.

Common dolphins (*Delphinus* spp.)

Two species of common dolphin are currently recognised, the short-beaked common dolphin (*Delphinus delphis*) and the long-beaked common dolphin (*Delphinus capensis*). The long-beaked common dolphin (*D. capensis*) is resident to the temperate Agulhas Bank with sightings extending as far up the West Coast as St Helena Bay and up the East coast to Richards Bay, in waters less than 500 m deep. Individuals of this species are wide ranging within this area and may move hundreds of kilometers in short periods of time. They are not known to show any degree of residency to coastal areas. Group sizes in this species tend to be large: 100s to even 1000s of animals. No population estimate is available for the two species, but they are thought to be large (15,000 – 20,000; Cockcroft & Peddemors 1990; Peddemors 1999).

The short-beaked common dolphin prefers offshore habitats and is likely to be encountered along the deeper sections of the subsea cable route. Estimates of the population size and seasonality for the subregion are lacking. A few studies have suggested that common dolphins inhabit the Eastern Cape coastline during summer, with movements towards the KwaZulu-Natal coastline during winter (Ross 1984; Cockcroft & Peddemors 1990; O'Donoghue *et al,* 2010a, 2010b, 2010c), although sightings off KZN have also been made during summer. These movements are associated with the annual sardine migration up the east coast in winter (Best 2007). Patterns in their spatial and temporal distribution along the coast are unclear, but long-beaked common dolphins may be observed off the East Coast year round, and are likely to be encountered along the subsea cable route.

As with the common bottlenose dolphins, an average of 39 animals die annually through entanglement in the shark nets (Best 2007).

<u>Other species</u>

Killer whales, false killer whales and common bottlenose dolphins are regularly reported by fishermen operating in deeper waters off East Coast of South Africa. These species are therefore likely to occur along the subsea cable route. Rarely encountered dwarf and pygmy sperm whales, pygmy killer whales, Risso's and Frazer's dolphins, striped, spinner and Pan-tropical spotted dolphins, and several beaked whale species have distributions that overlap with the project area (Findlay *et al,* 1992; Best 2007); their occurrence is thought to be rare, but insufficient data is available on the abundance and spatio-temporal distribution of these species to make an accurate assessment of their susceptibility to human disturbance.

The genus *Kogia* currently contains two recognised species, the pygmy (*K. breviceps*) and dwarf (*K. sima*) sperm whales.

Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. The majority of what is known about Kogiid whales in the southern African subregion results from studies of stranded specimens (eg, Ross 1979; Findlay *et al,* 1992; Plön 2004; Elwen *et al,* 2013). *Kogia* species most frequently occur in pelagic and shelf edge waters, and are thus likely to occur along the offshore sections of the subsea cable route at low levels; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters. However, abundance along the subsea cable route is likely to be very low.

Killer whales (Figure 28, right) have a cosmopolitan distribution, being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off the South Africa coast (Best *et al,* 2010) although on the East Coast whaling grounds their abundance was reported to be correlated with that of baleen whales, especially sei whales on their southward migration. Killer whales are found in all water depths from the coast to deep open ocean environments and may thus be encountered along the subsea cable route at low levels.

Although the false killer whale is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species' taxonomy may be needed (Best 2007). The species has a tropical to temperate distribution and most sightings off Southern Africa have occurred in waters deeper than 1,000 m but with a few close to shore as well (Findlay *et al,* 1992). False killer whales usually occur in groups ranging in size from 1-100 animals (mean 20.2) (Best 2007), and are thus likely to be fairly easily seen in most weather conditions. However, the strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the western Cape, between St Helena Bay and Cape Agulhas), which may exaggerate the consequences of any injury or harassment by seismic sounds (eg, during Vertical Seismic Profiling of the well) or associated activities. There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007).

Short-finned pilot whales display a preference for warmer tropical waters than their counterparts, the long-finned pilot whales. Although distinguishing between the two pilot whale species at sea is difficult, those occurring along the subsea cable route are most likely to be the short-finned pilot whales (Best 2007). The species is usually associated with the continental shelf or deep water adjacent to it, and is likely to be among the most commonly encountered odontocete in the project area.

Beaked whales were never targeted commercially and their pelagic distribution makes them largely inaccessible to most researchers, making them the most poorly studied group of cetaceans. They are all considered to be true deep water species, usually being seen in waters in excess of 1,000 - 2,000 m in depth (see various species accounts in Best 2007). With recorded dives of well over an hour to depths in excess of 2 km, beaked whales are amongst the most extreme divers of air breathing animals (Tyack *et al,* 2011). All the beaked whales that may be encountered are pelagic species that tend to occur in small groups of usually less than five individuals, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007).

The long, deep dives of beaked whales make them difficult to detect visually, but PAM will increase the probability of detection as animals are frequently echo-locating when on foraging dives. Beaked whales are particularly vulnerable to certain types of man-made noise, particularly mid-frequency naval sonar. The exact reason why is not yet fully understood, but necropsy of stranded animals has revealed gas embolisms and haemorrhage in the brain, ears and acoustic fat - injuries consistent with decompression sickness (acoustically mediated bubble formation) may also play a role (Fernadez *et al,* 2005).

In summary, the majority of data available on the seasonality and distribution of large whales along the proposed subsea cable route is largely the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (eg, migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although with almost all data being limited to the continental shelf. Whaling data indicates that several other large whale species are also abundant on the East Coast for much of the year: fin whales peak in May-July and October-November and sei whale numbers peak in May-June and again in August-October. Data on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of eastern South Africa is lacking. Beaked whales are all considered to be true pelagic species usually being seen in small groups in waters in excess of 1,000 - 2,000 m depth. Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed[3], killed or fished. No vessel or aircraft may approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft. Whales and dolphins are also listed as 'protected' in the List of Marine Threatened or Protectes Species (TOPS) as part of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA).

3.2.10 Marine Protected Areas

KwaZulu-Natal boasts three existing Marine Protected Areas (MPAs) and four recently approved MPAs, although none occur along the subsea cable route (Figure 30). The MPAs that are locatated between Richards Bay ans Port Shepstone are described below.

The **Aliwal Shoal MPA** is situated on the south coast between Umkomaas and Ocean View. The Aliwal Shoal MPA is 125 km^2 in size, approximately 18 km long and stretches ~4 nautical miles offshore. Further south lies the small Trafalgar Marine Reserve, which stretches for only 6 km along the KwaZulu-Natal south coast adjacent to the Mpenjati Nature Reserve, and extends 500 m offshore.

The **uThukela Banks MPA** is located between the Mlalazi and Seteni estuary. The purpose of this MPA is to protect coastal habitats including sandy beaches, rocky shores and estuaries as well as offshore habitats including the soft sediment and reef systems, submarine canyons, the shelf edge and slope ecosystems (Government Gazette 39646, 2016).

The **Protea Banks MPA** is an offshore Area in the 20m to 3,000m depth range with the southern portion lying adjacent to the existing Trafalgar Marine Protected Area. The purpose of this MPA is to conserve and protect submarine canyons, deep reefs, cold water coral reefs and other habitats of the shelf edge and slope (Government Gazette 39646, 2016).

3 In the Regulations for the management of boat-based whale watching and protection of turtles as part of the Marine Living Resources Act of 1998 the definition of "harassment" is given as "behaviour or conduct that threatens, disturbs or torments cetaceans".

Critical Biodiversity Areas

The objectives of the KwaZulu-Natal Coastal and Marine Biodiversity Plan (previously referred to as the SeaPLAN project) were to 1) provide a systematic framework for assessment of the status of biodiversity protection in KZN, and 2) enable planning for marine biodiversity protection by identifying spatial priorities for ongoing and future marine conservation efforts. Using systematic conservation planning (SCP) principles, and SCP software (C-Plan and Marxan), KZN's Coastal and Marine Biodiversity Plan assessed the state of protection of biodiversity, and identified key areas that required increased protection within existing protected areas, as well as areas outside of these protected areas that are important for future conservation management actions.

The final spatial product of the Plan was a map of Focus Areas for additional marine biodiversity protection (Harris *et al,* 2012). These were made up of Critical Biodiversity Areas (CBAs) that are considered either "irreplaceable" or "optimal" (Figure 29). Irreplaceable CBAs represent areas of significantly high biodiversity value and in some cases the areas are the only localities for which the conservation targets for one or more of the biodiversity features can be achieved ie, there are few, or no, alternative sites available. Optimal CBAs are areas representing the best option, out of a potentially larger selection of options, of a selection of planning units that meet biodiversity targets. The optimal CBAs equate to the "Best solution" output minus the irreplaceable CBAs described above (Harris *et al,* 2012). The key drivers determining the selection of each focus area are provided in Table 8. The subsea cable route does not overlap with any CBAs.

The Focus Areas of the Plan were subsequently used to guide South Africa's National Protected Area Expansion Strategy, which had identified a need to increase the protection in the Natal Bioregion as well as in the offshore areas. The CBAs map was thus used, to help determine exact boundaries and zonation of any new proposed offshore MPAs in KZN.

The KZN Marine Biodiversity Plan is scheduled to be updated every five years with any new information that becomes available. Future analyses aim to produce separate benthic and pelagic biodiversity plans, thereby streamlining conservation efforts and allowing for more specific protection and management for particular habitats, species and processes, with the use of a suite of management tools such as MPAs, temporally closed areas, harvesting quotas, fishing gear restrictions, bycatch management, improved industry standards for particular activities, etc.

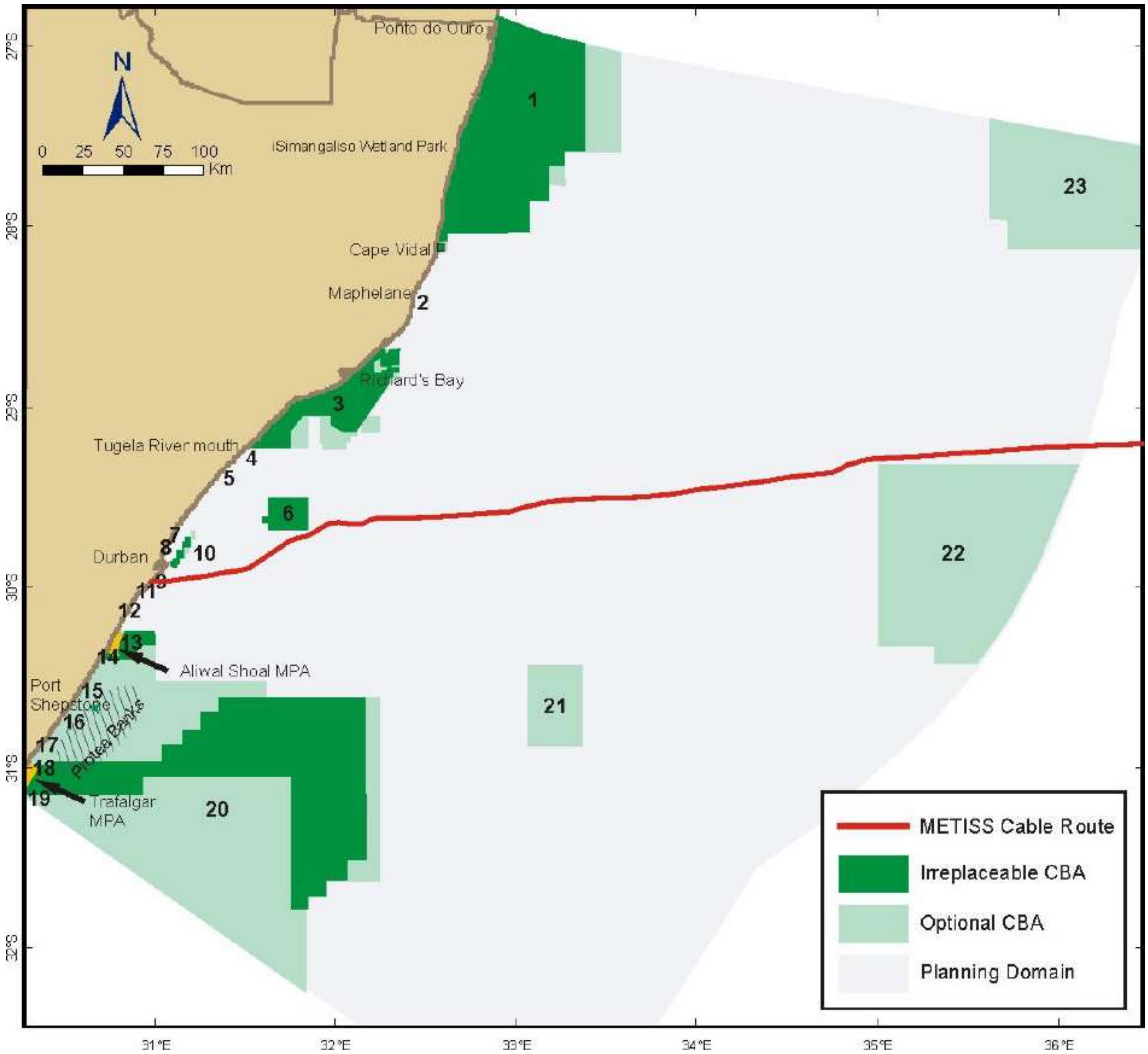


Figure 29: Critical Biodiversity Areas (CBAs) within the Exclusive Economic Zone off the KwaZulu-Natal coast in relation to the subsea cable route. The numbers represent the various biodiversity focus areas provided in Table 10.

Table 8: The key drivers determining the selection of each focus area (Harris *et al*, 2012).

Focus Area Number	Area	Key Drivers
1	iSimangaliso Wetland Park extension	Offshore extension of iSimangaliso, Offshore habitats, processes and fish species
2	Cape St Lucia area	Southern extension of iSimangaliso, Shoreline habitats, high rock ledges, broken rocks and rock boulders; fish species
3	Thukela Banks Area	Shoreline habitats: estuaries, vegetated dune hummocks, intermediate sandy shores; Offshore soft Sediment habitat and reefs, fish, sharks and mammals
4	Zinkwazi Estuary and shoreline area	Shoreline habitats: dissipative sandy shore, rock ledges and scattered rocks
5	Mhlali estuary and shoreline	Mhlali Estuary and mixed shore
6	KZN Bight	Offshore area near continental shelf edge of the KZN Bight consisting of offshore habitats; Chl-a and SST fronts; fish species
7	Beachwood Mangroves	Shoreline habitats: vegetated dune hummocks, rock boulders and the Mgeni estuary
8	Durban	Subtidal fish species
9	Bluff Area	Shoreline habitats: Vegetated Dune hummocks, broken ledges: subtidal fish species, rocky reefs
10	KZN Bight	Subtidal fish species
11	iSipingo	iSipingo estuary and shoreline habitats: mixed shores plus intermediate sandy shore
12	Karridene	Shoreline area south of Karridene between the Msimbazi and Mgababa Rivers mixed shores plus intermediate sandy shore
13	Aliwal Shoal	Shoreline habitats: mixed shores, rock ledges, dissipative and intermediate sandy shores; offshore habitats: rocky reefs; number of fish species
14	Umdoni	Shoreline habitats: high rock ledges, solid rocks and boulder shores
15-19	Hibiscus Coast	Shoreline habitats: high rock ledges, solid rocks and boulder shores and a number of estuaries
20	Offshore areas	Offshore habitat: biozones, offshore processes: SST and Chl-a fronts; fish, shark and mammal species
21-23	Offshore areas	Offshore habitat: biozones, SST fronts and Eddys

Ecologically and Biologically Significant Areas (EBSAs)

Following application of the Conservation on Biological Diversity's (CBD) Ecologically or Biologically Significant marine Areas (EBSA) criteria[4], a number of areas around the South African coast were identified as potentially requiring enhanced conservation and management. These were presented at the CBD regional workshop for the description of marine EBSAs in the Southern Indian Ocean (July/August 2012) (CBD 2013).

Three Ecologically or Biologically Significant Areas (EBSA) have been proposed and inscribed for the East Coast under the Convention of Biological Diversity (CBD) (CBD 2013), namely Protea Banks and the Sardine Route, the Natal Bight and the Delagoa Shelf Edge. Of these the Natal Bight EBSA overlaps with the subsea cable route. In meeting the EBSA criteria various endemic and rare chondrychthian and teleost species were listed for the Natal Bight and Thukela Bank, and IUCN listed species and threatened habitat types identified. The Protea Banks area includes submarine canyons, an area of steep shelf edge and a unique deep-reef system, all of which may support fragile habitat-forming cold-water coral species. This area also includes a major component of the migration path for several species undertaking the 'sardine run'. The Delagoa Shelf Edge, Canyons and Slope is a transboundary EBSA that includes the iSimangaliso Wetland Park, a Ramsar and World Heritage Site in South Africa, and Ponta do Ouro Partial Marine Reserve in Mozambique. This EBSA supports a variety of fish, sharks, turtles, whales and other marine mammals by including their migratory routes, nursery areas, spawning/breeding areas, and foraging areas, and notably provides nesting habitat for Loggerhead and Leatherback turtles. Many of the species in the EBSA are threatened, such as: coelacanths, Seventy-Four seabream, marine mammals, turtles, and sharks. Potential VMEs include numerous submarine canyons, paleo-shorelines, deep reefs, and hard shelf edge, with reef-building cold-water corals also recovered at depths of more than 900 m.

Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat. The pelagic habitat of the Natal Bight is characterized by cool productive water advected onto the shelf in this sheer-zone through Agulhas Current-driven upwelling cells. In the Protea Banks EBSA, the dynamic pelagic environment and the sardine run also contribute to the high diversity in the pelagic ecosystems.

Following new research conducted in the area since the original description of these EBSAs, the boundaries, names, descriptions and criteria ranks have recently been updated. No specific management actions have as yet been formulated for these EBSAs, although the uniqueness of

[4] In 2008, the Conference of the Parties to the Convention on Biological Diversity (COP 9) adopted the following scientific criteria for identifying ecologically or biologically significant marine areas in need of protection in open-ocean waters and deep-sea habitats (further details available at http://www. cbd.int/marine/doc/azores-brochure-en.pdf):

1. Uniqueness or Rarity
2. Special importance for life history stages of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, Fragility, Sensitivity, or Slow recovery
5. Biological Productivity
6. Biological Diversity
7. Naturalness

In 2010, COP 10 noted that the application of the EBSA criteria was a scientific and technical exercise, and that areas found to meet the criteria may require enhanced conservation and management measures, and that this could be achieved through means such as marine protected areas and impact assessments. It was emphasised that the identification of EBSAs and the selection of conservation and management measures was a matter for States and competent intergovernmental rganisations, in accordance with international law , including the UN Convention on the Law of the Sea.

the areas contributed to the development of the recently approved offshore MPAs. The proposed subsea cable route traverses the Thukela Bank EBSA.

Offshore Marine Biodiversity Protection Areas

Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments a systematic biodiversity plan was developed for the South African coast with the objective of identifying both coastal and offshore priority areas for MPA expansion. To this end, numerous offshore focus areas were identified for protection between 30°E and 35°E, and these carried forward through Operation Phakisa for the proposed development of offshore MPAs. This network of 20 MPAs was approved by Cabinet on 24 October 2018, thereby increasing the ocean protection within the South African Exclusive Economic Zone (EEZ) to 5 percent. The existing and recently approved MPAs within the project area are shown in Figure 30 [5]. The subsea cable route does not traverse any MPAs.

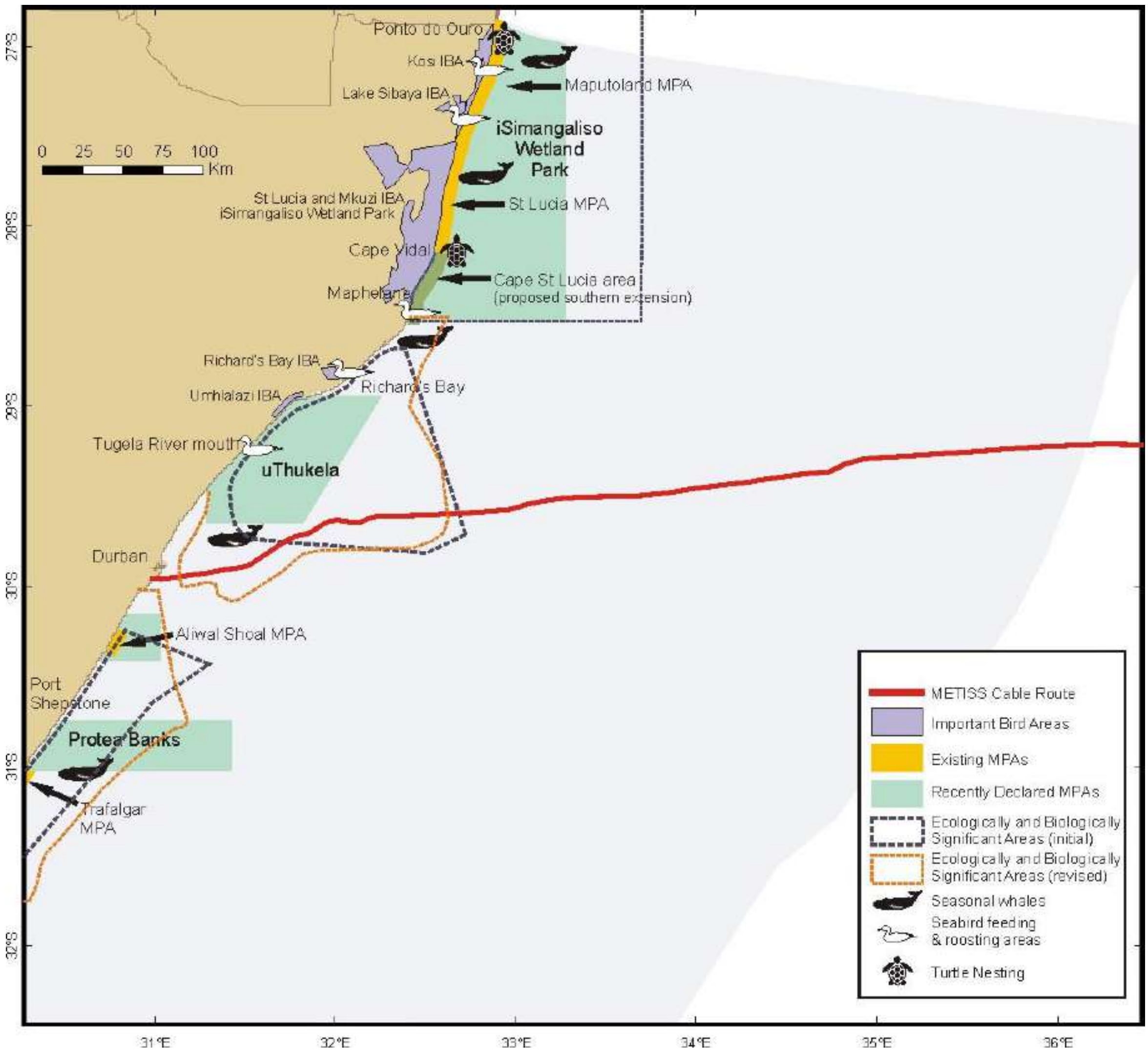


Figure 30: Marine Protected Areas, Important Bird Areas (IBAs), recently approved and existing Marine Protected Area (MPA) within the Exclusive Economic Zone (grey shading) off the KwaZulu-Natal coast in relation to the subsea cable route (red line).

5 The MPA boundaries illustrated are based on those provided on the Operation Phakisa map and may change following finalisation of the Draft Notice declaring the various MPAs released in February 2016.

Hope Spots are defined by Mission Blue of the Sylvia Earle Alliance as special conservation areas that are critical to the health of the ocean. The first six Hope Spots were launched in South Africa in 2014 and include Aliwal Shoal in KZN, Algoa Bay, Plettenberg Bay, Knysna, the Cape Whale Coast (Hermanus area) and False Bay in the Western Cape. Of these, the Aliwal Shoal Hope Spot is located to the south of the subsea cable route.

4. ASSESSMENT OF IMPACTS ON MARINE FAUNA

4.1. Impact Assessment Methodology

An EIA methodology should minimise subjectivity as far as possible and accurately assess the project impacts. In order to achieve this ERM has followed the methodology defined below.

4.1.1 Impact Identification and Characterisation

An 'impact' is any change to a resource or receptor caused by the presence of a project component or by a project-related activity. Impacts can be negative or positive.

Impacts are described in terms of their characteristics, including the impact type and the impact spatial and temporal features (namely extent, duration, scale and frequency). Table 9 describes the terms used in this EIA Report.

Table 9: Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the project (in terms of cause and effect).	**Direct** - Impacts that result from a direct interaction between the project and a resource/receptor (eg between occupation of the seabed and the habitats which are affected). **Indirect** - Impacts that follow on from the direct interactions between the project and its environment as a result of subsequent interactions within the environment (eg viability of a species population resulting from loss of part of a habitat as a result of the project occupying the seabed). **Induced** - Impacts that result from other activities (which are not part of the project) that happen as a consequence of the project. **Cumulative** - Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect.
Duration	The time period over which a resource / receptor is affected.	**Temporary** - period of less than 3 years - negligible/pre-construction/ other. **Short term** - period of less than 5 years ie, production ramp up period. **Long term** - impacts that will continue for the life of the Project, but ceases when the Project stops operating. **Permanent** - a period that exceeds the life of plant – ie, irreversible.

Characteristic	Definition	Terms
Extent	The reach of the impact (ie, physical distance an impact will extend to)	**On-site** - impacts that are limited to the site area only.. **Local** - impacts that are limited to the project site and and adjacent properties. **Regional** - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems. **National** - impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences. **Trans-boundary/International** - impacts that affect internationally important resources such as areas protected by international conventions or impact areas outside of South Africa.
Scale	Quantitative measure of the impact (eg the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.

4.1.2 Determining Impact Magnitude

Once impacts are characterised they are assigned a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource/receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale; and
- Frequency.

Magnitude (from Negligable to Large) is a continuum. Evaluation along the continum requires professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is noted. Magnitude designations for negative effects are: negligible, small, medium and large.

The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the project is expected to result in a positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a negligible magnitude.

4.1.3 Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

High Magnitude Impact affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measureable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A high magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

Moderate Magnitude Impact affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.

Low Magnitude Impact affects a specific area, system, aspect (physical), group of localised individuals within a population (biological) and at sufficient magnitude to result in a small increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) over a short time period (one plant/animal generation or less, but does not affect other trophic levels or the population itself), and localised area.

Negligible Magnitude Impact is one where the area of the impact to the resource/receptor (including people) is immeasurable, undetectable or within the range of normal from natural background variations.

4.1.4 Determining Receptor Sensitivity

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered. Where the receptor is biological or cultural (ie, the marine environment or a coral reef), its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered.

As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of a receptor is rated as Low, Medium or High.

For ecological impacts, sensitivity is assigned as low, medium or high based on the conservation importance of habitats and species. For the sensitivity of individual species, Table 10 presents the criteria for deciding on the value or sensitivity of individual species.

Table 10: Biological and Species Value / Sensitivity Criteria

Value / Sensitivity	Low	Medium	High
Criteria	Not protected or listed as common / abundant; or not critical to other ecosystem functions (eg key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions eg, CITES Listed as rare, threatened or endangered eg, IUCN

Note: The above criteria should be applied with a degree of caution. Seasonal variations and species lifecycle stage should be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods. This table uses listing of species (eg, IUCN) or protection as an indication of the level of threat that this species experiences within the broader ecosystem (global, regional, local). This is used to provide a judgement of the importance of affecting this species in the context of project-level changes.

4.1.5 Assessing Significance

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in Table 11.

Table 11: Impact Significance

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Sensitivity/Vulnerability/Importance of Resource/Receptor</th></tr>
<tr><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><th rowspan="4">Magnitude of Impact</th><th>Negligible</th><td>Negligible</td><td>Negligible</td><td>Negligible</td></tr>
<tr><th>Low</th><td>Negligible</td><td>Minor</td><td>Moderate</td></tr>
<tr><td>Medium</td><td>Minor</td><td>Moderate</td><td>Major</td></tr>
<tr><td>High</td><td>Moderate</td><td>Major</td><td>Major</td></tr>
</table>

The matrix applies universally to all resources/receptors, and all impacts to these resources/receptors, as the resource/receptor-specific considerations are factored into the assignment of magnitude and sensitivity/vulnerability/ importance designations that enter into the matrix. A context for what the various impact significance ratings signify is provided below.

An impact of **NEGLIGIBLE** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
An impact of **MINOR** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
An impact of **MODERATE** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
An impact of **MAJOR** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie, ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the project.

4.1.6 Mitigation Potential and Residual Impacts

A key objective of an EIA is to identify and define socially, environmentally and technically acceptable and cost effective measures to manage and mitigate potential impacts. Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Table 12

The priority is to first apply mitigation measures to the source of the impact (ie, to avoid or reduce the magnitude of the impact from the associated project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie, to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures. The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Table 12.

Table 12: Mitigation Hierarchy

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project (eg avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).
Abate on Site: add something to the design to abate the impact (eg pollution control equipment).
Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site (eg traffic measures).
Repair or Remedy: some impacts involve unavoidable damage to a resource (eg material storage areas) and these impacts require repair, restoration and reinstatement measures.
Compensate in Kind; Compensate through Other Means: where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate (eg financial compensation for degrading agricultural land and impacting crop yields).

Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

Cumulative Impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact.

How the impacts and effects are assessed is strongly influenced by the status of the other activities (ie, already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet built or operating; and
- Projects that are a realistic proposition but are not yet built.

4.2. Assessing Significance of Risks for Accidental Events

The methodology used to assess the significance of the risks associated with accidental events differs from the impact assessment methodology described above. Risk significance for accidental events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing control and mitigation measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects.

Definitions used in the assessment for likelihood and consequence are set out below.

Likelihood

Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:

- **Low**: the event or incident is reported in the telecommunication industry, but rarely occurs;
- **Medium**: the event or incident does occur but is not common; and/or
- **High**: the event or incident is likely to occur several times during the project's lifetime.

Consequence

The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in accidental events is similar to significance (magnitude x sensitivity) of planned events and is classified as either a:

- **Minor consequence**: impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required;
- **Moderate consequence**: impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or
- **Major consequence**: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in Table **13** is used to determine the risk significance for accidental events. The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 13: Accidental Events Risk Significance

Risk Significance Rating				
	Likelihood	Low	Medium	High
Consequence	Minor	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of accidental events occurring. However, the mitigation strategy to minimise the risk of the occurrence of accidental events is outlined below.

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through:

- Reducing the likelihood of the event ie, preventative maintenance measures, emergency response procedures and training);
- Reducing the consequence ; and
- A combination of both of these.

Recovery/ remediation: includes contingency plans and response

- Emergency Response Plans and
- Tactical Response Plans.

4.3. Identification of Impacts

Potential impacts to the marine environment as a result of the installation and operation of the subsea cable are briefly summarised below, and discussed in more detail in Sections 4.4 and 4.5.

4.3.1 Subsea Cable Installation

The installation of the subsea cable would result in:

- Disturbance of sediments and associated fauna during the pre-lay grapnel run;
- Disturbance of sediments and associated fauna during cable installation;
- Elimination of biota in the cable's structural footprint;
- Reduced area of unconsolidated seabed available for colonisation by infaunal communities; and
- Physical presence of the cable providing an alternative substratum for colonising benthic communities, or resulting in faunal attraction to fish and mobile invertebrates.

4.3.2 Shore crossing of the Subsea Cable

Infrastructure crossing the shore will impact on intertidal and shallow subtidal biota during the construction phase in the following ways:

- Temporary loss of benthic habitat and associated sessile communities due to preparation of seabed for buried cable laying, excavations for construction of beach manhole and associated activities;
- Possible temporary impacts on adjacent habitat health due to turbidity generated during trenching and installation;
- Temporary disturbance of marine biota, particularly marine mammals and coastal birds, due to construction activities;
- Possible impacts to marine water quality and sediments through hydrocarbon pollution by marine construction infrastructure and machinery, inappropriate disposal of used lubricating oils from marine machinery maintenance and spillage of drilling fluids at the offshore exit point in the case of HDD; and
- Potential contamination of marine waters and sediments by inappropriate disposal of spoil from trenching activities or backfilling, and human wastes, which could in turn lead to impacts upon marine flora, fauna and habitat.

4.3.3 Operation of the Subsea Cable System

As no routine maintenance of the subsea cable system is required, impacts associated with the operational phase would consitute temporary disturbance of the seabed if subsea cable sections require replacing. Impacts would be highly localised and sporadic.

4.3.4 Decommissioning

As the subsea cable will most likely be left in place at decommissioning, the potential impacts during the decommissioning phase are expected to be minimal and no key issues related to the marine environment are identified at this stage. As full decommissioning will require a separate EIA process, potential issues related to this phase will not be dealt with further in this report.

4.4. Installation of the Subsea Cable

Construction phase impacts associated with the installation of the beach manhole and subsea cable are discussed below.

4.4.1 Disturbance of the Coastal Zone[4]

Installation of the subsea cable through the surf-zone and across the beach would require the subsea cable to be buried to sufficient depth to ensure it is not exposed during seasonal variation of the beach levels. Excavated material would be disposed of onto the beach and into the surf-zone down-current of the construction site. Subtidal trenching would result in the mobilisation and redistribution of sediments in tidal currents and the littoral drift. This would result in localised increased suspended sediment concentrations in the water column. Where burial cannot be achieved and additional cable protection is required, an articulated split-pipe may be used to maximise cable security. The trenching, and cable burial process would result in disturbance of high shore, intertidal and shallow subtidal sandy beach habitats and their associated macrobenthic communities through displacement, injury or crushing.

4 The coastal zone is defined as the coastal strip from 500 m inland of the high water mark to the 30 m depth contour (Sink *et al*, 2012).

Excavation of the beach manhole would similarly result in the deposition of excavated material onto the beach. Construction activities would require a sufficiently large and relatively flat onshore area for the stockpiling of equipment and machinery.

Potential impacts associated with this construction area will not be further assessed here as it will be located well above the high water mark.

Although the activities on the shore and in the shallow subtidal regions would be localised and confined to within a few 10s of metres of the construction site and cable shore-crossing route, the benthic biota would be damaged or destroyed through moving of equipment and machinery and the general activities of contractors around the construction site. Mobile organisms such as fish and marine mammals, on the other hand, would be capable of avoiding the construction area. Any shorebirds feeding and/or roosting in the area would also be disturbed and displaced for the duration of construction activities.

The invertebrate macrofauna inhabiting these beaches are all important components of the detritus / beach-cast seaweed-based food chains, being mostly scavengers, particulate organic matter and filter-feeders (Brown & McLachlan 1994). As such, they assimilate food sources available from the detritus accumulations typical of this coast and, in turn, become prey for surf-zone fishes and migratory shorebirds that feed on the beach slope and in the swash zone. By providing energy input to higher trophic levels, they are all important in nearshore nutrient cycling, and significant reduction or loss of these macrofaunal assemblages may therefore have cascade effects through the coastal ecosystem (Dugan *et al*, 2003).

Once the cable has been buried, the affected seabed areas would, with time, be recolonised by benthic macrofauna. The ecological recovery of the disturbed sea floor is generally defined as the establishment of a successional community of species, which progresses towards a community that is similar in species composition, population density and biomass to that previously present (Ellis 1996). In general, communities of short-lived species and/or species with a high reproduction rate (opportunists) may recover more rapidly than communities of slow growing, long-lived species. Opportunists are usually small, mobile, highly reproductive and fast growing species and are the early colonisers. Sediments in the nearshore wave-base regime, which are subjected to frequent disturbances, are typically inhabited by these opportunistic species (Newell *et al*. 1998). Recolonisation will start rapidly after cessation of trenching, and species diversity and abundance may recover within short periods (weeks) whereas biomass often remains reduced for several years (Kenny & Rees 1994, 1996). Provided the construction activities are all conducted concurrently, the duration of the construction disturbance should be limited to a few weeks. Disturbed subtidal communities within the wave base (<40 m water depth) might recover even faster (Newell *et al*. 1998). However, while recovery of the intertidal and subtidal communities is rapid, physical alteration of the shoreline in ways that cannot be remediated by swell action, such as deposition of large piles of pebbles and boulders, can be more or less permanent. Whilst the construction activities associated specifically with the cable installation are unlikely to have a significant effect at the ecosystem level, the cumulative effects of increasing development along this stretch of coast must be kept in mind.

The impacts on benthic communities as a result of cable installation through the littoral zone would be of medium intensity. Impacts would, however, be once-off and highly localised, being restricted to an ~10 m wide strip through the intertidal and surf-zone. Impacts would be expected to endure over the short-term only as communities within the wave-influenced zone are adapted to frequent natural disturbances and recover relatively rapidly. As the subsea cable routing passes through coastal and inshore benthic habitats identified as 'vulnerable' the impact can be considered of medium sensitivity. Impacts to vulnerable habitats are, however, only temporary. The potential impacts on benthic organisms of installation of the shoreline crossing is consequently deemed to be of **MODERATE** significance without mitigation.

Mitigation Measures

The following mitigation measures are recommended:

- Plan routing of proposed subsea cable to as far as practicably possible avoid sensitive benthic habitats in the coastal and nearshore zone;
- Ensure that construction activities required for subsea cable installation occur concurrently thereby minimizing the disturbance duration in the coastal and nearshore zone.

Disturbance and destruction of sandy beach biota during trench excavation and subsea cable installation		
Characteristic	Impact	Residual Impact
Extent	Local: limited to within a few metres of the subsea cable route, buth with indirect effects on adjacent areas	Local
Duration	Short-term; recovery is expected within 2-5 years	Short-term
Scale	Small	Small
Reversibility	Fully reversible	
Loss of resource	Low	
Magnitude	Medium	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Low
Significance of Impact	**MODERATE**	**MINOR**
Mitigation Potential	High	

Trenching of the subsea cable in the littoral zone beyond 10-15 m depth would result in the mobilisation and redistribution of sediments in tidal currents and the littoral drift. This would result in localised increased suspended sediment concentrations in the water column. Where burial cannot be achieved and additional cable protection is required, an articulated split-pipe may be used to maximise cable security. Within the wave-base (0 – 50 m), the subsea cable and/or articulated split-pipes may be held in place with saddle clamps at specific locations. This would require drilling into the bedrock to secure the clamps. The subsea cable burial and/or securing process would result in disturbance of subtidal unconsolidated sediments and their associated macrobenthic communities through displacement, injury or crushing. Potential impacts associated with this construction area will not be further assessed here as it will be located well above the highwater mark.

Although the activities in the subtidal regions would be localised and confined to within a few metres of the subsea cable route, the benthic biota would be disturbed, damaged or destroyed through displacement of sediments during trenching and subsea cable burial.

Mobile organisms such as fish and marine mammals, on the other hand, would be capable of avoiding the construction area. Any shorebirds feeding and/or roosting in the area would also be disturbed and displaced for the duration of construction activities.

The invertebrate macrofauna inhabiting unconsolidated sediments in the coastal zone are all important components of the detritus / beach-cast seaweed-based food chains, being mostly scavengers, particulate organic matter and filter-feeders (Brown & McLachlan 1994). As such, they assimilate food sources available from the detritus accumulations typical of this coast and, in turn, become prey for surf-zone fishes and migratory shorebirds that feed on the beach slope and in the swash zone. By providing energy input to higher trophic levels, they are all important in nearshore nutrient cycling, and significant reduction or loss of these macrofaunal assemblages may therefore have cascade effects through the coastal ecosystem (Dugan *et al,* 2003).

Once the subsea cable has been buried, the affected seabed areas would, with time, be recolonised by benthic macrofauna. The ecological recovery of the disturbed sea floor is generally defined as the establishment of a successional community of species, which progresses towards a community that is similar in species composition, population density and biomass to that previously present (Ellis *et al,* 1996). In general, communities of short-lived species and/or species with a high reproduction rate (opportunists) may recover more rapidly than communities of slow growing, long-lived species. Opportunists are usually small, mobile, highly reproductive and fast growing species and are the early colonisers. Sediments in the nearshore wave-base regime, which are subjected to frequent disturbances, are typically inhabited by these opportunistic species (Newell *et al,* 1998). Recolonisation will start rapidly after cessation of trenching, and species diversity and abundance may recover within short periods (weeks) whereas biomass often remains reduced for several years (Kenny & Rees 1994, 1996). Disturbed subtidal communities within the wave base (<40 m water depth) might recover even faster (Newell *et al,* 1998). However, while recovery of the intertidal and subtidal communities is rapid, physical alteration of the shoreline in ways that cannot be remediated by swell action, such as deposition of large piles of pebbles and boulders, can be more or less permanent. Whilst the construction activities associated specifically with the subsea cable installation are unlikely to have a significant effect at the ecosystem level, the cumulative effects of increasing development along this stretch of coast must be kept in mind.

The impacts on benthic communities as a result of the subsea cable installation beyond the cable entry point would be of low magnitude. Impacts would, however, be once-off and highly localised, being restricted to within a few metres of the cable entry point and subsea cable route, possibly extending to immediately adjacent areas. Impacts would be expected to endure over the short-term only as communities within the wave-influenced zone are adapted to frequent natural disturbances and recover relatively rapidly. As the cable routing passes through inshore benthic habitats identified as 'vulnerable' the impact can be considered of medium sensitivity. However, as the diameter of the subsea cable is only 35 mm at most, the proportion of vulnerable habitat affected by the subsea cable installation can be considered negligible in relation to the available habitat area (see Table 2). The potential impacts on benthic organisms of installation of the shoreline crossing is consequently deemed to be of **MODERATE** significance without mitigation.

Mitigation Measures

The following mitigation measure is recommended:

- Using the results of the seabed survey undertaken to design the subsea cable routing, plan the routing to as far as practicably possible avoid sensitive benthic habitats in the coastal and nearshore zone.

Disturbance and destruction of nearshore biota in unconsolidated sediments during trench excavation and cable installation		
Characteristic	Impact	Residual Impact
Extent	Local: limited to within a few metres of the subsea cable route and shore-crossing entry point, with indirect effects on adjacent areas	Local
Duration	Short-term; recovery is expected within 2-5 years	Short-term
Scale	Small	Small
Reversibility	Fully reversible	
Loss of resource	Low	
Magnitude	Medium	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**MODERATE**	**MINOR**
Mitigation Potential	Low	

4.4.2 Increase in Noise

Noise propagation represents energy travelling either as a wave or a pressure pulse through a gas or a liquid. Due to the physical differences between air and water (density and the speed at which sound travels), the decibel units used to describe noise underwater are different from those describing noise in air. Furthermore, hearing sensitivities vary between species and taxonomic groups. Underwater noise generated by drilling activities is therefore treated separately from noise generated in the air.

During installation of the subsea cable shore-crossing, noise and vibrations from excavation machinery may have an impact on surf-zone biota, marine mammals and shore birds in the area. Noise levels during construction are generally at a frequency much lower than that used by marine mammals for communication (Findlay 1996), and these are therefore unlikely to be significantly affected. Additionally, the maximum radius over which the noise may influence is very small compared to the population distribution ranges of surf-zone fish species, resident cetacean species and shore birds. Both fish and marine mammals are highly mobile and should move out of the noise-affected area (Findlay 1996). Similarly, shorebirds and terrestrial biota are typically highly mobile and would be able to move out of the noise-affected area.

Further offshore, underwater noise generated during subsea cable installation could affect a wide range of fauna; from benthic invertebrates and demersal species residing on the seabed along the subsea cable route, to those invertebrates and vertebrates occurring throughout the water column and in the pelagic habitat near the surface.

Due to their hearing frequency ranges, the taxa most vulnerable to noise disturbance are turtles, pelagic seabirds, large migratory pelagic fish, and both migratory and resident cetaceans.

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC 2003). Natural ambient noise will vary considerably with weather and sea state, ranging from about 80 to 120 dB re 1 µPa (Croft & Li 2017). Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock *et al,* 2003). Other forms of anthropogenic noise include 1) multi-beam sonar systems, 2) seismic acquisition, 3) hydrocarbon and mineral exploration and recovery, and 4) noise associated with underwater blasting, pile driving, and construction (Figure 31).

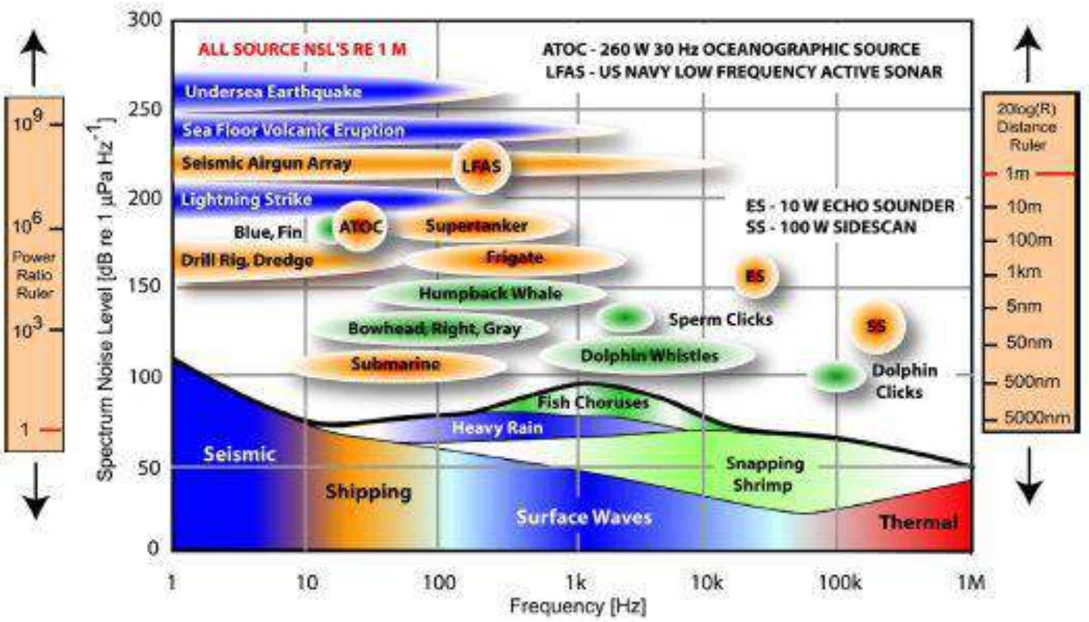


Figure 31: Comparison of noise sources in the ocean (Goold & Coates 2001).

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön 2012). The sound level generated by the subsea cable laying vessel and subsea apparatus would fall within the hearing range of most fish and marine mammals, and would be audible for considerable ranges (in the order of tens of kms) before attenuating to below threshold levels. However, the noise is not considered to be of sufficient amplitude to cause direct physical injury or mortality to marine life, even at close range. The underwater noise may, however, induce localised behavioural changes or masking of biologically relevant sounds in some marine fauna, but there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry 2005).

Disturbance and injury to marine biota due to construction noise or noise generated by the vessel and cable plough is thus deemed of low magnitude within the immediate vicinity of the construction site/subsea cable route, with impacts persisting over the short-term only. In both cases impacts are fully reversible once construction and subsea cable installation operations are complete. Without mitigation, the direct impacts of construction and vessel noise are therefore assessed to be of **MINOR** significance, respectively. As the noise associated with construction and subsea cable installation is unavoidable, no direct mitigation measures, other than the no-project alternative, are possible. Impacts of construction noise can, however, be kept to a minimum through responsible construction practices.

Mitigation Measures

The following mitigation measures are recommended:

- If cable installation is scheduled during the whale migration period (beginning of June to end of November), give consideration for the cable-laying vessels to accommodate dedicated independent Marine Mammal Observers (MMOs) with experience in seabird, turtle and marine mammal identification and observation techniques, to carry out daylight observations of the subsea cable route and record incidence of marine mammals, and their responses to vessel activities. Data collected should include position, distance from the vessel, swimming speed and direction, and obvious changes in behaviour (eg, startle responses or changes in surfacing/diving frequencies, breathing patterns). Both the identification and the behaviour of the animals must be recorded accurately.
- Alternatively, relevant vessel staff trained in seabird, turtle and marine mammal identification and observation techniques should be assigned for observation, distance estimation and reporting, to perform marine mammal observations and notifications.

Disturbance and avoidance behaviour of surf-zone fish communities, shore birds and marine mammals through coastal construction noise and offshore cable installation noise		
Characteristic	Impact	Residual Impact
Extent	Local: limited to the construction site	Local
Duration	Temorary: for duration of shore-crossing installation and construction	Temorary
Scale	Small	Small
Reversibility	Fully reversible	
Loss of resource	Negligible	
Magnitude	Low	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**MINOR**	**MINOR**
Mitigation Potential	Very Low	

Behavioural changes and masking of biologically significant sounds in Marine Fauna due to noise from cable installation operations		
Characteristic	Impact	Residual Impact
Extent	Local: limited to vicinity of the vessel and subsea equipment	Local
Duration	Temorary: for duration of installation	Temorary
Scale	Small	Small
Reversibility	Fully reversible	
Loss of resource	Low	
Magnitude	Low	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**MINOR**	**MINOR**
Mitigation Potential	None	

4.4.4 Disturbance of Offshore Habitats

The grapnel used during the pre-lay grapnel run, and the subsea cable plough and tracked trenching/burial ROV implemented during subsea cable laying would result in the disturbance and turnover of unconsolidated sediments in an ~0.5 m wide strip along the length of the subsea cable route. Any epifauna or infauna associated with the disturbed sediments are likely to be displaced, damaged or destroyed. Similarly, the plough skids or ROV tracks would injure or crush benthic invertebrates in their path. Mobilisation and redistribution of sediments in near-bottom currents during trenching would result in localised increased suspended sediment concentrations near the seabed and in the water column (see Section 4.3.5).

Although the cable is typically only 25 mm[5] – 200 mm[6] in diameter the presence of the cable effectively reduces the area of seabed available for colonisation by macrobenthic infauna. The loss of substratum would, however, be temporary, as the cable itself would provide an alternative substratum for colonising benthic communities or provide shelter for mobile invertebrates (see Section 4.3.6). Where the subsea cable is exposed, colinisation of the cable would commence within a few weeks.

The potential direct impacts on benthic organisms of crushing and sediment disturbance would be of medium magnitude and once off (unless cable repair is necessary). Although the cable will extend along some 9,000 km of seabed, benthic impacts will be highly localised along the length of the subsea cable route. Impacts would be limited to the medium-term only as recolonisation of disturbed sediments will occur from adjacent areas within a year. In the wave based regime communities will have recovered to functional similarity within 2-5 years. The change in habitat from unconsolidated sediments to the hard sustratum of the cable itself would, however, be permenent. Although the subsea cable route passes through shelf edge benthic habitats identified as 'vulnerable' the impact can be considered of low sensitivity due to the negligible proportion of the available habitat that would be affected by the cable installation (see Figure 3 and Table 2). Consequently, the potential impacts on benthic organisms of cable installation across the continental shelf and abyss is deemed to be of **MINOR** significance without mitigation.

The elimination of marine benthic communities in the structural footprint of the cable is an unavoidable consequence of the installation of subsea cables, and no direct mitigation measures, other than the no-project option, are possible. Impacts will, however, be temporary as recolonisation of disturbed sediments from adjacent areas will occur within a few weeks.

Disturbance and destruction of subtidal sandy biota during cable laying

Characteristic	Impact	Residual Impact
Extent	On-site: limited to the subsea cable route	On-site
Duration	Short-term; recovery is expected within 2-5 years	Short-term
Scale	Small	Small
Reversibility	Partially reversible	
Loss of resource	Low	
Magnitude	Medium	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**MINOR**	**MINOR**
Mitigation Potential	Very Low	

[5]un-armoured cable at depths >900 m.

[6]armoured cable in the littoral zone, articulated split-pipes.

4.4.5 Increased Turbidity

The disturbance and turnover of sediments during the pre-lay grapnel run and during trenching will result in increased suspended sediments in the water column and physical smothering of biota by the re-depositing sediments. The effects of elevated levels of particulate inorganic matter and depositions of sediment have been well studied, and are known to have marked, but relatively predictable effects in determining the composition and ecology of intertidal and subtidal benthic communities (eg, Zoutendyk & Duvenage 1989, Engledow & Bolton 1994, Iglesias *et al,* 1996, Slattery & Bockus 1997). Increased suspended sediments in the surf-zone and nearshore can potentially affect light penetration and thus phytoplankton productivity and algal growth, whereas further offshore it can load the water with inorganic suspended particles, which may affect the feeding and absorption efficiency of filter-feeders.

The impact of the sediment plume, however, is expected to be relatively localised and temporary (only for the duration of pre-lay, construction and trenching activities below the low water mark). As the biota of sandy and rocky intertidal and subtidal habitats in the wave-dominated nearshore areas of southern Africa are well adapted to high suspended sediment concentrations, periodic sand deposition and resuspension, impacts are expected to occur at a sublethal level only.

Rapid deposition of material from the water column and direct deposition of excavated sands on adjacent areas of seabed may result in the physical smothering of resident biota by the depositing sediments. Some mobile benthic animals inhabiting soft-sediments are capable of migrating vertically through more than 30 cm of deposited sediment (Maurer *et al,* 1979; Newell *et al,* 1998; Ellis 2000; Schratzberger *et al,* 2000a, 2000b). Sand inundation of shallow-water reef habitats was found to directly affect species diversity, whereby community structure and species richness appears to be controlled by the frequency, nature and scale of disturbance of the system by sedimentation (Seapy & Littler 1982; Littler *et al,* 1983; Schiel & Foster 1986, McQuaid & Dower 1990, Santos 1993, Airoldi & Cinelli 1997 amongst others). For example, frequent sand inundation may lead to the removal of grazers, thereby resulting in the proliferation of algae (Hawkins & Hartnoll 1983; Littler *et al,* 1983; Marshall & McQuaid 1989; Pulfrich *et al,* 2003a, 2003b; Pulfrich & Branch 2014).

Elevated suspended sediment concentrations due to trenching and burial activities associated with the subsea cable installation is deemed of low magnitude and would extend locally around the subsea cable route and down-current of the shore-crossing, with impacts persisting only temporarily. Within the wave-base at least, marine biota are typically adapted to periods of elevated turbidity and as suspended sediment concentrations would remain at sub-lethal levels, this indirect impact can be considered of low sensitivity. The impact is therefore assessed to be of **NEGLIGIBLE** significance without mitigation. As elevated suspended sediment concentrations are an unavoidable consequence of trenching activities, no direct mitigation measures, other than the no-project alternative, are possible. In the intertidal and shallow subtidal zone, impacts can however be kept to a minimum through responsible construction practices.

Reduced physiological functioning of marine organisms due to increased turbidity in surf-zone as a result of excavations and mobilising of sediments		
Characteristic	**Impact**	**Residual Impact**
Extent	Local: limited to the immediate vicinity of the excavations and construction site with indirect effects on adjacent areas	Local
Duration	Temporary	Temporary
Scale	Small	Small
Reversibility	Fully reversible	
Loss of resource	Negligible	
Magnitude	Low	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**NEGLIGIBLE**	**NEGLIGIBLE**
Mitigation Potential	Very Low	

4.4.6 Physical Presence of Subsea Cable

Although the cable is typically only 25 mm – 200 mm in diameter the presence of the cable effectively reduces the area of seabed available for colonisation by macrobenthic infauna in seabed sediments. The subsea cable itself, however, would serve as an alternative substratum for colonising benthic communities or provide shelter for mobile invertebrates and demersal fish (Figure 32). Assuming that the hydrographical conditions around the subsea cable and repeaters would not be significantly different to those on the seabed, a similar community to that typically found on hard substrata in the area can be expected to develop over time. As offshore portions of the subsea cable will be located on unconsolidated sediments, biota developing on the structures would be significantly different from the original soft sediment macrobenthic communities. The presence of subsea infrastructure (namely cable and repeaters) can therefore alter the community structure in an area, and effectively increase the availability of hard substrate for colonisation by sessile benthic organisms, thereby locally altering and increasing biodiversity and biomass.

Figure 32: Subsea cables can provide alternative substratum for colonising benthic biota (left) and shelter for mobile invertebrates (right) (Source: www.digit.in/telecom/reliance-jio-launches-longest-100gbps-subsea-cable-system-aae-1-35827; www.farinia.com).

The composition of the fouling community on artificial structures depends on the age (length of time immersed in water) and the composition of the substratum, and usually differs somewhat from the communities of nearby natural rocky reefs (Connell & Glasby 1999; Connell 2001). In the intertidal and shallow subtidal habitats, colonisation of hard substratum goes through successional stages (Connell & Slayter 1977). Early successional communities are characterized by opportunistic algae (eg, *Ulva* sp., *Enteromorpha* sp.). These are eventually displaced by slower growing, long-lived species such as mussels, sponges and/or coralline algae, and mobile organisms, such as urchins and lobsters, which feed on the fouling community. With time, a consistent increase in biomass, cover and number of species can usually be observed (Bombace *et al,* 1994; Relini *et al,* 1994; Connell & Glasby 1999). Depending on the supply of larvae and the success of recruitment, the colonization process can take up to several years. For example, a community colonising concrete blocks in the Mediterranean was found to still be changing after five years with large algae and sponges in particular increasing in abundance (Relini *et al,* 1994). Other artificial reef communities, on the other hand, were reported to reach similar numbers of species (but not densities and biomass) to those at nearby natural reefs within eight months (Hueckel *et al,* 1989).

Ellis *et al,* (1996), who compared the abundance and size class structure of macroepifaunal invertebrates (shrimp, crabs, scallops, and starfish) at various distances from three oil platforms, concluded that differences in community structure of associated fauna were attributable to the physical presence of the subsea infrastructure, and the unique physical environment around each piece of infrastructure. Differences in abundance and size of epifaunal invertebrates near the platforms compared to far away were attributed to differences in food availability and predation. Mobile fish and invertebrates would be attracted by the shelter and food (biofouling organisms) provided by the underwater structures (Bull & Kendall 1994; Fechhelm *et al,* 2001).

The impacts on marine biodiversity through the physical presence of the subsea cable would be of medium magnitude and highly localised. As the subsea cable would likely be left in place on the seabed beyond decommissioning of the project, its impacts would thus be permanent. No direct mitigation measures, other than the no-project alternative, are possible. The potential impacts on marine biota is consequently deemed to be of **MINOR** significance without mitigation.

Physical presence of the subsea cable		
Characteristic	Impact	Residual Impact
Extent	Site-specific: limited to the cable and repeaters	Site-specific
Duration	Permanent	Permanent
Scale	Small	Small
Reversibility	Partially reversible	
Loss of resource	Low	
Magnitude	Medium	
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**MINOR**	**MINOR**
Mitigation Potential	Very Low	

4.5. Decommissioning Phase

No decommissioning procedures have been developed at this stage. In the case of decommissioning the cable will most likely be left in place. The potential impacts during the decommissioning phase are thus expected to be minimal in comparison to those occurring during the installation phase.

4.6. Unplanned Events

4.6.1 Pollution and Accidental Spills

Trenching during installation of the shore-crossing of the subsea cable will involve excavation and construction activities. There would thus be potential for or accidental spillage or leakage of fuel, chemicals or lubricants, litter, inappropriate disposal of human wastes and general degradation of ecosystem health on the shoreline. Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment through contamination of the water and/or sediments. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton, pelagic eggs and fish larvae, and habitat loss or contamination (CSIR 1998; Perry 2005). Many of the compounds in petroleum products have been known to smother organisms, lower fertility and cause disease in aquatic organisms. Hydrocarbons are incorporated into sediments through attachment to fine-grained particles, sinking and deposition in low turbulence areas. Due to differential uptake and elimination rates, filter-feeders, particularly mussels, can bioaccumulate organic (hydrocarbons) contaminants (Birkeland *et al,* 1976).

During construction, litter can enter the marine environment. Inputs can be either direct by discarding garbage into the sea, or indirectly from the land when litter is blown into the water by wind. Marine litter is a cosmopolitan problem, with significant implications for the environment and human activity all over the world. Marine litter travels over long distances with ocean currents and winds. It originates from many sources and has a wide spectrum of environmental, economic, safety, health and cultural impacts. It is not only unsightly, but can cause serious harm to marine organisms, such as turtles, birds, fish and marine mammals. Considering the very slow rate of decomposition of most marine litter, a continuous input of large quantities will result in a gradual increase in litter in coastal and marine environment. Suitable waste management practices should thus be in place to ensure that littering is avoided.

Potential hydrocarbon spills and pollution in the intertidal and shallow subtidal zone during installation of the subsea cable are deemed of medium magnitude within the immediate vicinity of the construction site, with impacts persisting over the short- to long-term. Impacts of pollution and accidental spills would be direct, indirect and cumulative. As the coastal habitats at the shore-crossing have been identified as 'vulnerable', the impact can be considered of medium sensitivity. The risk of pollution and accidental spills on the shoreline during the construction phase is therefore assessed to be of **MODERATE** significance.

Mitigation Measures

The recommended mitigation measures for the construction phase of the proposed METISS cable installation are:

- Keep heavy vehicle traffic associated with construction in the coastal zone to a minimum.
- Restrict vehicles to clearly demarcated access routes and construction areas only. These should be selected under guidance of the local municipality.
- Conduct a comprehensive environmental awareness programme amongst contracted construction personnel, emphasising compliance with relevant provincial and national legislation and the EMPr, pollution control and minimising construction impacts to the intertidal habitat and associated communities.
- For equipment maintained in the field, oils and lubricants must be contained and correctly disposed of off-site.
- Maintain vehicles and equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled.
- There is to be no vehicle maintenance or refuelling on beach.
- Vehicles should have a spill kit (peatsorb/ drip trays) onboard in the event of a spill to ensure that all accidental diesel and hydrocarbon spills are cleaned up accordingly.
- No mixing of concrete in the intertidal zone.
- Regularly clean up concrete spilled during construction.
- No dumping of construction materials, excess concrete or mortar in the intertidal and subtidal zones or on the sea bed.
- Ensure regular collection and removal of refuse and litter from intertidal areas.
- Good housekeeping must form an integral part of any construction operations on the beach from start-up.
- All construction activities in the coastal zone must be managed according to a strictly enforced EMPr.
- After completion of construction activities remove all artificial constructions or created shore modifications from above and within the intertidal zone. No accumulations of excavated intertidal sediments should be left above the high water mark, and any substantial sediment accumulations below the high water mark should be levelled.

If these mitigation measures are implemented, all residual impacts are expected to be of low significance.

Accidental spillage or leakage of fuel, chemicals or lubricants, cement and disposal of litter may cause water or sediment contamination and/or disturbance to intertidal and subtidal biota	
Characteristic	Risk Significance
Type of Impact	Direct, indirect and cumulative
Likelihood	Medium
Consequence	Moderate
Risk Significance	**Moderate**
Reversibility	Partially Reversible
Loss of resource	Low
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium

4.6.2 Collisions with and entanglement by Marine Fauna

Depending on the onboard equipment and types of ploughs used, prevailing sea conditions as well as the nature of the seabed, subsea cable vessels can lay 100-150 km of cable per day, with modern ships and ploughs achieving up to 200 km of cable laying per day (www.independent.co.uk>science). This equates to a vessel speed of between 2.3 – 4.5 knots. The pre-laying grapnel run is typically consudted at 0.5 knots. Given the slow speed of the vessel during the pre-lay grapnel run and the cable installation, ship strikes with marine mammals and turtles or entanglement of marine fauna in the cable are unlikely, and should the impact occur it would be very infrequent.

In the event of a collision or entaglement, the impact is deemed of low magnitude and would be site specific to the vessel location. Injury through collision and/or entanglement would persist over the medium term and considering the slow vessel speed would likely remain at sub-lethal levels. Although this direct impact can be considered of high sensitivity, the impact is assessed to be of **NEGLIGIBLE** significance without mitigation.

Mitigation Measures

The recommended mitigation measures for the installation phase of the proposed METISS subsea cable are:

- Give consideration for the subsea cable-laying vessels to accommodate dedicated independent Marine Mammal Observers (MMOs) with experience in seabird, turtle and marine mammal identification and observation techniques, to carry out daylight observations of the subsea cable route and record incidence of marine mammals, and their responses to vessel activities. Data collected should include position, distance from the vessel, swimming speed and direction, and obvious changes in behaviour (eg, startle responses or changes in surfacing/diving frequencies, breathing patterns). Both the identification and the behaviour of the animals must be recorded accurately.
- Alternatively, relevant vessel staff trained in seabird, turtle and marine mammal identification and observation techniques should be assigned for observation, distance estimation and reporting, to perform marine mammal observations and notifications.

Collions with and Entanglement by Marine Fauna	
Characteristic	**Risk Significance**
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor**
Reversibility	Fully Reversible
Loss of resource	Low
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High

5. ENVIRONMENTAL STATEMENT AND CONCLUSIONS

5.1. Environmental Statement

Construction of the beach manhole and installation of the cable will potentially result in localised disturbance of the upper beach and intertidal and shallow subtidal sandy habitats, as well as unconsolidated seabed beyond the surf-zone and across the shelf. Most potentially negative impacts were rated as being of negligible to minor significance, with only disturbance of coastal communities at the shore crossing and pollution and accidental spills during construction rated as moderate significance. As recovery of marine communities over the medium-term can be expected, residual impacts were all considered minor or negligible.

5.2. Management Recommendations

From the marine ecology assessment in Chapter 4, certain recommendations can be put forward as how best to manage potential impacts to the marine environment of the proposed installation of the subsea cable. These include:

- Plan routing of proposed cable to as far as practicably possible avoid sensitive benthic habitats in the coastal and nearshore zone.
- Keep heavy vehicle traffic associated with construction and cable installation in the coastal zone to a minimum.
- Restrict vehicles to clearly demarcated access routes and construction areas only. These should be selected under guidance of the local municipality.
- Conduct a comprehensive environmental awareness programme amongst contracted construction personnel, emphasising compliance with relevant provincial and national legislation and the EMPr, pollution control and minimising construction impacts to the intertidal habitat and associated communities.
- For equipment maintained in the field, oils and lubricants must be contained and correctly disposed of off-site.
- Maintain vehicles and equipment to ensure that no oils, diesel, fuel or hydraulic fluids are spilled.
- There is to be no vehicle maintenance or refuelling on beach.
- Vehicles should have a spill kit (peatsorb/ drip trays) onboard in the event of a spill to ensure that all accidental diesel and hydrocarbon spills are cleaned up accordingly.
- No mixing of concrete in the intertidal zone.
- Regularly clean up concrete spilled during construction.
- No dumping of construction materials, excess concrete or mortar in the intertidal and subtidal zones or on the sea bed.
- Ensure regular collection and removal of refuse and litter from intertidal areas.
- Good housekeeping must form an integral part of any construction operations on the beach from start-up.

- All construction activities in the coastal zone must be managed according to a strictly enforced EMPr.
- After completion of construction activities remove all artificial constructions or created shore modifications from above and within the intertidal zone. No accumulations of excavated intertidal sediments should be left above the high water mark, and any substantial sediment accumulations below the high water mark should be levelled.
- Give consideration for the subsea cable-laying vessels to accommodate dedicated independent MMOs with experience in seabird, turtle and marine mammal identification and observation techniques, to carry out daylight observations of the subsea cable route and record incidence of marine mammals, and their responses to vessel activities. Data collected should include position, distance from the vessel, swimming speed and direction, and obvious changes in behaviour (eg, startle responses or changes in surfacing/diving frequencies, breathing patterns). Both the identification and the behaviour of the animals must be recorded accurately.
- Alternatively, relevant vessel staff trained in seabird, turtle and marine mammal identification and observation techniques should be assigned for observation, distance estimation and reporting, to perform marine mammal observations and notifications.

5.3. Conclusions

If all environmental guidelines and appropriate management and monitoring recommendations advanced in this report are implemented, there is no reason why the proposed installation of the METISS fibre optics cable should not proceed.

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Employment History and Professional Experience

1998-present: Director: Pisces Environmental Services (Pty) Ltd. Specifically responsible for environmental impact assessments, baseline and monitoring studies, marine specialist studies, and environmental management programme reports.

1999: Senior researcher at the University of Cape Town on contract to Namdeb Diamond Corporation and De Beers Marine South Africa; investigating and monitoring the impact of diamond mining on the marine environment and fisheries resources; experimental design and implementation of dive surveys; collaboration with fishermen and diamond divers; deep water benthic sampling, sample analysis and macrobenthos identification.

1996-1999: Senior researcher at the University of Cape Town, on contract to the Chief Director: Marine and Coastal Management (South African Department of Environment Affairs and Tourism); investigating and monitoring the experimental fishery for periwinkles on the Cape south coast; experimental design and implementation of dive surveys for stock assessments; collaboration with fishermen; supervision of Honours and Masters students.

1989-1994: Institute for Marine Science at the Christian-Albrechts University of Kiel, Germany; research assistant in a 5 year project to investigate the population dynamics of mussels and cockles in the Schleswig-Holstein Wadden Sea National Park (employment for Doctoral degree); extensive and intensive dredge sampling for stock assessments, collaboration with and mediation between, commercial fishermen and National Park authorities, co-operative interaction with colleagues working in the Dutch and Danish Wadden Sea, supervision of Honours and Masters projects and student assistants, diving and underwater scientific photography. Scope of doctoral study: experimental design and implementation of a regular sampling program including: (i) plankton sampling and identification of lamellibranch larvae, (ii) reproductive biology and condition indices of mussel populations, (iii) collection of mussel spat on artificial collectors and natural substrates, (iv) sampling of recruits to the established populations, (v) determination of small-scale recruitment patterns, and (vi) data analysis and modelling. Courses and practicals attended as partial fulfilment of the degree: Aquaculture, Stock Assessment and Fisheries Biology, Marine Chemistry, and Physical and Regional Oceanography.

1988-1989: Australian Institute of Marine Science; volunteer research assistant and diver; implementation and maintenance of field experiments, underwater scientific photography, digitizing and analysis of stereo-photoquadrats, larval culture, analysis of gut contents of fishes and invertebrates, carbon analysis.

1985-1987: Sea Fisheries Research Institute of the South African Department of Environment Affairs and Tourism: scientific diver on deep diving surveys off Cape Agulhas; censusing fish populations, collection of benthic species for reef characterization.

South African National Research Institute of Oceanography and Port Elizabeth Museum: technical assistant and research diver; quantitative sampling of benthos in Mossel Bay, and census of fish populations in the Tsitsikamma National Park.

University of Cape Town, Department of Zoology and Percy Fitzpatrick Institute of African Ornithology; research assistant; supervisor of diving survey and collection of marine invertebrates, Prince Edward Islands.

1984-1986: University of Cape Town, Department of Zoology; research assistant (employment for MSc Degree) and demonstrator of first year Biological Science courses. Scope of MSc study: the biology, ecology and fishery of the western Cape linefish species *Pachymetopon blochii*, including (i) socio-economic survey of the fishery and relevant fishing communities, (ii) collection and analysis of data on stomach contents, reproductive biology, age and growth, (iii) analysis of size-frequency and catch statistics, (iv) underwater census, (v) determination of hook size selectivity, (vi) review of historical literature and (vii) recommendations to the Sea Fisheries Research Institute of the South African Department of Environment Affairs and Tourism for the modification of existing management policies for the hottentot fishery.

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

Environmental Impact Assessment for a METISS Subsea Cable System to be Landed in Amanzimtoti

Specialist:	Dr Andrea Pulfrich		
Contact person:	Dr Andrea Pulfrich		
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Professional affiliation(s) (if any)	South African Council for Natural Scientific Professions (Pr.Sci.Nat. No: 400327/06) South African Institute of Ecologists and Environmental Scientists International Association of Impact Assessment (South Africa) Registered Environmental Assessment Practitioner (Certification Board for Environmental Assessment Practitioners of South Africa).		

Project Consultant:	Environmental Resources Management		
Contact person:	Vicky Stevens		
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Telephone:	021 681 5400	Cell:	
E-mail:	metiss-subseacable-	Fax:	

4.2 The specialist appointed in terms of the Regulations_

I, Andrea Pulfrich, declare that -- General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Andrea Pulfrich

Signature of the specialist:

Pisces Environmental Services (Pty) Ltd

Name of company (if applicable):

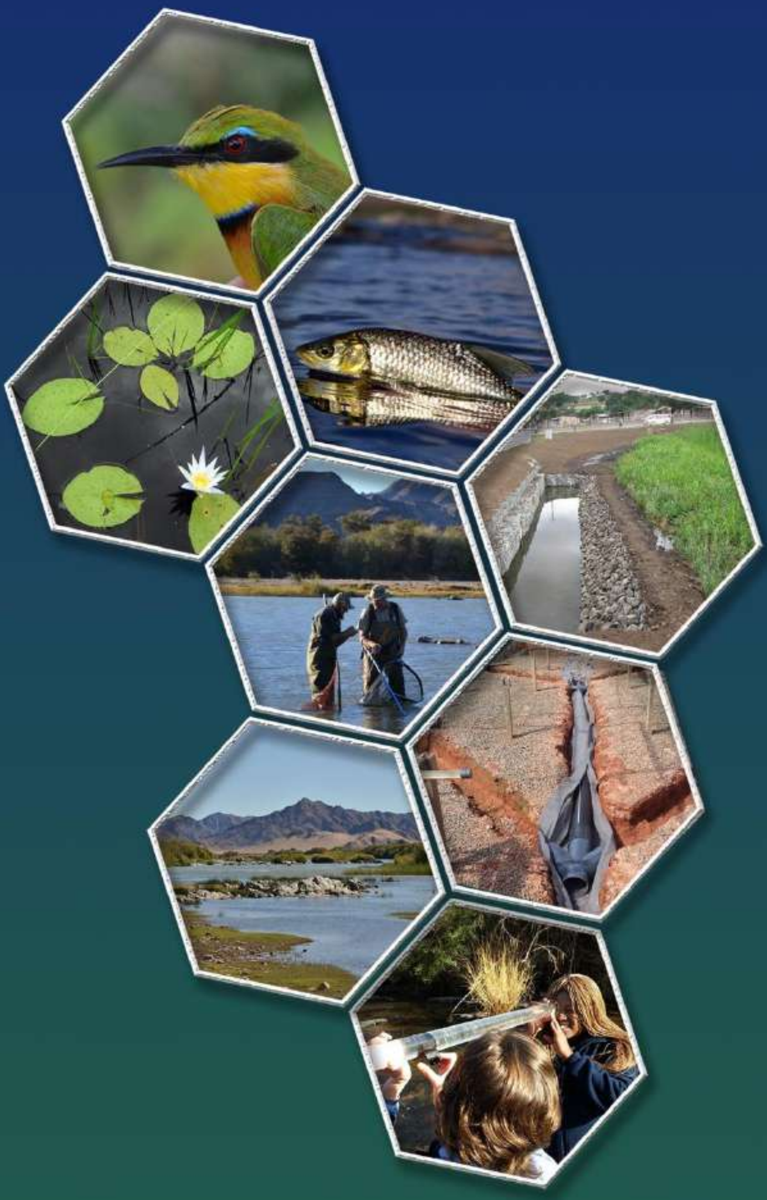
10 December 2018

Date:

APPENDIX F3 TERRESTRIAL ECOLOGY

TERRESTRIAL ECOLOGICAL ASSESSMENT OF THE METISS SUBMARINE CABLE SYSTEM (SOUTH AFRICA)

FINAL REPORT



MAY 2019

PROJECT REF: GTB212

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Report Issue	Final Draft Report		
Consultant Ref Number	GTB212-29052019		
Title	Terrestrial Ecological Assessment of the METISS Submarine Cable System (South Africa)		
Prepared by:	GroundTruth Water, Wetlands and Environmental Engineering		
Consultant sign-off	**Name / Prof. Reg.**	**Signature**	**Date**
Author(s)	Gary de Winnaar		29 May 2019
	Dr Mahomed Desai		02 May 2019
Director	Dr Mark Graham		29 May 2019
Prepared for:	ERM		
Client sign-off	**Name**	**Signature**	**Date**
Document Reviewer	Reinett Mogotshi		30 May 2019
Approved by	Vicky Stevens		30 May 2019
Reference No			

Copyright

Indemnity

The project deliverables, including the reported results, comments, recommendations and conclusions, are based on the author's professional knowledge, as well as available information. The study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of survey undertaken. GroundTruth therefore reserves the right to modify aspects of the project deliverables if and when new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

GroundTruth exercises reasonable skill, care and diligence in the provision of services; however, GroundTruth accepts no liability or consequential liability for the use of the supplied project deliverables (in part, or in whole) and any information or material contained therein. The client, including their agents, by receiving these deliverables, indemnifies GroundTruth (including its members, employees and sub-consultants) against any actions, claims, demands, losses, liabilities, costs, damages and expenses arising directly or indirectly from, or in connection with services rendered, directly or indirectly, by GroundTruth.

1 Project deliverables (including electronic copies) comprise *inter alia*: reports, maps, assessment and monitoring data, ESRI ArcView shapefiles, and photographs.

Declaration of Independence

GroundTruth Water, Wetlands and Environmental Engineering (GroundTruth) hereby acknowledge that it does not have any invested interests in the following project, and is thus independent to the proponent as required in terms of Section 33 of Government Notice Regulation 358 published under Section 24 of the National Environmental Management Act (Act 107 of 1998). Furthermore, in line with Appendix 6 of the 2014 EIA regulations (GN R982), I, Gary de Winnaar, as the specialist representing GroundTruth for this project, declare that:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a) to (e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signed: ………………………………………… Date: 21 May 2019 ……………………………………

Gary de Winnaar

Pr. Sci. Nat. (Ecology) Reg. No. 400454/13

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List of Abbreviations

Animal Demography Unit	ADU
Critical Biodiversity Area	CBA
Critically Endangered	CR
Department of Environmental Affairs and Tourism	DEAT
Durban Metropolitan Open Space System	D'MOSS
Endangered	EN
Environmental Impact Assessment	EIA
Environmental Resources Management	ERM
Ezemvelo KwaZulu-Natal Wildlife	EKZNW
Melting Pot Indianoceanic Submarine System	METISS
National Environmental Management: Biodiversity Act	NEMBA
South African Bird Atlas Project 2	SABAP2
South African National Biodiversity Institute	SANBI
Terrestrial Cable Route	TCR
Vulnerable	VU

Specialist Report Checklist

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	Cross-reference in this report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 6 – Appendix g
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 3.5 and 4.2
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Sections 2.2 and 4.1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 3.5
(g) an identification of any areas to be avoided, including buffers;	Sections 3.3 and 3.5
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3.3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.1
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities.	Sections 4.2 and 4.3
(k) any mitigation measures for inclusion in the EMPr;	Section 0
(l) any conditions for inclusion in the environmental authorisation;	Section 0
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 0
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 0
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 2.2
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
(q) any other information requested by the competent authority.	None

1. INTRODUCTION

GroundTruth Water, Wetlands and Environmental Engineering (GroundTruth) were appointed by Environmental Resources Management (ERM) to conduct a terrestrial ecological assessment for the proposed Melting Pot Indianoceanic Submarine System (METISS) fibre optic submarine cable system proposed to link South Africa, Madagascar, Réunion Island and Mauritius. The anticipated METISS submarine cable footprint within South African waters (inclusive of Territorial and Economic Exclusive Zone) is 538 km. The system includes a 14 to 35 mm diameter cable that will enter the South African Exclusive Economic Zone (200 nautical miles from the sea shore), pass through to the Territorial Waters (12 nautical miles from the sea shore) and land onshore at Amanzimtoti Pipeline Beach in KwaZulu-Natal Province. The terrestrial area perceived to be influenced by the installation of the terrestrial section of the cable and associated manholes/splicing manholes (i.e. area of influence) is hereafter referred to as the "study area" as presented in **Figure 1-1**. Two terrestrial cable routes (TCR) were considered initially (i.e. TCR 1 and 2 – see Figure 1-1). However, TCR 2 has been selected at the preferred option due to environmental sensitivities associated with TCR 1. TCR 2 largely traverses the existing road network and smaller fragments of mostly degraded vegetation.

This assessment is a component of the specialist studies informing the overall Environmental Impact Assessment (EIA) process and accordingly, the primary purpose of this assessment is to evaluate the ecological features associated within the study area so as to inform the planning and installation of the proposed METISS cable.

The following scope of work was defined for the assessment:

- **i.** Collate available data to establish the ecological context of the study area;
- **ii.** Undertake a field investigation to identify, map and assess biodiversity features, and to provide a baseline description of the study area in terms of vegetation and available habitat for fauna of interest;
- **iii.** Identify and assess impacts associated with the proposed development according to the ERM's standard impact assessment methodology;
- **iv.** Document the findings and results from this investigation; and
- **v.** Provide recommendations to address impacts that may result from the development.

Figure 1-1 Study area map for the terrestrial ecological assessment

2. METHODOLOGY

2.1 Desktop Assessment

Available information and/or data was collated and used to identify and characterise the reference (i.e. original) and present-day ecology and biodiversity of the study area. This was achieved using data from, *inter alia*:

- **i.** Classification systems and maps of **vegetation types** for South Africa (Mucina and Rutherford, 2006) and KwaZulu-Natal (Scott-Shaw and Escott, 2011);
- **ii.** **Threatened and protected ecosystems** (SANBI and DAEA, 2009); and
- **iii.** Ezemvelo KwaZulu-Natal Wildlife's (EKZNW) **Biodiversity Spatial Planning** (EKZNW, 2016).

All spatially relevant data (e.g. habitats/ecosystems, vegetation communities, sensitive areas/ecosystems, etc.) were mapped at a desktop level using ESRI ArcMap 10. Verification of the desktop mapping was provided through interrogation of high-resolution aerial imagery.

Fauna and flora, including those of conservation importance that potentially occurred within the study area were identified using available literature:

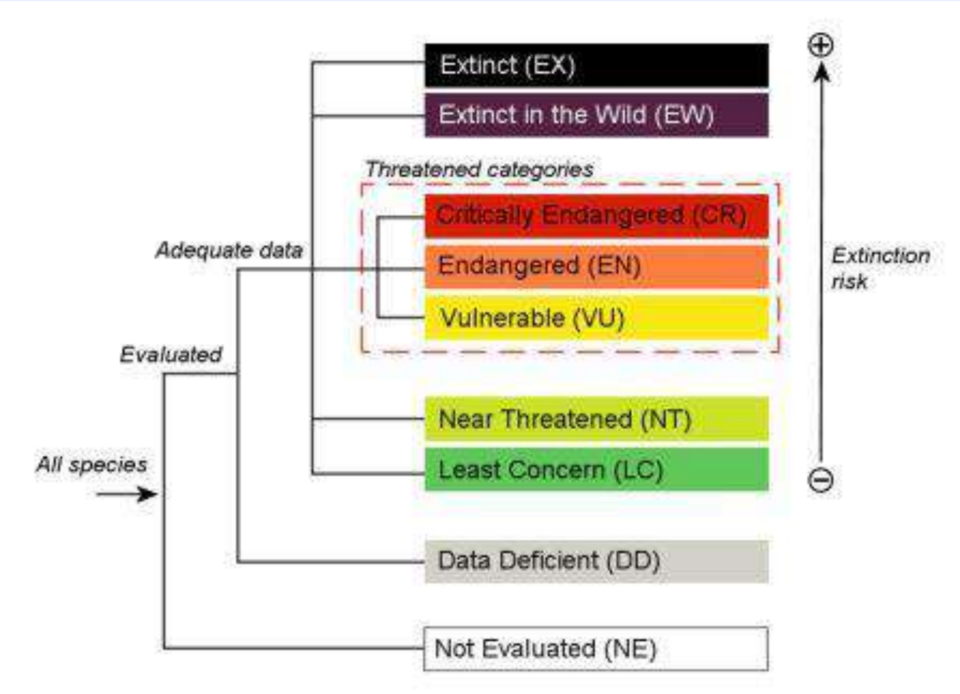
- **i.** **Plants** (Botanical Database of Southern Africa (BODATSA), 2019; Raimondo *et al.*, 2009; Ranwashe, 2015; Scott-Shaw, 1999);
- **ii.** **Lepidoptera** (Mecenero *et al.*, 2013; Virtual Museum/Animal Demography Unit);
- **iii.** **Amphibians** (du Preez and Carruthers, 2009; Minter *et al.*, 2004; Virtual Museum/Animal Demography Unit).
- **iv.** **Reptiles** (Bates *et al.*, 2014; Branch, 1998; Virtual Museum/Animal Demography Unit); and
- **v.** **Birds** (Taylor *et al.*, 2015; SABAP2).

In cases where the virtual museum was utilised to obtain a species list, the 3030BB quarter degree cell was the filtered area of interest, due to the study area falling within this specific quarter degree cell.

Species of conservation concern are listed, and the levels of threat to extinction are as defined under International Union for Conservation of Nature (IUCN) guidelines:

- **Extinct (EX) –** there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW) –** species is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
- **Regionally Extinct (RE) –** extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
- **Critically Endangered (CR) –** the species is facing an extremely high risk of extinction.
- **Endangered (EN) –** the species is facing a very high risk of extinction.
- **Vulnerable (VU) –** the species is facing a high risk of extinction.
- **Near Threatened (NT) –** the species is likely to become at risk of extinction in the near future.
- **Least Concern (LC) –** the species is widespread and abundant.
- **Not Evaluated (NE) –** the species has not been evaluated against the criteria.

The hierarchy of the categories listed above are illustrated in the figure below (IUCN, 2017).



2.2 Field-based Biota Assessment

A single site visit to the study area was undertaken on the 3rd April 2019 whereby the TCR 2 (including the associated manholes) was traversed and the vegetation/habitat along the route was observed, accompanied by representatives of LiquidTelecom and ERM. The assessment considered the footprint of the trench required (i.e. 0.5 m wide, dug to a depth of 1.0 m) to install the terrestrial cable and the adjacent working area. The working area for installing splicing manholes is 5.0 x 5.0 m, dug to a depth of 2.0 m). Geotagged photographs of the dominant floral species, as well as the floral species of conservation concern were captured. Although, TCR 1 was no longer considered feasible, the dune vegetation that it would have traversed was nevertheless assessed, as it would have provided a more complete and useful benchmark for vegetation and flora species within the context of the surrounding landscape. In addition, invasive alien plants (IAPs) were recorded within the study area, as well as other forms of disturbance/habitat degradation.

Based on the nature of the project, and in addition to the direct impacts to vegetation, fossorial fauna (i.e. burrowing animals that inhabit leaf litter and soil layers) would potentially be negatively impacted. Accordingly, while traversing the site, any woody debris or rocks were overturned, and the top soil raked (**Figure 2-1**), in an attempt to observe any fossorial fauna that may be of conservation concern, as well as to establish presence/absence, noting that the field visit was not based on exhaustive, scientifically rigorous surveys. Vegetation structure and community was also observed for their suitability for supporting biota of conservation concern. The dune vegetation, in particular, was surveyed to confirm the presence/absence of species of conservation concern.

Figure 2-1 Photograph illustrating the method used to search for target fossorial fauna such as Durban Dwarf Burrowing Skink *Scelotes inornatus*

3. RESULTS

3.1 Reference Vegetation

The original, reference vegetation defining the broader landscape through which the terrestrial cable traverses comprises three vegetation types as defined nationally by Mucina and Rutherford (2006), namely:

i. **Sub-Tropical Seashore Vegetation** (Azonal Vegetation Biome) occupying the eastern boundary of the study area;
ii. **Northern Coastal Forest** (Forest Biome) occupying relatively narrow bands within the study area, including both coastal and dune forest types; and
iii. **KwaZulu-Natal Coastal Belt Grassland** (Indian Ocean Coastal Belt Biome).

The national vegetation types have since been revised by Scott-Shaw and Escott (2011) and split into more, regionally appropriate vegetation types. These vegetation types mapped for the KZN Province are illustrated in **Figure 3-1**, but described in the following sections based on extracts from Mucina and Rutherford (2006).

3.1.1 KwaZulu-Natal Coastal Belt Grassland

KwaZulu-Natal Coastal Belt Grassland is a **Critically Endangered** vegetation type within KZN (Scott-Shaw and Escott, 2011). It occupies a long, and in places broad, coastal strip along the KZN coast, and occurs on undulating coastal plains possessing Ordovician Natal Group sandstone, Dwya tillite, Ecca shale and Mapumulo gneiss as the dominant geological substrate (Mucina *et al.*, 2006a). In natural situations, this vegetation type is defined by various types of subtropical coastal forest interspersed with *Themeda triandra* grassland. Only a very small area (i.e. less than 1% of original area) is protected. Over the years, the natural vegetation of this unit has been highly transformed and fragmented, primarily from extensive sugarcane cultivation, timber plantations and urban sprawl. Due to the extensive transformation, the natural vegetation has been replaced by a mosaic of secondary grasslands (dominated by *Aristida sp.*), seral thickets and bushveld most of which is severely threatened by alien plant invasion. Accordingly, Southern Coastal Grasslands are listed as 'Critically Endangered' and categorised as criterion F which are "Priority areas for meeting explicit biodiversity targets as defined in a systematic biodiversity plan" (Government Gazette No. 34809, 2011).

Figure 3-1 Map of reference vegetation and their conservation status occurring within the study area (after Scott-Shaw and Escott, 2011)

Table 3-1 provides a list of the principal plant species typically associated with natural to near natural occurences of KwaZulu-Natal Coastal Belt Grassland. **Figure 3-1** provides a spatial illustration of the distribution and extent of the vegetation type in its original, reference state in relation to the terrestrial cable.

Table 3-1 List of principal floral taxa defining the KwaZulu-Natal Coastal Belt Grassland (Mucina et al., 2006)

Functional growth form	Species
Important taxa	
Small tree	*Bridelia micrantha, Phoenix reclinata, Syzygium cordatum*
Woody climber	*Abrus laevigatus, Asparagus racemosus, Smilax anceps*
Tall shrub	*Antidesma venosum, Vachellia natalitia*
Herb	*Berkheya speciosa, speciosa, Cyanotis speciosa, Senecio glaberrimus, Alepidea longifolia, Centella glabrata, Helichrysum cymosum cymosum, Eriosema squarrosum, Hibsicus pedunculatus, Indigofera hilaris, Pentanisia prunelloides, Vernonia galpinii, Vernonia oligocephala*
Geophytic herb	*Bulbine asphodeloides, Disa polygonoides, Hypoxis filiformis, Ledebouria floribunda, Pachycarpus asperifolius, Schizocarphus nervosus, Tritonia disticha*
Graminoids	*Aristida junciformis galpinii, Digitaria eriantha, Panicum maximum, Themeda triandra, Cymbopogon caesius, Eragrostis curvula, Hyparrhenia filipendua, Melinis repens*
Biogeographically important taxa	
Geoxylic suffrutex	*Ancylobotrys petersiana, Eugenia albanensis, Salacia kraussi*
Small tree	*Vachellia nilotica kraussiana, Anastrabe integerrima*
Low shrubs	*Agathisanthemum bojeri, Helichrysum kraussi, Desmodium dregeanum*
Geophytic herb	*Kniphofia gracilis, Kniphofia littoralis, Kniphofia rooperi, Pachystigma venosum, Zeuxine africana*
Graminoid	*Cyperus natalensis, Eragrostis lappula*
Endemic taxa	
Geophytic herb	*Kniphofia pauciflora*

3.1.2 Northern Coastal Forest

The Northern Coastal Forest type occurs on coastal plains and stabilised coastal dunes (Mucina and Geldenhuys, 2006). The underlying geology is well-developed, sand-loamy soil types of the Karoo Supergroup and Jurassic intrusive dolerites. The stabilised dune systems are formed from Holocene marine sediments. The forest is generally species-rich, and the dominant vegetation structure is tall/medium in height. The extent of Northern Coastal Forests, however, has been reduced from agriculture, forestry, urbanisation and mining, and further threatened by the presence of IAPs. Scott-Shaw and Escott (2011) have split the national delineation of Northern Coastal Forest into several sub-forms, including KZN Dune

Forest and KZN Coastal Forest as associated with the study area, both of which have been assessed within the KZN Province as **Critically Endangered**.

Table 3-2 provides a list of the principal plant species typically associated with natural to near natural occurences of KZN Dune Forest and KZN Coastal Forest (i.e. Northern Coastal Forest). **Figure 3-1** provides a spatial illustration of the distribution and extent of the vegetation type in its original, reference state in relation to the terrestrial cable.

Table 3-2 List of principal floral taxa defining the Northern Coastal Forest (Mucina and Geldenhuys, 2006)

Functional growth form	Species
Important taxa	
Tall tree	*Albizia adianthifolia, Mimusops caffra, Psydrax obovata, Sideroxylon inerme*
Small tree	*Brachylaena discolor, Brachylaena uniflora, Bequaertiodendron natalense, Buxus natalensis, Gymnosporia nemorosa, Cavacoa aurea, Xylotheca kraussiana, Deinbollia oblongifolia*
Woody climber	*Senegalia kraussiana, Rhoicissus tomentosa, Dalbergia aramta, Monanthotaxis caffra, Uvaria caffra*
Herbaceous climber	*Gloriosa superba*
Tall shrub	*Carissa bispinosa bispinosa, Hyperacanthus amoenus*
Soft shrub	*Isoglossa woodii*
Megaherb	*Dracaena aletriformis, Strelitzia nicolai*
Herb	*Asystasia gangetica, Larpotea peduncularis*
Low shrub	*Chrysanthemoides monilifera rotundata*
Geophytic herb	*Microsorum scolopendria*
Graminoid	*Cyperus albostriatus, Oplismenus hirtellus*
Biogeographically important taxa[2]	
Tall tree	*Celtis gomphophylla, Chrysophyllum viridifolium, Drypetes natalensis*
Small tree	*Coffea racemosa, Dovyalis longispina, Artabotrys monteiroae*
Endemic taxa[3]	
Tall tree	*Vachellia kosiensis*

It has been reported that forest habitats provide an array of ecosystem services (Escobedo et al. 2011; Miura et al. 2015). Given the geographical context of the forested habitats within the project area, the forest is likely to provide coastal stabilisation by preventing erosion and impeding sea winds, as well as air quality amelioration and local climate control.

2 Taxa that are not necessarily endemic but carry additional importance by being either; limited to a small group of vegetation units, they are listed a regionally endemic in an established Centre of Endemism, they occur at the limits of their distribution area or they show a very disjunct distribution pattern.

3 Plant taxa that occur exclusively within the vegetation unit concerned

3.1.3 Sub-Tropical Seashore Vegetation

The Sub-tropical Seashore Vegetation is characterised by open, grassy, herbaceous and shrubby features (Mucina *et al.*, 2006a). They are formed by deposition of recent coastal sandy sediments that are exposed to storms and consequently, are dynamic environments. Tropical coastal elements increase along the north-south gradient shift. The vegetation type is classified as '**Least Threatened**' with approximately 30% formerly protected. Approximately 10% has been transformed.

Table 3-1 provides a list of the principal plant species typically associated with natural to near natural occurences of Sub-tropical Seashore Vegetation. **Figure 3-1** provides a spatial illustration of the distribution and extent of the vegetation type in its original, reference state in relation to the METISS submarine cable.

Table 3-3 List of principal floral taxa defining Sub-Tropical Seashore Vegetation (Mucina *et al.*, 2006)

Functional growth form	Species
Important taxa[4]	
Succulent shrub	*Phylohydrax carnosa*, *Scaevola plumieri*, *Scaevola sericea*
Herbaceous climber	*Ipomoea pes-caprae*, *Ipomoea wightii*
Herbs	*Canavalia rosea*, *Gazania rigens, Chironia decumbens, Dasispermum suffruticosum, Gladiolus geunzii, Helichrysum praecinctum, Launea sarmentosa, Phyllopodium cuneifolium, Silene primuliflora, Tephrosia purpurea canescens,*
Geophytic herb	*Trachyandra divaricata*
Succulent herb	*Arctotheca populifolia, Carpobrotus dimidiatus*
Graminoid	*Juncus kraussii, Sporobolus virgnicus, Cyperus crassifolius*

Dune habitats are characterised by plant communities which usually consist of four distinct zones as described by Kee and Nichols (2004), and typically transition between seashore vegetation and inland vegetation types (e.g. coastal forest and grassland). These zones are generally defined according to different stages of plant succession – the first dune comprising hardy pioneer plants that respond well to the rapidly shifting sands of the foredune, with zones further inland becoming more stable, and supporting more advanced levels of forest succession (Kee and Nichols, 2004; Tinley, 1985; Weisser, 1980). The communities associated with the foredunes are adapted to tolerate harsh conditions (e.g. salt spray, high temperatures, wind, erosion, low nutrients, etc.), and as a result only pioneer plant species such as *Carpobrotus dimidiatus* and *Scaevolia plumieri* inhabit this zone (Kee and Nichols, 2004). Higher up the foredunes, the plant community starts to include bush clumps with shrubs such as *Brachylaena discolour*, *Carissa macrocarpa*,

4 Species (and lower taxa) that have a high abundance, a frequent occurrence or are prominent in the landscape.

Chrysanthemoides monilifera and *Strelitzia Nicolai* (Kee and Nichols, 2004). Weisser (1980) collectively refers to the seaward-facing foredunes as coastal thicket due to the dense, stunted vegetation that is characterised by salt-spray and onshore winds, and the transition to dune forest tends to be gradual. However, an important feature is the dune crest, which principally separates coastal thicket from the 'proper' dune forest located on the landward-facing dunes and in the dune valleys.

3.2 National threatened ecosystems

The South African National Biodiversity Institute (SANBI) and the Department of Environmental Affairs and Tourism (DEAT) (2009), in accordance with the National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004), provides a listing of threatened or protected ecosystems, categorised by four categories, namely Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or protected.

The METISS TCR traverses two threatened ecosystems (**Figure 3-2**), both of which are classified as **Critically Endangered**, namely:

- ***Interior South Coast Grasslands –*** originally covered 148 000 hectares. At present only about 9% remains, and a small proportion (~2%) of the original extent is protected. The remaining areas of Interior South Coast Grasslands support a number of threatened or endemic plants and animals. Key biodiversity features include: three millipedes (*Centrobolus anulatus*, *Doratogonus infragilis* and *D. montanus*), four reptiles (*Bradypodion angustiarum*, *B. caeruleogula*, *B. melanocephalum* and *B. wezae*) and seventeen plants (e.g. *Begonia rudatisii, Craterostigma nanum* var. *nanum, Diaphananthe millarii, Eugenia simii, Helichrysum woodii, Huernia hystrix parvula, Kniphofia pauciflora, Kniphofia rooperi, Streptocarpus primulifolius, Watsonia confusa*).
- ***Southern Coastal Grasslands –*** originally covered 23 000ha. At present only about 6% remains, and a very small proportion (<1%) of the original extent is protected. The area supports nine species of conservation concern. Key biodiversity features include: two millipedes (*Centrobolus anulatus* and *Doratogonus infragilis*), one amphibian (*Hyperolius pickersgilli*), three reptiles (*Bradypodion caeruleogula, B. melanocephalum* and *B. wezae*), two plants (*Helichrysum woodii* and *Kniphofia pauciflora*), and three vegetation types (i.e. Scarp Forest, KwaZulu-Natal Sandstone Sourveld and KwaZulu-Natal Coastal Belt).

Figure 3-2 Map of nationally threatened and protected ecosystems occurring within the study area (after SANBI and DEAT, 2009)

The aforementioned threatened ecosystems intercept various vegetation types, namely: KwaZulu-Natal Coastal Forest, KwaZulu-Natal Dune Forest, KwaZulu-Natal Sandstone Sourveld, Ngongoni Veld, KwaZulu-Natal Coastal Belt, Pondoland Scarp Forest, Pondoland-Ugu Sandstone Coastal Sourveld.

3.3 Areas of Conservation Importance

3.3.1 Provincial conservation planning

Ezemvelo KwaZulu-Natal Wildlife's (EKZNW's) Systematic Conservation Assessment (SCA, also referred to as systematic conservation planning) highlights areas that vary in terms of conservation importance as identified and mapped under the KZN biodiversity spatial planning terms and processes (EKZNW, 2016). This includes areas that are proclaimed as formally protected areas (e.g. Provincial reserves, private reserves and stewardship sites), as well as unprotected areas that are considered a priority in terms of containing important biodiversity features. In terms of the latter, areas within KZN are subdivided into Planning Units (PUs) of varying spatial scales each supporting/potentially supporting biodiversity features (e.g. conservation important species, vegetation types, etc.). The SCA broadly classifies areas of biodiversity value/importance using two categories, namely **Critical Biodiversity Area's (CBA's)** and **Ecological Support Areas (ESAs)**. CBAs comprise two subcategories, CBA: Irreplaceable and CBA: Optimal. PUs designated as CBA: Irreplaceable represent the only localities where conservation targets for specific biodiversity features can be met under the current conservation planning scenario. CBA: Optimal areas represent the best localities that provide critical linkages for CBA: Irreplaceable areas. ESAs represent areas that support and sustain the ecological functioning of the CBAs thereby ensuring the persistence and maintenance of biodiversity patterns and ecological processes.

A good portion of the study area contains land that is classified as **CBA: Irreplaceable** (**Figure 3-3**). These areas are considered highly sensitive from a biodiversity conservation perspective, and are considered mandatory by EKZNW (i.e. as the competent conservation authority for KZN) in terms of maintaining biodiversity targets within the province. Sections of the METISS terrestrial cable either traverses or bypasses some of these sensitive areas (**Figure 3-3**).

3.3.2 Municipal conservation planning

On a finer spatial scale, the eThekwini Municipality uses the Durban Metropolitan Open Space System (D'MOSS) plan to manage and conserve open spaces within the Durban region (**Figure 3-4**). The D'MOSS incorporates areas of high biodiversity value, nature reserves, environmentally sensitive areas, etc., and these areas have a fair degree of overlap with the

Figure 3-3 Map of provincially important conservation areas occurring within the study area (after EKZNW, 2016)

Figure 3-4 Map of important conservation areas for the eThekwini Municipality on occurring within the study area (after D'MOSS, 2011)

provincial CBAs as illustrated in **Figure 3-3**. Sections of the METISS terrestrial cable either traverses or bypasses areas that form part of D'MOSS (**Figure 3-4**).

3.4 Desktop-based Biota Assessment

3.4.1 Flora of Conservation Importance

Approximately 520 species of plant would have historically occurred within the broader landscape within which the study area occurs (Ranwashe, 2015); this excludes hydrophytes and lithophytes (**Appendix A**). These functional growth forms were omitted from the reference species list due to the geographical physiognomy (generally dune systems possessing a steep to gentle slope) of the study area. Thirty-six species derived from the aforementioned list are protected under provincial legislation, i.e. the KZN Nature Conservation Ordinance (NCO; Act No. 15 of 1974). The list includes four species of Amaryllidaceae, four species of Hyacinthaceae, nine species of Iridaceae and 15 species of Orchidaceae. There are also three species of trees that potentially occur within the study area that are protected under the National Forests Act, 1998 (Act No. 84 of 1998), namely: *Mimusops caffra* (Sapotaceae), *Sideroxylon inerme* (Sapotaceae) and *Pittosporum viridiflorum* (Pittosporaceae).

Based on collection records, five Red Listed species are expected to occur within the broader landscape of the study area. **Table 3-4** below summarises information considered pertinent to conservation of these species.

Table 3-4 Summary of Red Listed flora species recorded within the within the broader landscape of the Study area associated with the METISS submarine cable system

Species	Red-list Status	Habitat	Threats
Aloe thraskii	NT	Dense coastal bush on dunes from the beach margin to a few hundred metres inland, but no further than the top of the first sea-facing slope.	Transformation and degradation of coastal dunes by coastal development. Additional threats include removal of plants for horticultural purposes and climate change.
Cassipourea gummiflua var. *verticellata*	VU	An array of forest habitats, as well as Eastern Valley bushveld and Maputaland Wooded Grassland.	The bark of the species is in high demand for traditional medicinal use. Habitat loss is an additional cause for the species' decline in abundance.
Hyobanche fulleri	CR	Sandy soils within 1 km of the coast in Sub-tropical Seashore Vegetation and	Coastal development and dune stabilization. Dunes around developments are vegetated to prevent erosion, but this has

Species	Red-list Status	Habitat	Threats
		KwaZulu-Natal Coastal Belt Grassland.	negatively influenced this species as it requires fires and flooding for recruitment.
Mondia whitei	EN	In South Africa, predominantly in swamp forest, but occurs in scarp, riverine and coastal forest as well	Over-harvesting for medicinal use and habitat destruction. Within KwaZulu-Natal, the species had a wide historical distribution, but is presently considered extinct in the wild to the south of the Tugela River.
Stangeria eriopus	VU	Scarp forest, coastal forest, Ngongoni and coastal grassland	Over-exploited for the traditional medicinal market. Habitat destruction due to woodcutting and agriculture.

In addition to the Red Listed species, there are seven species of flora, although listed as 'Least Concern' that are currently declining in population size. The respective habitat and threats to these, less threatened species are summarised in **Table 3-5**.

Table 3-5 Summary of flora species with declining populations recorded within the within the broader landscape of the Study area associated with the METISS submarine cable system

Species	Habitat	Threats
Adenia gummifera var. *gummifera*	An array of forest habitats, as well as miombo woodland and savannah.	Exploited for traditional medicinal use.
Cassipourea malosana	Coastal and mistbelt forests in KwaZulu-Natal. An Afromontane understorey tree in Mpumalanga.	Unsustainable harvesting of bark for traditional medicine have caused a marked decrease in the abundance of sub-populations in KwaZulu-Natal. Habitat desctruction is an additional threat.
Cryptocarya latifolia	Riverine and coastal forests. South African endemic.	Bark is unsustainably harvested for traditional medicine and populations are declining as a result. Habitat desctruction is an additional threat.
Disperis woodii	Damp grassland from sea level to 800 m.a.s.l.	Habitat destruction due to urbanisation and expansion of sugarcane cultivation.
Elaeodendron croceum	Coastal and Afromontane forest margins.	Bark is unsustainably harvested for traditional medicine and

Species	Habitat	Threats
		populations are declining as a result. Habitat desctruction is an additional threat
Eulophia speciosa	Various habitats including sand dunes, savannah and thicket.	Declining due to unsustainable harvesting for traditional medicine.
Rapanea melanophloeos	An array of forest habitats, often in damp areas.	Declining due to unsustainable harvesting for traditional medicine.

3.4.2 Fauna of Conservation Importance

The following list stipulates the number of species of fauna recorded for selected taxonomic groups that potentially occur within the broader landscape that encompasses the study area. Species of conservation concern are summarised according to each taxon below. Furthermore, **Table 3-6** provides a summary of information pertinent to the management of species of conservation concern.

i. ***Lepidoptera* –** Approximately 224 species of Lepidoptera (i.e. Moths and Butterflies) were recorded within the 3030BB quarter degree cell (**Appendix B**). Of this diversity, none are Red Listed species, although the conservation status assessments for 65 of the species have not been evaluated.
ii. ***Amphibians* –** Approximately 17 species of amphibian potentially occur within the area under natural conditions (**Appendix C**). This represents 22% of the amphibian diversity in KZN. Two Red Listed species were recorded within the quarter degree cell: *Hyperolius pickersgilli* (Endangered) (IUCN, 2016a) and *Natalobatrachus bonebergi* (Endangered) (IUCN, 2016b).
iii. ***Reptiles* –** There were 21 species of reptile recorded within the quarter degree square, accounting for approximately 10% of all reptile species recorded within KZN (**Appendix D**). The species list includes the invasive Red-eared Slider *Trachemys scripta*. Two species recorded within the quarter degree cell are of conservation concern: *Bradypodion melanocephalum* (Near Threatened) (Tolley, 2018) and *Scelotes inornatus* (Critically Endangered) (Alexander *et al.,* 2018).
iv. ***Avifauna* –** According to the South African Bird Atlas Project 2 (SABAP2), 311 indigenous species of avifauna were recorded quarter degree square 3030BB (**Appendix E**). Eight species are regarded as conservation concern. However, within the boundary and nature of the study area, two of the species regarded will be possibly impacted, namely African Crowned Eagle (*Stephanoaetus coronatus*) and Lanner Falcon (*Falco biarmicus*). Although the aforementioned

avifauna species are listed as globally Near Threatened and Least Concern respectively, they are regionally listed as Vulnerable.

Table 3-6 Summary of ecological information relevant to the management of faunal species of conservation concern recorded within the broader landscape of the study area associated with the METISS submarine cable system

Taxonomic Group	Species	Range Description	Habitat	Threats
Amphibia	*Hyperolius pickersgilli*	This species is endemic to the coast of KwaZulu-Natal and is found within 15 km of the coast up to 380 m.a.s.l.	The species is a habitat specialist occurring primarily in Indian Ocean Coastal Belt Vegetation. The species requires an understory of thick vegetation from which the males call and taller broad-leaved vegetation, including the *Phragmites australis*, *Typha capensis* and *Cyperus* spp. on which to lay its eggs	Threatened primarily by habitat loss caused by urbanisation, afforestation and drainage for agricultural and urban development and more recently by dune mining and large-scale industrial developments. Invasive alien plants degrade habitat quality.
	Natalobatrachus bonebergi	This species is restricted to south-eastern South Africa.	It is a habitat specialist, inhabiting rocky streams in dense scarp and riparian forests. Requires clear shallow streams with overhanging vegetation and large rocks for egg clump attachment.	Habitat loss due to urbanization, agriculture and mining. Water quality degradation, excessive sedimentation of streams and invasive alien plants are further threats.
Reptilia	*Bradypodion melanocephalum*	Endemic to South Africa (KZN and Eastern Cape). The distribution reaches approximately 100 km inland, except in the southern portion of the range where the species appears to be confined to the coast.	Is found in a number of vegetation types such as grassland, bushland, thicket, trees and roadside verges.	Habitat fragmentation and invasive alien plants. The range is under heavy pressure for present and future land transformation, especially around the Durban municipal area.

Taxonomic Group	Species	Range Description	Habitat	Threats
	Scelotes inornatus	Endemic to South Africa and limited to the greater Durban area of KwaZulu-Natal. The current distribution comprises of extremely small remaining fragments, totalling 2.9 km^2	Found in Berea Red Sand associated with coastal forest below 70 m and within 4 km of the coast. This species is a fossorial habitat specialist.	Development of roads, housing, industrial development and farmland have caused habitat destruction and severe fragmentation.
Avifauna	*Falco biarmicus*	Widespread distribution throughout Africa, Europe and Asia	Inhabits a variety of habitats, from lowland deserts to forested mountains, and is recorded up to 5,000 m.a.s.l.	Threatened by habitat loss through urbanisation, agriculture, road-construction, mining and afforestation. Local declines in southern Africa are possibly attributed to pesticides (Birdlife International 2016).
	Stephanoaetus coronatus	Widespread throughout sub-Saharan Africa.	Inhabits an array of forest, woodland, savanna plantations included modified forested habitats.	Deforestation, agriculture and forestry expansion, mining and collisions with anthropogenic structures. The bushmeat trade has also negatively influenced the species' population.

3.5 Field-based Assessments

This section describes the results of the field survey undertaken and is accordingly divided into respective flora and fauna sections.

3.5.1 Flora species

Seventy species of indigenous flora were recorded along TCR 2 during the site visit (**Table 3-7**). The most diverse family was the Fabaceae, which comprised of 11 species with an array of functional growth forms (**Table 3-7**). Some of the more ubiquitous species observed were *Asystasia gangetica*, *Brachylaena discolor, Chrysanthemoides monilifera*, *Clerodendrum glabrum*, *Cyphostemma cirrhosum*, *Deinbollia oblongifolia*, *Ipomoea ficifolia*, *Senegalia kraussiana* and *Strelitzia nicolai* (**Figure 3-5**). Several of these species are regarded as 'important taxa' of Northern Coastal Forest (Mucina and Rutherford, 2006), as described in Section 3.1 of this report.

Table 3-7 Summary of indigenous plant species recorded within the study area along the Terrestrial Cable Route 2 (TCR 2) of the METISS submarine cable system in South Africa. LC = Least Concern and NE = Not Evaluated. Species highlighted in bold are protected by South African legislation.

Family	Species	Growth form	Conservation Status
Acanthaceae	*Asystasia gangetica*	Terrestrial herb	LC
	Isoglossa ciliata	Herbaceous shrub	LC
Anacardiaceae	*Protorhus longifolia*	Tall tree	LC
	Searsia chirindensis	Tall tree	LC
	Searsia nebulosa	Woody scrambler	LC
Apocynaceae	*Tabernaemontana ventricosa*	Tall tree	LC
Asphodelaceae	*Aloidendron barberae*	Megaherb	LC
Asteraceae	*Brachylaena discolor*	Small tree	LC
	Helichrysum panduratum	Herbaceous shrub	LC
	Senecio deltoideus	Herbaceous climber	LC
	Senecio tamoides	Herbaceous climber	LC
Bignoniaceae	*Tecomaria capensis*	Woody scrambler	LC
Boraginaceae	*Cordia caffra*	Small tree	LC
Celastraceae	*Gymnosporia nemorosa*	Small tree	LC
Combretaceae	*Combretum kraussi*	Tall tree	LC
Commelinaceae	*Aneilema aequinoctiale*	Terrestrial herb	LC
	Aneilema dregeanum	Terrestrial herb	LC
	Commelina erecta	Terrestrial herb	LC
Convolvulaceae	*Ipomoea ficifolia*	Herbaceous climber	LC
Cyperaceae	*Cyperus albostriatus*	Graminoid	LC
	Kyllinga alata	Graminoid	LC
Ebenaceae	*Euclea natalensis*	Small tree	LC
Euphorbiaceae	*Tragia glabrata*	Herbaceous climber	LC
Fabaceae	*Adenopodia spicata*	Woody climber	LC

Family	Species	Growth form	Conservation Status
	Baphia racemosa	Tall tree	LC
	Chamaecrista comosa	Terrestrial herb	LC
	Chrysanthemoides monilifera	Woody shrub	LC
	Dalbergia obovata	Woody scrambler	LC
	Erythrina caffra	Tall tree	LC
	Neonotonia wightii	Herbaceous climber	LC
	Rhynchosia caribaea	Herbaceous scrambler	LC
	Senegalia kraussiana	Woody climber	LC
	Vachellia robusta	Tall tree	LC
	Vachellia sieberiana	Tall tree	LC
Hyacinthaceae	***Ledebouria petiolata***	**Geophyte**	**LC**
Icacinaceae	*Apodytes dimidiata*	Tall tree	LC
Iridaceae	***Crocosmia aurea***	**Geophyte**	**LC**
Lamiaceae	*Clerodendrum glabrum*	Small tree	LC
	Leonotis glabrata	Terrestrial herb	LC
Malvaceae	*Grewia occidentalis*	Woody scrambler	LC
Moraceae	*Ficus burkei*	Tall tree (strangler)	LC
	Ficus burt-davyi	Woody scrambler	LC
	Ficus lutea	Tall tree	LC
Passifloraceae	*Adenia gummifera*	Woody climber	LC (declining)
Phyllanthaceae	*Antidesma venosum*	Small tree	LC
	Bridelia micrantha	Tall tree	LC
Plumbaginaceae	*Plumbago auriculata*	Herbaceous scrambler	LC
Poaceae	*Oplismenus hirtellus*	Graminoid	LC
	Panicum maximum	Graminoid	LC
	Setaria megaphylla	Graminoid	LC
Rhamnaceae	*Helinus integrifolius*	Herbaceous climber	LC
Rubiaceae	*Canthium inerme*	Small tree	LC
	Keetia gueinzii	Woody climber	LC
	Pavetta lanceolata	Small tree	LC
	Psychotria capensis	Small tree	NE
Sapindaceae	*Allophylus natalensis*	Small tree	LC
	Deinbollia oblongifolia	Small tree	LC
Sapotaceae	***Mimusops caffra***	**Tall tree**	**LC**
	Sideroxylon inerme	**Tall tree**	**LC**
Scrophulariaceae	*Chaenostoma floribunda*	Terrestrial herb	LC
Smilacaceae	*Smilax anceps*	Herbaceous climber	LC
Strelitziaceae	*Strelitzia nicolai*	Megaherb	LC
Ulmaceae	*Celtis africana*	Tall tree	LC
	Chaetacme aristata	Tall tree	LC
	Trema orientalis	Tall tree	LC
Urticaceae	*Obetia tenax*	Woody shrub/small tree	LC
Vitaceae	*Cyphostemma cirrhosum*	Herbaceous climber	LC
	Rhoicissus rhomboidea	Woody climber	LC
	Rhoicissus sp. (*cf. digitata*)	Woody climber	LC
	Rhoicissus tomentosa	Woody climber	LC

Asystasia gangetica

Ipomoea ficifolia

Clerodendrum glabrum

Cyphostemma cirrhosum

Strelitzia nicolai

Deinbollia oblongifolia

Figure 3-5 Photographs illustrating a portion of the predominant species within the study area of the Terrestrial Cable Route 2 (TCR 2) of the METISS submarine cable system in South Africa

No Red Listed species were recorded within the study area, albeit *Adenia gummifera*, a species with a declining population trend (Raimondo *et al.*, 2009), was recorded. However, this species was only observed within the sea-facing dune forest. Four protected species were recorded within the study area (**Table 3-7**; **Figure 3-6**), namely:

- *Crocosmia aurea* (Iridaceae) – Schedule 12 NCO[5];
- *Ledebouria petiolata* (Hyacinthaceae) – Schedule 12 NCO;
- *Mimusops caffra* (Sapotaceae) – NFA[6]; and
- *Sideroxylon inerme* (Sapotaceae) – NFA.

Sideroxylon inerme

Mimusops caffra (hosting *Bostra carnicolor*)

Crocosmia aurea

Ledebouria petiolata

Figure 3-6 Photographs illustrating protected species recorded within the study area of the Terrestrial Cable Route (TCR) of the METISS submarine cable system in South Africa

Thirty-two species of IAPs were recorded within the Study area during the assessment. The species observed, and their associated NEMBA category are summarised in **Table 3-8**. The NEMBA Alien and Invasive Species List document (DEA, 2016) categorises invasive species

[5] KZN Nature Conservation Ordinance (NCO; Act no. 15 of 1974)
[6] National Forests Act, 1998 (Act No. 84 of 1998)

with respect to restricted activities. Categories 1a, 1b, 2 and 3 Listed Invasive Species, in terms of which certain Restricted Activities are:

- Prohibited in terms of Section 71A(1);
- Exempted in terms of Section 71(3); or
- Require a Permit in terms of Chapter 7.

Table 3-8 Invasive alien plants (IAPs) recored within the study area along the Terrestrial Cable Route 2 (TCR 2) of the METISS submarine cable system in South Africa

Family	Species	Growth Form	NEMBA Category
Amaranthaceae	*Achyranthes aspera*	Terrestrial herb	-
Apiaceae	*Centella asiatica*	Terrestrial herb	-
Aristolochiaceae	*Aristolochia elegans*	Herbaceous climber	1b
Asteraceae	*Chromolaena odorata*	Shrub	1b
	Bidens pilosa	Terrestrial herb	-
	Montanoa hibiscifolia	Shrub	1b
	Tagetes minuta	Terrestrial herb	-
	Tithonia diversifolia	Shrub	1b
Basellaceae	*Anredera cordifolia*	Herbaceous climber	1b
Cactaceae	*Pereskia aculeata*	Woody climber	1b
Commelinaceae	*Tradescantia zebrina*	Geophyte	1b
Convolvulaceae	*Ipomoea indica*	Herbaceous climber	1b
	Ipomoea purpurea	Herbaceous climber	1b
Euphorbiaceae	*Euphorbia hirta*	Terrestrial herb	-
	Ricinus communis	Shrub	1b
Fabaceae	*Leucaena leucocephala*	Small tree	1a
Lamiaecae	*Vitex trifolia*	Small tree	1b
Malvaceae	*Malvastrum coromandelianum*	Terrestrial herb	1b
Meliaceae	*Melia azedarach*	Tall tree	1b
Moraceae	*Morus alba*	Tall tree	2
Nyctaginaceae	*Boerhavia diffusa*	Terrestrial herb	-
Passifloraceae	*Passiflora suberosa*	Herbaceous climber	1b
Phytolaccaceae	*Phytolacca dioica*	Tall tree	3
Phytolaccaceae	*Rivina humilis*	Terrestrial herb	1a
Poaceae	*Arundo donax*	Megagraminoid	1b
	Bambusa balcooa	Megagraminoid	-
	Coix lacryma-jobi	Graminoid	-
	Pennisetum clandestinum	Graminoid	-
	Pennisetum purpureum	Graminoid	1b
Solanaceae	*Cestrum laevigatum*	Tall tree	1b
Solanaceaea	*Solanum mauritianum*	Small tree	1b
Verbenaceae	*Lantana camara*	Shrub	1b

3.5.2 Vegetation description

The structure of the vegetation within the study area was spatially heterogenous. Furthermore, the landscape of the study area has been substantially transformed with a single disturbed remnant of KwaZulu-Natal Coastal Belt Grassland present. Although three of the important taxa were recorded for this vegetation type within the study area, the flora richness and structure were lacking. Within the study area, Northern Coastal Forest was the principal vegetation type, although there was evidence of considerable disturbance, particularly along the edges. Descriptions of the vegetation within the study area have been summarised in **Table 3-9** below.

Table 3-9 Description of vegetation structure along sections of the METISS submarine cable TCR 2, from the termination of the marine cable to the termination of TCR 2. GPS coordinates (decimal degrees) of protected flora species recorded along the route are provided.

TCR 2 at the BMH (Segment A) - 30.040371°S, 30.898889°E
The Sub-Tropical Seashore Vegetation along the route was discontinous and transformed. The vegetation along this route was dominated by *B. discolor* and *C. monilifera*. No specimens of *H. fulleri* (CR) were observed. In addition, *L. camara* has invaded this section of the vegetation indicating that it has been disturbed.
 
TCR 1 - 30.039932°S, 30.039932°E to 30.039061°S, 30.897500°E (N.B. no longer considered feasible)
This sea-ward facing Northern Coastal Forest is categorised as an irreplaceable CBA (see section 3.3.1 of this report). The segment of the area surveyed was dominated, with regards to cover, by *B. discolor*, *I. ficifolia*, *S. anceps* and *S. icolai*. Three specimens of *M. caffra* (Protected Tree; NFA) were recorded within the segment. The approximate coordinates are listed as follows: • -30.03988, 30.89817 • -30.03977, 30.89871 • -30.03974, 30.89876 The segment has been considerably disturbed as indicated by the relatively dense growth of the IAPs, *C. odorata* and *L. camara*, as well as the relatively high cover of indigenous pioneer species. In addition, there was evidence of illegal dumping of solid waste.


TCR 2 (Segment B) - 30.039931°S, 30.039931°E to 30.044082°S, 30.893611°E

This segment of the route has been transformed. Importantly, a specimen of *M. caffra* (Protected) was recorded along the route (30.04168°S, 30.89609°E).


TCR 2 (Segment C) - 30.044162°S,30.893475°E to 30.045824°S, 30.891082°E

This segment of the TCR was initially proposed to be placed on North of the road, but during the site visit, representatives from LiquidTelecom had indicated that this was not possible due to the presence of stormwater drains that were only observed during the site visit. Consequently, the route of the TCR has to be shifted South of the road (see photographs). Accordingly, the description below pertains to this new route.

The vegetation along the South paving was dominated by indigenous flora, with a relatively minor cover of IAPs. Dominant species included *A. gangetica*, *B. discolor*, *F. burt-davyi*, *G. occidentalis*, *Rhoicissus* sp. and *S. nebulosa*. The structure of the vegetation was not congruent with climax Northern Coastal Forest, but rather thicket vegetation. Nevertheless, this section has been highlighted as a D'MOSS component, and based on the species richness of the flora. A specimen of *S. inerme* (Protected Tree; NFA) was recorded along this route (30.044590°S, 30.893056°E).


TCR 2 (Segment D) - 30.04112306°S, 30.89416667°E to 30.039262°S, 30.895549°E

The vegetation within this section of the TCR is not considered as a CBA or a D'MOSS area. The vegetation along the TCR was considered more thicket than forest in structure. The vegetation was disturbed, with the edge dominated by IAPs including *A. cordifolia*, *C. odorata*, *I. pupurea*, *L. camara* and *R. communis*. This was particularly so adjacent to the bridge, where erosion was occurring. Furthermore, solid waste was present along the servitude. Indigenous species present included *B. discolor*, *C. glabrum* and *D. oblongifolia.*


TCR 2 (Segment E) - 30.039262°S, 30.895549°E to S30.039157°, 30.895438°E

The vegetation within this segment has been substantially altered. The section was dominated by graminoids, specifically *P. maximum*. Terrestrial herbs included *C. erecta*, *R. caribea and H. panduratum*. IAPs were prevalent parallel to the bridge and included *B. pilosa*, *C. asiatica* and *C. odorata*.

Several individuals of *C. aurea* (Protected Plant; NCO) were recorded here in close proximity to each other (30.03925°S, 30.89553°E).

TCR 2 (Segment F) - 30.039154°S, 30.895428°E to 30.038371°S, 30.894214°E

At the start of the segment, the structure of the vegetation was congruent with thicket. However, the segment was dominated by IAPs denoting disturbance. Species included *T. diversifolia*, *L. camara* and *I. purpurea*. Indigenous species were typically pioneer species including *N. wightii* and *T. orientalis*. However, beyond the edge the structure was congruent with Northern Coastal Forest. The remainder of the segment was largely transformed, and therefore, no habitat would have been affected by the development.

TCR 2 (Segment G) - 30.036960°S, 30.892778°E to 30.034780°S, 30.888902°E

The TCR within this segment traverses altered habitat, typically dominated by "weedy" species and *P. clandestinum*. Indigenous species were typically graminoids and comprised of *C. albostriatus*, *K. allata* and *O. hirtellus*. Solid waste dumping was also evident.

Nevertheless, the route was adjacent to climax Northern Coastal Forest that is regarded as an Irreplaceable CBA and D'MOSS area. This area was demarcated by a palisade fence and is not likely to be influenced by activities associated with placement of the terrestrial cable. A single *L. petiolata* (Protected Plant; NCO) was observed along the fenceline (30.035228°S, 30.891389°E).


TCR 2 (Segment H) - 30.034655°S, 30.888664°E to 30.033090°S, 30.889873°E

The vegetation within this segment has been largely transformed. Within this reach of the Amazimtoti River, the marginal and lower non-marginal riparian zone was dominated by invasive graminoids. The species included *P. purpureum* and *Coix lacryma-jobi*. Within the upper non-marginal zone *B. balcooa*, *L. camara* and *M. alba* formed a riparian thicket. Indigenous species provided intermittent cover and comprised of *B. micrantha*, *C. inerme* and *G. nemorosa*. The remainder of the segment was *P. clandestinum* interspersed with *S. nicolai* and *T. orientalis*.

A bank with exposed sedimentary rock along this route was inhabited by *T. capensis* and *P. auriculata*. These were likely planted as they occurred alongside the exotic *Bougainvillea*, a common horticultural species. These formed a scrub-like vegetation.


TCR 2 (Segment I) - 30.033090°S, 30.889873°E to 30.030702°S, 30.886754°E

The edge of the vegetation along this segment was typically altered, with *P. purpureum* predominating. Several indigenous trees were planted along the route and comprised of *E. caffra*, *V. robusta* and *V. sieberiana*.

The servitude was adjacent to forested habitat, albeit historically, this would have been Coastal Belt Grassland and therefore, indicative of a transformed landscape. Although there was a relatively high cover of IAPs, several of the canopy species were indigenous including *B. micrantha* and *S. chirindensis*. *D. obovata* provided relatively high cover.


3.5.3 Fauna species

No fossorial species of conservation concern were recorded within the study area during the assessment. The amphibian species listed in section 3.4.2 above are likely to not occur within the study area due to absence of suitable habitat. Nevertheless, there is suitable habitat available within the study area for the reptile species listed in section 3.4.2 (i.e. *S. inornatus* and *B. melanocephalum*). In order to confirm their presence focused surveys will be required. Nevertheless, there was an abundance of invertebrate groups that were observed during active searching, including Isopoda (Crustacea) and Sphaerotheriida (Chilognatha). These fossorial organsims provide ecosystem services by maintaining soil processes and properties (Lavelle *et al.*, 2006; Vries *et al.*, 2013) and thus are essential for maintaining suitable habitat for higher trophic organisms. Accordingly, the habitat must be managed by mitigating potential impacts from the development.

Woody debris and leaf litter within forest habitat

A specimen of Sphaerotheriida recorded within leaf litter and woody debris

Figure 3-7 Photographs illustrating important soil invertebrates and their associated habitat within the study area of the Terrestrial Cable Route 2 (TCR 2) of the METISS submarine cable in South Africa.

4. DISCUSSION

4.1 Assumptions and Limitations

The assessment undertaken in this report was based largely on the TCR 2 option of the terrestrial component of the METISS submarine cable system, which includes a number of manholes (three of which are required to splice the cable). As indicated by ERM and LiquidTelecom, TCR 1 was not feasible, and therefore not an option to route the cable. The footprint of the impact considered during earthworks was based on a 500 mm wide trench with a depth of 1 000 mm.

This report is based on a desktop assessment and a single-day site visit, and therefore it is possible that important taxa would not have been observed. In the case of flora, this would be due to the absence of floral or propagule organs and/or species entering a dormant phase. The main fauna species of concern are typically secretive and/or nocturnal and would require focused sampling efforts over longer periods of time to ascertain their presence.

4.2 Impact Description

The identified impacts were assessed using specialist impact assessment criteria provided by the ERM as presented in Appendix F. Each impact was assessed in terms of spatial extent, intensity, duration, reversibility, irreplaceability, probability, significance, status, and confidence.

Negative impacts to biodiversity that are expected due to the proposed project are discussed in the following sections. The impacts associated with construction of the Beach Manhole (BMH) and the proposed TCR were considered.

4.2.1 Loss of habitat (including areas of conservation importance)

Almost the entire study area is largely transformed, and includes high density urban developments and road networks. Nevertheless, pockets of vegetation supporting habitats for fauna and flora do occur. Depending on the specific aignment of TCR 2, installation of the cable (and various manholes) is likely to negatively impact vegetation/habitat characteristics, and potentially species of conservation concern.

The BMH will be located within an already transformed area with established road access. Hence, no further impacts are expected as a result of the METISS submarine cable.

The two, intitial terrestrial cable options presented for the TCR predominantly use the existing road network, and therefore loss of the existing natural vegetation will be minimal. A section of TCR 1 passess through Northern Coastal Forest (regionally referred to as KZN Dune Forest and KZN Coastal Forest – both are Critically Endangered vegetation types in KZN), which also form part of the provincial CBA: Irreplaceable network and D'MOSS. However, it is understood that TCR 1 is no longer being considered due to the risks to the environment.

4.2.2 Disturbance to flora and fauna

Direct impacts on flora would be restricted to clearing of land in preparation for the construction activities, including digging a 0.5m wide/1.0m deep trench to accommodate the cable, as well as a working area to install the various manholes (including three, larger splicing manholes of 5.0 x 5.0 m/2.0 m deep). Plant species that would potentially be affected, but only at a few localities, include nationally and regionally protected plant species such as the nationally protected trees *Mimusops caffra* and *Sideroxylon inerme*, and the regionally protected geophytes *Crocosmia aurea* and *Ledebouria petiolata*. No Threatened (i.e. Critically Endangered, Endangered and Vulnerable) plant species were observed or are expected to occur along the TCR 2 alignment.

The area has the potential to support fauna, including a small number of conservation important species (see Section 3.5). Direct impacts to fauna will be mostly direct through removal of individuals as a result of clearing the site during the construction phase. This impact would have been greatest for the section TCR 1 that passess through the dune forest, however, impacts associated with this area have been mitigated through omission of this route (i.e. TCR 2 has now been selected as the preferred route).

Indirect impacts will also be experienced as a result of added noise and other disturbances associated with construction. Earthworks, on the otherhand, would principally affect fossorial fauna, particularly sensitive species that are likely to occur in the areas (e.g. the Critically Endangered *Scelotes inornatus*). Furthermore, earthworks adjacent to strips of thicket and/or forest vegetation are likely to disturb and/or destroy habitat availability for *B. melanocephalum* – this species is knonw to inhabit areas degraded by IAPs.

4.2.3 Spread of invasive alien plants

Areas disturbed and/or transformed through development, will create opportunities for the spread of invasive alien plants (IAPs). IAPs that already occur in the area are likely to invade newly disturbed areas. IAP infestation has the potential to further degrade existing natural vegetation, thereby reducing ecological functioning and integrity, as well as compromising the establishment and survival of indigenous fauna and flora. Moreover, the infestation of

IAPs along the route will lead to accessibility challenges for short-term and long-term maintenance.

4.3 Characteristics and Significance of Impacts

The characteristics and significance of the negative impacts associated with the route of the METISS terrestrial cable are summarised in **Table 4-1**. Scale measurements have not been included as the project traverses a relatively narrow linear route. Based on the assessments, there is a moderate significance of impact resulting from habitat loss and disturb to wildlife (Table 4-1). This is due to the actual presence of protected flora species and potential for Red Listed reptile species, *albeit* on a relatively small scale. The spread of IAPs as a consequence of disturbed areas, however, is more of a concern as this will threaten habitat suitability over a relatively wider area (Table 4-1).

The residual significance of impacts, i.e. the assessment that considers implementation of mitigation measures, suggests a decrease in significance for all three of the above-mentioned impacts (Table 4-1). Specifically regarding the threat of the spread of IAPs, this is due to a decrease in the magnitude of the impact, albeit sensitivity of the resource/receptor remains high.

Table 4-1 Characteristics and significance of impacts associated with the Terrestrial Cable Route (TCR) of the METISS cable in South Africa

Terrestrial Cable Route 2 (TCR 2)			
Characteristic	Loss of habitat	Disturbance to fauna	Spread of IAPs
Type	Direct	Direct and Indirect	Indirect
Extent	Local	Local	Local
Duration	Permanent	Temporary	Permanent
Scale	N/A[7]	N/A	N/A
Reversibility	Reversible	Reversible	Reversible
Irreplaceability	Replaceable	Moderate	N/A
Magnitude	Small	Small	High
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High	High	High
Significance of Impact	**Moderate**	**Moderate**	**Major**
Residual significance of Impact	**Minor**	**Minor**	**Moderate**

[7] Scale was regarded as N/A as this is a linear development with no expansive polygon area of impact.

4.4 Recommendations for Impact Avoidance and/or Mitigation

The following preliminary recommendations are provided to avoid and/or mitigate impacts that may arise from the proposed project:

- Ensure, as far as possible, that the development avoids Northern Coastal Forest (i.e. dune and coastal forest), as well as untransformed land that is charactersised as CBA: Irreplaceable and/or D'MOSS. However, as already mentioned, impacts associated with TCR 1 have been mitigated through omission of this route. Furthermore, the terrestrial cable and associated manholes will be aligned mostly with existing roads and walkways, with minimal encroachment on natural, largely degraded, habitats.
- During the earthworks phase, where possible, excavating the sidewalk for placement of the terrestrial cable/manholes should be undertaken rather than vegetation. However, where this is not possible, then forest/thicket habitat must be clearly demarcated using barrier tape to avoid disturbance to these habitats. Disturbances outside these direct impact zones should be prohibited and regulated by a competent Environmental Control Officer (ECO). This is especially important in segments with protected flora species. Please see Table 3-9 for where these were recorded.
    - In **Segment B** it is important that the *M. caffra* not be subjected to adverse root damage during the excavation phase.
    - In **Segment E** it is recommended that the installation of the terrestrial cable be done immediately adjacent to the bridge. This will avoid removal of *C. aurea*. It is also improtant that no excavated material smother these plants.

  Where avoidance of these plants is not possible, then necessary permits will need to be obtained from the regional and national authorities (i.e. EKZNW and DAFF).
- Upon completion of the installation of the cable and the various manholes/splicing manholes, the excavation should be re-filled with the same soil or with soil of the same consistency. No finer material should be used. It is recommended that the topsoil (upper 300 mm of the soil profile) be stored separately from the rest of the soil material and be re-used for re-vegetation purposes.
- The re-filled excavation must be level with the surrounding soil and re-vegetated with suitable indigenous plant species. Species recommended include *Asystasia gangetica*, *Cynodon dactylon* and *Oplismenus hirtellus*. These are fast- and low-

growing species and therefore will aid in suppressing invasive plant growth and will not provide challenges to accessibility for maintenance.

- All waste material/solid waste should be disposed in a sensible manner at designated legal disposal sites and should not be dumped in the proximal vegetation.
- An IAP control programme should be devised for the project based on the finalised development layout. The programme should then be implemented to control problematic IAPs that will most likely invade new areas in response to disturbance of land during the excavation phase. The object is to prevent further spread and establishment of IAPs. The IAP programme will require routine follow-ups to manage re-growth.
- Appointment of a suitably qualified and experienced Environmental Control Officer (ECO) will be essential to minimise unnecessary impacts and disturbance during construction.

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6. APPENDICES

Appendix A: Summary of historically potential protected plant species within the study area (after Ranwashe, 2015)

Family	Species	Growth Form	Legislation
Amaryllidaceae	*Crinum macowanii*	Geophyte	Schedule 12 NCO[8]
Amaryllidaceae	*Cyrtanthus breviflorus*	Geophyte	Schedule 12 NCO
Amaryllidaceae	*Scadoxus membranaceus*	Geophyte	Schedule 12 NCO
Amaryllidaceae	*Scadoxus puniceus*	Geophyte	Schedule 12 NCO
Apocynaceae	*Ceropegia pachystelma pachystelma*	Herbaceous climber	Schedule 12 NCO
Asphodelaceae	*Aloe thraskii*	Woody Succulent	Schedule 12 NCO
Colchicaceae	*Gloriosa superba*	Geophytic climber	Schedule 12 NCO
Dioscoreaceae	*Dioscorea dregeana*	Geophytic climber	Schedule 12 NCO
Hyacinthaceae	*Dipcadi viride*	Geophyte	Schedule 12 NCO
Hyacinthaceae	*Ledebouria cooperi*	Geophyte	Schedule 12 NCO
Hyacinthaceae	*Ledebouria ovatifolia*	Geophyte	Schedule 12 NCO
Hyacinthaceae	*Ledebouria petiolata*	Geophyte	Schedule 12 NCO
Hyacinthaceae	*Ornithogalum tenuifolium tenuifolium*	Geophyte	Schedule 12 NCO
Iridaceae	*Aristea torulosa*	Geophyte	Schedule 12 NCO
Iridaceae	*Crocosmia aurea*	Geophyte	Schedule 12 NCO
Iridaceae	*Dierama tysonii*	Geophyte	Schedule 12 NCO
Iridaceae	*Dietes grandiflora*	Geophyte	Schedule 12 NCO
Iridaceae	*Dietes iridioides*	Geophyte	Schedule 12 NCO
Iridaceae	*Freesia laxa*	Geophyte	Schedule 12 NCO
Iridaceae	*Gladiolus inandensis*	Geophyte	Schedule 12 NCO
Iridaceae	*Gladiolus oppositiflorus*	Geophyte	Schedule 12 NCO
Iridaceae	*Gladiolus parvulus*	Geophyte	Schedule 12 NCO
Orchidaceae	*Aerangis mystacidii*	Epiphyte	Schedule 12 NCO
Orchidaceae	*Brachycorythis ovata ovata*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Disa polygonoides*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Eulophia hians nutans*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Eulophia macowanii*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Eulophia ovalis ovalis*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Eulophia speciosa*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Habenaria dregeana*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Habenaria epipactidea*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Habenaria falcicornis falcicornis*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Mystacidium capense*	Epiphyte	Schedule 12 NCO
Orchidaceae	*Mystacidium flanaganii*	Epiphyte	Schedule 12 NCO
Orchidaceae	*Orthochilus foliosus*	Terrestrial herb	Schedule 12 NCO
Orchidaceae	*Polystachya pubescens*	Epiphyte	Schedule 12 NCO
Orchidaceae	*Tridactyle bicaudata rupestris*	Epiphyte	Schedule 12 NCO
Pittosporaceae	*Pittosporum viridiflorum*	Tree	NFA[9]

[8] KZN Nature Conservation Ordinance (NCO; Act no. 15 of 1974)

Family	Species	Growth Form	Legislation
Sapotaceae	*Mimusops caffra*	Tree	NFA
Sapotaceae	*Sideroxylon inerme*	Tree	NFA

[9] National Forests Act, 1998 (Act No. 84 of 1998)

Appendix B: Summary of Lepidoptera species recorded within the 3030BB quarter degree square (ADU)

Family	Species	Red List Category
Aganaidae	*Asota speciosa*	Not evaluated
Arctiidae	*Euchromia amoena*	Not evaluated
Arctiidae	*Nyctemera apicalis*	Not evaluated
Arctiidae	*Nyctemera leuconoe*	Not evaluated
Arctiidae	*Rhodogastria similis*	Not evaluated
Arctiidae	*Siccia caffra*	Not evaluated
Arctiidae	*Utetheisa pulchella*	Not evaluated
Bombycidae	*Ocinara ficicola*	Not evaluated
Crambidae	*Aethaloessa floridalis*	Not evaluated
Crambidae	*Agrotera citrina*	Not evaluated
Crambidae	*Bocchoris inspersalis*	Not evaluated
Crambidae	*Bradina admixtalis*	Not evaluated
Crambidae	*Diasemia monostigma*	Not evaluated
Crambidae	*Herpetogramma phaeopteralis*	Not evaluated
Crambidae	*Palpita unionalis*	Not evaluated
Crambidae	*Sameodes cancellalis*	Not evaluated
Crambidae	*Spoladea recurvalis*	Not evaluated
Crambidae	*Uresiphita gilvata*	Not evaluated
Erebidae	*Egybolis vaillantina*	Not evaluated
Geometridae	*Acanthovalva inconspicuaria*	Not evaluated
Geometridae	*Chiasmia brongusaria brongusaria*	Not evaluated
Geometridae	*Chiasmia observata*	Not evaluated
Geometridae	*Chiasmia rectistriaria*	Not evaluated
Geometridae	*Chiasmia simplicilinea*	Not evaluated
Geometridae	*Chiasmia subcurvaria*	Not evaluated
Geometridae	*Isturgia deerraria*	Not evaluated
Geometridae	*Xenimpia erosa*	Not evaluated
Geometridae	*Zerenopsis lepida*	Not evaluated
Hesperiidae	*Acleros mackenii mackenii*	Least Concern (SABCA 2013)
Hesperiidae	*Afrogegenes letterstedti*	Least Concern (SABCA 2013)
Hesperiidae	*Afrogegenes ocra*	Not evaluated
Hesperiidae	*Borbo borbonica borbonica*	Least Concern (SABCA 2013)
Hesperiidae	*Borbo fallax*	Least Concern (SABCA 2013)
Hesperiidae	*Borbo fatuellus fatuellus*	Least Concern (SABCA 2013)
Hesperiidae	*Borbo lugens*	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades forestan forestan*	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades keithloa*	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades libeon*	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades pisistratus*	Least Concern (SABCA 2013)
Hesperiidae	*Eagris nottoana nottoana*	Least Concern (SABCA 2013)
Hesperiidae	*Eretis djaelaelae*	Least Concern (SABCA 2013)
Hesperiidae	*Gomalia elma elma*	Least Concern (SABCA 2013)

Hesperiidae	*Kedestes callicles*	Least Concern (SABCA 2013)
Hesperiidae	*Kedestes macomo*	Least Concern (SABCA 2013)
Hesperiidae	*Larsenia gemella*	Least Concern (SABCA 2013)
Hesperiidae	*Metisella metis paris*	Least Concern (SABCA 2013)
Hesperiidae	*Netrobalane canopus*	Least Concern (SABCA 2013)
Hesperiidae	*Parnara monasi*	Least Concern (SABCA 2013)
Hesperiidae	*Pelopidas mathias*	Least Concern (SABCA 2013)
Hesperiidae	*Pelopidas thrax*	Least Concern (SABCA 2013)
Hesperiidae	*Sarangesa motozi*	Least Concern (SABCA 2013)
Hesperiidae	*Sarangesa phidyle*	Least Concern (SABCA 2013)
Hesperiidae	*Spialia dromus*	Least Concern (SABCA 2013)
Hesperiidae	*Spialia spio*	Least Concern (SABCA 2013)
Hesperiidae	*Tagiades flesus*	Least Concern (SABCA 2013)
Lycaenidae	*Actizera lucida*	Least Concern (SABCA 2013)
Lycaenidae	*Alaena amazoula amazoula*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene amarah amarah*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene definita definita*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene larydas*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene lemnos lemnos*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene livida livida*	Least Concern (SABCA 2013)
Lycaenidae	*Anthene otacilia otacilia*	Least Concern (SABCA 2013)
Lycaenidae	*Azanus jesous*	Least Concern (SABCA 2013)
Lycaenidae	*Azanus mirza*	Least Concern (SABCA 2013)
Lycaenidae	*Azanus moriqua*	Least Concern (SABCA 2013)
Lycaenidae	*Azanus natalensis*	Least Concern (SABCA 2013)
Lycaenidae	*Cacyreus lingeus*	Least Concern (SABCA 2013)
Lycaenidae	*Cacyreus marshalli*	Least Concern (SABCA 2013)
Lycaenidae	*Chilades trochylus*	Least Concern (SABCA 2013)
Lycaenidae	*Cigaritis natalensis*	Least Concern (SABCA 2013)
Lycaenidae	*Cupidopsis cissus cissus*	Least Concern (SABCA 2013)
Lycaenidae	*Deudorix antalus*	Least Concern (SABCA 2013)
Lycaenidae	*Eicochrysops hippocrates*	Least Concern (SABCA 2013)
Lycaenidae	*Eicochrysops messapus mahallakoaena*	Least Concern (SABCA 2013)
Lycaenidae	*Euchrysops barkeri*	Least Concern (SABCA 2013)
Lycaenidae	*Euchrysops malathana*	Least Concern (SABCA 2013)
Lycaenidae	*Euchrysops osiris*	Least Concern (SABCA 2013)
Lycaenidae	*Hypolycaena buxtoni buxtoni*	Least Concern (SABCA 2013)
Lycaenidae	*Hypolycaena philippus philippus*	Least Concern (SABCA 2013)
Lycaenidae	*Iolaus silas*	Least Concern (SABCA 2013)
Lycaenidae	*Lachnocnema bibulus*	Least Concern (SABCA 2013)
Lycaenidae	*Lachnocnema durbani*	Least Concern (SABCA 2013)
Lycaenidae	*Lachnocnema laches*	Least Concern (SABCA 2013)
Lycaenidae	*Lampides boeticus*	Least Concern (SABCA 2013)
Lycaenidae	*Lepidochrysops patricia*	Least Concern (SABCA 2013)
Lycaenidae	*Lepidochrysops plebeia plebeia*	Least Concern (SABCA 2013)

Lycaenidae	*Leptomyrina gorgias gorgias*	Least Concern (SABCA 2013)
Lycaenidae	*Leptomyrina gorgias sobrina*	Not evaluated
Lycaenidae	*Leptotes pirithous pirithous*	Least Concern (SABCA 2013)
Lycaenidae	*Myrina dermaptera dermaptera*	Least Concern (SABCA 2013)
Lycaenidae	*Myrina silenus ficedula*	Least Concern (SABCA 2013)
Lycaenidae	*Pentila tropicalis tropicalis*	Least Concern (SABCA 2013)
Lycaenidae	*Tuxentius melaena melaena*	Least Concern (SABCA 2013)
Lycaenidae	*Virachola dinochares*	Least Concern (SABCA 2013)
Lycaenidae	*Virachola diocles*	Least Concern (SABCA 2013)
Lycaenidae	*Zizeeria knysna knysna*	Least Concern (SABCA 2013)
Lycaenidae	*Zizina otis antanossa*	Least Concern (SABCA 2013)
Lycaenidae	*Zizula hylax*	Least Concern (SABCA 2013)
Lymantriidae	*Aroa discalis*	Not evaluated
Lymantriidae	*Euproctis aethiopica*	Not evaluated
Lymantriidae	*Euproctis punctifera*	Not evaluated
Lymantriidae	*Knappetra fasciata fasciata*	Not evaluated
Lymantriidae	*Naroma varipes*	Not evaluated
Noctuidae	*Achaea finita*	Not evaluated
Noctuidae	*Achaea lienardi*	Not evaluated
Noctuidae	*Anoba disjuncta*	Not evaluated
Noctuidae	*Ariathisa abyssinia*	Not evaluated
Noctuidae	*Bareia incidens*	Not evaluated
Noctuidae	*Cyligramma latona*	Not evaluated
Noctuidae	*Dysgonia properans*	Not evaluated
Noctuidae	*Dysgonia torrida*	Not evaluated
Noctuidae	*Earias cupreoviridis*	Not evaluated
Noctuidae	*Earias insulana*	Not evaluated
Noctuidae	*Egybolis vaillantina vaillantina*	Not evaluated
Noctuidae	*Eudocima divitiosa*	Not evaluated
Noctuidae	*Eudocima materna*	Not evaluated
Noctuidae	*Gracilodes caffra*	Not evaluated
Noctuidae	*Heraclia perdix*	Not evaluated
Noctuidae	*Hypopyra capensis*	Not evaluated
Noctuidae	*Hypospila nigropicta*	Not evaluated
Noctuidae	*Mocis frugalis*	Not evaluated
Noctuidae	*Mocis mayeri*	Not evaluated
Noctuidae	*Ozarba abscissa*	Not evaluated
Noctuidae	*Ozarba corniculans*	Not evaluated
Noctuidae	*Ozarba nigroviridis*	Not evaluated
Noctuidae	*Sphingomorpha chlorea*	Not evaluated
Noctuidae	*Trigonodes hyppasia*	Not evaluated
Nymphalidae	*Acraea aganice aganice*	Least Concern (SABCA 2013)
Nymphalidae	*Acraea natalica*	Least Concern (SABCA 2013)
Nymphalidae	*Acraea neobule neobule*	Least Concern (SABCA 2013)
Nymphalidae	*Acraea oncaea*	Least Concern (SABCA 2013)

Nymphalidae	*Acraea petraea*	Least Concern (SABCA 2013)
Nymphalidae	*Amauris albimaculata albimaculata*	Least Concern (SABCA 2013)
Nymphalidae	*Amauris echeria echeria*	Least Concern (SABCA 2013)
Nymphalidae	*Amauris niavius dominicanus*	Least Concern (SABCA 2013)
Nymphalidae	*Amauris ochlea ochlea*	Least Concern (SABCA 2013)
Nymphalidae	*Bicyclus safitza safitza*	Least Concern (SABCA 2013)
Nymphalidae	*Brakefieldia perspicua perspicua*	Least Concern (SABCA 2013)
Nymphalidae	*Byblia anvatara acheloia*	Least Concern (SABCA 2013)
Nymphalidae	*Byblia ilithyia*	Least Concern (SABCA 2013)
Nymphalidae	*Cassionympha cassius*	Least Concern (SABCA 2013)
Nymphalidae	*Catacroptera cloanthe cloanthe*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes brutus natalensis*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes candiope*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes cithaeron cithaeron*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes druceanus druceanus*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes ethalion ethalion*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes varanes varanes*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes wakefieldi*	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes zoolina*	Least Concern (SABCA 2013)
Nymphalidae	*Cymothoe coranus coranus*	Least Concern (SABCA 2013)
Nymphalidae	*Danaus chrysippus orientis*	Least Concern (SABCA 2013)
Nymphalidae	*Eurytela dryope angulata*	Least Concern (SABCA 2013)
Nymphalidae	*Eurytela hiarbas angustata*	Least Concern (SABCA 2013)
Nymphalidae	*Hypolimnas anthedon wahlbergi*	Least Concern (SABCA 2013)
Nymphalidae	*Hypolimnas deceptor deceptor*	Least Concern (SABCA 2013)
Nymphalidae	*Hypolimnas misippus*	Least Concern (SABCA 2013)
Nymphalidae	*Junonia hierta cebrene*	Least Concern (SABCA 2013)
Nymphalidae	*Junonia natalica natalica*	Least Concern (SABCA 2013)
Nymphalidae	*Junonia oenone oenone*	Least Concern (SABCA 2013)
Nymphalidae	*Junonia orithya madagascariensis*	Least Concern (SABCA 2013)
Nymphalidae	*Junonia terea elgiva*	Least Concern (SABCA 2013)
Nymphalidae	*Lachnoptera ayresii*	Least Concern (SABCA 2013)
Nymphalidae	*Melanitis leda*	Least Concern (SABCA 2013)
Nymphalidae	*Neptis laeta*	Least Concern (SABCA 2013)
Nymphalidae	*Neptis saclava marpessa*	Least Concern (SABCA 2013)
Nymphalidae	*Phalanta phalantha aethiopica*	Least Concern (SABCA 2013)
Nymphalidae	*Precis archesia archesia*	Least Concern (SABCA 2013)
Nymphalidae	*Precis octavia sesamus*	Least Concern (SABCA 2013)
Nymphalidae	*Protogoniomorpha anacardii nebulosa*	Least Concern (SABCA 2013)
Nymphalidae	*Protogoniomorpha parhassus*	Least Concern (SABCA 2013)
Nymphalidae	*Pseudacraea boisduvalii trimenii*	Least Concern (SABCA 2013)
Nymphalidae	*Pseudacraea eurytus imitator*	Least Concern (SABCA 2013)
Nymphalidae	*Pseudacraea lucretia tarquinea*	Least Concern (SABCA 2013)
Nymphalidae	*Sevenia boisduvali boisduvali*	Least Concern (SABCA 2013)
Nymphalidae	*Sevenia morantii*	Least Concern (SABCA 2013)

Nymphalidae	*Sevenia natalensis*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia cabira*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia cerasa cerasa*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia encedon encedon*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia esebria*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia igola*	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia serena*	Least Concern (SABCA 2013)
Nymphalidae	*Vanessa cardui*	Least Concern (SABCA 2013)
Papilionidae	*Graphium leonidas leonidas*	Least Concern (SABCA 2013)
Papilionidae	*Graphium policenes policenes*	Least Concern (SABCA 2013)
Papilionidae	*Papilio constantinus constantinus*	Least Concern (SABCA 2013)
Papilionidae	*Papilio dardanus cenea*	Least Concern (SABCA 2013)
Papilionidae	*Papilio demodocus demodocus*	Least Concern (SABCA 2013)
Papilionidae	*Papilio nireus lyaeus*	Least Concern (SABCA 2013)
Papilionidae	*Papilio ophidicephalus phalusco*	Least Concern (SABCA 2013)
Pieridae	*Afrodryas leda*	Least Concern (SABCA 2013)
Pieridae	*Appias epaphia contracta*	Least Concern (SABCA 2013)
Pieridae	*Appias sabina phoebe*	Least Concern (SABCA 2013)
Pieridae	*Belenois aurota*	Least Concern (SABCA 2013)
Pieridae	*Belenois creona severina*	Least Concern (SABCA 2013)
Pieridae	*Belenois gidica abyssinica*	Least Concern (SABCA 2013)
Pieridae	*Belenois thysa thysa*	Least Concern (SABCA 2013)
Pieridae	*Catopsilia florella*	Least Concern (SABCA 2013)
Pieridae	*Colias electo electo*	Least Concern (SABCA 2013)
Pieridae	*Colotis annae annae*	Least Concern (SABCA 2013)
Pieridae	*Colotis antevippe gavisa*	Least Concern (SABCA 2013)
Pieridae	*Colotis erone*	Least Concern (SABCA 2013)
Pieridae	*Colotis euippe mediata*	Not evaluated
Pieridae	*Colotis euippe omphale*	Least Concern (LC)
Pieridae	*Colotis ione*	Least Concern (SABCA 2013)
Pieridae	*Dixeia charina charina*	Least Concern (SABCA 2013)
Pieridae	*Dixeia pigea*	Least Concern (SABCA 2013)
Pieridae	*Dixeia spilleri*	Least Concern (SABCA 2013)
Pieridae	*Eronia cleodora*	Least Concern (SABCA 2013)
Pieridae	*Eurema brigitta brigitta*	Least Concern (SABCA 2013)
Pieridae	*Eurema desjardinsii regularis*	Least Concern (SABCA 2013)
Pieridae	*Eurema hecabe solifera*	Least Concern (SABCA 2013)
Pieridae	*Leptosia alcesta inalcesta*	Least Concern (SABCA 2013)
Pieridae	*Mylothris agathina agathina*	Least Concern (SABCA 2013)
Pieridae	*Mylothris rueppellii haemus*	Least Concern (SABCA 2013)
Pieridae	*Nepheronia argia varia*	Least Concern (SABCA 2013)
Pieridae	*Nepheronia buquetii buquetii*	Least Concern (SABCA 2013)
Saturniidae	*Pseudaphelia apollinaris*	Not evaluated
Saturniidae	*Pseudobunaea natalensis*	Not evaluated
Scythrididae	*Eretmocera laetissima*	Not evaluated

Sphingidae	*Hippotion eson*	Not evaluated
Sphingidae	*Macroglossum trochilus*	Not evaluated

Appendix C: Summary of Amphibia species recorded within the 3030BB quarter degree square (ADU; du Preez and Carruthers, 2009)

Family	Species	Red List Category
Arthroleptidae	*Arthroleptis wahlbergi*	Least Concern
Arthroleptidae	*Leptopelis natalensis*	Least Concern
Brevicepitidae	*Breviceps mossambicus*	Least Concern
Bufonidae	*Sclerophrys capensis*	Least Concern
Bufonidae	*Sclerophrys gutturalis*	Least Concern
Hyperoliidae	*Afrixalus fornasinii*	Least Concern
Hyperoliidae	*Afrixalus spinifrons*	Least Concern
Hyperoliidae	*Hyperolius marmoratus*	Least Concern
Hyperoliidae	*Hyperolius pickersgilli*	Endangered
Hyperoliidae	*Hyperolius pusillus*	Least Concern
Hyperoliidae	*Hyperolius tuberilinguis*	Least Concern
Hyperoliidae	*Kassina senegalensis*	Least Concern
Phrynobatrachidae	*Phrynobatrachus mababiensis*	Least Concern
Ptychadenidae	*Ptychadena oxyrhynchus*	Least Concern
Pyxicephalidae	*Amietia delalandii*	Least Concern
Pyxicephalidae	*Cacosternum nanum*	Least Concern
Pyxicephalidae	*Natalobatrachus bonebergi*	Endangered

Appendix D: Summary of Reptilia species recorded within the 3030BB quarter degree square (ADU)

Family	Species	Red List Category
Agamidae	*Acanthocercus atricollis*	Least Concern
Chamaeleonidae	*Bradypodion melanocephalum*	Near-Threatened
Chamaeleonidae	*Chamaeleo dilepis*	Least Concern
Colubridae	*Crotaphopeltis hotamboeia*	Least Concern
Colubridae	*Philothamnus hoplogaster*	Least Concern
Colubridae	*Philothamnus natalensis*	Least Concern
Colubridae	*Philothamnus occidentalis*	Least Concern
Colubridae	*Philothamnus semivariegatus*	Least Concern
Emydidae	*Trachemys scripta**	N/A
Gekkonidae	*Hemidactylus mabouia*	Least Concern
Gekkonidae	*Lygodactylus capensis capensis*	Least Concern
Lamprophiidae	*Amblyodipsas concolor*	Least Concern
Lamprophiidae	*Aparallactus capensis*	Least Concern
Lamprophiidae	*Boaedon capensis*	Least Concern
Lamprophiidae	*Lycodonomorphus rufulus*	Least Concern
Lamprophiidae	*Lycophidion capense capense*	Least Concern
Lamprophiidae	*Psammophis brevirostris*	Least Concern
Scincidae	*Panaspis wahlbergi*	Least Concern
Scincidae	*Scelotes inornatus*	Critically Endangered
Scincidae	*Trachylepis striata*	Least Concern
Viperidae	*Causus rhombeatus*	Least Concern

Appendix E: Summary of Avifauna species recorded within the 3030BB quarter degree square (SABAP 2). Red list categories are global assessments with relevant regional category in parentheses.

Scientific Name	Common Name	Red list Category
Accipiter melanoleucus	Black Sparrowhawk	LC
Accipiter minullus	Little Sparrowhawk	LC
Accipiter tachiro	African Goshawk	LC
Acrocephalus arundinaceus	Great Reed-warbler	LC
Acrocephalus baeticatus	African Reed-warbler	LC
Acrocephalus gracilirostris	Lesser Swamp-warbler	LC
Acrocephalus palustris	Marsh Warbler	LC
Actitis hypoleucos	Common Sandpiper	LC
Actophilornis africanus	African Jacana	LC
Alcedo cristata	Malachite Kingfisher	LC
Alcedo semitorquata	Half-collared Kingfisher	LC
Alopochen aegyptiacus	Egyptian Goose	LC
Amaurornis flavirostris	Black Crake	LC
Amblyospiza albifrons	Thick-billed Weaver	LC
Anas capensis	Cape Teal	LC
Anas erythrorhyncha	Red-billed Teal	LC
Anas hottentota	Hottentot Teal	LC
Anas platyrhynchos	Mallard Duck	LC
Anas smithii	Cape Shoveler	LC
Anas sparsa	African Black Duck	LC
Anas undulata	Yellow-billed Duck	LC
Anastomus lamelligerus	African Openbill	LC
Andropadus importunus	Sombre Greenbul	LC
Anhinga rufa	African Darter	LC
Anthus cinnamomeus	African Pipit	LC
Apalis flavida	Yellow-breasted Apalis	LC
Apalis thoracica	Bar-throated Apalis	LC
Apaloderma narina	Narina Trogon	LC
Aplopelia larvata	Lemon Dove	LC
Apus affinis	Little Swift	LC
Apus barbatus	African Black Swift	LC
Apus caffer	White-rumped Swift	LC
Apus horus	Horus Swift	LC
Ardea cinerea	Grey Heron	LC
Ardea goliath	Goliath Heron	LC
Ardea melanocephala	Black-headed Heron	LC
Ardea purpurea	Purple Heron	LC
Ardeola ralloides	Squacco Heron	LC
Arenaria interpres	Ruddy Turnstone	LC
Aviceda cuculoides	African Cuckoo Hawk	LC
Balearica regulorum	Grey Crowned Crane	LC

Batis capensis	Cape Batis	LC
Batis molitor	Chinspot Batis	LC
Bostrychia hagedash	Hadeda Ibis	LC
Bradypterus baboecala	Little Rush-warbler	LC
Bradypterus barratti	Barratt's Warbler	LC
Bubo africanus	Spotted Eagle-owl	LC
Bubulcus ibis	Cattle Egret	LC
Burhinus capensis	Spotted Thick-knee	LC
Burhinus vermiculatus	Water Thick-knee	LC
Buteo rufofuscus	Jackal Buzzard	LC
Buteo vulpinus	Steppe Buzzard	LC
Butorides striata	Green-backed Heron	LC
Bycanistes bucinator	Trumpeter Hornbill	LC
Calidris alba	Sanderling Sanderling	LC
Calidris ferruginea	Curlew Sandpiper	LC
Calidris minuta	Little Stint	LC
Camaroptera brachyura	Green-backed Camaroptera	LC
Campephaga flava	Black Cuckoo-shrike	LC
Campethera abingoni	Golden-tailed Woodpecker	LC
Caprimulgus europaeus	European Nightjar	LC
Caprimulgus pectoralis	Fiery-necked Nightjar	LC
Catharacta antarctica	Subantarctic Skua	LC
Centropus burchellii	Burchell's Coucal	LC
Cercomela familiaris	Familiar Chat	LC
Cercotrichas leucophrys	White-browed Scrub-robin	LC
Cercotrichas signata	Brown Scrub-robin	LC
Ceryle rudis	Pied Kingfisher	LC
Ceuthmochares australis	Green Malkoha	LC
Chalcomitra amethystina	Amethyst Sunbird	LC
Chalcomitra senegalensis	Scarlet-chested Sunbird	LC
Charadrius hiaticula	Common Ringed Plover	LC
Charadrius leschenaultii	Greater Sand Plover	LC
Charadrius marginatus	White-fronted Plover	LC
Charadrius pecuarius	Kittlitz's Plover	LC
Charadrius tricollaris	Three-banded Plover	LC
Chlidonias leucopterus	White-winged Tern	LC
Chlorocichla flaviventris	Yellow-bellied Greenbul	LC
Chloropeta natalensis	Dark-capped Yellow Warbler	LC
Chrysococcyx caprius	Diderick Cuckoo	LC
Chrysococcyx cupreus	African Emerald Cuckoo	LC
Chrysococcyx klaas	Klaas's Cuckoo	LC
Ciconia episcopus	Woolly-necked Stork	LC
Ciconia nigra	Black Stork	LC (VU)
Cinnyricinclus leucogaster	Violet-backed Starling	LC
Cinnyris afer	Greater Double-collared Sunbird	LC

Cinnyris bifasciatus	Purple-banded Sunbird	LC
Cinnyris chalybeus	Southern Double-collared Sunbird	LC
Cinnyris talatala	White-bellied Sunbird	LC
Circaetus pectoralis	Black-chested Snake-eagle	LC
Cisticola aberrans	Lazy Cisticola	LC
Cisticola ayresii	Wing-snapping Cisticola	LC
Cisticola chiniana	Rattling Cisticola	LC
Cisticola erythrops	Red-faced Cisticola	LC
Cisticola fulvicapilla	Neddicky Neddicky	LC
Cisticola galactotes	Rufous-winged Cisticola	LC
Cisticola juncidis	Zitting Cisticola	LC
Cisticola natalensis	Croaking Cisticola	LC
Cisticola tinniens	Levaillant's Cisticola	LC
Colius striatus	Speckled Mousebird	LC
Columba arquatrix	African Olive-pigeon	LC
Columba guinea	Speckled Pigeon	LC
Coracina caesia	Grey Cuckoo-shrike	LC
Corvus albicollis	White-necked Raven	LC
Corvus albus	Pied Crow	LC
Corvus capensis	Cape Crow	LC
Corvus splendens	House Crow	LC
Cossypha caffra	Cape Robin-chat	LC
Cossypha dichroa	Chorister Robin-chat	LC
Cossypha natalensis	Red-capped Robin-chat	LC
Creatophora cinerea	Wattled Starling	LC
Crithagra gularis	Streaky-headed Seedeater	LC
Crithagra mozambicus	Yellow-fronted Canary	LC
Crithagra scotops	Forest Canary	LC
Crithagra sulphuratus	Brimstone Canary	LC
Cuculus clamosus	Black Cuckoo	LC
Cuculus gularis	African Cuckoo	LC
Cuculus solitarius	Red-chested Cuckoo	LC
Cyanomitra olivacea	Olive Sunbird	LC
Cyanomitra veroxii	Grey Sunbird	LC
Cypsiurus parvus	African Palm-swift	LC
Dendrocygna viduata	White-faced Duck	LC
Dendropicos fuscescens	Cardinal Woodpecker	LC
Dendropicos griseocephalus	Olive Woodpecker	LC
Dicrurus adsimilis	Fork-tailed Drongo	LC
Dicrurus ludwigii	Square-tailed Drongo	LC
Dryoscopus cubla	Black-backed Puffback	LC
Egretta alba	Great Egret	LC
Egretta ardesiaca	Black Heron	LC
Egretta garzetta	Little Egret	LC
Egretta intermedia	Yellow-billed Egret	LC

Elanus caeruleus	Black-shouldered Kite	LC
Estrilda astrild	Common Waxbill	LC
Estrilda perreini	Grey Waxbill	LC
Euplectes ardens	Red-collared Widowbird	LC
Euplectes axillaris	Fan-tailed Widowbird	LC
Euplectes capensis	Yellow Bishop	LC
Euplectes orix	Southern Red Bishop	LC
Euplectes progne	Long-tailed Widowbird	LC
Falco biarmicus	Lanner Falcon	LC (VU)
Falco peregrinus	Peregrine Falcon	LC
Fulica cristata	Red-knobbed Coot	LC
Gallinula chloropus	Common Moorhen	LC
Gallirex porphyreolophus	Purple-crested Turaco	LC
Geronticus calvus	Southern Bald Ibis	LC
Gypohierax angolensis	Palm-nut Vulture	LC
Haematopus moquini	African Black Oystercatcher	LC
Halcyon albiventris	Brown-hooded Kingfisher	LC
Halcyon senegaloides	Mangrove Kingfisher	LC (EN)
Haliaeetus vocifer	African Fish-eagle	LC
Hedydipna collaris	Collared Sunbird	LC
Himantopus himantopus	Black-winged Stilt	LC
Hirundo abyssinica	Lesser Striped Swallow	LC
Hirundo albigularis	White-throated Swallow	LC
Hirundo cucullata	Greater Striped Swallow	LC
Hirundo fuligula	Rock Martin	LC
Hirundo rustica	Barn Swallow	LC
Hirundo smithii	Wire-tailed Swallow	LC
Indicator indicator	Greater Honeyguide	LC
Indicator minor	Lesser Honeyguide	LC
Indicator variegatus	Scaly-throated Honeyguide	LC
Ispidina picta	African Pygmy-Kingfisher	LC
Ixobrychus minutus	Little Bittern	LC
Jynx ruficollis	Red-throated Wryneck	LC
Lagonosticta rubricata	African Firefinch	LC
Lagonosticta senegala	Red-billed Firefinch	LC
Lamprotornis corruscus	Black-bellied Starling	LC
Lamprotornis nitens	Cape Glossy Starling	LC
Laniarius ferrugineus	Southern Boubou	LC
Lanius collaris	Common (Southern) Fiscal	LC
Larus cirrocephalus	Grey-headed Gull	LC
Larus dominicanus	Kelp Gull	LC
Leptoptilos crumeniferus	Marabou Stork	LC (NT)
Limosa lapponica	Bar-tailed Godwit	LC
Lioptilus nigricapillus	Bush Blackcap	LC
Lophaetus occipitalis	Long-crested Eagle	LC

Lybius torquatus	Black-collared Barbet	LC
Macronyx croceus	Yellow-throated Longclaw	LC
Malaconotus blanchoti	Grey-headed Bush-shrike	LC
Mandingoa nitidula	Green Twinspot	LC
Megaceryle maximus	Giant Kingfisher	LC
Melaenornis pammelaina	Southern Black Flycatcher	LC
Melierax gabar	Gabar Goshawk	LC
Merops bullockoides	White-fronted Bee-eater	LC
Merops pusillus	Little Bee-eater	LC
Milvus aegyptius	Yellow-billed Kite	LC
Mirafra africana	Rufous-naped Lark	LC
Monticola rupestris	Cape Rock-thrush	LC
Morus capensis	Cape Gannet	VU
Motacilla aguimp	African Pied Wagtail	LC
Motacilla capensis	Cape Wagtail	LC
Motacilla clara	Mountain Wagtail	LC
Muscicapa adusta	African Dusky Flycatcher	LC
Muscicapa caerulescens	Ashy Flycatcher	LC
Muscicapa striata	Spotted Flycatcher	LC
Mycteria ibis	Yellow-billed Stork	LC (EN)
Nectarinia famosa	Malachite Sunbird	LC
Nilaus afer	Brubru Brubru	LC
Numenius phaeopus	Common Whimbrel	LC
Numida meleagris	Helmeted Guineafowl	LC
Nycticorax nycticorax	Black-crowned Night-Heron	LC
Onychognathus morio	Red-winged Starling	LC
Oriolus larvatus	Black-headed Oriole	LC
Pandion haliaetus	Osprey Osprey	LC
Parus niger	Southern Black Tit	LC
Passer diffusus	Southern Grey-headed Sparrow	LC
Passer melanurus	Cape Sparrow	LC
Pavo cristatus	Common Peacock	LC
Pelecanus onocrotalus	Great White Pelican	LC
Pelecanus rufescens	Pink-backed Pelican	LC
Pernis apivorus	European Honey-buzzard	LC
Phalacrocorax africanus	Reed Cormorant	LC
Phalacrocorax capensis	Cape Cormorant	LC
Phalacrocorax carbo	White-breasted Cormorant	LC
Phoeniculus purpureus	Green Wood-hoopoe	LC
Phyllastrephus terrestris	Terrestrial Brownbul	LC
Phylloscopus ruficapilla	Yellow-throated Woodland-warbler	LC
Phylloscopus trochilus	Willow Warbler	LC
Pinarocorys nigricans	Dusky Lark	LC
Platalea alba	African Spoonbill	LC
Platysteira peltata	Black-throated Wattle-eye	LC

Plectropterus gambensis	Spur-winged Goose	LC
Plegadis falcinellus	Glossy Ibis	LC
Ploceus bicolor	Dark-backed Weaver	LC
Ploceus capensis	Cape Weaver	LC
Ploceus cucullatus	Village Weaver	LC
Ploceus intermedius	Lesser Masked-weaver	LC
Ploceus ocularis	Spectacled Weaver	LC
Ploceus subaureus	Yellow Weaver	LC
Ploceus velatus	Southern Masked-weaver	LC
Ploceus xanthops	Golden Weaver	LC
Ploceus xanthopterus	Southern Brown-throated Weaver	LC
Pluvialis squatarola	Grey Plover	LC
Podica senegalensis	African Finfoot	LC (VU)
Pogoniulus bilineatus	Yellow-rumped Tinkerbird	LC
Pogoniulus pusillus	Red-fronted Tinkerbird	LC
Pogonocichla stellata	White-starred Robin	LC
Polyboroides typus	African Harrier-Hawk	LC
Porphyrio madagascariensis	African Purple Swamphen	LC
Prinia subflava	Tawny-flanked Prinia	LC
Prodotiscus regulus	Brown-backed Honeybird	LC
Psalidoprocne holomelaena	Black (Southern race) Saw-wing	LC
Pternistis natalensis	Natal Spurfowl	LC
Pycnonotus tricolor	Dark-capped Bulbul	LC
Quelea erythrops	Red-headed Quelea	LC
Quelea quelea	Red-billed Quelea	LC
Rallus caerulescens	African Rail	LC
Rhinopomastus cyanomelas	Common Scimitarbill	LC
Riparia paludicola	Brown-throated Martin	LC
Sarkidiornis melanotos	Knob-billed Duck	LC
Sarothrura elegans	Buff-spotted Flufftail	LC
Sarothrura rufa	Red-chested Flufftail	LC
Saxicola torquatus	African Stonechat	LC
Schoenicola brevirostris	Broad-tailed Warbler	LC
Scleroptila shelleyi	Shelley's Francolin	LC
Scopus umbretta	Hamerkop Hamerkop	LC
Serinus canicollis	Cape Canary	LC
Sigelus silens	Fiscal Flycatcher	LC
Spermestes cucullatus	Bronze Mannikin	LC
Spermestes fringilloides	Magpie Mannikin	LC
Spermestes nigriceps	Red-backed Mannikin	LC
Sphenoeacus afer	Cape Grassbird	LC
Stactolaema leucotis	White-eared Barbet	LC
Stephanoaetus coronatus	African Crowned Eagle	NT (VU)
Sterna albifrons	Little Tern	LC
Sterna bengalensis	Lesser Crested Tern	LC

Sterna bergii	Swift Tern	LC
Sterna caspia	Caspian Tern	LC (VU)
Sterna hirundo	Common Tern	LC
Sterna paradisaea	Arctic Tern	LC
Sterna sandvicensis	Sandwich Tern	LC
Streptopelia capicola	Cape Turtle-dove	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Streptopelia senegalensis	Laughing Dove	LC
Strix woodfordii	African Wood-owl	LC
Sturnus vulgaris	Common Starling	LC
Sylvietta rufescens	Long-billed Crombec	LC
Tachybaptus ruficollis	Little Grebe	LC
Tachymarptis melba	Alpine Swift	LC
Tauraco corythaix	Knysna Turaco	LC
Taxon_name	Common_name	LC
Tchagra senegalus	Black-crowned Tchagra	LC
Tchagra tchagra	Southern Tchagra	LC
Telophorus olivaceus	Olive Bush-shrike	LC
Telophorus quadricolor	Gorgeous Bush-shrike	LC
Telophorus sulfureopectus	Orange-breasted Bush-shrike	LC
Terpsiphone viridis	African Paradise-flycatcher	LC
Thamnolaea cinnamomeiventris	Mocking Cliff-chat	LC
Threskiornis aethiopicus	African Sacred Ibis	LC
Tockus alboterminatus	Crowned Hornbill	LC
Trachyphonus vaillantii	Crested Barbet	LC
Treron calvus	African Green-pigeon	LC
Tricholaema leucomelas	Acacia Pied Barbet	LC
Tringa glareola	Wood Sandpiper	LC
Tringa nebularia	Common Greenshank	LC
Trochocercus cyanomelas	Blue-mantled Crested-flycatcher	LC
Turdus libonyanus	Kurrichane Thrush	LC
Turdus olivaceus	Olive Thrush	LC
Turtur chalcospilos	Emerald-spotted Wood-dove	LC
Turtur tympanistria	Tambourine Dove	LC
Tyto alba	Barn Owl	LC
Upupa africana	African Hoopoe	LC
Uraeginthus angolensis	Blue Waxbill	LC
Urocolius indicus	Red-faced Mousebird	LC
Vanellus armatus	Blacksmith Lapwing	LC
Vanellus coronatus	Crowned Lapwing	LC
Vidua chalybeata	Village Indigobird	LC
Vidua funerea	Dusky Indigobird	LC
Vidua macroura	Pin-tailed Whydah	LC
Xenus cinereus	Terek Sandpiper	LC
Zoothera guttata	Spotted Ground-thrush	LC

Zosterops virens	Cape White-eye	LC

Appendix F: Specialist Impact Assessment Criteria as per the ERM methodology

The identification of potential impacts should include impacts that may occur during the construction and operational phases of the activity. The assessment of impacts is to include direct, indirect as well as cumulative impacts.

In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed activity is well understood so that the impacts associated with the activity can be understood. The process of identification and assessment of impacts will include:

- Determine the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Determine future changes to the environment that will occur if the activity does not proceed;
- An understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts which are likely to occur if the activity is undertaken.

As per DEA *Guideline 5: Assessment of Alternatives and Impacts* the following methodology is to be applied to the prediction and assessment of impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- **Spatial extent** – The size of the area that will be affected by the impact:
    - Site specific;
    - Local
    - Regional (within 30 km of site); or
    - National.
- **Intensity** –The anticipated severity of the impact:
    - High (severe alteration of natural systems, patterns or processes);

  - Medium (notable alteration of natural systems, patterns or processes; or
  - Low (negligible alteration of natural systems, patterns or processes).
- **Duration** –The timeframe during which the impact will be experienced:
  - Temporary (less than 1 year);
  - Short term (1 to 6 years);
  - Medium term (6 to 15 years);
  - Long term (the impact will only cease after the operational life of the activity); or
  - Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient).
- **Reversibility of impacts -**
  - High reversibility of impacts (impact is highly reversible at end of project life);
  - Moderate reversibility of impacts;
  - Low reversibility of impacts; or
  - Impacts are non- reversible (impact is permanent).
- **Irreplaceability of resource loss caused by impacts –**
  - High irreplaceability of resources (project will destroy unique resources that cannot be replaced);
  - Moderate irreplaceability of resources;
  - Low irreplaceability of resources; or
  - Resources are replaceable (the affected resource is easy to replace/ rehabilitate.

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Significance** – Will the impact cause a notable alteration of the environment?
  - Low to very low (the impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Medium (the impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated); or
  - High (the impacts will result in major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making).

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	Medium	High
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Large	Moderate	Major	Major

Appendix G: Specialist Details

Name: Gary de Winnaar
Profession: Terrestrial and Aquatic Ecologist
Date of Birth: 24 February 1981
Marital Status: Married
Nationality: South African

Key Skills and Experience:

Over ten years of experience in professional consulting incorporating assessments of aquatic and terrestrial biodiversity (fauna and flora), associated ecosystems, and environmental hydrology. Provided specialist input for a range of studies requiring solutions regarding practical and applied terrestrial and aquatic ecology and hydrology, including abilities to integrate aquatic and terrestrial elements, survey fauna and flora, assess invasive alien species, analyse catchment processes and water flows, characterise and map environmental features (including biodiversity, sensitive habitats, catchment characteristics, land cover/use, etc.), conduct specialist GIS modelling and spatial analyses, as well as identifying and assessing impacts to biodiversity and the environment. Managed and integrated teams and inputs covering more specialized fields such as terrestrial invertebrates, botany, and ecosystem services/resource economics, environmental flows (E-Flows)/reserve Determinations, etc. Capable of addressing a broad range of studies and applications, for example:

- Desktop and in-field mapping with abilities for spatial analysis using Geographical Information Systems (GIS) particularly for broad-scale and strategic applications;
- Application of biomonitoring tools and indices for assessing the ecological status of ecosystems;
- Knowledge of wide range of biological taxa, sampling methods and understanding of ecological interactions;
- Spatial modelling and analysis of biodiversity and physical landscape features to facilitate site optimisation through explicit mapping of development constraints and opportunities;
- Ecohydrology, including assessing and understanding flow requirements for sustaining functions and processes of aquatic ecosystems.
- Specialist input for a range of projects from Green Building Council South Africa (GBCSA) developments to environmental hydrology to large-scale mining projects; and
- Understanding the functionality of aquatic and terrestrial systems and how such ecosystems are affected by impacting activities, as well as providing guidance on mitigation, offsetting and rehabilitation.

Education and Training:

- 2003 B.Sc. University of Natal, Pietermaritzburg - Majoring in Hydrology & Zoology
- 2004 B.Sc. (Honors) University of KwaZulu-Natal, Pietermaritzburg - Majoring in Hydrology
- 2009 M.Sc. University of KwaZulu-Natal, Pietermaritzburg - Majoring in Hydrology (*cum laude*)
- 2018 met the training requirements and is in the process of applying for accreditation as a water stewardship service provider with the Alliance for Water Stewardship (AWS), a global standard and framework for major water users to understand their water use and impacts, and to work collaboratively and transparently for sustainable water management within a catchment context.

Professional Memberships/Accreditations:

- Professional Natural Scientist (Pr.Sci.Nat) in Ecological Science - The South African Council for Natural Scientific Professions (Reg. No. 400353/13)
- 2010-2013 and 2013-2016 Department of Water and Sanitation (DWS) Accredited SASS5 Practitioner
- Member – Bat Interest Group of KwaZulu-Natal

Experience Record:

2008 to date: **GroundTruth – Water, Wetlands and Environmental Engineering (GroundTruth)**

Management of the biodiversity division within GroundTruth while providing support to the river and wetland divisions. Projects have covered a range of applications for mining industries, agriculture, developers, renewable and non-renewable energy sectors, linear developments, non-government organisations, and governmental departments. These have included studies for a number of mining houses such as AngloGold, Barrick Gold Corporation, Exxaro, Freeport McMoRan, Gécamines, GEM Diamonds, Phelps Dodge, Rockgate, Vedanta and Zimplats. , providing specialist input and services to industries, consultants, developers, non-government organisations, and regional and national government departments. Assessments have involved aquatic biomonitoring and water quality, terrestrial fauna and flora surveys (employing a range of sampling techniques), characterising ecological health and conditions, mapping of ecosystems, habitats and important/sensitive areas, assessment of ecosystem services, and environmental flows. Studies have also needed to be compliant with national regulations/legislation as well as international policies, notably the International Finance Corporation (IFC) Performance Standards. A key input from these studies has been the identification and assessment of project related impacts and providing recommendations for appropriate mitigation, rehabilitation and monitoring to ensure environmental benefits are properly achieved and sustainable.

2007 to 2008: **Greenbelt Mapping**

Ground-truthing and mapping of alien plant species and densities for the Working for Water alien plant programme to facilitate the planning and management of alien plant control in various areas of KwaZulu-Natal, namely Jozini, Impendle, South Coast, and Escourt/Mooi River.

2001 to 2005: **University of KwaZulu-Natal**

Involved with numerous research projects as an assistant for Professor Colleen Downs from the Schools of Biological and Conservation Sciences (including trapping and behaviour monitoring of Hyrax, Bushbuck telemetry tracking, rodent trapping, Cape Parrot and afromontane forest surveys) as well as the department for Bioresources Engineering and Environmental Hydrology which involved various developing desktop and field-based studies.

Countries Worked in:

Democratic Republic of Congo, Guinea, Lesotho, Mali, South Africa, Zambia, Zimbabwe, and Madagascar.

List of Projects and Experience

- Nation-wide Strategic Environmental Assessment (SEA) of rivers, wetlands and aquatic fauna and flora for gas and electrical grid infrastructure across South Africa, developing methods map, analyses and collate multiple datasets in order to develop sensitivity maps to inform impact assessments and required management measures. Current.
- Forest offset management plan (including a comprehensive invasive alien plant assessment) for BidVest Tanks in the South Dunes area of the Richards Bay Port, KwaZulu-Natal (South Africa). February 2018.

- Development of the Environmental Management Framework (EMF) for the Umgungundlovu District Municipality in KwaZulu-Natal (South Africa) providing specialist input for biodiversity and surface water resources. June 2017.
- Development of a revised Water Conservation and Water Demand Management Plan for Dube TradePort. September 2016.
- Investing in Ecological Infrastructure to Enhance Water Security in the uMngeni River Catchment – A Green Fund Project conducted by SANBI and the University of KwaZulu-Natal, with specialist input to modelling and mapping water-related services supplied by ecological infrastructure. November 2015.
- Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) study for Water Management Areas WMA5, WMA6 and WMA11, KZN. November 2012.
- Assessment of Vegetation Response Assessment Index (VEGRAI) and Index of Habitat Integrity (IHI) for the DWA's River Health Assessment for the KZN region. June 2012.
- Biodiversity Sector Plan (BSP) for Ezemvelo KZN Wildlife for the uMgungundlovu District Municipality, KZN. November 2011.
- Development of an Environmental Management Framework (EMF) and GIS tool for the Hibiscus Coast Municipality, KZN. October 2011.
- Spatial biodiversity study for Cato Ridge Local Area Plan, eThekwini District Municipality. October 2010.
- Spatial assessment of biodiversity features associated with the Assmang development area, Cato Ridge, KZN. May 2010.
- Assessment of surface water resource for the development of the Strategic Environmental Assessment (SEA) and Environmental Management Framework (EMF) for the uMshwathi City Development Node, KZN. December 2009.
- On-going monitoring of water supply, water quality and waste treatment systems at Phinda Private Nature Reserve, in northern KwaZulu-Natal, including various water sources such as storage tanks, rainwater harvesting, taps, boreholes, treated bottle water, rivers and dams.
- Environmental flows (E-flows) assessment for a hydroelectric project on the Kalungwishi River in the Northern Province of Zambia for ERM and Globeleq. December 2017.
- Biodiversity study and impact assessment to inform the decommissioning of landfills areas at the Bayside Aluminium Smelter, Richards Bay, with an invasive alien plant assessment and protected plant survey. November 2016 and July 2015.
- Biodiversity baseline surveys to develop a relocation strategy and offset plan for Exxaro coal mine in Belfast, Mpumalanga, with focused Africa Grass Owl, Baboon Spiders and conservation site surveys. May 2016 and ongoing.
- Assessment of Terrestrial and Aquatic Ecology Associated with the Floating Power Plant in Richards Bay as part of the Richards Bay Independent Power Project. March 2016.
- Surveys of aquatic macroinvertebrates as part of the routine monitoring at the Tenke Fungurume Mine in Katanga, DRC. October 2015.
- Assessment of riparian vegetation along the Orange River from Douglas to Alexander Bay using the Vegetation Response Assessment Index (VEGRAI) as part of the Joint Basin Survey 2 (JBS 2) for the Orange-Senqu River Basin Commission (ORASECOM). September 2015.
- Freshwater Aquatic Ecosystems Rehabilitation Plan for the Keystone Park Development, Hammarsdale, KZN. July 2014.
- Ecological study for the Cornubia Phase 1A Social Facilities Cluster to inform the Green Star rating process according to the Green Building Council of South Africa (GBCSA), KZN. March 2014.
- Assessment of aquatic ecosystems for the proposed Chimiwungo Extension Project at Lumwama, Zambia. August 2013.
- Biodiversity baseline study, including in depth surveys of fauna (mammals, birds, reptiles and amphibians) and flora, for the Kisanfu Copper Project, Southern Katanga, Democratic Republic of the Congo (DRC). July 2013.
- Biodiversity baseline study for the Falea Uranium Mine in Mali for Rockgate Capital Corporation. July 2013.
- Assessment of riparian ecosystems and sensitive fauna and flora associated with the Wekeweke River System for the proposed Shongweni Regional Retail/Commercial Development. June 2013.
- Assessment of fauna and aquatic ecology for the Gamsberg Zinc Mine, Northern Cape, with a follow on regional ant study of the Bushmanland Inselberg Region to determine the occurrence of undescribed

Messor and *Camponotus* Ant Species Recorded from the Gamsberg Project EIA. April 2013 and October 2013.
- Biodiversity study to inform the Basic Assessment for the Candover-Mbazwana, Mbazwana-Gezisa Eskom Distribution 132kV powerlines and Mbazwana and Gezisa 132/22kV Substations, northern KZN. May 2012.
- Assessment of Ecosystem Goods and Services to inform land-use management and closure planning for the Siguiri Gold Mine, Guinea. October 2011.
- Terrestrial and aquatic biodiversity study for the Mongbwalu Project, North-eastern Democratic Republic of Congo (DRC), including in-field surveys, with employment of sampling methods, to determine the diversity of fauna (mammals, birds, reptiles and amphibians) and flora. August 2011.
- Assessment of terrestrial and riparian systems for Tongaat Huletts Development: uShukela Highway (eastern portion) and Inyaninga and uShukela Highway (western portion). January 2011.
- Environmental Impact Assessment (EIA) for the proposed Eskom Venus-Sigma 765 KV transmission line (EIA: 12/12/20/1397/1) and Sigma-Hector 2 X 400 KV Transmission Lines (EIA: 12/12/20/1397/3): Specialist Fauna Report. October 2010.
- Rehabilitation plan for wetland and terrestrial vegetation associated with the proposed Hope Children's Home on Portion 84 of Clifton Farm no. 939, eThekwini Municipality Outer West, KZN. May 2010.
- Sani Pass Road Upgrade: Baseline Biodiversity Assessment of the Aquatic Ecosystems of the Sani Pass Region, Southern Drakensberg, KZN. January 2010.

Name: Mahomed Desai

Profession: Senior Ecologist

Date of Birth: 09 March 1983

Marital Status: Married

Nationality: South African

Key Experience:

- Estuarine ecological assessments and biomonitoring
- Freshwater ecological assessments and biomonitoring
- Terrestrial macro-invertebrate surveys
- Terrestrial vegetation surveys
- GIS spatial analysis and digital cartography
- Undertaking Ecological Water Requirement (EWR) and Ecological Risk assessments
- Persistent Organic Pollutant assessments

Professional Memberships/Accreditations:
- Accredited SASS5 practitioner
- Member of the Zoological Society of Southern Africa

Education and Training:
- Ph.D. Ecological Science – Evaluating the influence of environmental drivers on ichthyofauna communities within select east-draining rivers in southern Africa
- M.Sc. Environmental Engineering – The efficacy of utilising the microalgae *Chlorella* sp. for the treatment of hazardous landfill leachate
- B.Sc. Hons. Marine Ecology – The macrobenthos community of Lake St. Lucia, South Africa, during the 2005 drought
- B.Sc. Biological Sciences – Environmental Biology
- Stable Isotope Analysis – University of Cape Town
- Micro-PIXE Analysis – iThemba Labs, Cape Town

- Energy from Waste – University of KwaZulu-Natal
- SANBI BGIS – University of KwaZulu-Natal

Experience Record:

Period	**Employer**	**Position**
Present	GroundTruth Consulting	Senior Ecological Consultant
December 2015 – January 2019	Aquatic Ecosystem Research Programme	Senior Researcher
April 2013 – November 2015	GroundTruth Consulting	Ecological Consultant
January 2010 – December 2010	Orient Islamic School	Locum Teacher
September 2008 – April 2009	DeTect Inc.	Scientific, Environmental and Ornithological Consultant
January 2002 – December 2004	Research Assistant	University of KwaZulu-Natal
January 2006 – December 2008	Research Assistant	University of KwaZulu-Natal

Countries Worked:

- South Africa
- Mozambique
- Sudan
- Mali (desktop study)

Examples of Past and Current Projects:

- KwaZulu-Natal River Eco-Status Monitoring Programme
- Sappi Stanger Paper and Pulp Mill Routine Biomonitoring
- Sappi Tugela Paper and Pulp Mill Routine Biomonitoring
- Sappi Tugela Paper and Pulp Mill Ecological Risk Assessment
- Pavua Dam Environmental Impact Assessment
- Kranskloof Dam Aquatic Assessment
- Zululand Anthracite Colliery (ZAC) Environmental Impact Assessment
- Nile Basin Environmental Flow Assessment – Dinder River Case Study
- Update of the Western Cape Estuary Management Framework
- E-flows for the Upper Niger River and Inner Niger Delta
- LHDA Phase II – Polihali Dam E-flow Requirements
- ORASECOM Joint Basin Survey 2
- Mooi Catchment Ecological State
- Springrove Dam Offset
- Metiss Subsea Cable - Terrestrial Ecological Assessment
- Letseng Mine Nitrate Risk Assessment
- uMngeni River Flood Attenuation Assessment
- Zimbali Estuary and Coastal Zone Assessment

APPENDIX F4 MARITIME HERITAGE

Maritime Heritage Impact Assessment: ASN Africa METISS Subsea Fibre Optic Cable System

Report prepared for

ERM Southern Africa

On behalf of

Alcatel Submarine Networks (ASN) and Elettra Tlc SpA

March 2019

Version 3.0

ACO Associates cc
Archaeology and Heritage Specialists

Prepared by

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ACO Associates CC

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Executive Summary

ACO Associates was appointed to conduct a desk-based assessment of the maritime archaeological potential of the marine portion of the proposed METISS subsea cable system, to determine the likely impacts of the cable on maritime and underwater cultural heritage resources, and to the propose measures to mitigate such impacts.

METISS is owned by a Consortium of companies comprising Canal+ Télécom, CEB FiberNet, EMTEL, Zeop, SRR (SFR) and TELMA. The Consortium was formed for the purposes of developing the system, and has contracted ASN and Elettra for the manufacture and installation of the subsea cable system. The Consortium has contracted Liquid Telecom to act as the Landing Party in South Africa, responsible for all operational aspects in South Africa.

In line with national legislation and policy regarding the marine environment, this maritime archaeological assessment is for the area below the high water.

The proposed subsea cable will be approximately 3200 km long and with a total length of approximately 538 km in South African waters. It will be laid on and in the seabed of South Africa's exclusive economic zone (EEZ), contiguous zone and territorial waters, to a landing site at Amanzimtoti Pipeline Beach in KwaZulu-Natal.

The subsea cable will be laid on the surface of the seabed in water depths greater than 1000 m. Between the low water mark and the 1000 m depth contour the cable will be buried to a target depth of 1 m below the seabed. Burial will be by ploughing using a cable plough, jetting using a remotely operated vehicle or, on the approach to the beach and the low water mark, by diver jet burial using hand-held jets. On the beach the subsea cable will be buried to a target depth of 2 m using a small tracked digger.

Findings: This assessment, which draws its information from readily available documentary sources, South African Heritage Resources Agency's (SAHRA) Maritime and Underwater Cultural Heritage database, a database created by Fedde van den Bosch, the South African Naval Hydrographer's Office list of charted wrecks and obstructions and a database of underwater heritage resources maintained by ACO Associates, reviewed the subsea cable route, buffered by 20 km for maritime and underwater cultural heritage resources.

There are no known submerged prehistoric sites in the Amanzimtoti area or along the proposed subsea cable route and only three known wrecks within the 20 km Marine Study Area around the proposed cable route alignment in the contiguous zone and territorial waters. Two of these wrecks are currently less than 60 years of age and are thus not protected by the National Heritage Resources Act (NHRA) as heritage resources.

An unidentified wreck charted by the South African Naval Hydrographer's Office (SANHO) lies within 40 m of the proposed subsea cable alignment, approximately 45 km from the landfall and the basis of the available data poses the greatest risk to cable lay and construction plant and the subsea cable.

Further offshore, within the EEZ there are two recorded wrecks within the Marine Study Area. Confidence in the positions of both wrecks is extremely low and although the remit of the NHRA does not extend to these two wrecks in respect of this Project their presence is worth noting as a potential risk to cable lay and construction plant and to the subsea cable.

This assessment has found that there is unlikely to be any impact on submerged prehistoric archaeological resources or historical shipwrecks from the Project. No mitigation is required or proposed in respect of potential submerged prehistoric archaeology in the Marine Study Area but the archaeological review of geophysical data is recommended to locate the unidentified SANHO charted wreck and ensure that two wrecks in the EEZ not be affected by, or affect the subsea cable or cable lay plant. The geophysical data review also has the benefit of identifying previously unknown wrecks on the seabed within the subsea cable route corridor.

In the event a previously unknown or unrecorded shipwreck is encountered during the installation of the subsea cable, the Project archaeologist and SAHRA must be notified immediately. If the wreck will be impacted by the subsea cable laying, all work must cease until the archaeologist and SAHRA have assessed the significance of the site and a decision has been taken as to how to deal with it.

Provided the mitigation measures recommended above are implemented, the maritime elements of the proposed METISS fibre optic cable are unlikely to have any impact on known or unknown maritime and underwater cultural heritage resources and are considered archaeologically acceptable.

Content of the Specialist Report Checklist

The content of this report has been prepared in terms of Regulation GNR 326 of 2014, as amended, Appendix 6, as shown in Table 1.

Table 1: Specialist Report Checklist

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	**Cross-reference in this report**
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix B and C
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix C
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1: Introduction Section 2: Terms of Reference
(cA) an indication of the quality and age of base data used for the specialist report;	Section 5 and 5.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	N/A
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;;	Section 7
(g) an identification of any areas to be avoided, including buffers;	Section 8
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 5
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5.1
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities.	Section 6
(k) any mitigation measures for inclusion in the EMPr;	Section 8
(l) any conditions for inclusion in the environmental authorisation;	Section 8
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A

Contents of this report in terms of Regulation GNR 982 of 2014, Appendix 6	**Cross-reference in this report**
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 9
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A – HIA to be submitted to SAHRA for comment
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(q) any other information requested by the competent authority.	N/A

Table of Contents

1 Introduction

ACO Associates cc was appointed by ERM Southern Africa (ERM), on behalf of Alcatel Submarine Networks (ASN),Elettra Tlc SpA (Elettra) and Liquid Telekom to undertake a maritime archaeological assessment for the South African section of the proposed METISS Subsea Fibre Optic Cable System linking South Africa, Madagascar, Réunion and Mauritius.

This assessment forms part of the Environmental Impact Assessment (EIA) process being undertaken for ASN and Elettra by ERM to evaluate the potential environmental impacts of the proposed Project, to manage in-country consultation with authorities, and to manage the process of obtaining Environmental Authorization from the national Department of Environmental Affairs (DEA) for the Project. If the Environmental Aurthorization is approved, it will be given to Liquid Telecom as they are responsible for all operational aspects in South Africa.

2 Terms of Reference

ACO Associates was appointed to conduct a baseline, desk-based assessment of the maritime archaeological potential of the marine portion of the proposed cable route, to determine the likely impacts of the construction and installation of the subsea cable on maritime and underwater cultural heritage resources, and to the propose measures to mitigate such impacts.

In line with national legislation and policy regarding the marine environment, this maritime archaeological assessment is for the area below the high water mark (see Section 4.1 below).

3 Project Description

The METISS Subsea Cable System will consist of a 14 mm to 35 mm diameter subsea cable from South Africa to Mauritius with branches to Madagascar and Reunion. The subsea cable will be approximately 3200 km long and with a total length of approximately 538 km within South African waters. It will cross the Exclusive Economic Zone (EEZ) (approximately 370 km from the seashore) and continue through the territorial waters (approximately 22 km from the seashore), to a landing site at Amanzimtoti Pipeline Beach in KwaZulu-Natal (**Figure 1**).

The subsea cable will be laid on the surface of the seabed in water depths greater than 1000 m. Between the low water mark (LWM) and the 1000 m depth contour the subsea cable will be buried to a target depth of 1 m below the seabed. Burial will be by ploughing using a cable plough, jetting using a remotely operated vehicle (ROV) or, on the approach to the beach and the low water mark, by diver jet burial using hand-held jets. The expected maximum width of the seabed fluidised by jet burial is approximately 210 mm.

On the beach between the LWM and the Beach Manhole the subsea cable will be buried to a target depth of 2 m using a small tracked digger. The burial trench will be approximately 500 mm wide.

Figure 1: Route of the proposed METISS subsea cable from the outer edge of the South African continental shelf to the landfall at Amanzimtoti on the KZN coast.

4 Relevant Legislation

4.1 *National Heritage Resources Act (No 29 of 1999)*

The National Heritage Resources Act (NHRA) came into force in 2000 with the establishment of the SAHRA, replacing the National Monuments Act (No 28 of 1969 as amended) and the National Monuments Council as the national agency responsible for the management of South Africa's cultural heritage resources.

The NHRA reflects the tripartite (national/provincial/local) nature of public administration under the South African Constitution and makes provision for the devolution of cultural heritage management to the appropriate, competent level of government. Because national government is responsible for the management of the seabed below the high water mark, however, the management of maritime and underwater cultural heritage resources under the NHRA does not devolve to provincial or local heritage resources authorities but remains the responsibility of the national agency, SAHRA.

The NHRA gives legal definition to the range and extent of what are considered to be South Africa's heritage resources. According to Section 2(xvi) of the Act a heritage resource is "any place or object of cultural significance". This means that the object or place has aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

In terms of the definitions provided in Section 2 of the NHRA, maritime and underwater cultural heritage can include the following sites and/or material relevant to this assessment:

- material remains of human activity which are in a state of disuse and are in or on land [which includes land under water] and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures (Section 2(ii));

- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, a defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation (Section 2(ii)); and
- any movable property of cultural significance which may be protected in terms of any provisions of the NHRA, including any archaeological artefact or palaeontological specimen (Section 2(xxix));

Of the heritage resource types protected by the NHRA, the laying of the proposed subsea cable has the potential to impact the following:

- submerged pre-colonial archaeological sites and materials; and
- maritime and underwater cultural heritage sites and material, which are principally historical shipwrecks.

As per the definitions provided above, these cultural heritage resources are protected by the NHRA and a permit from SAHRA is required to destroy, damage, excavate, alter, deface or otherwise disturb any such site or material.

It is also important to be aware that in terms of Section 35(2) of the NHRA, all archaeological objects and palaeontological material is the property of the State and must, where recovered from a site, be lodged with an appropriate museum or other public institution.

4.2 *Kwazulu-Natal Heritage Act (No 4 of 2008)*

KwaZulu-Natal (KZN) has its own provincial heritage legislation, the Kwazulu-Natal Heritage Act (No 4 of 2008), originally promulgated as Act No. 10 of 1997, prior to the promulgation of the NHRA in 1999.

The KZN legislation provides for the conservation, protection and administration of both the physical and the living or intangible heritage resources of the Province of KwaZulu-Natal. In terms of the Act, the provincial heritage agency, Amafa aKwaZulu-Natali (Amafa), is responsible for the management and protection of battlefield sites, archaeological sites, rock art sites, palaeontological sites, historic fortifications, and meteorite or meteorite impact sites in KZN.

As described above in relation to the NHRA, national government is responsible for the management of the seabed below the high water mark and the management of maritime and underwater cultural heritage resources in KZN therefore takes place under the NHRA and by SAHRA and does not devolve to Amafa. Letter of Exemption for terrestrial Heritage Impact Assessment was submitted to Amafa on 4 March 2019.

4.3 ***Maritime Zones Act (No 15 of 1994)***

South Africa's Maritime Zones Act of 1994 is the national legislative embodiment of the international maritime zones set out in the United Nations Convention on the Law of the Sea (UNCLOS).

The Act defines the extent of the territorial waters, contiguous zone, EEZ and continental shelf which together comprises some 4.34 million square kilometres of seabed, and sets out South Africa's rights and responsibilities in respect of these various maritime zones.

Under the terms of the maritime zones established by the Act, the application of the NHRA applies within South Africa's territorial waters (12 nautical miles seaward of the baseline) and extends to the outer limit of the maritime cultural zone (contiguous zone) (24 nautical miles seaward of the baseline). Any offshore activities that have the potential to disturb or damage cultural heritage resources located in or on the seabed within the territorial waters and maritime cultural zone require the involvement of SAHRA, as a commenting body in respect of the NEMA EIA process and as permitting authority where impacts to sites or material cannot be avoided and damage or destruction will occur.

In terms of Section 9 of the Maritime Zones Act, activities undertaken from installations operating within South Africa's EEZ or on the continental shelf may be subject to the requirements of any law in force in the Republic. The definition of "installation" (which includes vessels) provided in the Act, however, appears to limit this to activities related to seabed mining and mineral exploitation.

The extent of the application of the NHRA and Maritime Zones Act in respect of the METISS subsea cable and route is therefore, limited to area between the baseline and the outer edge of the contiguous/maritime cultural zone.

4.4 ***National Environmental Management Act (Act No 107 of 1998)***

The National Environmental Management Act (No 107 of 1998) (NEMA) provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals that are likely to have a negative effect on the environment.

Regulations governing the environmental authorisation process have been promulgated in terms of NEMA and include the 2014 EIA Regulations (as amended).

The proposed METISS subsea cable triggers a number of activities in the Listing Notices and, in terms of GNR 325 therefore, the Project will be subject to an Environmental Impact Assessment process and Liquid Telekom will be required to obtain a positive Environmental Authorisation from the national Department of Environmental Affairs (DEA) prior to commencement of the proposed activities.

5 Method

This desk-based baseline report provides an assessment of the maritime and underwater cultural heritage potential of the Marine Study Area defined as a corridor 20 km wide, centred on the proposed subsea cable alignment between the outer limit of South Africa's contiguous zone/maritime cultural zone (24 nautical miles from the baseline) and the high water mark at the subsea cable landfall on Amanzimtoti Pipeline Beach (**Figure 2**).

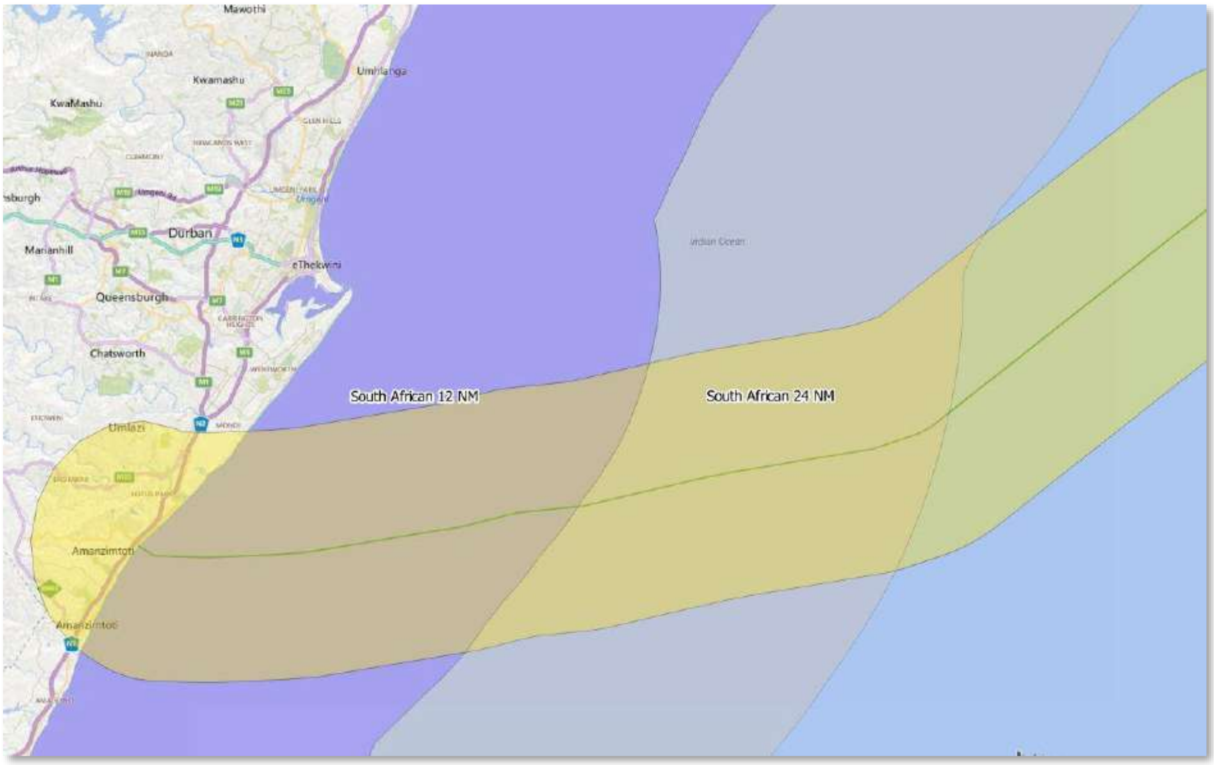

Figure 2: Proposed subsea cable alignment with the 20 km Marine Study Area (yellow) across the South African contiguous zone (grey) and territorial waters (purple).

The report includes a description of what comprises South Africa's maritime and underwater cultural heritage, a brief maritime history of the KZN coast area and a discussion of known heritage resources within the Marine Study Area.

The report draws its information from readily available documentary sources, SAHRA's Maritime and Underwater Cultural Heritage database, a database created by Fedde van den Bosch (2014), the South African Naval Hydrographer's Office (SANHO) list of charted wrecks and obstructions and a database of underwater heritage resources maintained by ACO Associates.

The potential impacts arising from the proposed installation of the METISS subsea cable system on maritime and underwater cultural heritage resources are assessed and, where necessary, recommendations are made to mitigate such impacts.

5.1 ***Limitations***

The record of South Africa's maritime and underwater cultural heritage resources is based principally on historical documents and other secondary sources. Where available this is supplemented by primary sources such as geophysical data and other field-based observations and site recordings.

The reliance on secondary data sources means that there are gaps and inaccuracies in this record. Thus, while every effort has been made to ensure the accuracy of the information presented below, the potential exists for currently unknown and/or unrecorded maritime heritage sites to be encountered in the course of the proposed Project.

It is for this reason too that the relatively large (20 km wide) Marine Study Area described above has been used for this report, rather than one that is more narrowly defined around the proposed routing of the subsea cable.

6 Underwater Cultural Heritage

South Africa has a rich and diverse underwater cultural heritage. Strategically located on the historical trade route between Europe and the East, South Africa's rugged and dangerous coastline has witnessed more than its fair share of shipwrecks and maritime dramas in the last 500 years. At least 2500 vessels are recorded as having been wrecked, sunk, abandoned or scuttled in South African waters since the early 1500s.

This list is not complete and does not include the as yet unproven potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions along the South African east coast. It is thus anticipated that further research in local and foreign archives, together with physical surveys to locate the remains of historical shipwrecks will produce a final tally of more than 3000 wrecks in South African waters.

More than 1900 of the wrecks currently recorded in South African waters are older than 60 years and are thus protected by the NHRA as archaeological resources.

The record of South Africa's long association with the sea is much broader than shipwrecks and extends far back into prehistory. This element of our maritime and underwater cultural heritage is represented around the coast by thousands of pre-colonial shell middens which reflect prehistoric human exploitation of marine resources since the Middle Stone Age, more than 150,000 years ago.

Stone-walled inter-tidal fish traps are another, potentially ancient feature of particularly the south-western and southern Cape coast (see Kemp, 2006), although their age is contentious with some authors proposing that they are pre-colonial in origin (Goodwin, 1946; Avery, 1975; Gribble, 2005) and others that they are much more recent (Hine, 2008; Hine *et al*, 2010).

Another, until recently, largely unacknowledged and unexplored aspect of our maritime and underwater cultural heritage are pre-colonial terrestrial archaeological sites and palaeolandscapes which are now inundated by the sea.

This report considers those maritime and underwater cultural heritage resources in the vicinity of the proposed METISS subsea cable route which are located below the high water mark, namely submerged prehistoric resources and historical shipwrecks.

6.1 ***Submerged Prehistory***

Since the start of the Quaternary, approximately 2.6 million years ago, the world has been subject to a series of cooling and warming climatic cycles in which sea level was mainly lower than it is today. During the last 900,000 years global sea levels have fluctuated substantially on at least three occasions, the result of increased and decreased polar glaciation. The dropping of sea levels was caused by the locking up in the polar ice caps of huge quantities of seawater as global temperatures cooled. The most extreme recent sea level drop occurred between circa 20,000 and 17,000 years ago when at the height of the last glaciation (Marine Isotope Stage (MIS) 2) the sea was more than 120m lower than it is today (Waelbroeck *et al*, 2002; Rohling *et al*, 2009).

The lower sea levels during glaciations which correspond with MIS 4 (~70,000 years ago), MIS 6 (~190,000 years ago), MIS 8 (~301,000 years ago) and MIS 12 (~478,000 years ago), for example, would have “added a large coastal plain to the South African land mass” (Van Andel, 1989:133) where parts of the continental shelf were exposed as dry land (see Cawthra *et al*, 2016). This would have been most pronounced on the wide Agulhas Bank off the southern Cape coast, but would also have occurred along the narrow continental shelves on South Africa’s west and east coasts. It is estimated that this exposed continental shelf may have represented a new area of land as much as 80,000km^2 in extent during the successive glacial maxima (Fisher *et al*, 2010). **Figure 3** below gives an indication of the extent of the continental shelf exposure during the second to last glaciation.

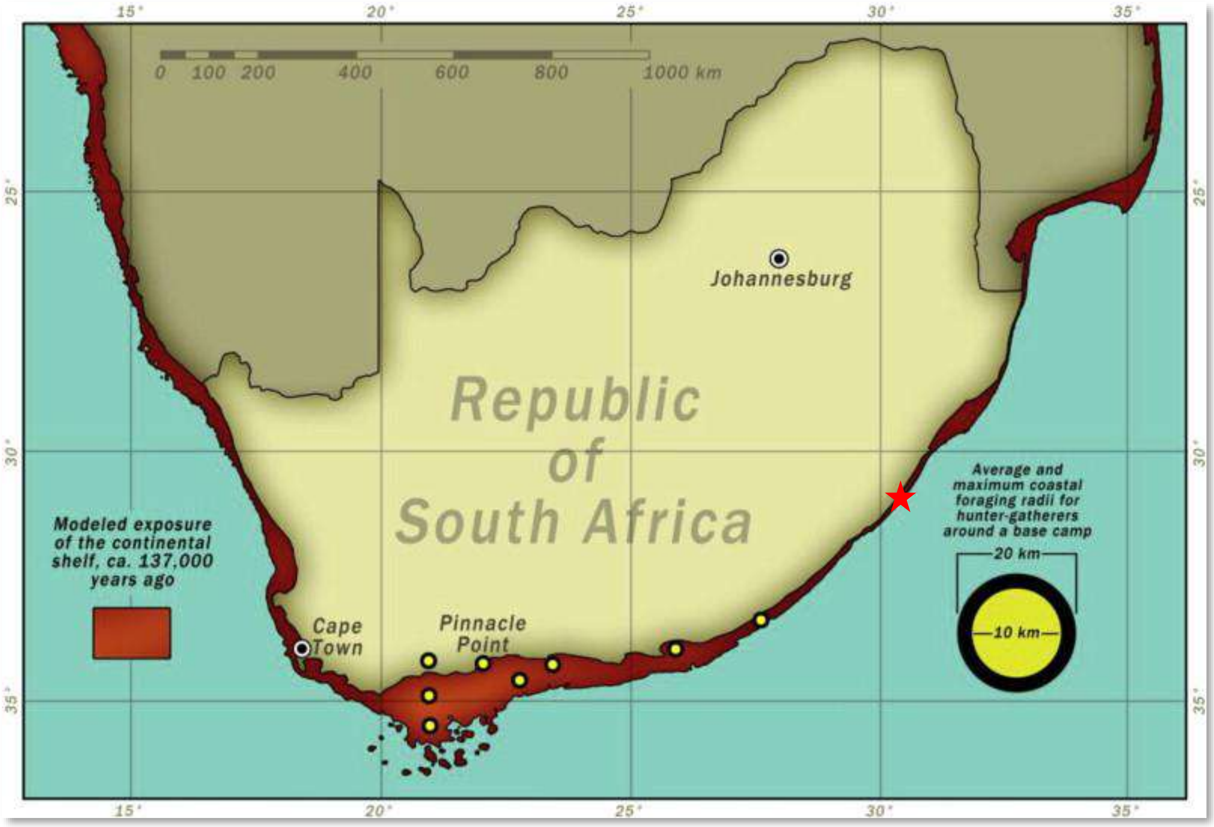

Figure 3: Possible extent of the South African continental shelf during MIS 6. The approximate location of Amamzimtoti is marked by the red star (Source: Franklin et al, 2105)

The exposed continental shelf was quickly populated by terrestrial flora and fauna, and also by our human ancestors who were dependant on these resources (Compton, 2011). As a result, for periods numbering in the tens of thousands of years on at least three occasions during the last 500,000 years our ancestors inhabited areas of what is now seabed around the South African coast. This means that a large part of the archaeological record of the later Middle and early Later Stone Age is located on the continental shelf and is now "inundated and for all practical purposes absent from [that] record" (Van Andel, 1989:133-134).

Until relatively recently there was little or no access to the submerged prehistoric landscapes and sites on the continental shelf, although evidence from various parts of the world of drowned, formerly terrestrial landscapes hinted at the tantalising prospect of prehistoric archaeological sites on and within the current seabed. Perhaps the best-known example of such evidence is archaeological material and late Pleistocene faunal remains recovered by fishing trawlers in the North Sea between the United Kingdom and the Netherlands throughout the 20th century (Peeters *et al*, 2009; Peeters, 2011) and the recent archaeological interpretation of 3D seismic data, collected in the same area by the oil and gas industry, which has revealed well-preserved prehistoric landscape features under and on the seabed of the southern North Sea (Fitch *et al*, 2005).

Closer to home, there is archaeological evidence for a prehistoric human presence in what is now Table Bay. In 1995 and 1996 during the excavation of two Dutch East India Company shipwrecks, the *Oosterland* and *Waddinxveen*, divers recovered three Early Stone Age handaxes from the seabed under the wrecks (**Plate 1**).

The stone tools, which are between 300,000 and 1.4 million years old, were found at a depth of 7-8m below mean sea level and were within Pleistocene sediments associated with an ancient submerged and infilled river channel. Their unrolled and unworn condition indicated that they had not been carried to their current position by the ancient river and suggests that they were found more or less where they were dropped by Early Stone Age hominins at least 300,000 years ago, at a time when the sea level was at least 10m lower than it is today (Werz and Flemming, 2001; Werz *et al*, 2014).

Plate 1: Early Stone Age Acheulian hand axes found in Table Bay (Source: http://www.aimure.org/index.php/aimure-projects)

Ancient river courses, whose channels are today buried under modern seabed sediment, would have been an important focus for hominin activity in the past and, as demonstrated in Table Bay, there is the potential for the occurrence of submerged pre-colonial archaeological material in association with palaeo-river channels.

Where alluvial sediment within these channels has survived post-glacial marine transgressions there is also the potential to recover palaeoenvironmental data which can contribute contextual information to our understanding of the ancient human occupation of South Africa

6.1.1 Submerged Prehistory of the Amanzimtoti area

Although there are currently no known submerged prehistoric sites in the Amanzimtoti area or along the proposed subsea cable route, a number of studies of the wider KZN continental shelf describe Pleistocene and Holocene palaeolandscape features and sediments which have archaeological potential.

Martin and Flemming (1988) describe three Quaternary sequences overlying older strata: consolidated and fossilised aeolian foredune complexes, buried fluvial channels with infill sediments, and unconsolidated Holocene sediments.

Rugged and linear aeolianite shoals like the Protea Banks and Aliwal Shoal form prominent features on the KZN shelf and Cawthra *et al* (2012) also recently identified aeolianite deposits off of The Bluff in Durban. These aeolianite deposits form a succession of shore-parallel reef systems extending to depths in excess of 100 m below mean sea level. They are linked to global Quaternary sea level fluctuations and are thought to represent Late Pleistocene palaeocoastlines. They formed as coastal dunes associated with barrier beaches and are interpreted as submerged coastal dune cordons (Martin and Flemming, 1988; Bosman *et al*, 2005; Cawthra *et al*, 2012). Martin and Flemming (1988) suggest that they were formed during the last glacial, between 120 000 and 30 000 years ago. An Infrared Stimulated Luminescence age of 60 ka obtained by Cawthra *et al* (2012) supports this dune building during the Marine Isotope Stage 4, last glacial period. Coastal dunes are a known focus of pre-colonial human activity, and sites are often found in dune slacks which provide shelter from the prevailing wind. It is possible, therefore, that there will be archaeological sites and material associated with the aeolianite deposits off the KZN coast, although such material has not yet been identified.

A number of studies (see for example, Green and Garlick, 2011; Dladla, 2013) have also described incised valleys on the continental shelf which were cut during sea-level low-stands when river courses extended onto the shelf. This downcutting would have occurred during glacial periods and the resultant channels are filled by fluvial sediment and are overlain by Holocene sediments deposited when sea-level regained levels near to those of present day (Martin and Flemming, 1988). Such palaeo-rivers would have been attractive resources to our human ancestors on the now submerged continental shelf and just as on land, archaeological sites and material can be expected to be associated with these river valleys. Where fluvial deposits within the palaeochannels have survived subsequent marine transgression these have the potential to preserve palaeoenvironmental information useful in the reconstructing the environment and thus contributing to the study of our early ancestors in South Africa.

Across much of the continental shelf modern seabed sediments, laid down during the Holocene as the sea level rose to the level it is today, are draped over and infill the incised palaeochannels. Although this unconsolidated surface sediment is likely to have some archaeological potential, it is likely to be low.

6.2 ***Shipwrecks***

In 1498 the Portuguese explorer Vasco da Gama finally pioneered the elusive sea route around Africa from Europe to the East. Since then, the southern tip of the African continent has played a vital role in global economic and maritime affairs, and until the opening of the Suez Canal in 1869, represented the most viable route between Europe and the markets of the East (Axelson, 1973; Turner, 1988; Gribble, 2002; Gribble and Sharfman, 2013).

The South African coast is rugged and the long fetch and deep offshore waters mean that the force and size of seas around the South African coast are considerable, a situation exacerbated by prevailing seasonal winds.

The geographical position of the South African coast on the historical route to the East and the physical conditions mariners could expect to encounter in these waters have, in the last five centuries, been responsible for the large number of maritime casualties which today form the bulk of South Africa's maritime and underwater cultural heritage (Gribble, 2002).

For obvious historical reasons, the earliest known South African wrecks are Portuguese, dating to the sixteenth century when that country held sway over the route to the East. Due to the later, more prolonged ascendancy of first the Dutch and then the British in European trade with the East and control at the Cape, the majority of wrecks along the South African coast are Dutch and British. However, at least 36 other nationalities are represented amongst the other wrecks that litter the South African coast

Da Gama's maritime incursion into the Indian Ocean laid the foundation for more than 500 years of subsequent European maritime activity in the waters off the South African coast. The Portuguese and other European nations who followed their lead around the Cape and into the Indian Ocean, however, joined a maritime trade network that was thousands of years old and in which east and south east Africa was an important partner.

This trade spanned the Indian Ocean and linked the Far East, South East Asia, India, the Indian Ocean islands and Africa. Archaeological evidence from Africa points to an ancient trade in African products – gold, skins, ivory and slaves – in exchange for beads, cloth, porcelain, iron and copper. The physical evidence for this trade includes Persian and Chinese ceramics excavated sites on African Iron Age like Khami, Mapungubwe and Great Zimbabwe (see Garlake, 1968; Huffman, 1972; Chirikure, 2014), glass trade beads found in huge numbers on archaeological sites across eastern and southern Africa (Wood, 2012).

There is shipwreck evidence on the East African coast for this pre-European Indian Ocean trade (see for example Pollard *et al*, 2016) and clear archaeological and documentary evidence that this trade network extended at least as far south as Maputo in Mozambique. This suggests that there is the potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions to exist along the South African east coast and offshore waters.

The more than 2500 historical shipwrecks that make up the bulk of South Africa's underwater cultural heritage are a thus huge, cosmopolitan, repository of information about mainly global maritime trade during the last five centuries and potentially much further back into the past. These sites contain a wealth of cultural material associated with that trade and clues to the political, economic, social and cultural changes that accompanied this trade and which contributed to the creation of the modern world.

6.3 *Maritime History of the KZN Coast*

The earliest European detailed description of the KZN coast is by the Portuguese navigator and cartographer Manuel de Mesquita Perestrelo who charted the South African coast between November 1575 and January 1576 (**Figure 4**). One of the major coastal landmarks noted by Perestrelo was Durban Bluff, which he named Ponta Pescaria (Knox-Johnston, 1989; http://cvc.instituto-camoes.pt/navegaport/a31.html).

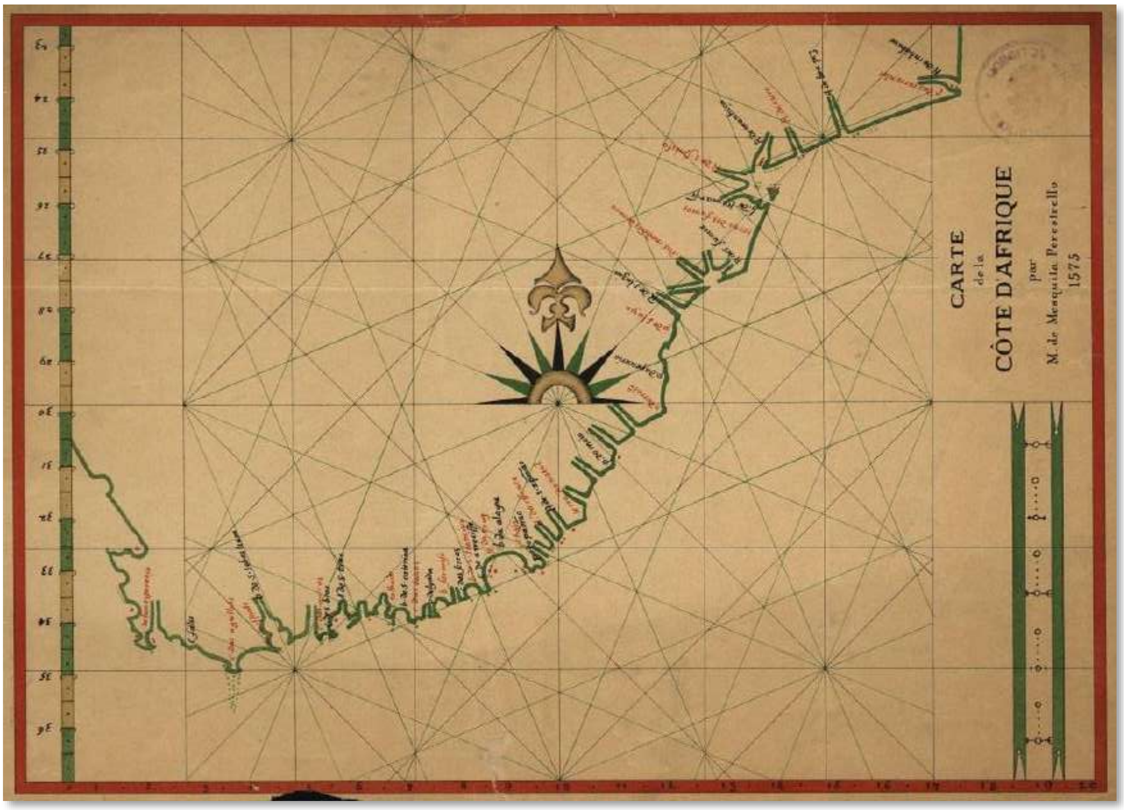

Figure 4: Manuel de Mesquita Perestrelo's map of the South African coast (Source: Wikipedia)

Sheltered behind the Bluff is Natal Bay, now Durban Harbour, a shallow and swampy lagoon surrounded by mangrove forests when the first visited by European shipwreck survivors in the 16th and 17th centuries.

Until the 1820s the KZN coastline was avoided whenever possible by European sailors because of its lack of shelter. The coast is characterised by long stretches of sandy beach punctuated by river mouths, very few of which are accessible from the sea or navigable.

After a Royal Navy survey of the coast by Captain Owen in 1822, however, a small group of settlers led by James King and Francis Farewell arrived at Port Natal, one of the few natural harbour on the coast, and established an agricultural community in 1824 (Knox-Johnston, 1989). During the 19th century Port Natal (renamed Durban after of the Governor of the Cape in 1835) was the principal harbour on the KZN coast, although small harbours were established at Scottburgh and Umkomaas in 1850 and 1861 respectively to export sugar (https://en.wikipedia.org/wiki/Scottburgh; https://en.wikipedia.org/wiki/Umkomaas), at Port Shepstone on the Mzimkulu River 120 km south of Durban in 1867 after the discovery of marble in the area (https://en.wikipedia.org/wiki/Port_Shepstone), and at Richards Bay in the Mhlatuze River lagoon during the Anglo-Zulu War of 1879 (https://en.wikipedia.org/wiki/Richards_Bay)

As a result, the records consulted for this study show a concentration of historical shipwrecks at KZN's historical ports, with relatively few wrecks in the areas in between.

There are, for example, at least 170 recorded wrecks in the immediate vicinity of Durban. In addition, the remains of nearly a dozen whalers and other vessels that were scuttled during the 20th century are charted by the SANHO to the east and south-east of Durban (see **Figure 5** below). These positions for these charted wrecks are relatively accurate, but those available for most of the historical shipwrecks are less so.

6.3.1 Amanzimtoti

Amanzimtoti, named according to local legend by the Zulu king Shaka for the sweetness of the water in the river, has no specific maritime history or heritage. The town developed around the Adams Mission, established inland of the modern town in 1836 by an American missionary, Dr Netwon Adams. A mission school, Adams College, was established in 1853 and still exists.

In 1897 the area was still largely rural (**Plate 2**) when a railway station was built at Amanzimtoti on the new line down the coast from Durban, and this improved access from Durban resulted in the growth of the town into the modern beach resort it is today (https://en.wikipedia.org/wiki/Amanzimtoti) (**Plate 3**).

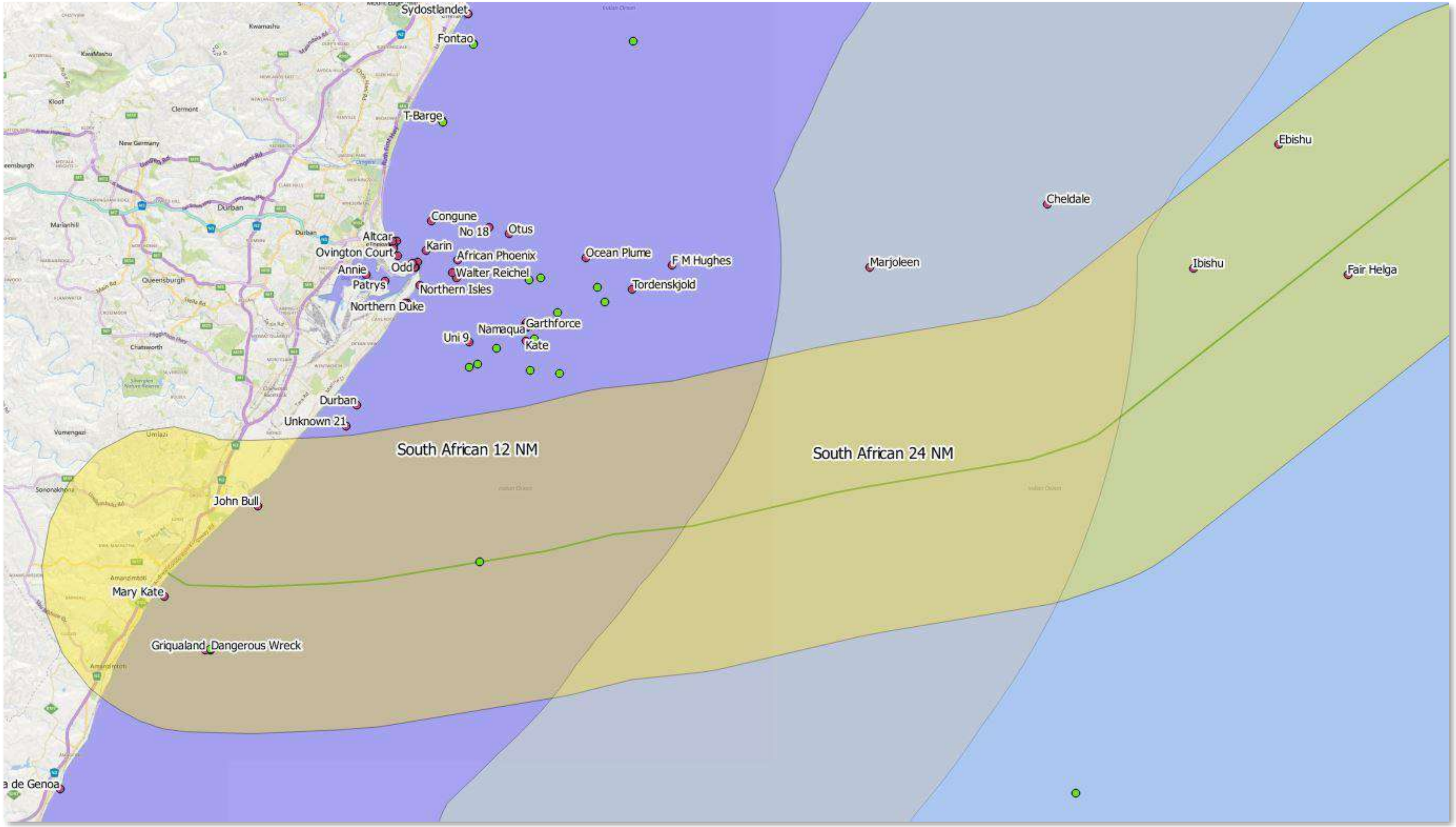

Figure 5: Known and recorded wrecks in the subsea cable route Marine Study Area within 24 nautical miles of the baseline. The 20 km study area shown as the yellow polygon. The green points on the image are unnamed SANHO charted wrecks. The green point on the subsea cable route is the SANHO "Position Approximate" wreck described in the report text. Please note that the number of wrecks shown around Durban is not a true reflection of the total number known.

Plate 2: Photograph of Amanzimtoti c. 1895-1900 (Source: http://www.oberlinlibstaff.com/omeka_anthro/items/show/86)

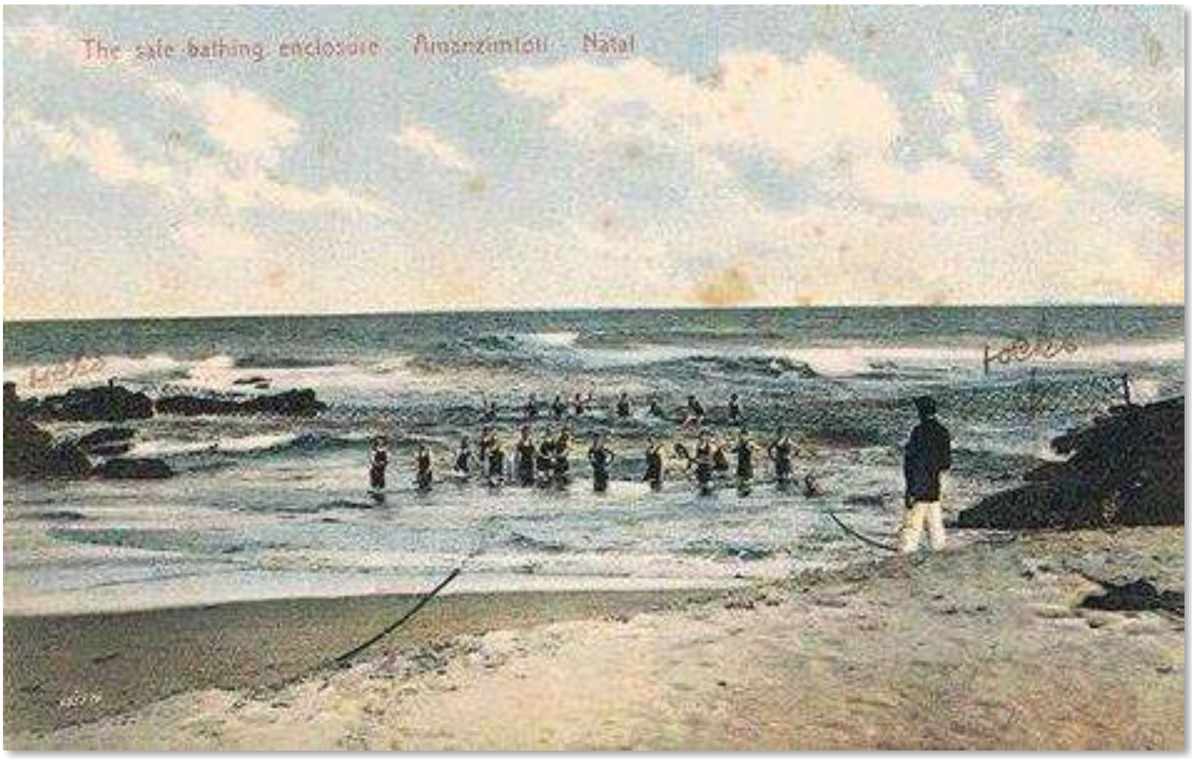

Plate 3: Bathing at the Chain Rocks, Amanzimtoti late 19th/early 20th century (Source: https://southcoastsun.co.za)

6.4 ***Shipwrecks in the Marine Study Area***

According to the available records, there are only three known wrecks within the 20 km Marine Study Area around the proposed subsea cable route alignment in the contiguous zone and territorial waters. These are the *John Bull*, *Griqualand* and *Mary Kate* and they are described below (see also **Appendix A**).

6.4.1 John Bull (1948)

The *John Bull* was a 15 ton Durban-based fishing boat which sank off Isipingo on 2 December 1948 after being hit by a freak 10 m wave. Four people died. No further information about this vessel is available.

6.4.2 Griqualand (1970)

The *Griqualand* was a motor coaster chartered by the Green 'R' Line which served ports around the South African coast (**Plate 4**). She was lost in strange circumstances in November 1970 when, shortly after leaving Durban with a cargo of spirits and petrochemicals, there was an explosion in her holds which set her highly inflammable cargo alight. After futile attempts by salvage tugs to douse the blaze and tow her offshore she was sunk by gunfire from HMS *Dido* (**Plate 5**). There were no casualties (Ingpen, 1979).

The wreck still contains part of its cargo of liquid chlorine and is considered dangerous.

Plate 4: The coaster *Griqualand* (Source: https://www.balticshipping.com/vessel/imo/5329293)

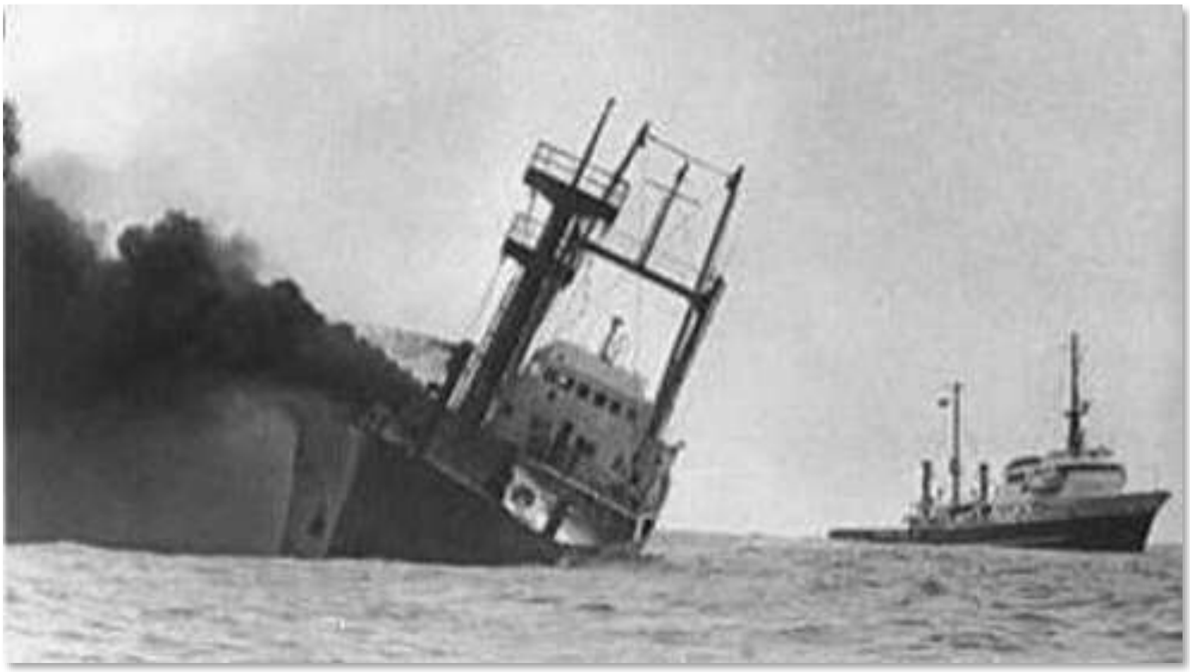

Plate 5: The *Griqualand* ablaze in November 1970 with the tug *Statesman* standing by (Source: https://www.wrecksite.eu/)

6.4.3 Mary Kate (1976)

The *Mary Kate* was another fishing vessel which foundered off Amanzimtoti on 27 December 1976. No further information about this vessel is available.

Although the accurate positions of these wrecks is not known, based on the descriptions of these casualties in the historical record it is safe to assume that they are sufficiently distant from the cable route to be discounted as potential risks to the Project.

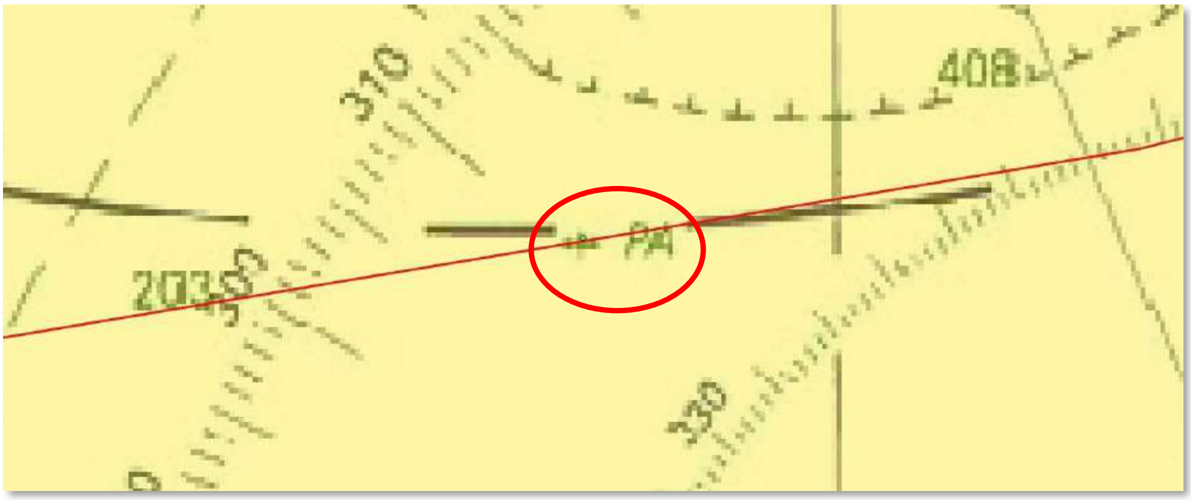

Figure 6: The SANHO wreck charted as "Position Approximate" (PA) (circled) which lies within 40 m of the subsea cable route alignment (Source: SAN Chart 0135)

Two unidentified wrecks charted by the SANHO are also within the Marine Study Area. The first is probably the *Griqualand* and its given position is likely to be relatively accurate. The identity of the second wreck, however, is not known and the chart gives its position as approximate. This latter wreck lies within 40 m of the proposed subsea cable alignment, approximately 45 km from the landfall (**Figure 6** above).

A last point to make is that only one of the known wrecks in the Marine Study Area (*John Bull*) is currently less than 60 years of age and thus protected by the NHRA as a heritage resource.

6.5 *Shipwrecks within the EEZ*

Further offshore, within the EEZ there are two recorded wrecks within the Marine Study Area: the whaler *Fair Helga*, which sank in 1927 and a crayfish boat, the *Ibishu*, lost in 1967. Confidence in the positions of both wrecks is extremely low.

Although the remit of the NHRA does not extend to these two wrecks in respect of this Project (see Section 4.3 above) their presence is worth noting as a potential risk to Project plant and to the subsea cable.

7 Impact Assessment

To minimise subjectivity and accurately assess the Project impacts, the impact assessment methodology supplied by ERM and shown in Apprndix D has been followed.

It is important to note that with respect to determnining the magnitude of impacts heritage receptors do not fit comfortably into the either of the two categories provided, namely biophysical impacts and socio-economic impacts. The best fit is biophysical impacts and this has been used for this impact assessment.

7.1 *Submerged Prehistory*

The available information about the palaeolandscapes of the KZN continental shelf suggests that while no submerged pre-colonial archaeological sites or material are known from the Amanzimtoti area, the potential exists for such material to be present associated with the palaeochannel of the Amanzimtoti River or with any aeolianite reefs offshore.

7.1.1 Impact Description

The risk to submerged prehistoric archaeological resources from the installation of the proposed subsea cable is from **direct impacts** that can arise from the physical penetration and disturbance of the seabed during cable burial, or where the plough or ROV encounters heritage resources, on the seabed surface

7.1.2 Impact Assessment

Where direct impacts from the installation of the proposed subsea cable occur these will be **permanent** as heritage resources are non-renewable and cannot recover from disturbance or damage. The **extent** of impacts are likely to be on-site and their **scale** will be limited to the footprint of the area disturbed by the Project – in this case the maximum extent will probably be the plough zone.

7.1.3 Mitigation

The small footprint and limited penetration of the seabed intervention associated with the burial of the subsea cable mean that it is likely to affect only unconsolidated surface Holocene sediments. This suggests that the potential for interaction with or direct impact on submerged prehistoric archaeological material is **unlikely**.

No mitigation is therefore proposed in respect of potential submerged prehistoric archaeology in the Marine Study Area and the potential residual impact on submerged prehistoric archaeology is **Moderate**.

Table 2: Significance of Impacts on Submerged Prehistoric Archaeological Resources

Characteristic	**Impact**	**Residual Impact**
Extent	Local (On-site)	Local (On-site)
Duration	Permanent	Permanent
Scale	The footprint of the area disturbed by project activities. Probably the maximum extent of the plough zone for this receptor	The footprint of the area disturbed by project activities. Probably the maximum extent of the plough zone for this receptor
Reversibility	Irreversible	
Loss of resource	High – Any archaeological material disturbed or destroyed is essentially lost and cannot be replaced or renewed	
Magnitude	Small – the limited penetration of the seabed intervention means that activities are likely to affect only unconsolidated surface Holocene sediments. Furthermore, the extent of impacts is likely to be on-site and their scale will be limited to the footprint of the area disturbed by the Project.	Small - the limited penetration of the seabed intervention means that activities are likely to affect only unconsolidated surface Holocene sediments. Furthermore, the extent of impacts is likely to be on-site and their scale will be limited to the footprint of the area disturbed by the Project.
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High – heritage resources are finite and non-renewable and are protected under the terms of the National Heritage Resources Act (1999)	High - heritage resources are finite and non-renewable and are protected under the terms of the National Heritage Resources Act (1999)
Significance of Impact	**Moderate**	**Moderate**

7.2 ***Shipwrecks***

Although there is a large concentration of historical shipwrecks around Durban, only a handful are recorded in the vicinity of the proposed subsea cable alignment within the 24 nautical mile limit of the contiguous zone covered by this report.

The *John Bull* off Isipingo is roughly 8 km north of the subsea cable alignment, and the positions given for the *Griqualand* are more than 4.5 km south of the proposed subsea cable route. Neither of these wrecks is likely to affected by the installation of the subsea cable.

7.2.1 Impact Description

The risk to historical shipwrecks from the installation of the proposed subsea cable is from **direct impacts** that can arise from contact during pre-lay grapnel runs, from the physical penetration and disturbance of the seabed during cable burial, or where the plough or ROV encounters a wreck on the seabed surface.

7.2.2 Impact Assessment

The two wrecks at most risk of impacts from the Project are the *Mary Kate*, recorded as lost off Amanzimtoti and the SANHO charted wreck marked as “Position Approximate” which is less than 40 m from the current route alignment.

Any direct impacts from the installation of the proposed subsea cable occur on historical shipwrecks will be **permanent** as heritage resources are non-renewable and cannot recover from disturbance or damage. The **extent** of impacts are likely to be on-site and their **scale** will be limited to the footprint of the area disturbed by the project.

Because of the risk wrecks pose to seabed machinery and to the subsea cable, the route alignment will always be adjusted to avoid wrecks, which makes the potential for any interaction with or impact on historical wrecks by the installation of the proposed METISS subsea cable unlikely, except during pre-lay grapnel runs where the risk of impact is greater.

7.2.3 Mitigation

The archaeological review of geophysical data, particularly sidescan sonar and multibeam bathymetry, is recommended before the grapnel run or subsea cable laying to locate the SANHO "Position Approximate" wreck and ensure that the wrecks of the *Fair Helga*, and *Ibishu* will not be affected by, or affect the subsea cable or cable-laying machinery. The geophysical data review has the additional benefit of identifying any previously unknown wrecks on the seabed within the subsea cable route corridor.

In the event a previously unknown or unrecorded shipwreck is encountered during the grapnel run or installation of the subsea cable, the Project archaeologist and SAHRA must be notified immediately. If the wreck will be impacted by the subsea cable laying, all work must cease until the archaeologist and SAHRA have assessed the significance of the site and a decision has been taken as to how to deal with it.

Table 3: Significance of Impacts on Historical Shipwrecks

Characteristic	Impact	Residual Impact
Extent	On-site	On-site
Duration	Permanent	Permanent
Scale	The footprint of the area disturbed by project activities. Probably the maximum extent of the plough zone for this receptor	Unknown wrecks maybe damaged if present
Reversibility	Irreversible	
Loss of resource	High – Any archaeological material disturbed or destroyed is essentially lost and cannot be replaced or renewed	
Magnitude	Small	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High – heritage resources are finite and non-renewable and are protected under the terms of the National Heritage Resources Act (1999)	Low – Sites will be avoided through the implementaiotn of mitigation measures
Significance of Impact	**Moderate**	**Negligible**

8 Mitigation

No mitigation is required or proposed in respect of potential submerged prehistoric archaeology in the Marine Study Area.

In respect of shipwrecks, the archaeological review of geophysical data, particularly sidescan sonar and multibeam bathymetry, is recommended to locate the SANHO "Position Approximate" wreck and ensure that the wrecks of the *Fair Helga*, and *Ibishu* will not be affected by, or affect the subsea cable or cable-lay plant. The geophysical data review also has the benefit of identifying previously unknown wrecks on the seabed within the subsea cable route corridor. There should be early communication between the geophysical and archaeological contractors on the Project with regard to this archaeological data review.

In the event a previously unknown or unrecorded shipwreck is encountered during the installation of the subsea cable, the Project archaeologist and SAHRA must be notified immediately. If the wreck will be impacted by the cable laying, all work must cease until the archaeologist and SAHRA have assessed the significance of the site and a decision has been taken as to how to deal with it.

9 Conclusion

Provided the mitigation measures recommended above are implemented, the maritime elements of the proposed METISS subsea cable system are unlikely to have any impact on known or unknown maritime and underwater cultural heritage resources and are considered archaeologically acceptable.

Any impact from the Project on previously unknown shipwreck or other maritime archaeological material encountered during the cable laying can be dealt with through the implementation of the mitigation measures proposed in this report.

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Appendix A: Gazetteer of Known Shipwrecks within 20 km Buffer Zone

Ship Name	Area	Place	EventType	Ship Type	Nationality	Date	Notes
Griqualand	Durban	Amanzimtoti	Sunk	Coaster	South African	1970-11-14	Vessel caught fire shortly after leaving Durban. She was sunk by gunfire from a British frigate, the HMS Dido, 15km south of Durban, and 8km offshore. Her crew of 12 were all saved.
John Bull	Isipingo	Isipingo	Foundered	Fishing Vessel	South African	1948-12-02	Vessel struck by 30ft wave and sank. 4 lives lost.
Mary Kate	Amanzimtoti	Amanzimtoti	Foundered	Fishing Vessel	South African	1976-12-27	Foundered in heavy seas off Amanzimtoti.

Appendix B: Specialist's CV

Name:	John Gribble
Profession:	Archaeologist
Date of Birth:	15 November 1965
Parent Firm:	ACO Associates cc
Position in Firm:	Senior Archaeologist
Years with Firm:	1
Years of experience:	28
Nationality:	South African
HDI Status:	n/a

Education:

1979-1983	Wynberg Boys' High School (1979-1983)
1986	BA (Archaeology), University of Cape Town
1987	BA (Hons) (Archaeology), University of Cape Town
1990	Master of Arts, (Archaeology) University of Cape Town

Employment:

- ACO Associates, Senior Archaeologist and Consultant, September 2017 – present
- South African Heritage Resources Agency, Manager: Maritime and Underwater Cultural Heritage Unit, 2014 – 2017 / Acting Manager: Archaeology, Palaeontology and Meteorites Unit, 2016-2017
- Sea Change Heritage Consultants Limited, Director, 2012 – present
- TUV SUD PMSS (Romsey, United Kingdom), Principal Consultant: Maritime Archaeology, 2011-2012
- EMU Limited (Southampton, United Kingdom), Principal Consultant: Maritime Archaeology, 2009-2011
- Wessex Archaeology (Salisbury, United Kingdom), Project Manager: Coastal and Marine , 2005-2009
- National Monuments Council / South African Heritage Resources Agency, Maritime Archaeologist, 1996-2005
- National Monuments Council, Professional Officer: Boland and West Coast, Western Cape Office, 1994-1996

Professional Qualifications and Accreditation:

- Member: Association of Southern African Professional Archaeologists (No. 043)
- Principal Investigator: Maritime and Colonial Archaeology, ASAPA CRM Section
- Field Director: Stone Age Archaeology, ASAPA CRM Section
- Member: Chartered Institute for Archaeologists (CIfA), United Kingdom
- Class III Diver (Surface Supply), Department of Labour (South Africa) / UK (HSE III)

Experience:

I have nearly 30 years of combined archaeological and heritage management experience. After completing my postgraduate studies, which were focussed on the vernacular architecture of the West Coast, and a period of freelance archaeological work in South Africa and aboard, I joined the National Monuments Council (NMC) (now the South African Heritage Resources Agency (SAHRA)) in 1994. As the Heritage Officer: the Boland I was involved in day to day historical building control and heritage resources management across the region. In 1996 I become the NMC's first full-time maritime archaeologist in which role was responsible for the management and protection of underwater cultural heritage in South Africa under the National Monuments Act, and subsequently under the National Heritage Resources Act.

In 2005 I moved to the UK to join Wessex Archaeology, one of the UK's biggest archaeological consultancies, as a project manager in its Coastal and Marine Section. In 2009 I joined Fugro EMU Limited, a marine geosurvey company based in Southampton to set up their maritime archaeological section. I then spent a year at TUV SUD PMSS, an international renewable energy consultancy based in Romsey, where I again provided maritime archaeological consultancy services to principally the offshore renewable and marine aggregate industries.

In August 2012 I set up Sea Change Heritage Consultants Limited, a maritime archaeological consultancy. Sea Change provides archaeological services to a range of UK maritime sectors, including marine aggregates and offshore renewable energy. It also actively pursues opportunities to raise public awareness and understanding of underwater cultural heritage through educational and research projects and programmes, including some projects being developed in South Africa.

Projects include specialist archaeological consultancy for more than 15 offshore renewable energy projects and more than a dozen offshore aggregate extraction licence areas.

In addition to managing numerous UK development-driven archaeological projects, I have also been involved in important strategic work which developed guidance and best practice for the offshore industry with respect to the marine historic environment. This has included the principal authorship of two historic environment guidance documents for COWRIE and the UK renewable energy sector, and the development of the archaeological elements of the first Regional Environmental Assessments for the UK marine aggregates industry. In 2013-14 I was lead author and project co-ordinator on the Impact Review for the United Kingdom of the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage. In 2016 I was co-author of a Historic England / Crown Estate / British Marine Aggregate Producers Association funded review of marine historic environment best practice guidance for the UK offshore aggregate industry (.

I returned to South African in mid-2014 where I was re-appointed to my earlier post at SAHRA: Manager of the Maritime and Underwater Cultural Heritage Unit. In July 2016 I was also appointed Acting Manager of SAHRA's Archaeology, Palaeontology and Meteorites Unit.

I left SAHRA in September 2017 to join ACO Associates as Senior Archaeologist and Consultant.

I have been a member of the ICOMOS International Committee for Underwater Cultural Heritage since 2000 and have served as a member of its Bureau since 2009. I am currently the secretary of the Committee.

I have been a member of the Association of Southern African Professional Archaeologists for more than twenty years and am accredited by ASAPA's CRM section. I have been a member of the UK's Chartered Institute for Archaeologist's (CIfA) since 2005, and served on the committee of its Maritime Affairs Group between 2008 and 2010. Since 2010 I have been a member of the UK's Joint Nautical Archaeology Policy Committee.

I am currently a member of the Advisory Board of the George Washington University / Iziko Museums of South Africa / South African Heritage Resources Agency / Smithsonian Institution 'Southern African Slave Wrecks Project' and serve on the Heritage Western Cape Archaeology, Palaeontology and Meteorites Committee.

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Appendix C: Details Of Specialist and Declaration of Interest

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

ASN Africa METISS Subsea Fibre Optic Cable System

Specialist:	Maritime Heritage		
Contact person:	John Gribble		
Postal address:	Unit D17, Prime Park, Mocke Road, Diep River		
Postal code:	7800	Cell:	0786162961
Telephone:	021 706 4104	Fax:	
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Professional affiliation(s) (if any)	Member: ASAPA		

Project Consultant:			
Contact person:			
Postal address:			
Postal code:		Cell:	
Telephone:		Fax:	
E-mail:			

4.2 The specialist appointed in terms of the Regulations_

I, John Gribble, declare that -- General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

ACO Associates

Name of company (if applicable):

28 February 2019

Date:

Appendix D: Impact Assessment Methodology

10.2 *Assumptions and Limitations*

Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIA deals with the future there is, inevitably, some uncertainty about what will actually happen in reality. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties could not be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided.

In line with best practice, this EIA has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists has used professional experience to judge whether a significant impact is likely to occur or not. Throughout the assessment, this conservative approach has been adopted to the allocation of significance.

10.3 *Impact Identification and Characterisation*

An 'impact' is any change to a resource or receptor caused by the presence of a Project component or by a Project-related activity. Impacts can be negative or positive. Impacts are described in terms of their characteristics, including the impact's type and the impact's spatial and temporal features (namely extent, duration, scale and frequency). Terms used in this EIA process are described Table 0-1.

Table 0-1 Impact Characteristics

Characteristic	Definition	Terms
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect).	**Direct** - Impacts that result from a direct interaction between a planned Project activity and the receiving environment/receptors (ie, between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality). **Indirect** - Impacts that result from other activities that are encouraged to happen as a consequence of the Project (ie, in-migration for employment placing a demand on resources). **Induced** - Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project. **Cumulative** - Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.
Duration	The time period over which a resource / receptor is affected.	**Temporary** - (period of less than 3 years - negligible/ pre-construction/ other). **Short term** - (period of less than 5 years ie, production ramp up period).

		Long term -impacts that will continue for the life of the Project, but ceases when the Project stops operating. **Permanent** - (a period that exceeds the life of plant – ie, irreversible.).
Extent	The reach of the impact (ie, physical distance an impact will extend to)	**On-site** - impacts that are limited to the Project site. **Local** - impacts that are limited to the Project site and adjacent properties. **Regional** - impacts that are experienced at a regional scale. **National** - impacts that are experienced at a national scale. **Trans-boundary/International** - impacts that are experienced outside of South Africa.
Scale	Quantitative measure of the impact ie, the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.).	Quantitative measures as applicable for the feature or resources affects. No fixed designations as it is intended to be a numerical value.
Frequency	Measure of the constancy or periodicity of the impact.	No fixed designations; intended to be a numerical value or a qualitative description.

10.4 *Determining Magnitude*

Once impacts are characterised they are assigned a 'magnitude'. Magnitude is a function of some combination (depending on the resource/ receptor in question) of the following impact characteristics:

- Extent;
- Duration;
- Scale; and
- Frequency.

Magnitude (from small to large) is a continuum. Evaluation along the continuum requires professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is described. Magnitude designations for negative effects are: Negligible, Small, Medium and Large.

The magnitude designations themselves are universally consistent, but the definition for the designations varies by issue. In the case of a positive impact, no magnitude designation has been assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a Positive impact.

Some impacts will result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes are regarded as having no impact, and characterised as having a Negligible Magnitude.

Determining Magnitude for Biophysical Impacts

For biophysical impacts, the semi-quantitative definitions for the spatial and temporal dimension of the magnitude of impacts used in this assessment are provided below.

Large Magnitude Impact affects an entire area, system (physical), aspect, population or species (biological) and at sufficient magnitude to cause a significant measureable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) or a decline in abundance and/ or change in distribution beyond which natural recruitment (reproduction, immigration from unaffected areas) would not return that population or species, or any population or species dependent upon it, to its former level within several generations (physical and biological). A High Magnitude impact may also adversely affect the integrity of a site, habitat or ecosystem.

Medium Magnitude Impact affects a portion of an area, system, aspect (physical), population or species (biological) and at sufficient magnitude to cause a measurable numerical increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) and may bring about a change in abundance and/or distribution over one or more plant/animal generations, but does not threaten the integrity of that population or any population dependent on it (physical and biological). A moderate magnitude impact may also affect the ecological functioning of a site, habitat or ecosystem but without adversely affecting its overall integrity. The area affected may be local or regional.

Small Magnitude Impact affects a specific area, system, aspect (physical), group of localised individuals within a population (biological) and at sufficient magnitude to result in a small increase in measured concentrations or levels (to be compared with legislated or international limits and standards specific to the receptors) (physical) over a short time period (one plant/animal generation or less, but does not affect other trophic levels or the population itself), and localised area.

Determining Magnitude for Socio-Economic Impacts

For socio-economic impacts, the magnitude considers the perspective of those affected by taking into account the likely perceived importance of the impact, the ability of people to manage and adapt to change and the extent to which a human receptor gains or loses access to, or control over socio-economic resources resulting in a positive or negative effect on their well-being. The quantitative elements are included into the assessment through the designation and consideration of scale and extent of the impact.

10.4.1 Determining Receptor Sensitivity

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. Where the receptor is physical (for example, a water body) its current quality, sensitivity to change, and importance (on a local, national and international scale) are considered.

Where the receptor is biological or cultural (ie, the marine environment or a coral reef), its importance (local, regional, national or international) and sensitivity to the specific type of impact are considered. Where the receptor is human, the vulnerability of the individual, community or wider societal group is considered. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of receptor is Low, Medium and High.

For ecological impacts, sensitivity is assigned as Low, Medium or High based on the conservation importance of habitats and species. For the sensitivity of individual species, Table 0-2 presents the criteria for deciding on the value or sensitivity of individual species.

For socio-economic impacts, the degree of sensitivity of a receptor is defined as the level of resilience (or capacity to cope) with sudden social and economic changes. Table 0-2 and Table 0-3 present the criteria for deciding on the value or sensitivity of biological and socioeconomic receptors.

Table 0-2 Biological and Species Value / Sensitivity Criteria

Value / Sensitivity	**Low**	**Medium**	**High**
Criteria	Not protected or listed as common / abundant; or not critical to other ecosystem functions ie, key prey species to other species).	Not protected or listed but may be a species common globally but rare in South Africa with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Specifically protected under South African legislation and/or international conventions e.g. CITIES Listed as rare, threatened or endangered e.g. IUCN

Note: The criteria are applied with a degree of caution. Seasonal variations and species lifecycle stage will be taken into account when considering species sensitivity. For example, a population might be deemed as more sensitive during the breeding/spawning and nursery periods. This table uses listing of species ie, IUCN) or protection as an indication of the level of threat that this species experiences within the broader ecosystem (global, regional, local). This is used to provide a judgement of the importance of affecting this species in the context of Project-level changes.

Table 0-3 Socio-Economic Sensitivity Criteria

Sensitivity	**Low**	**Medium**	**High**
Criteria	Those affected are able to adapt with relative ease and maintain pre-impact status.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support.	Those affected will not be able to adapt to changes and continue to maintain-pre impact status.

10.4.2 Assessing Significance

Once magnitude of impact and sensitivity of a receptor have been characterised, the significance can be determined for each impact. The impact significance rating will be determined, using the matrix provided in Figure 0-1.

Figure 0-1 Impact Significance

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

The matrix applies universally to all resources/ receptors, and all impacts to these resources/ receptors, as the resource/ receptor-specific considerations are factored into the assignment of magnitude and sensitivity/ vulnerability/ importance designations that enter into the matrix. Box 0.1 provides a context for what the various impact significance ratings signify.

Box 0.1 Context of Impact Significances

An impact of **Negligible** significance is one where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
An impact of **Minor** significance is one where a resource/receptor will experience a noticeable effect, but the impact magnitude is sufficiently small and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
An impact of **Moderate** significance has an impact magnitude that is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Clearly, to design an activity so that its effects only just avoid breaking a law and/or cause a major impact is not best practice. The emphasis for moderate impacts is therefore on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
An impact of **Major** significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of IA is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (ie, ALARP has been applied). An example might be the visual impact of a facility. It is then the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

10.5 *Mitigation Potential and Residual Impacts*

A key objective of an EIA process is to identify and define socially, environmentally and technically acceptable and cost effective measures to manage and mitigate potential impacts.

Mitigation measures are developed to avoid, reduce, remedy or compensate for potential negative impacts, and to enhance potential environmental and social benefits.

The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Box 0.2.

The priority is to first apply mitigation measures to the source of the impact (ie, to avoid or reduce the magnitude of the impact from the associated Project activity), and then to address the resultant effect to the resource/receptor via abatement or compensatory measures or offsets (ie, to reduce the significance of the effect once all reasonably practicable mitigations have been applied to reduce the impact magnitude).

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures. The approach taken to defining mitigation measures is based on a typical hierarchy of decisions and measures, as described in Box 0.2.

Box 0.2 Mitigation Hierarchy

Avoid at Source; Reduce at Source: avoiding or reducing at source through the design of the Project ie, avoiding by siting or re-routing activity away from sensitive areas or reducing by restricting the working area or changing the time of the activity).

Abate on Site: add something to the design to abate the impact ie, pollution control equipment).

Abate at Receptor: if an impact cannot be abated on-site then control measures can be implemented off-site ie, traffic measures).

Repair or Remedy*:* some impacts involve unavoidable damage to a resource ie, material storage areas) and these impacts require repair, restoration and reinstatement measures.

Compensate in Kind; Compensate Through Other Means where other mitigation approaches are not possible or fully effective, then compensation for loss, damage and disturbance might be appropriate ie, financial compensation for degrading agricultural land and impacting crop yields).

10.5.1 Residual Impact Assessment

Once mitigation measures are declared, the next step in the impact assessment process is to assign residual impact significance. This is essentially a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional declared mitigation measures.

10.5.2 Cumulative Impacts

A cumulative impact is one that arises from a result of an impact from the Project interacting with an impact from another activity to create an additional impact.

How the impacts and effects are assessed is strongly influenced by the status of the other activities (ie, already in existence, approved or proposed) and how much data is available to characterise the magnitude of their impacts.

The approach to assessing cumulative impacts is to screen potential interactions with other projects on the basis of:

- Projects that are already in existence and are operating;
- Projects that are approved but not as yet built or operating; and
- Projects that are a realistic proposition but are not yet built.

10.6 *Assessing Significance of Risks for accidental events*

The methodology used to assess the significance of the risks associated with accidental events differs from the impact assessment methodology set out in Section 5 of this Report. Risk significance for accidental events is based on a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood and consequence of the event also includes the existing control and mitigation measures for this project.

The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the technical team.

The assessment of consequence is based on specialists' input and their professional experience gained from similar projects.

Definitions used in the assessment for likelihood and consequence are set out in Box 0.3.

Box 0.3 Risk Significance Criteria for Accidental Events

Likelihood

Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:

- **Low**: the event or incident is reported in the telecommunication industry, but rarely occurs;
- **Medium**: the event or incident does occur but is not common; and/or
- **High**: the event or incident is likely to occur several times during the project's lifetime.

Consequence

The potential consequence of an impact occurring is a combination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact). Consequence in accidental events is similar to significance (magnitude x sensitivity) of planned events and is classified as either a:

- **Minor consequence**: impacts of Low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required;
- **Moderate consequence**: impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures; or
- **Major consequence**: exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will

recover in the long term only with the implementation of significant/remediation measures.

Once a rating is determined for likelihood and consequence, the risk matrix in Table 0.4 is used to determine the risk significance for accidental events. The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the project design, and the management plans to be implemented by the project.

Table 0.4 Accidental Events Risk Significance

Risk Significance Rating				
Likelihood		Low	Medium	High
Consequence	Minor	Minor	Minor	Moderate
	Moderate	Minor	Moderate	Major
	Major	Moderate	Major	Major

It is not possible to completely eliminate the risk of accidental events occurring. However, the mitigation strategy to minimise the risk of the occurrence of accidental events is outlined in Box 0.4.

Box 0.4 Mitigation Strategy for Accidental Events

Control: aims to prevent or reduce the risk of an incident happening or reduce the magnitude of the potential consequence to As Low as Reasonably Possible (ALARP) through:

- Reducing the likelihood of the event ie, preventative maintenance measures, emergency response procedures and training);
- Reducing the consequence ; and
- A combination of both of these.

Recovery/ remediation: includes contingency plans and response

- Emergency Response Plans and

Tactical Response Plans.