Exploration Drilling within Block ER236, off the East Coast of South Africa

Draft Environmental Impact Assessment Report

Version 1

September 2018

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Exploration Drilling within Block ER236, off the East Coast of South Africa

Eni

Draft Environmental impact Assessment Report

September 2018

Compiled by: Vicky Stevens and Lindsey Bungartz

For and on behalf of Environmental Resources Management

Approved by: Ingeborg McNicoll

Signed:

Position: Senior Partner

Date: 19 September 2018

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Abbreviations

°C	Celsius Degrees
°F	Fahrenheit Degrees
ADGE	*Aeropuertos De Guinea Ecuatorial*
ADI	Areas of Direct Influence
AEL	Atmospheric Emission Licence
AIDS	Acquired Immune Deficiency Syndrome
AII	Areas of Indirect Influence
ALARP	As low as reasonably practicable
AOI	Area of Influence
BAR	Basic Assessment Report
bbl	Barrel
BID	Background Information Document
BOP	Blowout Preventer
CA	Competent Authority
$CaCl_2$	Calcium Chloride
$Ca(OH)_2$	Calcium Hydroxide
CBD	Convention on Biological Diversity
CCAPS	Climate Change and African Political Stability
CH_4	Methane
CITES	Convention on International Trade in Endangered Species
cm	centimetres
CMS	Convention on Migratory Species
CO	Carbon monoxide
CO_2	Carbon dioxide
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CPUE	Catch per Unit Effort
CRR	Comment and Responses Report
CSIR	Council for Scientific and Industrial Research
CV	Curriculum Vitae
CWDP	Coastal Waters Discharge Permit
DAFF	Department of Agriculture, Forestry and Fishery
DAH	Dissolved-phase Aromatic Hydrocarbons
dB	Decibel
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DMR	National Department of Mineral Resources
DP	Dynamic Positioning
DPS	Dynamic Positioning System
DSR	Demand Side Response
DWAF	Department of Water Affairs and Forestry
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECC	Emergency Control Centre
ECCAS	Economic Community of Central African States
EEPEG	ExxonMobil Exploration and Production Equatorial Guinea
EEZ	Exclusive Economic Zone
EHP	Environmental Health practitioner
EKZNW	Ezemvelo KZN Wildlife
EIA	Environmental Impact Assessment
EIR	Environmental Implementation Review
EMBF	Enhanced Mineral Oil Based Fluid
EMEPSAL	ExxonMobil Exploration and Production South Africa Limited
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
EOC	Emergency Operations Centre

EPAs	Estuary Protected Areas
ESG	Emergency Support Group
FAO	Food and Agricultural Organization
FMP	Fisheries Management Plan
FPSO	Floating Production Storage and Offloading Vessel
GCLME	Guinea Current Large Marine Ecosystem
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GPS	Global Positioning System
GWP	Global Warming Potential
GRT	Gross Registered Tonnage
GSLWP	Greater St Lucia Wetland Park
ha	Hectares
HCFC	Halons and hard chlorofluorocarbons
HIV	Human Immunodeficiency Virus
HQ	Head Quarter
HSE	Health Safety & Environment
HSEQ	Health Safety Environment & Quality
HSSE	Health Safety Security & Environment
HydroSAN	South African Navy Hydrographic Office
Hz	Hertz
I&APs	Interested and Affected Parties
IA	Impact Assessment
IAEA	International Atomic Energy Agency
IBAs	Important Bird Areas
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICRC	International Commission on Radiological Protection
IDP	Integrated Development Plan
IDZ	Industrial Development Zone
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IMO	International Maritime Organization
in^3	Cubic Inch
IOGP	International Association of Oil & Gas Producers
IOPP	International Oil Pollution Prevention
IOTC	Indian Ocean Tuna Commission
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation
ITOPF	International Tanker Owners Pollution Federation
ITCZ	Intertropical Convergence Zone
IUCN	International Union for Conservation of Nature
IWCF	International Well Control Forum
JNCC	Joint Nature Conservation Committee
KCDM	King Cetshwayo District Municipality
KCl	Potassium Chloride
km	Kilometer
km^2	Square kilometer
kt	kilotonnes
KZN	KwaZulu-Natal
LC_{50}	Lethal Concentration 50%
LM	Local Municipalities
LNG	Liquefied Natural Gas
LTMBF	Low Toxicity Mineral Oil Based Fluids
LWD	Logging while Drilling
m	Meter
m^3	Cubic Meter
MARPOL	International Convention for the Prevention of Pollution by Ships

MEDAVAC	Medical Evacuation
MEGI	Mobil Equatorial Guinea Inc.
MES	Minimum Emission Standards
MGO	Marine Gas Oil
MIG	Municipal Infrastructure Grant
MLRA	Marine Living Resources Act
mm	Millimeter
MM	Metropolitan Municipality
MMH	Ministry of Mines and Hydrocarbons
MMO	Marine Mammal Observer
MPAs	Marine Protected Areas
MPRDA	Mineral and Petroleum Resources Development Amendment
MPRDAA	Mineral and Petroleum Resources Development Amendment Act
MSD	Marine Sanitation Device
NABF	Non Aqueous Base Fluid
NaCl	Sodium Chloride
NADF	Non-aqueous drilling fluid
NAPA	National Action Plan for Adaptation to Climate Change
NARRT	North America Regional Response Team
Navtext	Navigational Telex
NE	North-east
NEMA	National Environmental Management Act
NEMAA	National Environmental Management Amendment Act
NEMAQA	National Environmental Management: Air Quality Act
NEMICMA	National Environmental Management: Integrated Coastal Management Act
NEMWA	National Environmental Management: Waste Act
NOx	Oxides of Nitrogen
NTS	Non-Technical Summary
N_2O	Nitrous oxide
OGP	Oil & Gas Producers
OIM	Offshore Installation Manager
OIMS	Operations Integrity Management System
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
OSRP	Oil Spill Response Plan
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PASA	Petroleum Agency South Africa
POB	Personnel on Board
PM2.5	Particulate Matter < 2.5 µm
PM10	Particulate Matter < 10 µm
PPE	Personal Protective Equipment
ppm	Parts Per Million
PPP	Public Participation Process
PS	Performance Standard
PSC	Production Sharing Contract
PSV	Platform Supply Vessel
RBIDZ	Richards Bay Industrial Development Zone
RDP	Reconstruction and Development Programme
RO	Reverse Osmosis
ROV	Remote Operated Vehicle
s	Second
SA	South Africa
SAHRA	South African Heritage Resource Agency
SAMSA	South African Maritime Safety Authority
SANBI	South African National Biodiversity Institute

SBF	Synthetic Based Fluids
SDCEA	South Durban Community Environmental Alliance
SDF	Spatial Development Framework
S&EIR	Scoping and Environmental Impact Report
SEGESA	*Sociedad de Electricidad de Guinea Ecuatorial*
SEZ	Special Economic Zones
SO_2	Sulphur dioxide
SO_x	Sulphur oxide
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SMP	Stakeholder Management Plan
SNC	Second National Communication
SSB	Single Side Band
SSHE	Security Safety Health and Environment
TAE	Total Applied Effort
TB	Tuberculosis
TSS	Total Suspended Solids
UNCLOS	United Nations Convention on Law of the Sea
UNEP	United Nation Environment Programme
UNFCCC	UN Framework Convention on Climate Change
USAID	United States Agency for International Development
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VOC	Volatile Organic Compound
VOS	Voluntary Observing Ship
VSP	Vertical Seismic Profile
WBF	Water Based Fluid
WBM	Water Based Mud
WCCP	Well Control Contingency Plan
WCMC	World Conservation Monitoring Centre
WESSA	Wildlife and Environment Society of South Africa
WGS84	World Geodetic System 1984
WIOFish	Western Indian Ocean Fisheries
WML	Waste Management Licence
WMP	Waste Management Plan
WWC	World Water Council

1 INTRODUCTION

1.1 PROJECT BACKGROUND

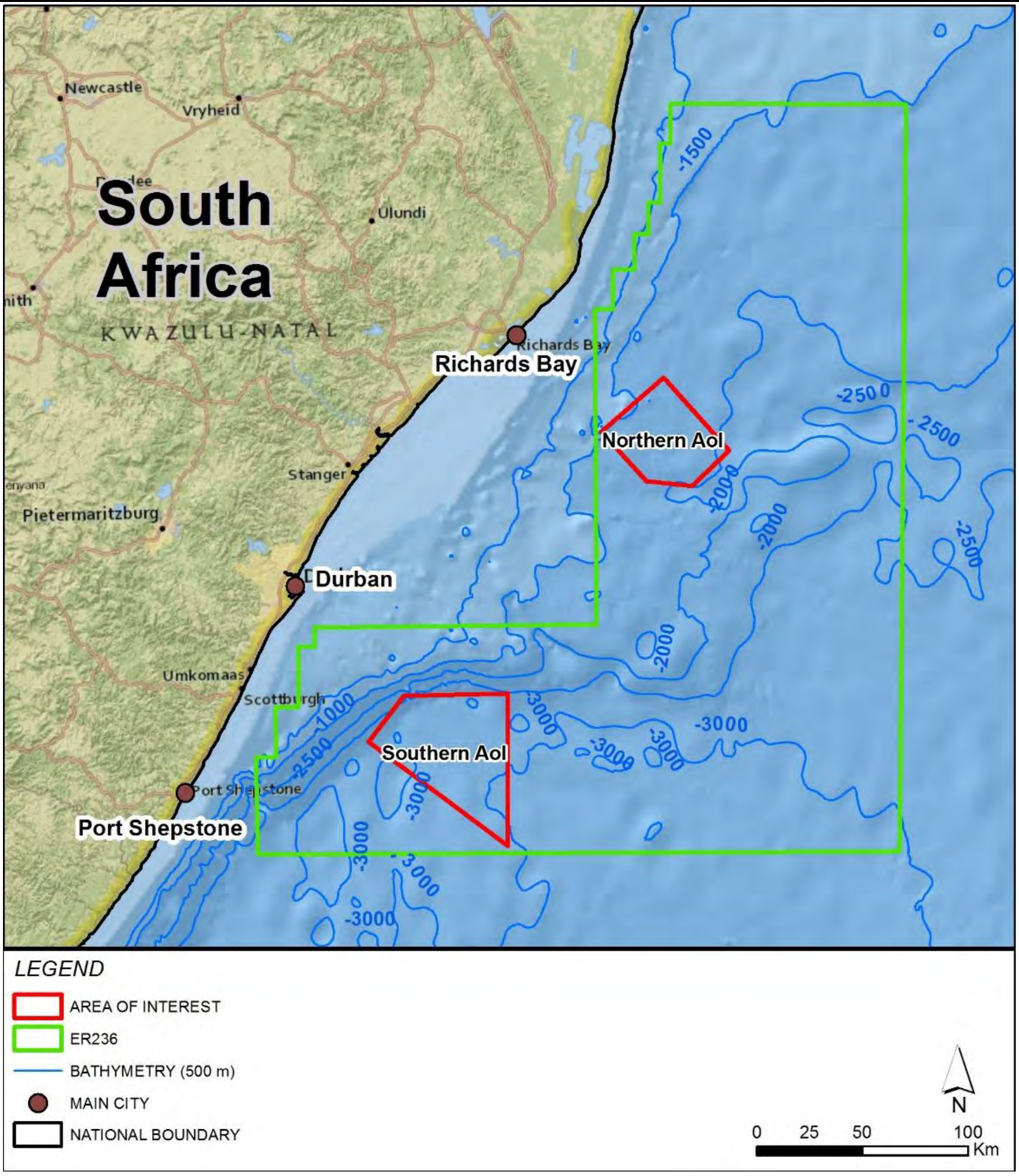
Eni South Africa BV (Eni), and Sasol Africa Limited (Sasol) hold an Exploration Right off the East Coast of South Africa. Eni and Sasol are considering the possibility of conducting an exploration drilling programme in Block ER236 (12/3/236) to assess the commercial viability of the hydrocarbon reservoir for future development.

Eni is considering drilling up to six deep water wells within Block ER236, four wells within the 1,717.50 km^2 northern area of interest, in water depths ranging between 1,500 m and 2,100 m and two wells within the 2,905 km^2 southern area of interest (*Figure 1.1*), in water depth ranging between 2,600 m and 3,000 m. The specific number of wells and their locations would be based on a number of factors, including further analysis of geological data, the geological target (the hydrocarbon bearing geology into which the well is to be drilled), and the presence of any seafloor obstacles. In addition, the success (if valuable hydrocarbon is discovered) of the first well in each area will determine whether or not subsequent wells are drilled. The drilling of the northern and the southern areas of interest will be undertaken as two separate campaigns, commencing either in the northern or southern area of interest.

The drilling of the first exploration well is planned for some time between November 2019 and March 2020, dependent on drillship availability, amongst a number of other planning requirements. The expected drilling depth would be approximately 3,800 m and 4,100 m from the sea surface, through the seabed, to target depth in the northern area, while at around 5,100 m in the southern one. The drilling of one well is expected to take in the order of two months to complete.

Depending on the success of the first well within the northern area of interest, up to three additional wells comprising an additional exploration well at a second location and the possibility of one appraisal close to each exploration well location, may be drilled to establish the quantity and potential flow rate of any hydrocarbon present. The time sequence of these possible additional wells will be dependent on the results of the first exploration well, and will not occur immediately after the drilling of the initial well. Within the southern area of interest, one potential exploration well may be drilled and a possible appraisal well depending on the results of the first well. Well testing may be conducted on the appraisal wells if they present potential commercial quantities of hydrocarbon.

Figure 1.1 Locality Map



1.2 PURPOSE OF THIS REPORT

ERM has been appointed by Eni to undertake the full Environmental Impact Assessment (EIA) process as per the National Environmental Management Act (NEMA) (Act No. 107 of 1998) Regulations, 2014 (as amended in 2017). The project requires Environmental Authorisation (EA) from the National Department of Mineral Resources (DMR), through the Petroleum Agency South Africa (PASA). The authorisation would be under NEMA. Since this is an offshore oil and gas project, the DMR is the competent authority, which means that it has powers to either authorise the development or refuse it.

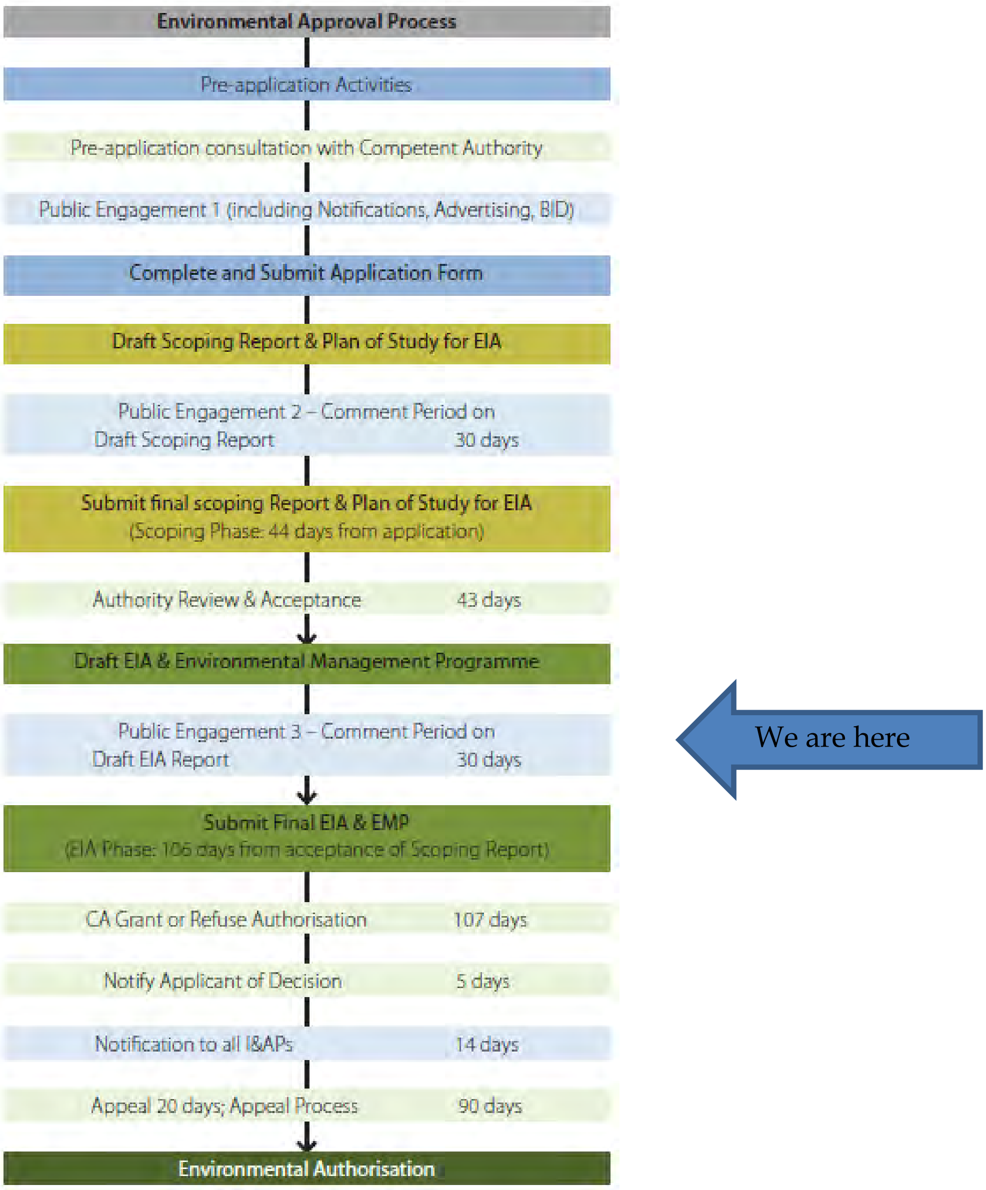
This draft EIA Report summarises the EIA process undertaken to date and provides an overview of the proposed project, affected environment and the findings of the specialist studies.

It also assesses the significance of the potential impacts of the proposed project and determines measures to manage and mitigate these impacts.

1.3 SUMMARY OF EIA PROCESS

The EIA process in South Africa is regulated by the NEMA Environmental Assessment Regulations (GNR R982/2014). The overall Scoping and Impact Assessment process is illustrated in *Figure 1.2*.

Figure 1.2 Environmental Impact Assessment Process



Source: ERM, 2017

1.3.1 *Pre-Assessment Public Participation (Initial Notification)*

The EIA process is initiated through a pre-assessment Public Participation Process (PPP). The pre-assessment process is not a mandatory requirement in terms of the EIA regulations (2014) but is beneficial in order to identify Interested and Affected Parties (I&APs). As part of this process, adverts announcing the project were released in four newspapers; namely the Mercury (English), Isolezwe (isiZulu), Ilanga (isiZulu) and the Zululand Observer (English). These adverts were released during the week of 18 September 2017.

1.3.2 *Application*

On 22 January 2018, the Environmental Authorisation Application Form together with the draft Scoping Report was submitted to PASA.

PASA is responsible for evaluating the Environmental Authorisation Application for this project. PASA is then expected to enter into negotiations with the applicant (Eni) and make recommendations to the Minister of Mineral Resources (Competent Authority) on the acceptability of the application.

1.3.3 *Scoping*

A principal objective of the Scoping Phase is to identify the key environmental, social and health issues and those project activities with the potential to contribute to, or cause, impacts to the environmental and social receptors.

At the Scoping Phase, the key issues are identified (often together with input from key stakeholders) and understood to a level, which allows the definition of the Plan of Study for the EIA Report.

Issues that are not relevant are scoped out. This enables the resources for the EIA process to be focused on collecting required information and identifying significant impacts while carrying out specialist studies and stakeholder engagement activities in an effective and efficient manner.

Specifically, the objectives of the Scoping Phase are to:

- Understand the legislative context and establish a description of baseline conditions;

- Identify project alternatives and preferred options for the proposed development;

- Identify stakeholders and plan or initiate communication with these stakeholders so as to gather issues of concern;

- Identify potential significant impacts; and

- Develop the Plan of Study for the EIA Report which sets out the proposed approach to the EIA process, potential impacts to be evaluated and methodology to be used.

The following steps have been undertaken as part of the Scoping Phase, and are described below:

- Pre-application correspondence with the PASA;
- Desktop review of available information;
- Preparation of the draft Scoping Report;
- Submission of application form;
- Release of draft Scoping Report for public comment; and
- Finalisation of Scoping Report for submission to PASA.

The draft Scoping Report was made available to stakeholders, on 22 January 2018[1] for a period of 30 days, through the project website, selected libraries and hard copies (provided on request). Adverts were published on 22 January 2018 in four newspapers; The Mercury (in English) and Isolezwe (in Zulu) and The Zululand Observer and Ilanga Newspaper (in Zulu) to advertise the release of the draft Scoping Report and public engagement sessions.

During the 30 day comment period (ended on 5 March), three public engagement sessions were undertaken from 7 to 9 February 2018 in Richards Bay, Durban and Port Shepstone respectively.

Based on specific stakeholder request, an additional (fourth) follow up meeting was held on 28 February 2018 at the Austerville Community Hall. An isiZulu language translator was present at this meeting as requested. Stakeholders comments and answers have been included in a Comment and Responses Report (CRR), compiled and included as an annex in the final Scoping Report (FSR). The objective of the stakeholder engagement undertaken was to present the proposed project and EIA process as well as identify associated issues, concerns and opportunities. Further details on the stakeholder consultation and engagement process are included in *Chapter 5*.

The final Scoping Report (including Plan of Study) was submitted to PASA on 8 March 2018 for its consideration. PASA's Approval Letter of the final Scoping Report was issued on 16 April 2018.

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[1] *It should be noted that an earlier version of the draft Scoping Report was released for comment on 27 October 2017. Due to a change in project scope a notification was sent out on 7 November 2017 to notify stakeholders that the report would be re-released for a full 30 day comment period in early 2018.

1.3.4 *Baseline Data Collection*

This draft EIA Report provides a description of the existing biophysical, biological and socio-economic conditions as a basis against which the impacts of the project can be assessed. The baseline includes information on receptors and resources that were identified during Scoping as having the potential to be significantly affected by the proposed project. The description of the baseline has the following main objectives:

- To identify the key physical, biological and socio-economic resources and conditions in areas potentially affected by the project;
- To describe, and where possible quantify, their characteristics (i.e. their nature, condition, quality and extent);
- To provide data to aid the prediction and evaluation of possible impacts;
- To inform judgements about the importance, value and sensitivity or vulnerability of resources and receptors; and
- To serve as a reference for future monitoring of impacts of the project.

For the current project, baseline data were obtained from existing sources including previous projects that have occurred in the surrounding blocks, municipal documents and social websites as referenced at the end of this document. Further to this, Marine Ecology, Fisheries and Heritage Assessments were conducted to determine the baseline conditions of the Project Area. The Project Area is offshore of the KwaZulu-Natal (KZN) coast, between St Lucia and East London and includes the entire Block ER236.

1.3.5 *Lapse of Application*

ERM experienced unforeseen delays in the finalising of specialist studies for the Exploration Drilling within Block ER236, which have resulted in subsequent delays in the drafting of certain chapters of the EIA Report. Consequently, ERM was not able to finalise and release the draft report for comment and comply with the stipulated 106 day timeframe in which to submit the final EIA Report by the 3 August 2018, as prescribed in Section 23(1)(a) of the NEMA EIA Regulations. As such, the current EIA Application lapsed on the 3 August 2018.

The final Scoping Report was submitted to PASA on 8 March and approved on 16 April 2018. ERM are confident that the baseline environmental and social conditions described in the final Scoping Report have not changed since it was compiled. In line with Section 21(2)(a) and (b) of the NEMA EIA Regulations, Eni has commenced the new EIA process with the submission of an amended application form and the release of the draft EIA Report for comment. PASA confirmed that this approach was acceptable on 29 August 2018

1.3.6 *Impact Assessment*

Impact assessment and development of mitigation measures is an iterative process that commences during the Scoping stage and continues throughout the EIA process. The key objectives of this process are as follows:

- To analyse how the project may interact with the baseline conditions in order to define, predict and evaluate the likely extent and significance of environmental, social and health impacts that may be caused by the project.

- To develop and describe acceptable and cost effective mitigation measures that avoid, reduce, control, remedy or compensate for negative impacts and enhance positive benefits.

- To evaluate the predicted positive and negative residual impacts of the project.

- To develop a system whereby mitigation measures will be integrated with the project and will be taken forward as commitments.

- This is achieved through the development of a draft Environmental Management Programme, included in *Chapter 9*.

The objectives of the impact assessment process described above may thus be summarised by reference to the following four main steps:

- Prediction of what will happen as a consequence of project activities;

- Evaluation of the importance and significance of the impact;

- Development of mitigation measures to manage significant impacts where practicable; and

- Evaluation of the significance of the residual impact.

Where significant residual impacts remain after mitigation measures are applied, further options for mitigation may be considered and impacts re-assessed until they are reduced to as low as reasonably practicable (ALARP) levels.
This approach takes into account the technical and financial feasibility of mitigation measures. The methodology used to assess the significance of impacts from planned activities is described in more detail in *Chapter 6* of this report.

In addition to predicted impacts from planned activities, those impacts that could result from an accident or a non-routine event within the project are taken into account in *Chapter 8*. In these cases the likelihood (probability) of the event occurring is considered. The impact of non-routine events is therefore assessed in terms of the risk, taking into account both the consequence of the event and the probability of occurrence.

1.3.7 Management Planning

The range of measures to mitigate impacts identified through the EIA process is included within the Project Description and Impact Assessment chapters in this report. These have been brought together in the Environmental Management Programme (EMPr) for the project (*Chapter 9*).

The EMPr consists of the set of management, mitigation and monitoring measures to be taken during implementation of the project, to eliminate adverse environmental and socioeconomic impacts, offset them, or reduce them to acceptable levels. The plan details the specific actions that are required to implement the controls and mitigation measures that have been agreed through the EIA process, including details on monitoring, responsible parties, documentation and reporting.

1.3.8 Reporting and Disclosure

This draft EIA Report was released on 25 September 2018 for a 30 day comment period. A notification letter has been sent to all registered I&APs on the stakeholder database to inform them that a new EIA process has been initiated and that the draft EIA Report is available for comment. The report is available online on the project webpage (www.erm.com/eni-exploration-eia) and at the following locations:

- Durban Central Lending Public Library
- Port Shepstone Library
- Richards Bay Library
- East London Central Library
- Nelson Mandela Bay Municipality – Linton Grange Library

Based on comments received on the draft EIA Report, the report will be revised and submitted to PASA for consideration. A notification letter will be sent to all registered I&APs on the project database and the report is to be made available online on the project webpage (www.erm.com/eni-exploration-eia) and at the public locations mentioned above.

1.4 PROJECT PROPONENT

The contact details for the applicant are presented below:

Box 1.1 Contact Details of Project Applicant / Proponent

Eni South Africa BV
1st Floor, Icon Building c/o Cube WS
Cnr Lower Long St. & Hans Strijdom Rd.
Foreshore, 8001, Cape Town, South Africa
Wrk: +27 21 412 1582
Contact: Nicole Lomberg, HSE & Sustainability Coordinator.

1.5 THE EIA TEAM

ERM is a global environmental consulting organisation employing over 5,000 specialists in over 150 offices in more than 40 countries. In South Africa, ERM Southern Africa employs over 150 environmental consultants out of offices in Johannesburg, Durban and Cape Town.

1.5.1 Declaration of Independence

The requirement for environmental consultants to act independently and objectively is a well-established principle in South African law and elsewhere. The EIA regulations (GN R.982, as amended), specifically state that an EAP (environmental assessment practitioner) (must have) no business, financial, personal or other interest in the activity, application or appeal in respect of which that EAP is appointed in terms of these Regulations other than fair remuneration for work performed in connection with that activity; or that there are no circumstances that may compromise the objectivity of that EAP in performing such work.

ERM is a privately owned company registered in South Africa. ERM has no financial ties to, nor is ERM a subsidiary, legally or financially, of Eni. Remuneration for the services by the Proponent in relation to this report is not linked to an approval by the decision-making authority. Furthermore, ERM has no secondary or downstream interest in the development.

The role of the environmental consultants is to provide credible, objective and accessible information to government and other stakeholders, so that an informed decision can be made about whether the project should proceed or not.

The ERM team selected for this project possess the relevant expertise and experience to undertake this EIA process. As such, ERM has signed the legally required declaration of independence to function as an objective Environmental Assessment Practitioner (EAP).

The CV and the declaration of independence from the Independent Environmental Practitioner are presented in *Annex A*.

The contact details of the EAP for the application are presented in *Box 1.2*

Box 1.2 Contact Details of the EAP

Environmental Resources Management Southern Africa (Pty) Ltd.
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7966

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Cape Town | South Africa
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E eni.exploration.eia@erm.com

The core EIA team members and specialists involved in this EIA Report are listed in *Table 1.1*.

Table 1.1 The EIA Team

Name	Organisation	Role	Qualifications, Experience
Ingeborg McNicoll	ERM	Project Director	BSc (Hons) Marine Biology. 35 years' experience
Vicky Stevens	ERM	Project Manager and EAP	MSc (oceanography), 12 years' experience
Lindsey Bungartz	ERM	Social and Stakeholder Engagement Specialist	BSocSc (Hons), 10 years' experience
Dr Andrea Pulfrich	Pisces Environmental Services (Pty) Ltd	Marine Ecology Specialist	PhD (Fisheries Biology), 20 years' experience
Dr David Japp	Capricorn Marine Environmental (Pty) Ltd (CapMarine)	Fisheries Specialist	MSc (Ichthyology and Fisheries Science), 30 years' experience
Sarah Wilkinson			BSc (Hons) Oceanography and Botany, University of Cape Town, 14 years' experience
Dr John Gribble	ACO Associates CC	Maritime Heritage Specialist	BA (Hons), MA Archaeology, 20 years' experience
Michael J. Fichera	ERM	Oil Spill and Drill cuttings modelling Specialist	B.S. in Civil Engineering and an M.E. in Environmental Engineering, 25 years' experience
Mr Stephen Luger	PRDW	Modelling Peer Reviewer	MSc Engineering, 24 years' experience

1.6 UNDERTAKING BY EAP

Section 16 (1) (b) (iv), Appendix 1 Section 3 (1) (r), Appendix 2 Sections 2 (1)(i) and (j) and Appendix 3 Section 3 (s) of the Environmental Impact Assessment (EIA) Regulations, 2014 (promulgated in terms of NEMA), require an undertaking under oath or affirmation by the Environmental Assessment Practitioner (EAP) in relation to:

- The correctness of the information provided in the report;
- The inclusion of comments and inputs from stakeholders and interested and affected parties;
- Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties; and
- The level of agreement between the EAP and interested and affected parties on the Plan of Study for undertaking the environmental impact assessment.

As such ERM and the practitioners managing the project confirm the following:

- To the best of our knowledge that the information provided in this Report is the most recent detail provided by the proponent and specialists thus far in the process.
- Comments and associated response are included in *Annex B* and summarised in a comments and responses report (CRR).
- Information provided to and communication with stakeholders is included in *Annex B*.

1.7 EIA REPORT REQUIREMENTS AS PER EIA REGULATIONS GNR 982/2014

Table 1.2 illustrates the legislated content of the EIA Report.

Table 1.2 Legislated Content of EIA Report (GNR 982/2014) and Corresponding Sections in this Report

Legislated Content- Appendix 3 Section 3	Section in this Report
(a) details of-	
(i) the EAP who prepared the report	Chapter 1 and Annex A
(ii) the expertise of the EAP, including a curriculum vitae	Chapter 1 and Annex A
(b) the location of the activity	Chapter 3

Legislated Content- Appendix 3 Section 3	Section in this Report
(i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	
(c) a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is- (i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or (ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Chapter 3
(d) a description of the scope of the proposed activity, including-	
(i) all listed and specified activities triggered and being applied for; and	Chapter 2
(ii) a description of the associated structures and infrastructure related to the development;	Chapter 3
(e) a description of the policy and legislative context within which the development is located and explanation of how the proposed development complies with and responds to the legislation and policy context;	Chapter 2
(f) a motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred location;	Chapter 3
(g) a motivation for the preferred development footprint within the approved site;	Chapter 3
(h) a full description of the process followed to reach the proposed development footprint within the approved site, including:	
(i) details of all the development footprint alternatives considered;	Chapter 3
(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Chapter 5 and Annex B
(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Chapter 8 and Annex B
(iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Chapter 4
(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts- (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated.	Chapters 7 and 8
(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives	Chapter 6
(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects	Chapters 7 and 8
(viii) the possible mitigation measures that could be applied and level of residual risk	Chapters 7, 8 and 9
(ix) if no alternative development locations for the activity were investigated, the motivation for not considering such; and	N/A
(x) a concluding statement indicating the preferred alternative development location within the approved site;	Chapters 3 and 7

Legislated Content- Appendix 3 Section 3	Section in this Report
(i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred location through the life of the activity, including-	Chapters 3 and 7
(i) a description of all environmental issues and risks that were identified during the environmental impact process; and	Chapters 7 and 8
(ii) an assessment of the significance of each issue and risk and an identification of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Chapters 7 and 8
(j) an assessment of each identified potentially significant impact and risk, including-	Chapters 7 and 8
(i) cumulative impacts;	Chapters 7 and 8
(ii) the nature, significance and consequences of the impact and risk;	Chapters 7 and 8
(iii) the extent and duration of the impact and risk;	Chapters 7 and 8
(iv) the probability of the impact and risk occurring;	Chapters 7 and 8
(v) the degree to which the impact and risk can be reversed;	Chapters 7 and 8
(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and	Chapters 7 and 8
(vii) the degree to which the impact and risk can be mitigated;	Chapters 7 and 8
(k) where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	Chapters 7 and 8
(l) an environmental impact statement which contains-	
(i) a summary of the key findings of the environmental impact assessment;	Chapters 7 and 8
(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	Chapter 3
(iii) a summary of the positive and negative impacts of the proposed activity and identified alternatives;	Chapter 10
(m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	Chapter 9
(n) the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through assessment;	Chapters 3 and 7
(o) any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Chapter 9
(p) a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Chapters 7 and 8
(q) a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Chapter 10
(r) where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	N/A

Legislated Content- Appendix 3 Section 3	Section in this Report
(s) an undertaking under oath or affirmation b the EAP in relation to: (i) the correctness of the information provided in the reports; (ii) the inclusion of comments and inputs from stakeholders and I&APs; (iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	Annex A
(t) where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	Annex E
(u) an indication of any deviation from the approved Scoping Report, including the plan of study, including- (i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and (ii) a motivation for the deviation; (v) any specific information that may be required by the competent authority; and	Chapter 7 and Chapter 8
(w) any other matters required in terms of section24(4)(a) and (b) of the Act.	N/A

1.8 *STRUCTURE OF THE EIA REPORT*

The structure of this EIA Report is shown in *Table 1.3*.

Table 1.3 Proposed EIA Report Structure

Chapter Number	Contents Heading	Explanatory Note
Acronyms and Abbreviations		
Executive Summary		Summary of the entire EIA Report.
1	Introduction	This *Chapter* outlines the development and structure of the EIA Report including the background, terms of reference, EIA process approach and declaration.
2	Administrative Framework	This *Chapter* outlines the policy, legal and institutional framework within which the EIA process has been conducted.
3	Project Description	This *Chapter* provides the project motivation, as well as a concise description of the project and its geographical and temporal context. It will include a site description, an overview of the project design and details of project inputs and outputs.
4	Baseline Condition	This *Chapter* summarises the available baseline data on the environmental and social resources and receptors within the Project Area. It will be based on secondary data sources and will consider changes in the baseline condition without the development in place. Specialist input has been included in the *Chapter*.
5	Public Participation Process	This *Chapter* presents the results of consultation undertaken as part of the EIA process, plus plans for future consultation. It identifies key project stakeholders and present their feedback on the project.

Chapter Number	Contents Heading	Explanatory Note
6	Impact Assessment Methodology	This *Chapter* provides the methodology used to assess the impacts of the project on the bio-physical, terrestrial and socio-economic environment.
7	Impact Assessment – Planned Activities	This *Chapter* documents the predicted positive and negative impacts of the project, outline general and specific mitigation measures to reduce, remove or avoid negative impacts to environmental and social receptors as well as measuring for monitoring these impacts. Any residual impacts (post mitigation) are outlined. Cumulative impacts are assessed as appropriate.
8	Impact Assessment – Unplanned/Accidental Events	This *Chapter* documents the predicted impacts of unplanned events and provides mitigation measures to reduce, remove or avoid negative impacts to environmental and social receptors as well as measuring for monitoring these impacts.
9	Environmental Management Programme (EMPr)	The EMPr draws together the possible mitigation measures; group them logically into components with common themes; define the specific actions required and timetable for implementation; identify training needs, institutional roles and responsibilities for implementation.
9	Conclusion	This *Chapter* provides conclusions based on the assessment as well as outline any further recommendations.
Bibliography & References		All references made in the report and documents drawn upon during the course of the assessment
Annexes		• Annex A: Details of Environmental Assessment Practitioner and Declaration of Independence • Annex B: Public Participation Process • Annex C: Authority Communications • Annex D: Specialist Studies • Annex E: Financial Provision

2 *ADMINISTRATIVE AND LEGAL FRAMEWORK*

2.1 *INTRODUCTION*

This *Chapter* provides an overview of legislation, conventions and information documents that have informed the scope and content of this report and the approach to the EIA process.

2.2 *OVERVIEW OF 'ONE ENVIRONMENTAL SYSTEM'*

In 2007 / 2008, the Department of Environmental Affairs (DEA) and the Department of Mineral Resources (DMR) agreed that environmental regulation would be removed from the scope of the MPRDA and would be regulated under NEMA, which would give rise to a "One Environmental System" for the country relating to mining and related activities. The implementation of this was given effect by the National Environmental Management Amendment Act, 2008 (No. 62 of 2008) (NEMAA) and the Mineral and Petroleum Resources Development Amendment Act, 2008 (No. 49 of 2008) (MPRDAA).

Subsequent to the 8 December 2014, all applications for Environmental Authorisations (EA's), including those for mining and petroleum related activities, previously regulated in terms of the MPRDA, must now be undertaken in terms of NEMA and the associated EIA Regulations.

2.3 *KEY RELEVANT LEGISLATION*

2.3.1 *Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)*

The primary legislation governing the South African upstream mining and petroleum sector is the MPRDA. Although the MPRDA governs South Africa's petroleum industry as well as its mining industry, petroleum activities are primarily accommodated within a separate chapter of the statute, namely, *Chapter 6*. *Chapter 6* of the statute makes provision for two permits (reconnaissance permits and technical co-operation permits) and two rights (exploration rights and production rights).

In terms of the MPRDA, an Exploration Right must be approved prior to the commencement of exploration activities. Eni and Sasol hold an existing Exploration Right for ER236, which is currently in its first two year renewal period, as of 11 July 2017.

The Act should be read together with the Mineral and Petroleum Resources Development Regulations, 2004 (GNR.527 of 23 April 2004); (MPRDA Regulations) and it should be noted that the MPRDA is currently pending amendment by the MPRDA Amendment Bill 15D, 2013. The current form of the amendments would however not change the Environmental Authorisation process or requirements in terms of NEMA.

2.3.2 *National Environmental Management Act (Act No. 107 of 1998)*

The National Environmental Management Act (No.107 of 1998) (NEMA) is the South African framework legislation with respect to environmental protection and management. Section 2 of NEMA provides a range of environmental principles that are to be applied by organs of state when making decisions that significantly affect the environment. Two of the key principles include:

- Environmental management must place people and their needs at the forefront, and serve their physical, psychological, developmental, cultural and social interests equitably.

- Development must be socially, environmentally and economically sustainable.

NEMA also provides for the participation of Interested and Affected Parties (I&APs) and stipulates that decisions must take into account the interests, needs and values of all I&APs.

Section 28 of NEMA imposes a duty of care on every person who causes, has caused, or may cause significant pollution or degradation of the environment to take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring.

The Environmental Authorisation process in South Africa is governed by NEMA as amended and the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended) promulgated under NEMA. The relevance of this legislation is summarised below.

NEMA Environmental Authorisation

Chapter 5 of NEMA, as amended, outlines the general objectives and implementation of Integrated Environmental Management. This 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 detrimental effect on the environment. Whilst Section 23 sets out the basic objectives and principles of the IEM procedure, Section 24 sets out how these objectives and principles are to be accomplished.

Regulations governing the environmental authorisation process have been promulgated in terms of NEMA and include the following:

- Environmental Impact Assessment Regulations (GNR R982/2014);
- Environmental Impact Assessment Regulations Listing Notice 1 (GNR 983/2014);
- Environmental Impact Assessment Regulations Listing Notice 2 (GNR 984/2014); and
- Environmental Impact Assessment Regulations Listing Notice 3 (GNR 985/2014).

*It should be noted that the above regulations were amended in April 2017 by Government Notices 324, 325, 326 and 327.

Activities that trigger GNR 983 and GNR 985 require a Basic Assessment Report (BAR) process to be undertaken, whereas activities identified in terms of GNR 984 will require a full Scoping and Environmental Impact Report (S&EIR) process. GNR 982 sets out the general procedure to follow when conducting either a BAR or S&EIR process.

With reference to the EIA Regulations 2014 (as amended), the identification of the competent authority states as follows:

'The competent authority in respect of the activities listed in this part of the schedule is the competent authority in the province in which the activity is to be undertaken, unless-

a) It is an application for an activity contemplated in section 24C(2) of the Act, in which case the competent authority is the Minister or an organ of state with delegated powers in terms of section 42(1) of the Act; and

b) The listed or specified activity is or is directly related to:

    i. **Prospecting or exploration of a mineral or petroleum resource;** or
    ii. Extraction and primary processing of a mineral or petroleum resource'

It is therefore understood that the competent authority for this project will be the Department of Mineral Resources (DMR). As such, Eni will be required to obtain a positive Environmental Authorisation from the DMR prior to commencement of the proposed activities. The Petroleum Agency of South Africa (PASA) accept and process offshore petroleum EA applications on behalf of the DMR, however the DMR is required to sign off on the final decision.

Numerous trigger activities have been identified for this project in terms of all the listing notices (refer to *Table 1.4*).

In instances where all the listing notices are triggered (as in this project), GNR 984 requirements will take precedent and the project will be subject to a full Scoping &Environmental Impact Report process prior to commencement of any of the associated activities.

Table 1.4 Listed Activities in Terms of the NEMA EIA Regulations, 2014 (as amended, 2017)

Listed Activity	Activity Description	Project Trigger
GNR 983 Activity 14	The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	The proposed drilling operation would make use of infrastructure which would handle and potentially store oil, gas and/or fuel (diesel). Information on the anticipated storage capacity for these substances is currently not confirmed and this activity is included to provide for a situation where storage capacity exceeds 80 m^3 but falls below 500 m^3.
GNR 983 Activity 22	The decommissioning of any activity requiring – (i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or (ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.	In terms of Section 43(3) of the MPRDA, a closure certificate must be applied for upon, inter alia: • the lapsing of an Exploration Right; or • the relinquishment of any portion of the licence area. Based on the results of the well drilling programme, a decision would be made as to whether to permanently or temporarily abandon the wells. The possible abandonment of wells may result in a decision by Eni to relinquish the licence area or a portion thereof.
GNR 984 Activity 7	The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods— (i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day; (ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day;	The proposed project would make use of drilling infrastructure (e.g. pipes, casings etc.) which would potentially transport oil and/or gas to the drilling unit should a discovery be made. Due to the anticipated depth of the proposed wells, this infrastructure would exceed 1,000 m in length. The designed throughput capacity of this infrastructure could potentially exceed the thresholds specified in the listed activity.

Listed Activity	Activity Description	Project Trigger
GNR 984 Activity 14	The development and related operation of- (ii) An anchored platform; or (iii) any other structure or infrastructure on, below or along the sea bed	The proposed drilling operations would result in the placement of drilling equipment (ie a wellhead) on the seabed. In the case that a well is unsuccessful, the well will be abandoned and the BOP removed.
GNR 984 Activity 18	Any activity including the operation of that activity which requires an exploration right as contemplated in section 79 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including – (a) associated infrastructure, structures and earthworks;	Eni currently hold an Exploration Right for ER236. An Environmental Management Programme (EMPr) was undertaken for the initial Exploration Right application in terms of the MPRDA requirements at the time. The Work Programme approved for the Exploration Right and the EMPr did not cover the drilling of exploration wells. PASA has confirmed that an EIA in terms of NEMA is required to be undertaken for this activity.

Financial Provision Regulations, 2015

Section 24P of NEMA requires that the determination of financial provision is required by an applicant for EA relating to prospecting, mining, exploration, production or related activities on a prospecting, mining, exploration or production area (*Annex E*).

In terms of the National Environmental Management Act: Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations, Operations (GN R1147, which came into effect on 20 November 2015 and the subsequent amendment published on 16 April 2018) an applicant or holder of a right must determine financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of exploration operations, as contemplated in the Act and to the satisfaction of the Minister of Mineral Resources. The financial provision determination and a decommissioning plan must be submitted to the Minister as part of the Environmental Authorisation application process.

The prescribed financial provision for the rehabilitation, management and closure of environmental impacts will be in place before the commencement of the drilling activities.

At the end of the operation (i.e. drilling and well completion) the well will be plugged and abandoned ("decommissioning"). This will involve setting cement plugs inside the wellbore and testing them for integrity. The BOP will be then retrieved at surface. A final seabed and wellhead inspection will be performed with an ROV and finally the drillship and support vessels will depart the area.

Financial provisions for well plugging and abandonment activities (decommissioning) is required and will be submitted to the Minister as part of the Environmental Authorisation application process. Refer to *Annex E* for the determination of financial provision related to the decommissioning plan of one exploratory well.

Eni will have the technical programme and associated costs of abandonment activities verified by an independent third party when setting up the guarantee. The financial provisions related to the decommissioning activities will be reviewed annually.

2.3.3 National Environmental Management: Waste Act (Act No. 59 of 2008)

Section 19 of National Environmental Management: Waste Act (No. 59 of 2008) (NEMWA) provides for the listing of waste management activities that have, or are likely to have a detrimental effect on the environment.

In accordance with this, GN 921 of 29 November 2013 lists waste management activities for which a waste management licence (WML) is required in terms of Section 20 of the Act. Furthermore, it classifies each of the waste management activities into different categories, with more onerous provisions assigned for activities that are regarding as being more detrimental to the environment. In this regard, 'Category A' activities require a NEMA BAR process to be conducted prior to commencement. 'Category B' activities require a full S&EIR process to be conducted, while 'Category C' activities are wholly exempt from the WML permitting process, as long as they show compliance with a set of prescribed standards.

It is ERM's understanding that a WML is not required for the currently proposed activities. However on finalisation of the drilling programme, should the predicted activities regarding waste change, Eni will review the requirements for a Waste Management Licence under the Act.

2.3.4 National Environmental Management: Air Quality Act (Act No. 39 of 2004)

National Environmental Management: Air Quality Act (No. 39 of 2004) (NEMAQA) deals with the control and management of emissions related to activities contained in the Listed Activities and Associated Minimum Emission Standards GN 893 of 22 November 2013 (MES). NEMAQA prescribes the need for an Atmospheric Emission Licence (AEL) if more than 10 kg of operational waste is incinerated per day. The AEL process involves the undertaking of a Basic Assessment in accordance with NEMA.

Should Eni decide to incinerate non-toxic combustible wastes on the drilling unit and support vessels, they would be required to apply to DEA: Air Quality Management Services for an AEL. It is however currently Eni's intention to bring all wastes to shore for appropriate disposal.

2.3.5 *National Environmental Management: Integrated Coastal Management (No. 24 of 2008)*

The National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008) (NEMICMA) sets out a system of integrated coastal and estuarine management in South Africa to promote the conservation of the coastal environment and to ensure that the development and the use of natural resources within the coastal zone are socially and economically justifiable and ecologically sustainable. Section 69 of the NEMICMA prohibits the discharge of effluent that originates from a source on land into coastal waters except in terms of a CWDP issued by the DEA.

NEMICMA has also provided for the repeal of the former Sea-shore Act 21 of 1935 and the Dumping at Sea Control Act 73 of 1980.

Dumping Regulations

Dumping at Sea Regulations were published on 21 July 2017 in terms of sections 83(1) (g), (h), (k) and (r) of NEMICMA, these govern dumping permit applications as allowed for by section 71(1) of NEMICMA. However, it should be noted that, as per NEMICMA, dumping does not include:

- Disposing of or storing in the sea any tailings or other material from the bed or subsoil of coastal waters generated by the lawful exploration, exploitation and associated off-shore processing of mineral resources from the bed, subsoil or substrata of the sea; and

- Operational waste from a vessel, aircraft, platform or other man-made structure at sea.

As such it is understood that a dumping permit would not be required for this project.

2.3.6 *Marine Pollution (Control & Civil Liability Act) (No.6 of 1981) and South African Maritime Safety Authority Act (No. 5 of 1998)*

In terms of the Marine Pollution (Control and Civil Liability) Act 6 of 1981, the Department of Transport is charged with the responsibility of ensuring that the appropriate actions are taken in order to minimise the impact of discharges of harmful substances (e.g. oil) from ships, tankers, or offshore installations. In terms of the South African Maritime Safety Authority Act 5 of 1998, the majority of these responsibilities are transferred to the South African Maritime Safety Authority (SAMSA). Section 52 of the SAMSA Act, however, delegates the responsibility for combating pollution of the sea and shoreline by oil to the Minister of Environmental Affairs (DEA). The implication of this is that the DEA is responsible for protection and clean-up measures to be taken once oil has been released into the sea, while SAMSA‟s responsibilities are limited to those actions required while the oil is within the confines of the ship.

Prior to drilling, an Oil Spill Contingency Plan will be required to be submitted to SAMSA for approval and issuance of a certificate. Both PASA and the DEA will be required to comment on the OSCP prior to issuing of the certificate by SAMSA.

2.4 *OTHER APPLICABLE LEGISLATION*

This section provides a list of other national and international legislation and conventions potentially applicable to the proposed project.

Additional authorisations or permits may be required in terms of such legislation, but fall outside the scope of this EIA process.

2.4.1 *National Legislation*

National legislation potentially relevant for the project (in addition to those presented in preceding sections) is listed below.

- Constitution of the Republic of South Africa (No. 108 of 1996);
- National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008);
- National Water Act (No. 36 of 1998);
- National Heritage Resources Act (No. 25 of 1999);
- National Environmental Management: Biodiversity Act (No. 10 of 2004);
- National Environmental Management: Protected Areas Act (No. 57 of 2003);
- Sea-Shore Act (No. 21 of 1935);
- Marine Living Resources Act (No. 18 of 1998);
- Occupational Health and Safety Act (No. 73 of 1989);
- Gas Act (No. 48 of 2001);
- Noise Control Regulations under the Environmental Conservation Act (No. 73 of 1989);
- Major Hazard Installation Regulations (GNR. 692 of 30 July 2001);
- Hazardous Substances Act (56 of 1973) and Regulations (No. 85 of 1983);
- Explosives Act (No. 15 of 2003);
- Electricity Regulation Act (No. 4 of 2006);
- Nature and Environmental Conservation Ordinance (No. 19 of 1974);
- Marine Pollution (Prevention of Pollution from Ships) Act (No. 2 of 1986);
- National Ports Act (No. 12 of 2005);
- Marine Traffic Act (No. 2 of 1981);
- Carriage of Goods by Sea Act, 1986 (No. 1 of 1986);
- Dumping at Sea Control Act, 1980 (No. 73 of 1980);
- Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
- Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
- Maritime Zones Act, 1994 (No. 15 of 1994);
- Merchant Shipping Act, 1951 (No. 57 of 1951);

- Mine Health and Safety Act, 1996 (No. 29 of 1996);
- National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999);
- Nuclear Energy Act, 1999 (No. 46 of 1999);
- Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
- Ship Registration Act, 1998 (No. 58 of 1998);
- South African Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- South African Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

Applicable provisions from these laws and regulations will be incorporated into the design and implementation of the project.

2.4.2 International Requirements

International Marine Pollution Conventions

- International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
- Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08);
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention);
- United Nations Convention on Law of the Sea, 1982 (UNCLOS);
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol);
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973);
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989); and
- Convention on Biological Diversity (1992).

Other International Legislation

- International Commission on Radiological Protection (ICRC); and
- International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, 1984.

3 PROJECT DESCRIPTION

3.1 INTRODUCTION

This *Chapter* provides a description of the need and desirability for the proposed project, provides general project information, an overview of the proposed exploration drilling programme and a description of the project alternatives.

3.2 PROJECT NEED AND DESIRABILITY

Fossil fuels (including gas and oil) play an important role in the socio-economic development of South Africa, while simultaneously providing the necessary infrastructural economic base for the country to become an attractive host for foreign investments in the energy sector (Ministerial foreword of the White Paper on the Energy Policy 1998).

The South African White Paper on the Energy Policy (1998) is the overarching policy document which has guided and continues to guide future policy and planning in the energy sector in South Africa. The white paper states that 'Government will ensure the optimal and environmentally sustainable exploration and development of the country's natural oil and gas resources to the benefit of all' and undertakes to 'ensure private sector investment and expertise in the exploitation and development of the country's oil and gas resources'. The successful exploitation of these natural resources would contribute to the growth of the economy and relieve pressure on the balance of payments.

The position of the National Development Plan (NDP) is reinforced in the Draft Integrated Energy Plan (IEP) (2016[1]), which seeks to determine how current and future energy needs can be addressed efficiently. Key objectives outlined in the plan include security of supply, minimising the cost of energy, diversity in supply sources and primary sources of energy and minimising emissions. The plan indicates that projected demand for crude oil will continue to increase in the medium to long term if current policies, politics and levels of access continue (IEP,2016).

South Africa's current crude oil demand is over 600 000 barrels / day. South Africa currently imports approximately 70 percent of its liquid fuel, which comprises crude oil and finished products. The other approximately 30 percent is sourced from the local production of synfuels from coal and gas[2].

[1] Still under public review and comment

[2] http://www.energy.gov.za/files/petroleum_frame.html

South Africa's current crude oil requirements are met by imports, mainly from the Middle East and Africa. Almost all crude oil is used for the production of liquid fuels, with a small percentage used towards lubricants, bitumen, solvents and other petrochemicals. As is the case elsewhere in the world, liquid fuels are primarily used to meet the country's transportation needs (IEP, 2016).

As a net importer of crude oil, and a developing country, South Africa is not in position to influence the price of crude oil. The South African liquid fuels industry is highly impacted by global developments and fluctuations in the crude oil price and the economy as a whole is therefore extremely vulnerable to the volatility of the global oil market (IEP, 2016).

Producing more oil and gas within South Africa is expected to contribute towards more stable prices, create new jobs and industries in the upstream and downstream oil and gas industry supply chain and sectors and counter volatility related to instabilities in major oil producing regions.

In addition, in mid-2014 the South African government launched Operation Phakisa[1], an approach that aims to enable South Africa to implement its policies and programmes better, faster and more effectively. One of Operation Phakisa's aims is to unlock the economic potential of South Africa's oceans. In this regard four priority sectors have been selected as new growth areas in the ocean economy, including:

- Marine transport and manufacturing activities;
- Offshore oil and gas exploration;
- Aquaculture; and
- Marine protection services and ocean governance.

The proposed exploration drilling provides an opportunity to fulfil Operation Phakisa's aim to unlock the ocean's economy by providing opportunities for oil and gas exploration in South African waters.

In light of the above, exploration success would result in long-term benefits for South Africa consisting of improved security of supply, in-country investments in a development project (including job creation), increased government revenues, contribution to economic growth and reduced dependence on the importation of hydrocarbons.

3.3 *PROJECT LOCATION*

Eni proposes to drill up to six deep water wells inside Block ER236, within **two areas of interest**:

[1] https://www.operationphakisa.gov.za/pages/home.aspx

- A **northern area of interest** of 1,717.50 km², which is located, at its closest point, approximately 62 km from shore, in water depths ranging between 1,500 m and 2,100 m (*Figure 3.1*).

- A **southern area of interest** of approximately 2,905 km², which is located, at its closest point, approximately 65 km from shore, in water depths ranging between 2,600 m and 3,000 m (*Figure 3.1*).

The expected drilling depth would be approximately 3,800 m and 4,100 m from the sea surface, through the seabed, to target depth in the northern area of interest, and around 5,100 m in the southern area of interest. The co-ordinates of the Block ER236 and each area of interest are provided in *Table 9.3* and *Table 9.4* respectively.

Figure 3.1 ***Location of Block ER236, and the Northern and Southern Areas of Interest***

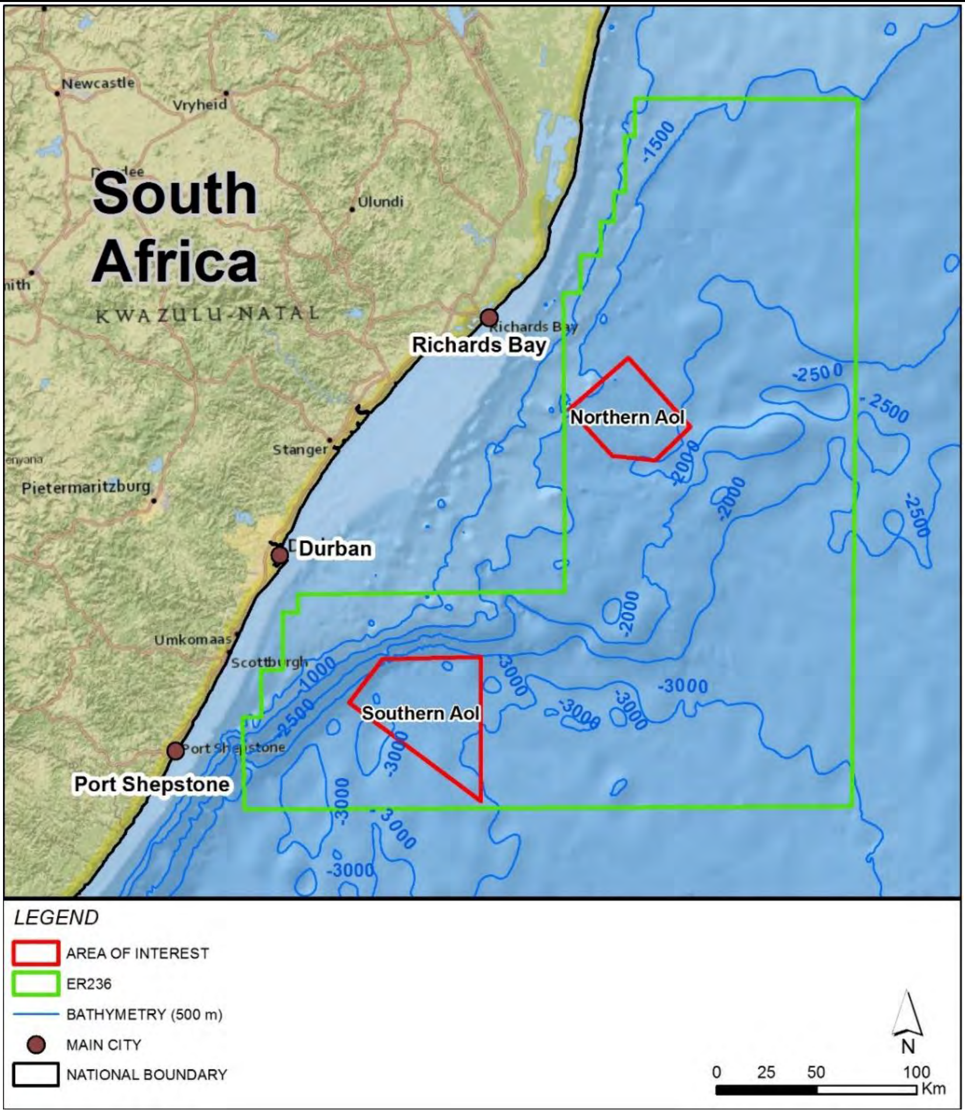


Table 3.1 Coordinates of the Block ER236 (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	27°48'30"S	32°52'0"E
B	27°48'30"S	34°0'0"E
C	31°0'0"S	34°0'0"E
D	31°0'0"S	30°49'0"E
E	30°35'0"S	30°49'0"E
F	30°35'0"S	30°55'0"E
G	30°22'24,6"S	30°55'0"E
H	30°22'24,72"S	31°2'0"E
I	30°7'0"S	31°2'0"E
L	30°2'0"S	32°30'0"E
M	28°41'18"S	32°30'0"E
N	28°41'18"S	32°35'20"E
O	28°31'4"S	32°35'20"E
P	28°31'4"S	32°41'30"E
Q	28°21'59"S	32°41'30"E
R	28°21'59"S	32°45'40"E
S	28°13'51"S	32°45'40"E
T	28°13'51"S	32°49'0"E
U	27°58'47"S	32°49'0"E
V	27°58'47"S	32°52'0"E

Table 3.2 Coordinates of the Northern Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	29° 12' 33,341"S	32° 31' 46.013"E
B	28° 58' 47.34"S	32° 49' 32.73"E
C	29°17'28.529"S	33°8'58.59"E
D	29°26'34.962"S	32°58'11.965"E
E	29°25'22.117"S	32°44'46.372"E

Table 3.3 Coordinates of the Southern Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	30°19' 39.588"E	32° 3' 48.518"E
B	30°58' 35.904"E	32° 3' 25.921"E
C	30°31' 35.022"E	31° 22' 26.396"E
D	30°19' 49.794"E	31° 33' 7.656"E

3.4 PROJECT SCHEDULE

The drilling of the exploration and/or appraisal wells will be undertaken as separate campaigns; the starting location (in the northern or southern area) as well as the sequence of wells, that is subject to the results of the first exploration well and geology data interpretation is not yet defined.

The drilling of the first exploration well, is planned for some time between November 2019 and March 2020. The drilling of one well is estimated to take approximately 71 days to complete.

The time sequence and the number of additional exploration and appraisal wells (up to 6 wells as a maximum total number, including the first well drilled) will be dependent on the results of the first exploration well.

The drillship will be mobilised from either West or East Africa and will enter South African waters either at the Namibian or Mozambican border; as such at the worst case mobilisation will take in the order of 5 days.

3.5 MAIN PROJECT COMPONENTS

This section describes the main project components and these include the following:

- Deep Water Drillship;
- Exclusion Zone;
- Shore base;
- Supply and stand-by vessels;
- Personnel;
- Crew transfer; and
- Infrastructure and services.

3.5.1 Deep Water Drillship

Various types of drilling vessels are used worldwide in offshore drilling operations, with the type of unit typically dependent on water depths in which it needs to operate. Alternative drilling vessels types are discussed further in *Section 3.9.2*. Due to water depth in each area of interest, it is anticipated that exploratory drilling will be conducted using a deep water drillship. The deep water drillship (*Figure 3.2)* will be kept in position using a dynamic positioning system (DPS) which allows for minimal subsea disturbance due to its ability to operate without moorings. A significant benefit to using a drillship is the ease of mobility as it is a self-propelled vessel with the flexibility to move from location to location without the need of transport vessels. An example of deep water drillship specifications is presented in *Table 3.4* below.

Figure 3.2 Example of a Drillship

Source: Shutterstock, 2017

Table 3.4 Example Drillship Specifications

Parameter	Example Drillship
Principal Dimensions / Operating Parameters	
Length	228 m
Breadth	42 m
Depth	19 m
Operational draft	12 m
Transit draft	13 m
Maximum water depth	3,658 m
Maximum drilling depth	10,660 m
Moonpool	25.6 m x 10.26 m
Available Accommodation	200 People on Board (POB)
Storage Capacities	
Active mud	2,000 bbl
Reserve mud	10,000 bbl
Brine water	3,000 bbl
Base oil	3,000 bbl
Bulk mud/cement	34,500 bbl
Drill water	18,000 bbl
Fuel oil	50 000 bbl
Machinery / Equipment / Fittings	
Main generator sets	6 x diesel generators, 9, 900 HP each

Source: Eni, 2015 and Saipem, 2017[1]

[1] http://www.saipem.com/SAIPEM_en_IT/scheda/Vessels/Saipem+12000.page

3.5.2 *Exclusion Zone*

During the drilling operations, there will be a temporary 500 m safety zone around the drillship, which will be enforced by a standby vessel. The safety zone will be described in a Notice to Mariners as a navigational warning.

The purpose of the safety zone is to prevent a vessel collision with the drillship during operations. Under the Marine Traffic Act, 1981 (No. 2 of 1981), an "exploration platform" or "exploration vessel" used in prospecting for or mining of any substance falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a drillship that is engaged in drilling operations is defined as a "vessel restricted in its ability to manoeuvre", which requires that power-driven and sailing vessels (e.g. fishing vessels) give way to a vessel restricted in her ability to manoeuvre. Vessels engaged in fishing are required to, so far as possible, keep out of the way of the well drilling operation.

3.5.3 *Shore Base*

An onshore logistics base will be located in either Richards Bay or Durban, on an existing brownfield site (previously developed land) within the Port or the Industrial Development Zone (IDZ). A final decision will be undertaken after a logistic survey in the identified areas.

This base will include the following facilities:

- An open storage area partially equipped with pipe racks for drilling tubular material storage;
- A covered warehouse for drilling material and other minor equipment;
- A shelter for storage of consumables (cement, barite, bentonite); and
- Temporary offices for logistic base personnel (5 to 8 persons).

Area for storage (less than 90 days) of less than 100 m^3 general waste and 80 m^3 hazardous waste at any one time.

These wastes will be transported to a licensed waste disposal facility by an appropriate waste contractor, and they will not be stored within the base except for the time strictly necessary for unloading from the ship and loading on the trucks for transport to the disposal site.

The following maximum[1] potential space requirements have been identified:

- Open area/pipe yard: up to 6,000 m^2;
- Warehouse: up to 500 m^2; and
- Shelter: up to 100 m^2.

Eni is planning to use existing infrastructure at either Richards Bay or Durban Ports, to provide the transport, storage and bunkering facilities for the project. They will also utilise the existing bunkering facilities in the Port for the refuelling of the supply and support vessels.

It is anticipated that a temporary mud plant will be required for the mixing of base fluid, brine and solids to obtain the desired density and flow structure of the fluid, as well as for the storage of drilling fluids and completion brines. The temporary mud plant will be located inside the shore base and will include two 80 m^3 storage tanks for brine and mud.

Supply vessels providing fuel, food supplies, water etc. to the drillship would dock at the selected Port, which shall have a mooring area with minimum draft of 6.5 m and length of about 100 m.

The location of the heliport for crew change and MEDEVAC services will be determined once the logistic base location is confirmed.

3.5.4 *Supply and Standby Vessels*

For the duration of the drilling operation, the drillship will be supported by platform supply vessels (PSVs), which are general purpose vessels designed to carry a variety of equipment and cargo. These vessels will supply the drillship three to four times a week with drilling muds, cement and equipment such as casing, drill pipe and tubing. They will also remove waste that must be appropriately disposed of on land. The number of firm PSVs has not yet been defined (it is anticipated that there will be two or three).
A standby vessel (or a PSV in dual mode – supply and standby) will also be available to support the drilling operations during an emergency, including oil containment/recovery and rescue and to supply any specialised equipment necessary in case of an emergency.

[1] These values are the maximum potential values as the maximum storage capacity of the drillship is being investigated in order to reduce onshore requirements.

The standby vessel will also be used to patrol the area to ensure that other vessels adhere to the 500 m exclusion zone around the drillship.

3.5.5 *Personnel*

The shore base will be located in Richards Bay or Durban and all shore based personnel will reside locally. The majority of on-shore staff employed will be local if an existing locally based logistics company will be evaluated as suitable for operational logistics support and follow up. If not suitable, expatriate staff expert in drilling operations will integrate with and train inexperienced local staff. Eni representatives will also be located in the Cape Town Office.

The drillship will accommodate around 150 to 200 personnel. The majority of staff employed will be expatriates due to the short-term nature of the work and the necessary expertise and required technical skills. In accordance with Eni's guidelines the vessel will be manned as a minimum in compliance with the requirements of the Flag State and the IMO Reg A 890 (21) – Principle of Safe Manning, dated 25 Nov. 1999. In addition, the crew must also be adequate in terms of number and qualifications to safely operate the vessel and to carry out all operations.

The number of personnel on the supply vessels will vary based on vessel size and the types of activities they support. The preferred option is to utilise local vessel and staff, if suitable, for drilling operations service. All workers will be provided with health and safety training and Personal Protective Equipment (PPE) suitable for the types of activities.

3.5.6 *Crew Transfers*

Transportation of personnel to and from the drillship will most likely be provided by helicopter operations from Richards Bay or Durban. The drillship will accommodate around 200 personnel. Crews will generally work in 12 hour shifts in 2 to 4 week cycles. Crew changes will be staggered, and in combination with ad hoc personnel requirements. Thus helicopter operations to and from the drillship will occur on an almost daily basis. The helicopter crew will generally work in 10 hour shifts in 2 to 4 week cycles and in accordance with Eni's Aviation Manual.

3.5.7 *Infrastructure Support and Services*

Freshwater

The project will require seawater and some limited industrial water for making the water based drilling muds for the tophole sections of the well and for rig cleaning. This industrial water will be transported from shore.

The drinking (potable) water for the POB the drillship will be either bottled water or provided by reverse osmosis system. The amount of water used by the project will be managed by implementing Eni's sustainable water management guideline.

Fuel

Estimates for the fuel (marine gas oil) use per day by the drillship and supply vessels during transit, standby and drilling operations are provided in *Table 3.5* below. The estimated total fuel consumption during the mobilisation and drilling phase (approximately 5 days drillship mobilisation and 71 days drilling) by all the project vessels is provided in *Table 3.6.*

Table 3.5 Estimated Daily Fuel Use by the Drillship and Supply Vessels

Vessel	Mobilisation	Drilling phase
Drillship (tonnes/day)	90	30
Supply Vessels for Supply Service (tonnes/day/vessel)	10	10
Supply Vessel for Standby Service	4	4

Table 3.6 Total Estimated Fuel Consumption by the Drillship and Supply Vessels

Fuel Demand Estimate	Total fuel consumption (tonnes)
Drillship	2,580
Supply Vessel for Supply service	710
Supply Vessel for Standby service	284
Total	**3,574**

Food Supplies and Local Services

A catering company will provide food and beverages to the offshore vessels. Food selection, quantities, and sourcing will be undertaken with support from the shore base (coordinate local purchases, etc.), it has not as yet been confirmed; however it is likely that the bulk of food will be purchased in either Richards Bay or Durban.

3.6 PROJECT ACTIVITIES

Project activities associated with drilling include the following phases:

1. Mobilisation of the supply vessels to Richards Bay or Durban, operation of the shore-based facilities for handling support services needed by the drillship;

2. Drilling of a well;

3. Well execution (side track, logging, completion) options;

4. Optional well testing;

5. Well abandonment; and

6. Demobilisation of the drillship, vessel and local logistics base.

All activities will be conducted in conformity with recognised industry international best practice.

3.6.1 Mobilisation Phase

Vessel Mobilisation and Site Preparation

The drilling locations will be identified prior to mobilisation of the drillship based on the results of the analysis of seismic data. The drilling locations will be within the identified area of interest.

During mobilisation, the drillship will arrive directly on location from previous country of intervention (probably from West Africa or East Africa). Support vessels could sail directly in convoy with the drillship to site or from the Richards Bay or Durban mooring area.

The drillship will be equipped with navigation equipment for accurate station keeping above the well location (dynamic positioning – using thrusters). Once in position, the drillship will carry out its pre-drilling activities comprising seabed survey; remote operated vehicle (ROV) dive; positioning; beacon placement and dynamic positioning (DP) trials.

Should any obstacles/sensitivities be identified at the drilling location, the well will be relocated to a nearby location where no obstacles/sensitivities are located.

These activities will be followed up with safety checks, drills, communication tests and drilling of the pilot hole. This will take approximately nine days to complete.

3.6.2 Drilling Phase

Well Drilling

After mobilisation, the first phase is the drilling phase. The drilling sequence for the exploration drilling is not yet defined as it will depend on the first exploration well results. However, it is currently planned that the drilling of the northern and the southern areas of interest will be undertaken as two separate campaigns.

In order to evaluate and confirm the commercial viability of the reservoir, a vertical well will be drilled to a total depth of approximately 3,800 m and 4,100 m below the seafloor for the wells located in the northern area, and 5,100 m for the well located in the southern area. The expected hydrocarbon for these wells is oil (*Figure 3.3*).

A standard well design and programme for subsea well has been described below, however this will be updated after the completion of seismic interpretation and stratigraphy evaluation by the geologists and petroleum engineers. The well path will be defined accordingly.

During the drilling phase, different drilling bit sizes are used to drill a series of telescoping holes, from the seabed to the total depth of the planned well. The first hole, the outer, is the biggest and called the tophole, while the next inner holes are progressively smaller and smaller as the well depth increases. This continues until the final hole, which is the smallest, reaches the reservoir level. Further details with regard to the section diameters, depths and planned profile of the well are provided in *Figure 3.4* and *Figure 3.5.*

During the drilling process, drilling fluids/muds are pumped down the inside of the drill pipe and exit at the drill bit to optimise drilling operations. For the first sections (tophole) of the well, riserless drilling (i.e. without riser installed) will be carried out with seawater in conjunction with high viscous pills and sweeps. In the bottom sections of the well, riser drilling (i.e. with riser and Blowout Preventer installed on top of the wellhead), will be carried out with either water based mud (WBM), also called water base fluid (WBF), or non-aqueous drilling fluid (NADF). The mud programme will be defined based on final well design and expected rheology.

The main functions of drilling fluids (also referred to as drilling muds) include the following:

- Removal of drilled rock cuttings from the the bottom of the well and from the well bore and transportation of these cuttings to the surface;
- Control of formation pressures and prevention of formation fluids entering the well bore (i.e. 'primary well control');
- Transmission of hydraulic horsepower to the drill bit;
- Provision of hydrostatic pressure as well as chemical stability to the rock to maintain the integrity of the hole and prevent hole collapse;
- Corrosion control of the metal components of the drilling tools; and
- Lubrication and cooling of the drill bit.

The drill bit is connected to surface by a string of hollow tubulars referred to as the drill string. On the rig floor, drill pipes are attached, one by one, to the top of the string as the drill bit advances into the borehole. The action of drilling (creating a hole in the rocks stratigraphy) is obtained by applying weight and rotation to the bit.

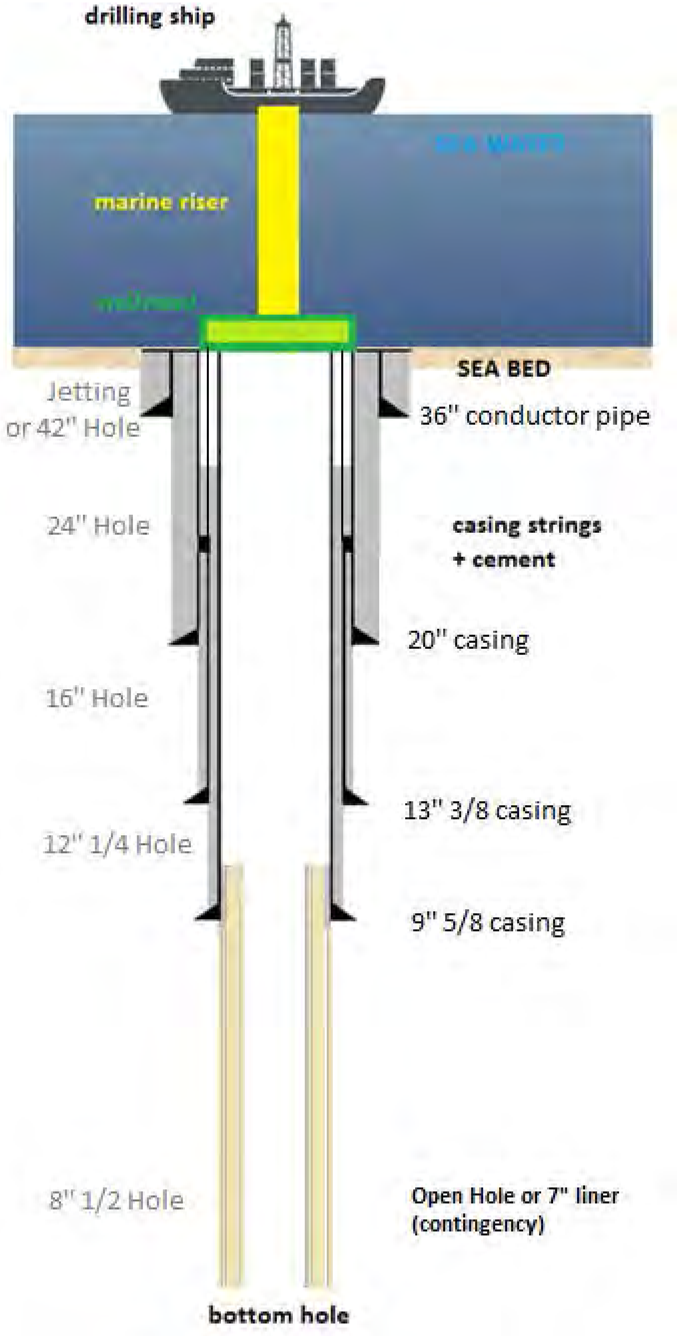
The topdrive, installed in the drillship's derrick, advances the drill string into the well, and provides the rotation and weight on bit required to drill. To give additional torque, sometimes a downhole motor is installed at the bottom of the string, whose rotor is connected to the bit. A sophisticated telemetry system is connected to the string and it transmits to surface the drilling parameters (direction, pressure, rotation, weight etc.) to guarantee a full control and safety during the drilling phase.

Once each hole section has been drilled, casing (steel tubulars) is run into the well and cemented in place to secure/seal the hole interval just drilled and to allow for the drilling of the next (smaller) hole section. The cement operation consists in pumping cement down the drill string to the bottom. The cement flows, out the bottom of the casing shoe and back up into the annular space around the casing, the space between the cased hole and open hole. Casing plus cement is a tested barrier that facilitates the drilling of the next section, allowing to reach the target final depth in the safest way.

A wellhead is then connected to the surface casing, to have a connection and anchoring point for the following casing head sections and the marine riser. After drilling the first casing interval, a drilling riser, i.e. a hollow tube known as the 'marine riser' is run between the drillship and the wellhead at seabed, so that drilling fluid can be pumped through the drill pipe, out through the drill bit and circulated back up to surface through the marine riser.
During the riserless drilling stage (tophole section drilling), fluid and cuttings are discharged directly on the seabed in immediate proximity of the well. Following installation of the riser (at the end of tophole section) excess seawater stored in tanks and excess drilling fluids will be discharged overboard. The amount of drill cuttings that will be discharged during the drilling of the planned well are described in *Section 3.7.2.*

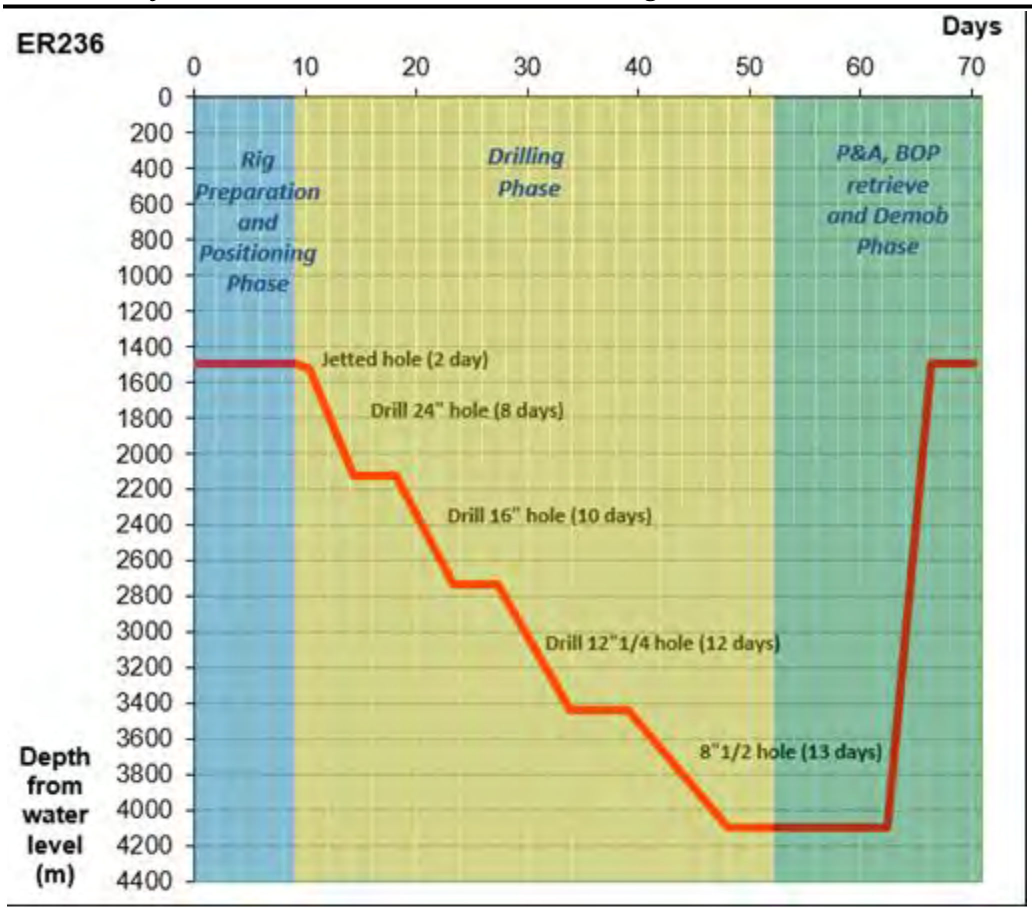
The physical and chemical properties of the drilling fluid are constantly monitored and adjusted to suit varying down-hole conditions. These conditions are, in part, due to the variation in formation pressure within the well bore at different depths. In particular, fluid density (or mud weight) is adjusted via weighting materials such as barite.

Figure 3.3 Subsea Well Schematic at the End of Drilling Phase



Source: ENI, 2018
Note: This drawing is not to scale, in particular for dimension of rig vs equipment and tubulars

Figure 3.4 Preliminary Well Construction Phases vs Drilling Time Schedule



Source: Eni; 2018

3.6.3 *Well Execution Options*

Side track

In case of issue related to stratigraphy (e.g. permeable zones with different pressure gradient, hole instability for fines presence, necessity to increase the inclination of the well to achieve the reservoir target) or problem during the drilling itself (e.g. BHA stuck) a common operation is drill a sidetrack. A sidetrack usually is a combination of a cement plug, to abandon the current open hole, and the setting of a whipstock in the open hole or above the shoe of the last set casing/liner.

The whipstock is a metal tool that facilitates the re-entry with the drilling string, milling in case the cased hole, and resume drilling in the formation with a different orientation and inclination.

Well Logging

Different sensor are used throughout the drilling operations to measure several parameters in real time: mud weight, formation pressure, temperature, weight on bit, rotation, torque, velocity, hydrocarbon detection, gamma ray, resistivity, gas content in mud, cement bond, casing wear etc.

All those parameters are used to optimize the drilling operations, improve the hole stability and identify different lithology in order to constantly update the mud plan and verify that the geological stratigraphy is the same expected from the seismic data interpretation.

Real time logs are also very important to detect hydrocarbon presence and typology (oil, condensate, gas). This information is provided in real time both from bottom hole (sensor installed in bottom hole assembly) and at surface, where mud samples and cuttings are regularly tested to confirm data interpretation from sensors.

In this way it is possible to immediately detect mud losses, drilling break or influx (kick) of hydrocarbon, in particular in the annulus drilling string-open hole, in order to adopt as soonest the control measure (e.g. increase of mud weight or decreasing or rate of penetration) and safely resume/continue operations.

A dedicated run to measure/log the cement bond and consistency in the annuli is performed at the end of each cement job, prior to start drilling operations in the next phase.
Further detailed information is obtained on the physical properties of the rock formations and fluids (water, oil, gas) by means of an open and cased hole logging using sensors introduced down- hole with a wireline cable, or coiled tubing unit.

This operation is usually performed at the end of the drilling phase, after the bottom hole final clean up.

The logging plan is developed in accordance with standard industry best practices. In the case of dry or exploration wells, once a full log of the reservoir section has been undertaken, the well will be plugged and abandoned. The completion phase, if confirmed in case of discovery, will be performed only for appraisal wells.

Well Completion

Well completion and well testing operations will not be conducted during drilling of exploration wells (first wells), however if hydrocarbon is discovered, may be performed after drilling any appraisal wells.

The completion phase of an oil or gas well takes place after the reservoir formation has been drilled and the production casing cemented. Preliminary completion operations are usually required to clean and condition a wellbore from mud, in order to prepare the well for the following operations.

At the beginning of the completion operations, the wellbore is displaced with a completion brine, necessary to balance the downhole pressure and, at the same time, to complete the removal of mud and solids from the well in order to minimise any potential damage to the formation.

Brine is a particular kind of WBM: basically it is a salty water, commonly a mixture of industrial water, NaCl or KCl salt and minor additional chemicals (e.g. corrosion inhibitor, de-foamer). The selection of salt and brine composition will be defined once the hydrocarbon has been discovered in the exploration well and reservoir lithology completely logged.

A specific tubular string, the completion string, is then run in hole. This string can be secondary named well testing or completion strings, if used during well testing or in the case of preparation for further production respectively.

This string allows subsea safety, guaranteeing full control of hydrocarbon flow during the testing or production phase.

Subsequently the weighted completion fluid that maintains sufficient pressure and prevents formation fluids from migrating into the hole, is displaced out of the well-bore in order to start the next phase, if required, the well testing phase.

Well Testing

As stated previously, well testing may be conducted on the appraisal wells if they present potential commercial quantities of hydrocarbon.

A well test is a temporary completion of a well to acquire dynamic rate through time, pressure, and fluid property data. The well test often indicates how the well will perform when it is subjected to various flow conditions.

An analysis is usually performed on the data to determine reservoir parameters and characteristics including pressure, volume, and temperature.

Current testing practices are carried out using modern testing equipment and high resolution pressure data acquisition system, getting the reservoir evaluation objectives depends on the behavior of the formation fluid properties, well completion, and flow assurance situations are only known when testing is carried out.

The well test objectives are to:

1. Determine key technical factors of the reservoir (eg size, permeability and fluid characteristics) and values for use in future drilling.
2. Obtain representative data including reservoir pressure, production rates and sample(s).

While testing, hydrocarbons are sent to a flare boom with a burner to ensure as complete destruction of fluids (including hydrocarbons) as possible. Flaring may be initiated using LNG or similar fuel to ignite the mixture. To ensure that burning can be done downwind of the drillship, more than one flare boom can be used, or the ships positioning may be adjusted. Water misters may be used to mitigate heat exposure on the rig.

The flow periods and rates will be limited to the minimum necessary to obtain the required reservoir information during the well test. It is anticipated that a maximum well test time for this project will be approximately 20 days.

Downhole sampling, if required, normally consists of recovering reservoir fluids via wireline or through specific tools added directly to the temporary test string. Wireline testing involves running instruments into the borehole on a cable to measure formation pressures and obtain fluid samples. Formation fluids are brought to the surface where the composition can then be analysed. The following key well testing preventative measures will be implemented during the well testing programme:

- Monitor flare performance to maximise efficiency of flaring operation;
- Ensure sufficient compressed air provided to oil burner for efficient flaring;
- Flare equipment appropriately inspected, certified and function tested prior to operations;
- Flare equipment appropriately maintained and monitored throughout well testing operations;
- The equipment is designed and built to appropriate codes and standards and certified; and

- The appropriate emergency stop mechanisms are in place to halt testing in case of emergency.

Well Control and Blowout Prevention

Health, safety and environmental protection are prioritised throughout the drilling process. In particular, there is a specific focus and attention during preparation and operations to avoid any potential accidental events, with related hydrocarbon release or uncontrolled flow from downhole to seabed or at surface (rig floor).

Well control during well operations is a routine function, with each well designed and executed to minimise risk of developing a well control incident. Down-hole conditions, such as shallow gas and high-pressure zones can cause control problems as a sudden variations in well pressure.
A well kick can occur if there is an influx of formation fluids with sufficient pressure to displace the well fluids. The primary well control against a well kick is provided by the maintenance of a sufficient hydrostatic head of weighted drilling mud/completion brine in the well bore to balance the pressures exerted by fluids in the formation being drilled.

Secondary well control is provided by the installation of mechanical device, such as the float collar in the drilling string and the blowout preventer (BOP) at seabed, installed on top of the wellhead after the running and setting of the surface casing.

The BOP effectively closes and seals the annulus if there is a sudden influx of formation fluids into the well bore, by the use of a series of hydraulically /electrically actuated rams. In addition, this device allows the formation fluids to be safely vented or pumped at the surface with the well closed, thereby enabling other methods to be applied to restore a sufficient hydrostatic head of mud on the well bore, for example pumping a higher density volume of mud, the so called 'kill mud'. The capacity and pressure rating of equipment, safety device and the BOP rating exceed the predicted reservoir pressures.

The well control philosophy and procedure, constantly updated by the Eni drilling department, includes the identification and assessment of all well blowout risks.

3.6.4 Well Abandonment (Plug and Abandonment "decommissioning")

Once drilling is completed, the well will be plugged and abandoned (P&A). The scope of well abandonment is to protect the environment by effectively sealing off all distinct permeable zones (i.e., the zones of potential hydrocarbons or water inflow penetrated by the well or perforated casing zones), to ensure that formation fluids are isolated, both within the wellbore and in annular spaces, and that their migration among different formations and/or up to seabed is prevented.

At the end of well construction, a cement plug setting job will be performed in both types of wells (exploration and appraisal) and for a successful hydrocarbon discovery or in the case of dry well.

For exploration wells, the plugging and abandonment job will be final, in that no re-entry of the well is planned. In the event of a discovery, for appraisal wells the cement plug will have a different composition and dimension (length) to allow the capability to re-drill the cement and recover the well for a future development phase.

In both configurations, the cement plugs are suitable to guarantee the effectiveness and integrity of the seal and are configured so that no future intervention is required.

In the presence of a single permeable zone, the well will be isolated by means of at least one well barrier (plug). When the formation pore pressure from a permeable zone is expected to exceed the formation fracture pressure anywhere else in the open hole, two well barriers shall be present in order to prevent formation breakdown or underground blowout.

For each distinct permeable zone, two well barriers, referred to as "primary" and "secondary", shall be present in order to prevent also cross flow to surface or seabed or vice versa. As per industry best practice, the primary well barrier envelope will have a well barrier element set across or above the highest point of potential influx (top permeable zone or top perforations) or as close as reasonably possible to it. The secondary well barrier shall have a well barrier element set in such a way to guarantee the sealing of the permeable zone in case of failure of the first well barrier.

The BOP will be then retrieved to surface and the wellhead will be left in place on the seabed.

In shallow waters, the cut and retrieval of the wellhead is an alternative option for well abandonment of exploration wells, for which no re-entry is expected and interactions may possible but unlikely, with other activities in the area of interest (e.g. demersal fishing activities). Considering there is no demersal fishing activities overlap with the Block and that the water depths of both areas of interest are deeper than 1,500 m, there is unlikely to be any interaction with demersal fishing activities and the wellhead will be left at seabed.

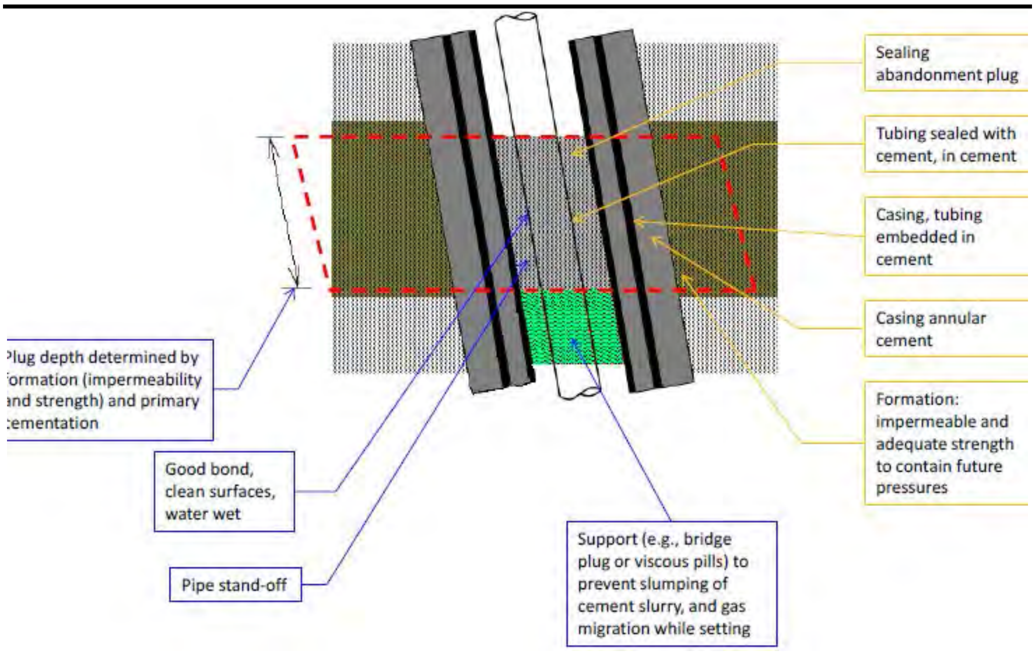
Plug and abandon operations ("decommissioning") shall be designed and executed in compliance with oil industry good practices and applicable technical standards[1]. The final program for well plugging and abandonment will be finalized after the end of drilling phase and log evaluation, in order to maximize the number and composition of plugs sealing in the single or multiple permeable zones discovered.

[1] E.g. but not limited to API RP 96, OGUK and NORSOK D-10

For deepwater wells the provisional preliminary plug and abandon program, included in the master drilling program, and the final program are usually prepared and revised directly by the drilling technical authority in the Eni Company Headquarters. The final cement plug program, design sequence and composition is revised by the Company drilling department, drilling contractor and cement contractors prior of finalization and execution. The technical program and associated costs to perform the operations are in addition verified by a third party contractor that will evaluate the program from the safety, technical and economic points of view.

At the end of the plug and abandonment operations, estimated at eight days prior to demobilization, the well schematic and wellhead location (including casings dimension, length, cement plug dimension and composition, pressure and inflow test results etc.) will be included in a final report submitted to PASA. The associated cost estimation for plug and abandonment operations for a single well in either drilling area of intrest is provided in *Annex E*. *Annex E* presents all the cost of abandonment activities.

Figure 3.5 ***Schematic of Cement Plug at Bottom Hole***



Source: Eni Manual for plug and abandon)

3.6.5 *Demobilisation*

On completion of drilling, the drillship and support vessels will leave the well location. A final ROV survey will be performed at seabed.

3.6.6 *HSE Risk Management during Operations*

As a component of Eni's HSE (health, security, environment and safety) risk management, a comprehensive HSE Policy is in place that includes mobilisation and demobilisation; drilling and completion operations and procedures.

Eni is committed to protecting the health, safety and security of its employees and those of its contractors, to ensure that all activities are conducted in a manner that protects the environment and people who are potentially impacted by its operations.

3.7 *PLANNED EMISSIONS AND DISCHARGES, WASTE MANAGEMENT*

This section presents the main sources of emissions to air, discharges to sea and waste that will result from the planned drilling activities and associated operations.

The principle of Eni for waste management is to follow the following Eni waste management hierarchy; in the order of priority: reduce, reuse, recycle, recover, treat, and dispose.

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with MARPOL 73/78. A project specific Waste Management Plan (covering all wastes generated offshore and onshore) will be developed in accordance with MARPOL requirements, South African regulations and Eni's waste management guidelines.

Waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of drilling.

3.7.1 *Emissions to Air*

The principal sources of emissions to air from the proposed drilling campaigns will be from exhaust emissions from power generation on the vessels. If well testing is conducted on the appraisal well, then emissions will be generated from hydrocarbon flaring for the limited duration of the well test.

Dynamically positioned vessels have relatively high fuel consumption and consequently high levels of corresponding air emissions. Diesel oil or marine gas oil (MGO), if available, will be used as fuel for all vessels resulting primarily in emissions of carbon dioxide (CO_2), sulphur oxides (SOx), nitrogen oxides (NOx) and carbon monoxide (CO). Relative to these pollutants, smaller quantities of non-methane volatile organic compounds (VOCs), methane (CH4) and particulate matter (PM10/PM2.5) will also be released.

These emissions are released during the normal operation of a marine vessel and have the potential to result in a short-term localised increase in pollutant concentrations. They also contribute to regional and global atmospheric pollution.

Helicopter emissions levels will depend on actual fuel consumption and hence will vary with flying time, payload, weather, speed etc. With those constraints, the helicopter flights have been estimated to use 15 to 20 tonnes of fuel during the drilling phase. The emissions generated from the drilling operation will be controlled through fuel efficiency measures.

As can been seen in *Table 3.7*, it is estimated that approximately 3,599 tonnes of fuel will be used by the proposed drillship, supply vessels and helicopter resulting in approximately 13.08 kt of GHG (CO_2, CH_4, N_2O) emissions being emitted to the atmosphere during the drilling operations.

Table 3.7 Predicted Total Atmospheric Emissions from Vessels during Drilling Operations

	Gaseous emission	Drillship	Supply Vessel	Helicopter	Total	CO_2 equivalent
Consumption (tonnes)		2,580	994	25	3,599	
Emissions (tonnes)	CO_2	9,355.08	3,604.33	76.20	13,035.61	13,035.61
	CO	1.79	0.69	0.12		
	NOx	8.62	0.33	0.06		
	N_2O	0.07	0.03	6.62E-4	0.10	30.85
	SO_2	22.65	8.73	0.02		
	CH_4	0.36	0.14	3.31E-3	0.50	10.47
	VOC	7.65	2.95	0.02		
Total CO_2 equivalent						**13,076.92**

Source: Calculated using SANGEA software http://www.api-sangea.org/

All project vessel emissions will comply with requirements set out in the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78).

3.7.2 Discharges to Sea

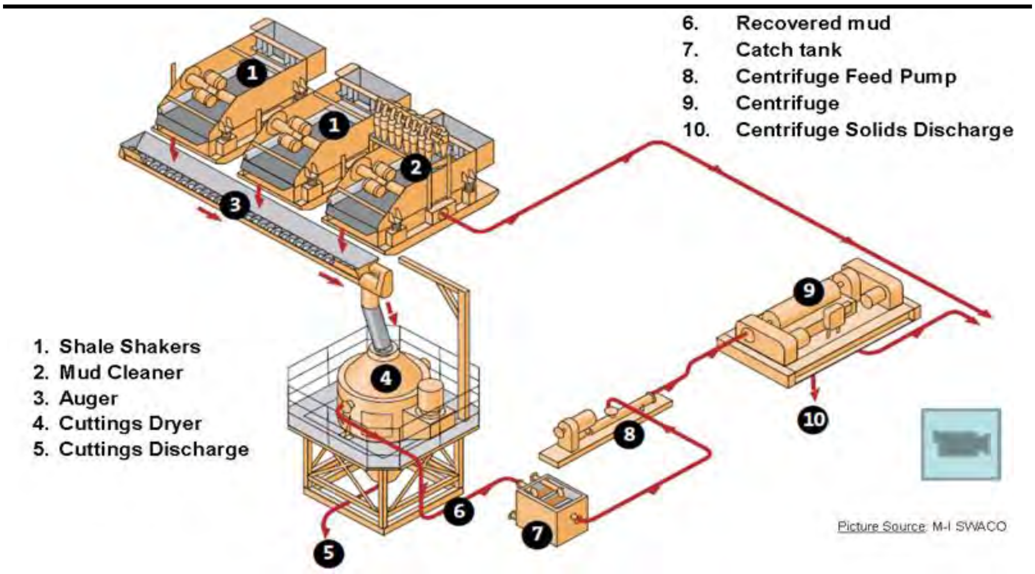
Drill Cuttings and Mud Disposal

For the first sections (tophole) of the well, riserless drilling (i.e. without riser installed) will be carried out with seawater in conjunction with high viscous pills and sweeps.

In the bottom sections of the well, riser drilling (i.e. with riser installed on top of the wellhead and BOP), will be carried out with either water based mud (WBM), also called water base fluid (WBF), or non-aqueous drilling fluid (NADF). The mud programme will be defined based on final well design and expected rheology.

During WBM/ NADF drilling, drilling muds are circulated in a closed loop system which recycles the drilling muds, control the mud weight and properties, and removes the drill cuttings. The returns from downhole (muds and cuttings) are routed to a treatment system (including the shakers, desilter, desander) which will physically separate the drill cuttings from the drilling muds (*Figure 3.6*).

Figure 3.6 Typical Solids Control/Fluid Recovery System



Source: MI-Swaco, 2016

Water Based Muds

Water-Based Muds (WBMs) consist of mixtures of clays, natural and synthetic organic polymers, mineral weighting agents, and other additives dissolved or suspended in freshwater, saltwater or brine (OGP, 2016). These muds are used subsequent to the installation of the riser. The main components of WBMs used on a typical well, their functions and description of their ecotoxicity are provided in *Table 3.8* below.

Table 3.8 *Main Components of Water-Based Muds*

Material	Use	Ecotoxicity
Aluminium stearate	Defoamer	Non-toxic, insoluble
Barite	Weighting agent	Non-toxic, insoluble, non-biodegradable
Bentonite	Viscosifer	Non-toxic, insoluble, non-biodegradable
Calcium carbonate	Bridging, loss of circulation	Non-toxic, insoluble
Caustic soda	pH and alkalinity control	Soluble, corrosive
Cellulose based polymers	Fluid loss control	Insoluble, non-toxic
Citric acid	pH control	Soluble, low toxicity, irritant
Diesel oil pill (< 0.1 % mud volume)	Stuck pipe spotting fluid	Slightly soluble, 96 hr LC_{50} >0.1-1000 ppm
Gilsonite (asphalt based)	Lubricant, fluid loss reducer	Low toxicity, slightly soluble
Gluteraldehyde (0.01% mud vol)	Bactericide (biocide)	Noted for its toxic properties, irritant
Lime	Carbonate and CO_2 control	Slightly soluble, non-toxic, irritant
Organic synthetic polymer blends	Filtrate reducing agent	Non-toxic, 96 hr LC_{50} >500 ppm
Palm oil ester	Lubricant, stuck pipe pills	Slightly soluble, biodegradable
Potassium chloride	Shale / clay inhibitor	Soluble, non-toxic
Soda ash	Alkalinity, calcium reducer	Soluble, non-toxic
Sodium bicarbonate	Alkalinity, calcium reducer	Soluble, non-toxic
Xanthan gum	Viscosity, rheology	Soluble, non-toxic

Source: OIGP 2016, Neff 2005, Boehm et al. 2001

The WBMs will be processed onboard and reused as much as possible in different drilling sections. When spent, WBMs will either be stored onboard and shipped to shore for recycling/disposal facilities or discharged overboard if in accordance with international recommendations and Eni's Waste Management Guidelines. WBM cuttings are discharged overboard if they will respect the following circumstances and limitations defined by local, international recommendations and Eni Best practises:

- Discharge of cuttings via a caisson in >15 m depth;
- Discharge of cuttings only in water >30 m depth;
- Hg: max 1 mg/kg dry weight in stock barite;
- Cd: max 3 mg/kg dry weight in stock barite;
- Maximum chloride contraction must be less the four time the ambient concentration of fresh or brackish receiving water; and
- Ship-to-shore otherwise.

Non-Aqueous Drilling Fluids

Non-Aqueous Drilling Fluids (NADFs): Deep water drilling concepts are technically challenging and require high performance drilling fluids with capabilities exceeding those available from WBM, in particular in terms of prevention of formation of hydrates and preservation of wellbore stability. As a result NADFs, for which the continuous phase is primarily a non-water soluble base fluid, have also been used extensively by the petroleum industry. Low toxicity mineral oil based fluids, highly refined mineral oils and synthetic fluids (esters, paraffin's and olefins) are generally used as base fluids. The main components of NADFs are provided in *Table 3.9*.

Table 3.9 Main Components of Non-Aqueous Drilling Fluids

Material	Description
Base oil	Non-aqueous drilling fluids use base fluids with significantly reduced aromatics and extremely low polynuclear aromatic compounds. New systems using vegetable oil, polyglycols or esters have been and continue to be used.
Brine phase	$CaCl_2$, NaCl, KCl.
Gelling products	Modified clays reacted with organic amines.
Alkaline chemicals	Lime eg Ca $(OH)_2$.
Fluid loss control	Chemicals derived from lignites reacted with long chain or quaternary amines.
Emulsifers	Fatty acids and derivatives, rosin acids and derivatives, dicarboxylic acids, polyamines.

Source: Adapted from OGP, 2003

An IOGP Group 3 non aqueous base fluid (NABF) with low to negligible aromatic content will be used for this project. (1) These fluids are characterised by PAH contents less than 0.001 percent and total aromatic contents less than 0.5 percent. Group III includes synthetic based fluids which are produced by chemical reactions of relatively pure compounds and can include synthetic hydrocarbons (olefins, paraffins, and esters). Base fluids derived from highly processed mineral oils using special refining and/or separation processes (paraffins, enhanced mineral oil based fluid (EMBF), etc) are also included. In some cases, fluids are blended to attain particular drilling performance conditions (OGP, 2003).

The NADF muds will be processed onboard and reused as much as possible in different drilling sections. When spent, NADF will either stored onboard and shipped to shore for recycling/disposal. No spent NADF will be discharged overboard. The NADF drill cuttings will be routed through an additional treatment process, the cuttings dryer (centrifuge type equipment) to maximize the removal of liquid content. Recovered liquid phase will be reused and circulated back in mud loop.

(1) Based on classification by the International Oil and Gas Producers (IOGP).

The drill cuttings and the retained NADF will be discharged overboard following treatment in accordance with local and international recommendations and Eni's Waste Management Guidelines. Base fluid retained on cuttings will not exceed limits detailed in *Section 3.7.2*. Solids removal efficiency for each hole section will be monitored to ensure solids control and fluids recovery equipment is operating as designed.

The NADF muds will be recovered, reused and when spent will be stored onboard prior of shipping to shore for recycle/disposal. No spent volume of NADF will be discharge overboard with the exclusion of marginal residual amount adhered to drilling cutting. In fact the NADF drill cuttings will be routed through an additional treatment system, the vertical cuttings dryer (centrifuge type equipment) to maximize the removal of residual liquids for reuse. The NADF retained on the drill cuttings will be discharged overboard under and if they will respect the following circumstances and limitations defined by MARPOL, international recommendations and Eni Best practises:

- Discharge of cuttings via a caisson in >15 m depth;
- Discharge of cuttings only in water >30 m depth;
- Organic Phase Drilling Fluid concentration: maximum residual non aqueous phase drilling fluid (NAF) 5% (C16-C18 internal olefins) or 9.4% (C12-C14 ester or C8 esters) on wet cuttings;
- Hg: max 1 mg/kg dry weight in stock barite;
- Cd: max 3 mg/kg dry weight in stock barite; and
- Ship-to-shore otherwise.

The amount of drilling waste discharge estimated for one well is quantified in *Table 3.10* below. Refer to *Section 3.9.2* for a discussion of the alternative methods for cuttings discharge.

Table 3.10 Typical Well Design and Estimated Discharges

Section	Hole Size (inches)	Casing size (inches)	Proposed Mud Type	Volume of cuttings (m3)	Volume of mud to be disposed of (m3)°
1	42"	36"	Seawater and sweeps	100	200 (seabed)
2	24"	20"	Seawater and sweeps	300	700 (seabed)
3	16"	13" 3/8	WBM/NADF	120	WBM Discharged/ recovered; NADF only recovered
4	12"1/4	9" 5/8	WBM/NADF	70	WBM Discharged/ recovered; NADF only recovered
5	8 ½	Open hole or 7"	WBM/NADF	30	WBM Discharged/ recovered; NADF only recovered
Total	-	-	-	**620**	**900**

Source: Eni; 2018

Note: spent WBM is discharged overboard if in compliance with required specification, while NADF will be recovered and disposed onshore. Final quantity of WBM discharged can be estimated only at end of drilling operations because mud volume will be recycled/re-use in next drilling phase or well as much as possible.

Cement

During the initial cementing operation (tophole section), the required cement volume will be pumped into the annular space between the casing and the borehole wall. An excess of cement, necessary to guarantee sufficient presence of cement through the overall annulus, will emerge out of the top of the well.

After the riser has been installed, for the next phases cement jobs, a limited excess cement will be returned via the riser to the drilling vessel and discharged overboard.

During cementing of the tophole section, excess cement (maximum of 100 m^3) will emerge out of the top of the well and onto the seabed, where it will dissolve into the surrounding water. Excess cement is necessary to guarantee that the conductor pipe and surface casing are cemented all the way to the seafloor. During subsequent cementing jobs excess cement will be returned to the drilling vessel via the riser and discharged overboard.

Offshore drilling operations typically use Portland cements, defined as pulverised clinkers consisting of hydrated calcium silicates and usually containing one or more forms of calcium sulphate. The raw materials used are lime, silica, alumina and ferric oxide. The cement slurry used is specially designed for the exact well conditions encountered. Additives can be used to adjust various properties in order to achieve the desired results. There are over 150 cementing additives available. The amount (concentrations) of these additives generally make up only a small portion (<10 percent) of the overall amount of cement used for a typical well. Usually, there are three main additives used: retarders, fluid loss control agents and friction reducers. These additives are polymers generally made of organic material and are considered non-toxic. When the cementing job is completed, a mechanical and sealing test is performed.

Bilge Water

All deck drainage from work spaces (bilge water) will be collected and piped into a sump tank on board the project vessels to ensure MARPOL 1973/78 Annex I compliance. The fluid will be monitored and any oily water will be processed through a suitable separation and treatment system prior to discharge overboard at a maximum of 15 ppm oil in water.

Sewage

Sewage discharge from the project vessels will meet the requirements of MARPOL 73/78 Annex IV. MARPOL 73/78 Annex IV requires that sewage discharged from vessels be disinfected, comminuted and that the effluent must not produce visible floating solids in, nor cause discoloration of the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination. The treated effluent is then discharged into the sea.

Galley Wastes

The disposal into the sea of galley waste is permitted, in terms of MARPOL 73/78 Annex V, when the vessel is located more than 3 nautical miles (approximately 5.5 km) from land and the food waste has been ground or comminuted to particle sizes smaller than 25 mm.

Detergents

Detergents used for washing exposed marine deck spaces will be managed as bilge water. The toxicity of detergents varies greatly depending on their composition. Water-based or biodegradable detergents are preferred for use due to their low toxicity.

In certain cases of specific area cleaning, eg marine deck with no contamination of pollutants, using no toxic detergent, direct overboard discharge may be considered.

3.7.3 Land Disposal

A number of other types of wastes generated during the drilling activities will not be discharged at sea but will be transported to shore for disposal. These wastes will be recycled or re-used if possible or transported and disposed of at an appropriate licensed municipal landfill facility or at an alternative approved site.

Where practicable, the following waste types will be recycled or reused onshore:

- Garbage (e.g. paper, plastic, wood and glass) including wastes from accommodation and workshops etc;
- Scrap metal and other material;
- Used oil, including lubricating and gear oil; solvents; hydro-carbon based detergents, possible drilling fluids and machine oil; and
- Drilling fluid, including LTSBM and cuttings, brine from drilling and completion activities.

The following wastes will be disposed of by a licensed waste contractor at licensed waste facilities.

- Drums and containers containing residues (e.g. lubricating oil) that may have environmental effects;
- Hazardous wastes (e.g. radioactive materials, neon tubes and batteries);
- Medical waste from treatment of personal onboard the vessel; and
- Filters and filter media from machinery.

At the end of operations, the overboard discharge of hazardous chemicals, bulk cement or any other chemical is not permitted by Eni. The preferred solution for unused chemicals is to return them to the supplier for reuse/recycle in other projects. Should this not be possible these could be managed or disposed as per the above mentioned Eni waste management hierarchy.

3.7.4 Noise Emissions

The main sources of noise from the proposed drilling programme include noise produced by the drillship and supply vessels. The noise characteristics and level of various vessels used in the drilling programme will vary between 130 and 182 dB re 1µPa at 1 m (Simmonds *et al*, 2003; Richardson *et al*, 1995). The particular activity being conducted by the vessels changes the noise characteristics, for example, if it is at idle, holding position using bow thrusters, or accelerating.

3.8 UNPLANNED EMISSIONS AND DISCHARGES

This section presents the main sources of emissions that will result from the unplanned/ accidental events during the drilling activities and associated operations.

3.8.1 Hydrocarbons and Chemical Spills

Two of the main types of unplanned/ accidental events that could occur while drilling wells that could result in a discharge of hydrocarbons or chemicals to the marine environment are loss of well containment and single-event/batch spills.

Loss of well containment is a continuous release (in worst situation, with no control and massive release, it is called "well blowout") which could last for a measurable period of time, while a single-event spill is an instantaneous or limited duration occurrence. Eni is committed to minimising the release of hydrocarbons and hazardous chemical discharge into the marine environment and avoiding unplanned spills.

In case of unplanned/ accidental events, Eni minimises any adverse effects to the environment and plans to accomplish this goal by:

i) Incorporating oil and chemical spill prevention into the drilling plans; and
ii) Ensuring that the necessary contingency planning has taken place to respond effectively in the event of an incident.

Eni will develop an Oil Spill Contingency Plan prior to the commencement of the drilling and this plan will be implemented in the event of an unplanned/ accidental release of oil offshore.

In addition, precautions are taken to ensure that all chemicals and petroleum products stored and transferred onshore and offshore are done so in a manner to minimise the potential for a spill and environmental damage in the event of an unplanned/ accidental release.

3.9 PROJECT ALTERNATIVES

One of the objectives of an EIA is to investigate alternatives to the project. In relation to a proposed activity **"alternatives"** means different ways of meeting the general purposes and requirements of the proposed activity.

Appendix 2 Section 2 (h)(i) of the EIA Regulations, 2014 (as amended), requires that all S&EIR processes must identify and describe alternatives to the proposed activity that are feasible and reasonable. Different types or categories of alternatives can be identified, eg location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The 'No Go' or 'No Project' alternative must also be considered.

Not all categories of alternatives are applicable to all projects. The consideration of alternatives is inherent in the detailed design and the identification of mitigation measures, and therefore, although not specifically assessed, alternatives have been and will continue to be taken into account in the design and EIA processes.

Despite many advances in seismic data acquisition and analysis, currently no alternatives exist to definitively establish the presence of hydrocarbon reserves other than through exploration and appraisal drilling. No activity alternatives have therefore been assessed.

It should however be noted that some pre-drilling activities may be undertaking, including an ROV survey. A summary is provided below of the alternatives considered for this EIA Report.

3.9.1 *Site Locality Alternative*

Drilling Location

Eni is the operator and holds an Exploration Right for ER236. Both 2D and 3D seismic surveys have been undertaken over ER236 and possible areas of interest identified. Based on the interpretation of the seismic information, Eni have identified two areas of interest covering a limited area of ER236, in which they are considering undertaking exploration drilling activities in order to determine the presence and viability of the reserve.

The northern area of interest (1,717.50 km^2) is located approximately 62 km offshore of Richards Bay, and the southern area of interest (2,905 km^2) approximately 65 km offshore of Port Shepstone.

Although the well locations are still to be finalised based on a number of factors, including further analysis of the seismic data, the geological target and seafloor obstacles. *Chapter 7* considers that the wells could be drilled anywhere within the northern and southern areas of interest.

Onshore Logistics Base

An onshore logistics base will either be located in the Port of Richards Bay or the Port of Durban, the decision between these locations will be dependent on discussions with Transnet and the availability of sufficient space to accommodate the logistics base.

This draft EIA Report will assess the impacts from a logistics base in either Richards Bay or Durban.

There no noticeable differences associated with the location of the onshore logistic base in either Port of Richards Bay or the Port of Durban.

3.9.2 *Technology Alternative*

Drilling Vessel Alternatives

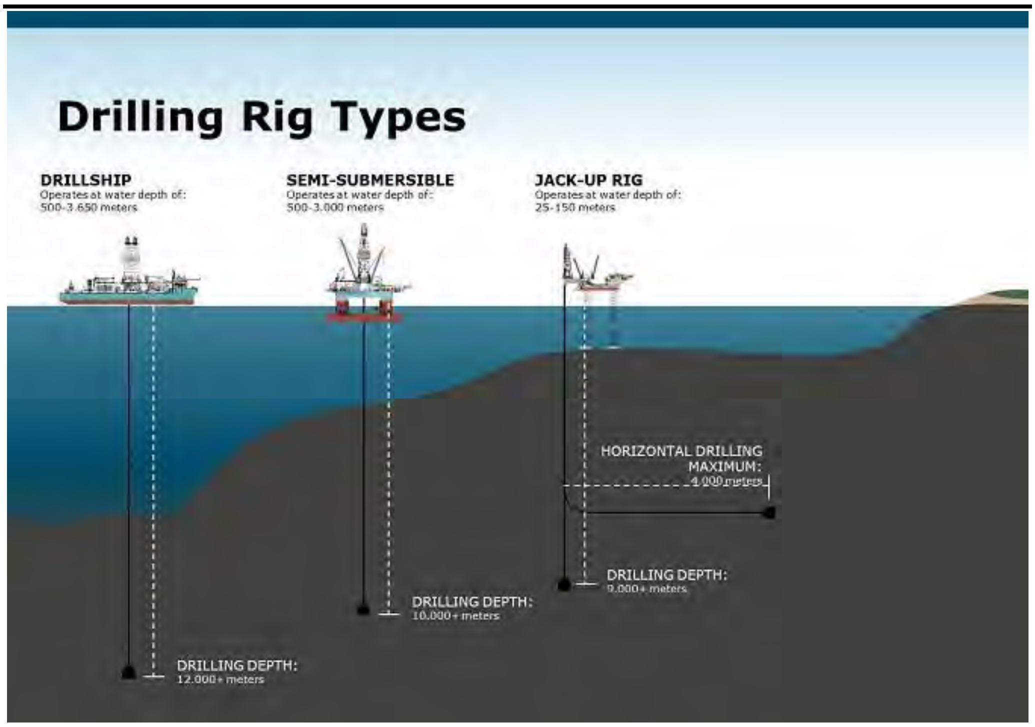
There is a range of drilling vessels available to conduct the drilling of an offshore well. For deep water areas these are restricted to two options, drillships or semi-submersible rigs. *Figure 3.7* shows the options available and the associated operation depths.

As discussed in *Section 3.5.1*, a drillship is commonly kept in position using a DPS which allows for minimal subsea disturbance due to its ability to operate without moorings. A significant benefit to using a drillship is the ease of mobility as it is a self-propelled vessel with the flexibility to move from well to well or location to location without the need of transport vessels. This option does however require greater energy use (and therefore emissions) and the DPS produces greater underwater sound during operation.

A semi-submersible drill rig has to be towed to a site and is either moored to the seabed using a series of anchors which may extend up to 1 km from the rig or may use dynamic positioning to stay in position. These rigs have a partially submerged structure below the water line. Water is used as a ballast control to maintain flotation and stability. This option will cause greater disturbance to the seabed due to the presence of the moorings, but requires less energy use and produces less underwater sound.

Both drilling units are self-contained units with derrick and drilling equipment, an internal access to the water surface called moonpool, a helicopter pad, fire and rescue equipment and crew quarters. The operations and discharges are similar. Each drilling unit will also require between one to three supply vessels, it is likely that a semi-submersible drill rig will require more support vessels (or more trips by the support vessel to the base) than a drillship, as a drillship has more onboard storage capacity. A drillship is also significantly more mobile than a semi-submersible.

Figure 3.7 Drilling Vessel Alternatives



Source: http://www.maerskdrilling.com/en/about-us/the-drilling-industry

Eni's preferred drilling vessel is a drillship due to distance from shore, water depth constraints and its availability, flexibility and ease of mobility.

Drilling Fluids

Various factors govern the best combination of drilling chemicals used to produce the required drilling mud needed to lubricate the drill bit, maintain well pressure control, and carry cuttings to the surface.

According to the IOGP classifications, the three types of NADF that could be used for offshore drilling can be defined as follows:

- Group I NADF (high aromatic content) - These base fluids were used during initial days of oil and gas exploration and include diesel and conventional mineral oil based fluids. They are refined from crude oil and are a non-specific collection of hydrocarbon compounds including paraffin, olefins and aromatic and polycyclic aromatic hydrocarbons (PAHs). Group 1 NADFs are defined by having PAH levels greater than 0.35%.

- Group II NADF (medium aromatic content) - These fluids are sometimes referred to as Low Toxicity Mineral Oil Based Fluids (LTMBF) and were developed to address the rising concern over the potential toxicity of diesel-based fluids. They are also developed from refining crude oil but the distillation process is controlled such that the total aromatic hydrocarbon concentration is less than Group I NADFs (0.5 – 5%) and the PAH content is less than 0.35% but greater than 0.001%.

- Group III NADF (low to negligible aromatic content) - These fluids are characterised by PAH contents less than 0.001% and total aromatic contents less than 0.5%. They include synthetic based fluids (SBF) which are produced by chemical reactions of relatively pure compounds and can include synthetic hydrocarbons (olefins, paraffins and esters). Using special refining and/or separation processes, base fluids of Group III can also be derived from highly processed mineral oils (paraffins, enhanced mineral oil based fluid (EMBF)). PAH content is less than 0.001%.

A combination of seawater, WBMs and/or NADFs may be used to drill the proposed exploration well. It is anticipated that an IOGP Group III non aqueous base fluid with low to negligible aromatic content will be used for this project in case of NADF choice.

Drill Cuttings Disposal Method

The solids control system applies different methods to remove solids (drill cuttings - particles of stone, clay, shale and sand) from the drilling fluid and to recover drilling fluid so that it can be reused. During riserless drilling, using sea water and high viscous sweeps and pills, cuttings are disposed of directly at the seabed.

Once the riser has been installed on top of the wellhead and cuttings can be returned to the rig, there is no standard practice for the treatment and disposal of drill cuttings that is applied worldwide.

As per IOGP (2016) there are three alternatives for the discharge of drill cuttings, namely:

- Offshore treatment and discharge to sea - where cuttings are discharged overboard from the drilling vessel or platform after undergoing treatment by solids control equipment and fluid contaminant reduction system;

- Re-injection - where drill cuttings are ground to fine particle sizes and disposed of, along with entrained drilling fluids, by injection into permeable subterranean formations; and

- Onshore disposal and treatment - where cuttings and the associated drilling fluids are collected and transported for treatment (eg thermal desorption, land farming) if necessary and final disposal by techniques such as land filling, land spreading, injection, or re-use.'

Re-injection is not an option in this location and is generally not possible during exploration drilling and as such the two potentially disposal options discussed below are discharge to sea and onshore disposal. Refer to *Table 3.11* which documents the advantages and disadvantages of each option.

Offshore Treatment and Discharge to Sea

This option involves discharging the drilling cuttings, after specific treatment, to the marine environment. Drill cuttings will be treated to separate drilling fluid and favour re-use of the same.

In particular NADF drill cuttings will be treated to remove drilling fluid for reuse and reduce oil content to less than 5 percent of wet cuttings weight (as low as possible) using a suitable combination of shakers, a centrifuge and/or a cuttings dryer.

The cuttings containing residual fluid are then mixed with sea water and discharged to the sea through a pipe known as a chute (or caisson). The end of the chute is typically located approximately 15 m below the water surface. Unlike the other disposal options, no temporary storage for cuttings is required.

In South Africa, offshore discharge is the accepted method of disposal, if cuttings have been treated and contamination concentrations are below the maximum allowable thresholds. The expected dispersion (fall and spatial extent of the deposition) of discharged cuttings was predicted in the "drilling discharge modelling - drill cuttings dispersion model" study (*Annex D*).

Offshore pre-treatment and Onshore Disposal

As per OGP (2003), this option will involve the processing of cuttings onboard the drilling vessel, followed by storage and transportation to shore for disposal.

Consequently, there are some aspects of onshore disposal that must be considered when evaluating the viability of this option, advantages and disadvantages of:

- Marine transport (skip and ship, which is common to all potential onshore disposal options);

- Onshore disposal facility option;

- Additional movements of skips on board of vessel with increased risk for workers during lifting operations; and

- Limited availability on deck space on board for equipment and reduced chemicals and fluids storage capacity; more difficult to allocate materials to guarantee stability of boat.

The potential onshore disposal options include:

- Landfill disposal: Depending on the level of treatment and residual oil content in percentage of dry cuttings, the cuttings will more than likely need to be disposed of at a hazardous landfill site.

- Land-farming: This involves spreading fully treated cuttings followed by mechanical tilling with the addition of nutrients, water and or oxygen as necessary to stimulate biodegradation by naturally occurring oil-degrading bacteria, material is applied several times at the same location. Depending upon the location of the land-farm, a liner, over liner, and/or sprinkler system may be required.

- Re-use (e.g. road construction). Treated cuttings may be used for construction or other alternative uses. If necessary or optimal, cuttings could be further treated prior to re-use, e.g. with thermal-mechanical treatment or bio-remediation.

Table 3.11 Advantages (+) and Disadvantages (-) of Offshore Discharge and Onshore Disposal of Drill Cuttings (adapted from OGP, 2003)

Economics	Operational	Environmental
Offshore Discharge		
+ Very low cost per unit volume treatment + No potential liabilities at onshore facilities – Potential future offshore liability – Cost for modelling and analysis (eg, compliance testing, dispersion model) - field analysis of cuttings prior of discharge and potential impacts (eg, compliance testing,, field monitoring programmes)	+ Simple process with limited equipment needed + No transportation to onshore involved (less movement of skips and supply vessel, less costs) + Limited number of skips on board, easier logistics and deck management+ Low power and fuel requirements + Low personnel requirements + Low safety, environment and health risks (eg filling and transport of skips, stability of rig, possible incident and contamination on deck) + Limited or no shore-based infrastructure required - Necessity of cuttings bulk to increase cutting storage capacity prior of treatment process - Drilling speed affected by treatment and discharge processes' speed + Very limited or No weather restrictions - Pre-treatment equipment required - Risk of plugging lines when using drier and washing system – Management requirements of fluid constituents - Continuous analysis of residual cuttings prior to discharge	+ No incremental air emissions + Low energy usage + No environmental issues at onshore sites - Potential for short-term localised impacts on seafloor (benthic community) and water column biology due to chemicals and sediments in the water column and settling on the seafloor

Onshore Disposal		
Marine transport: + Waste can be removed from drilling location eliminating future liability at the rig site – Transportation cost can be high for additional navigation of supply vessel and it could vary with distance of shorebase from the drilling location – Transportation may require chartering of additional supply vessels – Additional costs associated with offshore transport equipment (vacuums, augers) cuttings skips or bulk containers) and personnel – Operational shut-down due to inability to handle generated cuttings will make operations more costly	Marine transport: – Safety hazards associated with loading and unloading of waste containers on workboats and at the shorebase – Increased handling of waste is necessary at the drilling location and at shorebase – Additional personnel required – Risk of exposure of personnel to aromatic hydrocarbons – Efficient collection and transportation of waste are necessary at the drilling location – May be difficult to handle logistics of cuttings generated with drilling of high rate of penetration large diameter holes – Weather or logistical issues may preclude loading and transport of cuttings, resulting in a shut down of drilling or need to discharge - Rig stability may be effected in case of bad weather, necessity to additional move equipment and skips on board to guarantee balance	Marine transport: + No impacts on benthic community + Avoids seabed and water column possible impacts to environment and biotic sensitivities – Fuel consumption and consequent air emissions associated with transfer of wastes to a shore base – Increased risk of spills in transfer (transport to shore and offloading) – Disposal onshore creates new problems (eg, potential groundwater contamination) – Potential interference with shipping and fishing from increased vessel traffic and increased traffic at the port
Onshore operations: + On land transportation costs – Potential future liabilities	Onshore operations: – Onshore transport to site – Safety risk to personnel and local inhabitants in transport and handling – Disposal facilities require long-term monitoring and management - Additional footprint in logistic base for temporary storage of skips	Onshore operations: + Reduces impacts to seafloor and biota – Potential for onshore spills – Air emissions associated with transport and equipment operation -

Land-farming: + Inexpensive relative to other onshore options – Requires long-term land lease - Possible necessity of compensative/restoration activities for land use authorisation	Land-farming: - Limited use due to lack of availability of and access to suitable land – Requires suitable climatic conditions – Cannot be used for wastes with high salt content without prior treatment - Necessity to develop specific treatment facilities	Land-farming: + If managed correctly minimal potential for groundwater impact + Biodegradation of hydrocarbons – Air emissions from equipment use and off-gassing from degradation process – Runoff in areas of high rain may cause surface water contamination – May involve substantial monitoring requirements - Limited availability/experience for cuttings management in South Africa
Landfill: -Additional pressure on existing landfills - Possible necessity of compensative/restoration activities for land use authorisation	Landfill: -Requires appropriate management and monitoring may have requirements on maximum oil content of wastes - Necessity to develop specific treatment facilities – Land requirements – May be limited by local regulations	Landfill: – Potential groundwater and surface water impacts – Air emissions associated with earthmoving equipment – May be restrictions on oil content of wastes - Limited availability/experience for cuttings management in South Africa

Although the onshore disposal option has the benefit that it does not leave an accumulation of cuttings on the seafloor, it has several disadvantages (e.g. additional pressure on existing landfill sites and potential impacts on vegetation and groundwater) and involves a substantial amount of additional equipment, transportation, and facilities.

The additional transportation requirements to transfer the cuttings to shore increases environmental and safety risks associated with shipping and handling of materials.

Considering the aspects previously discussed, the dynamic nature of the marine environment in each area of interest and in order to limit the footprint for onshore land farming and waste facilities in the area, considering the lack of dedicated facilities for onshore cuttings treatment, according to South African legislation, international best practise and Eni technical guidelines, Eni's preferred option is to offshore treat and discharge cuttings in accordance with the previously defined requirements.

3.9.3 *Design or Layout Alternatives*

Number of Wells

Eni proposes to drill:

- Up to four wells within the northern area of interest: up to two exploration wells and up to two appraisal wells; and

- Up to two wells within the southern area of interest: one exploration well and one appraisal well.

The time sequence and the number of additional exploration and appraisal wells will be dependent on the success of the first exploration well.

Any additional wells will not be drilled at the same time as the first well. This report therefore assesses the impact of drilling of one well within each area of interest.

Scheduling

The drilling of the first exploration well, is planned for some time between November 2019 and March 2020, dependent on drillship availability, amongst a number of other planning requirements. The drilling of one well is estimated to take approximately 71 days to complete. The time sequence and the number of additional exploration and appraisal wells will be dependent on the results of the first exploration well.

Chapter 7 and *8* of this report assesses the impact of drilling of one well within each area of interest at any time of the year and therefore seasonality has been considered.

3.9.4 *No-Go Option*

The impact of the No-Go alternative is assessed, in *Chapter 7* of this report, in accordance with the requirements of the EIA Regulations, 2014 (as amended). The No Go alternative entails no change to the status quo, in other words the proposed exploration drilling activities will not be conducted in ER236.

The option not to proceed with exploration or appraisal drilling will leave the areas of the potential drilling sites in their current environmental state, with the oil/gas potential remaining unknown.

4 BASELINE CONDITIONS

4.1 OVERVIEW

The objective of this *Chapter* is to establish the characteristics of the existing biophysical and socio-economic conditions in the Project Area. The baseline serves as the reference point against which changes can be predicted and monitored.

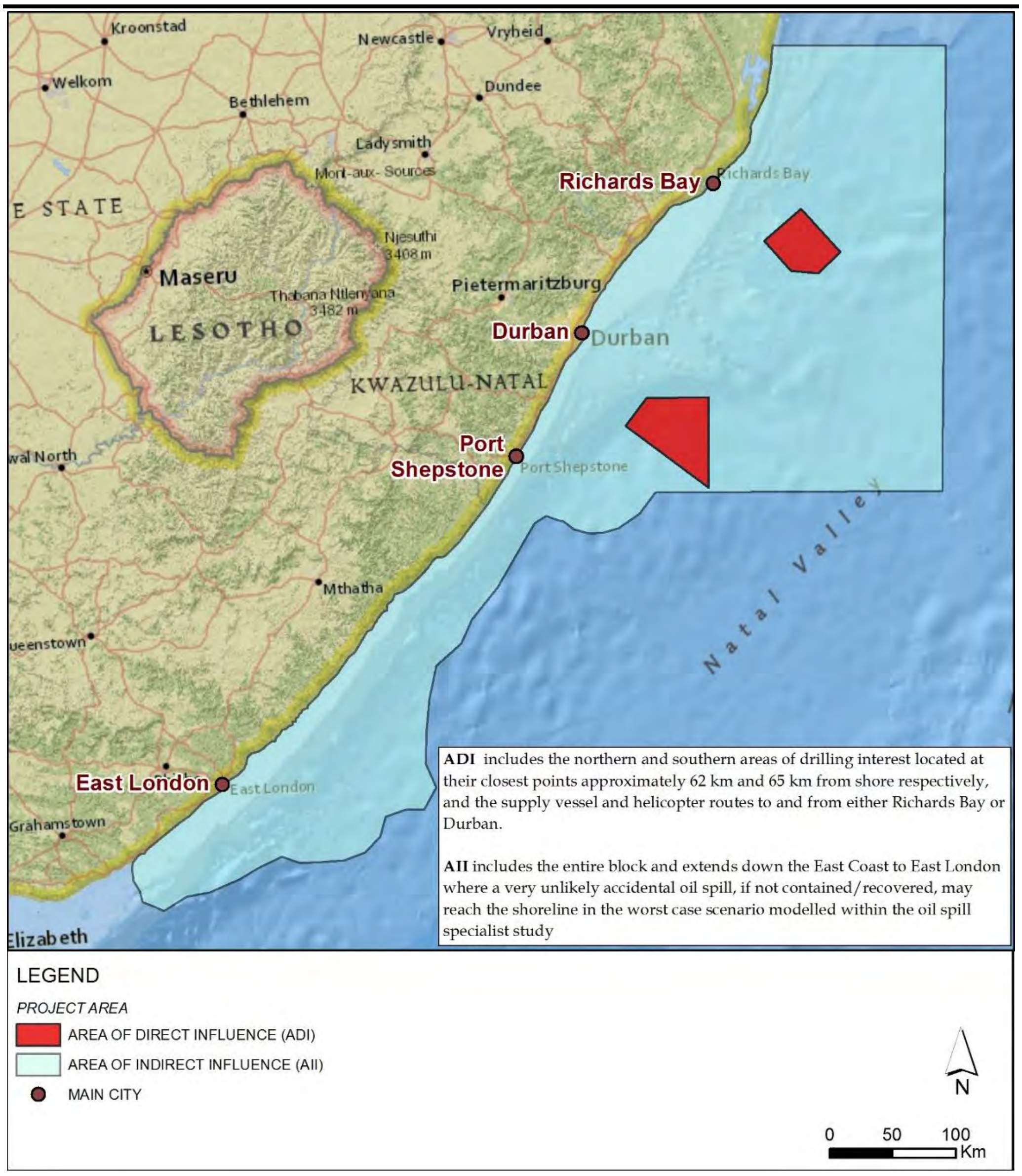
This *Chapter* presents the baseline conditions in the Project Area. The baseline was determined through a review of existing information, which includes previous projects that have occurred in the surrounding blocks, municipal documents, and social websites as referenced at the end of this document. Further to this, a Marine Ecology Assessment, a Fisheries Study and an Underwater Cultural Heritage Assessment were conducted to determine the baseline conditions of the Project Area.

4.2 PROJECT AREA

The Project Area comprises the various biophysical and socio-economic conditions receptors that may be affected both directly and indirectly by the project activities described below. The Project Area is separated into **Area of Direct Influence** (**ADI**) **and Area of Indirect Influence** (**AII**) depending on the source and causes of the impacts and these will vary in extent depending on the type of receptor affected.

The Project Area is offshore of the KwaZulu-Natal (KZN) coast, between St Lucia and East London and includes the entire Block ER236. The ADI includes the northern and southern areas of drilling interest (*Section 4.2*), located at their closest points approximately 62 km and 65 km from shore respectively, and the supply vessel and helicopter routes to and from either Richards Bay or Durban. The AII includes the entire block and extends down the East Coast to East London where an accidental oil spill, if not contained/recovered, may reach the shoreline in the worst case scenario modelled within the oil spill specialist study (*Figure 4.1*).

Figure 4.1 A Map showing the Project Area, including ADI and AII



4.3 *ENVIRONMENTAL BASELINE*

4.3.1 *Climate Change*

Greenhouse Gas (GHG) Emissions in South Africa

Concern over increasing amounts of greenhouse gases in the atmosphere and their potential to influence global climate change has produced a number of initiatives, including the United Nations Framework Convention on Climate Change in 1992. The stated objective of the UNFCCC is to achieve stabilisation of the concentrations of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The South African Government ratified the UNFCCC in August 1997.

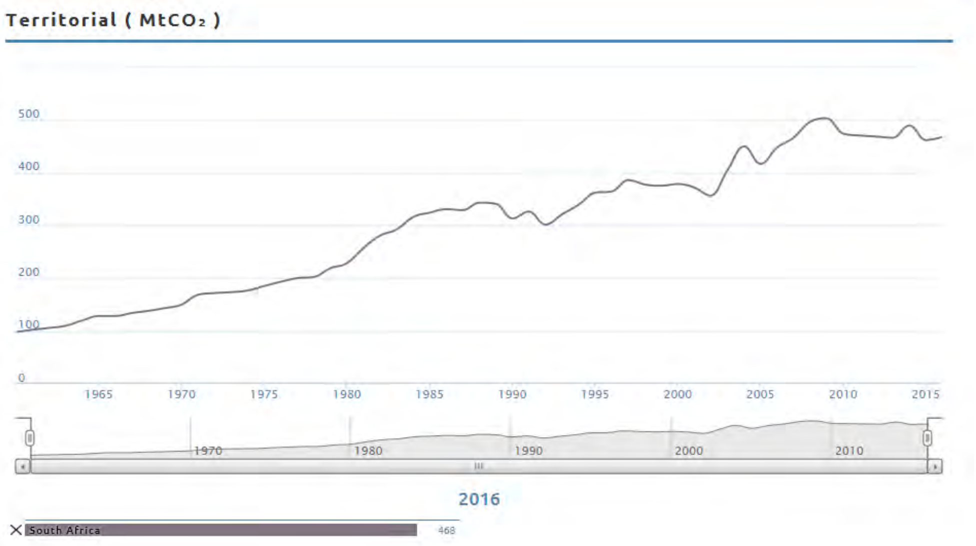
After 2001, public communication of the results of South Africa's initial communication to the UNFCCC drove a strong adaptation and mitigation action agenda both in national policy development and in UNFCCC negotiations. Thereafter, South Africa's policymakers and academics have worked together quite closely on climate change. In 2005, the work was evidenced by interlinked science and policy plenary sessions at the National Climate Change Summit, 'Climate Action Now'. Key policies that resulted include the National Climate Change Response White Paper and South Africa's Second National Communication under the United Nations Framework Convention on Climate Change (SNC) (WIREs Clim Change, 2014).

Climate change constitutes a key concern in South Africa. Mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65°C over the past five decades and extreme rainfall events have increased in frequency (WIREs Clim Change, 2014).

The South African economy is highly dependent on fossil fuels and the country can be judged to be a significant emitter due to the relatively high values that can be derived for emissions intensity and emissions per capita (DEAT, 2004).

South Africa has high per capita emissions compared with other countries on the African continent and, to some extent, globally. As a result, climate change mitigation has been a focus for a number of years. Current per capita CO_2 emissions are high (8.3 tonnes/person) as compared with other countries on the African continent and, to some extent globally (average 4.8 tonnes/person) and as a result, climate change mitigation has been a focus for a number of years. The current total annual CO_2 emissions in South Africa are 468 Mt of CO_2 (Global Carbon Atlas, 2018, WIREs Clim Change, 2014, *Figure 4.2*).

Figure 4.2 Total Greenhouse Gas Emissions for South Africa (Mt of CO_2)



Source: Global Carbon Atlas, 2018

Potential Impacts of Climate Change

The South African Country Studies Programme identified the health sector, the agriculture sector (particularly maize production), plant and animal biodiversity, water resources, and rangelands as areas of highest vulnerability to climate change with the need to be targeted for adaptation measures (DEAT, 2004).

According to Madzwamuse (2010), increased temperatures, reduced rainfall and water scarcity will significantly affect South African agricultural systems. Major impacts include reduction for land suitable for both arable and pastoral agriculture, the reduction in the length of the growing season and a decrease in yields, particularly along the margins of semi-arid and arid areas.

Biodiversity is important for South Africa because of its role in maintaining functional ecosystems, its economic value for tourism and its supporting role in livelihoods. Climate change impacts can lead to the loss of important ecosystems with high significance for local communities and national economies.

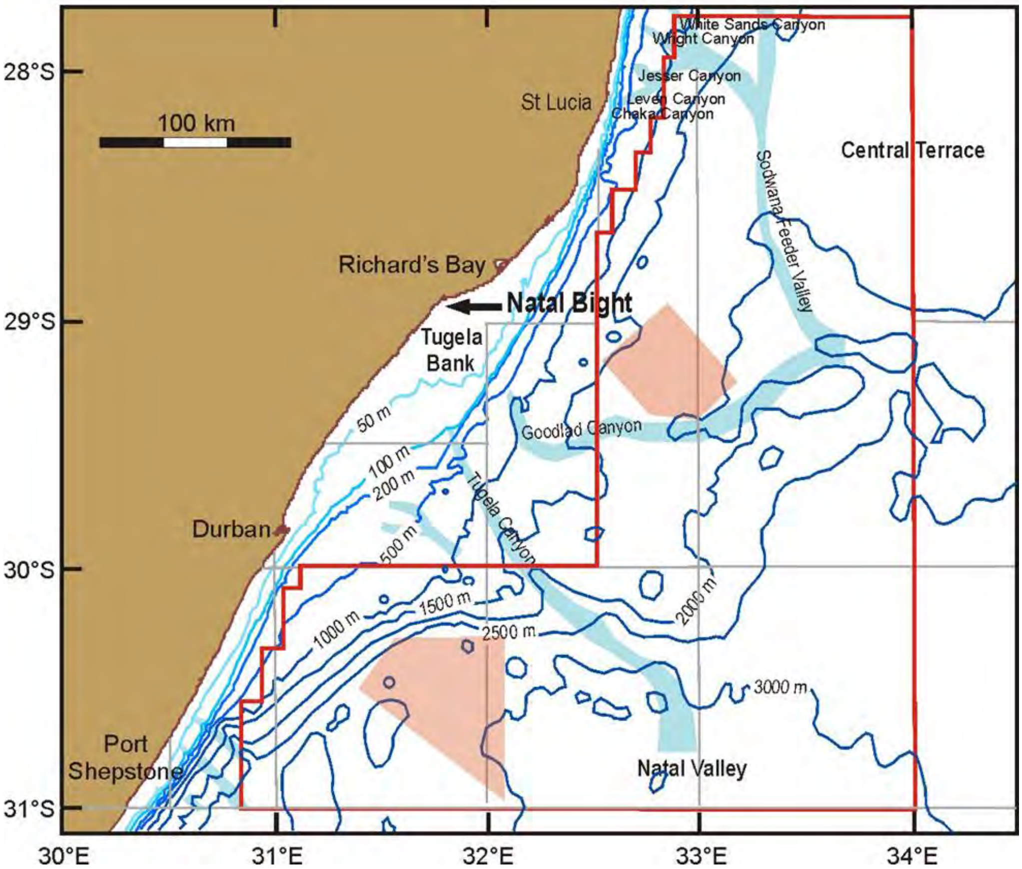
Waters resources can also be highly impacted by climate change effects leading to changes in hydrological resources resulting in water stress and scarcity and therefore impact to ecosystem services.

4.3.2 *Marine Environment (Abiotic components)*

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 (*Figure 4.3*).

Figure 4.3 Bathymetry of the South African East Coast



Note: Shown on the figure are Block ER236 (red polygon), the northern and southern areas of interest for drilling (orange shading) and features and places mentioned in the text. The positions of submarine canyons and feeder valleys (blue shading) as identified in Lombard *et al*. (2004) are also indicated.

Source: Pisces, 2018

The majority of the East Coast region has a narrow continental shelf and a steep continental slope. The Tugela Bank, located along the KZN coast between 28° 30′ S and 30° 20′ S, is a prominent feature on the continental shelf. 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 (*Figure 4.3*).

The Tugela Bank is interrupted by two canyons: the large and prominent Tugela Canyon, which is deeper than the smaller Goodlad Canyon (also referred to as 29°25' S). The northern area of interest for well drilling lies east of the Natal Bight in >1,500 m water depth. The southern area of interest lies off Port Shepstone in > 2,600 m water depth, to the south of the Tugela Canyon. Neither canyon is overlapped by either area of interest.

A further canyon is located to the south of the Bank where the continental shelf narrows and the continental margin descends into the Natal Valley (adjacent to Port Shepstone).

There are limited data on the Goodlad Canyon features; however, 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. The gradient of the canyon walls are less steep than those of the Tugela Canyon and limited tributaries occur (Young, 2009). No information specific to the Goodlad Canyon could be sourced (Pisces, 2018).

The Tugela and Goodland canyons differ significantly from those located in northern KZN. Firstly, the canyon heads lack the amphitheatre-shaped head morphology. Secondly, they are located at far greater depth than the Sodwana Feeder Valley and lack connectivity to the shelf, and finally, they show no significant tributary branches (Wiles *et al*., 2013).

The Tugela Bank is the major sedimentary deposition centre of the KZN continental shelf, being characterised by fluvial deposits of Tugela 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).

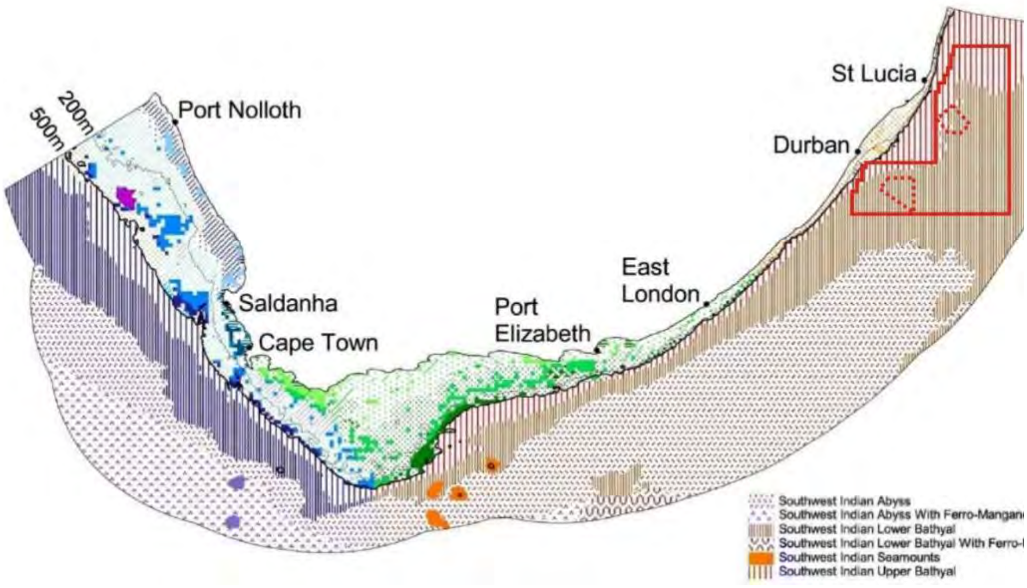
North of Durban, the shelf region is dominated by terrigenous sand (0.063 to 2 mm), with patches of gravel (>2 mm) occurring throughout the area. Areas on the mid-shelf contain sediments comprising up to 60 percent terrigenous mud. Two large mud depo-centres are found off the Tugela River mouth, while 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 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 Tugela Bank, the Agulhas Current generates active dune fields at the shelf edge (Flemming & Hay, 1988). In contrast, sediments on the shelf area of the Tugela Bank to a depth of 100 m are affected mostly by wave action (CSIR, 1998). 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). The northern area of interest for well drilling comprises Southwest Indian Upper and Lower Bathyal benthic habitats, whereas Southern Indian Lower Bathyal benthic habitat dominates in the southern area of interest (*Figure 4.4*). Both have been assigned an ecosystem threat status of 'least threatened' in the SANBI 2011 National Biodiversity Assessment (Sink *et al*., 2011) reflecting the great extent of these habitats within the South African Exclusive Economic Zone (EEZ) (*Figure 4.5*).

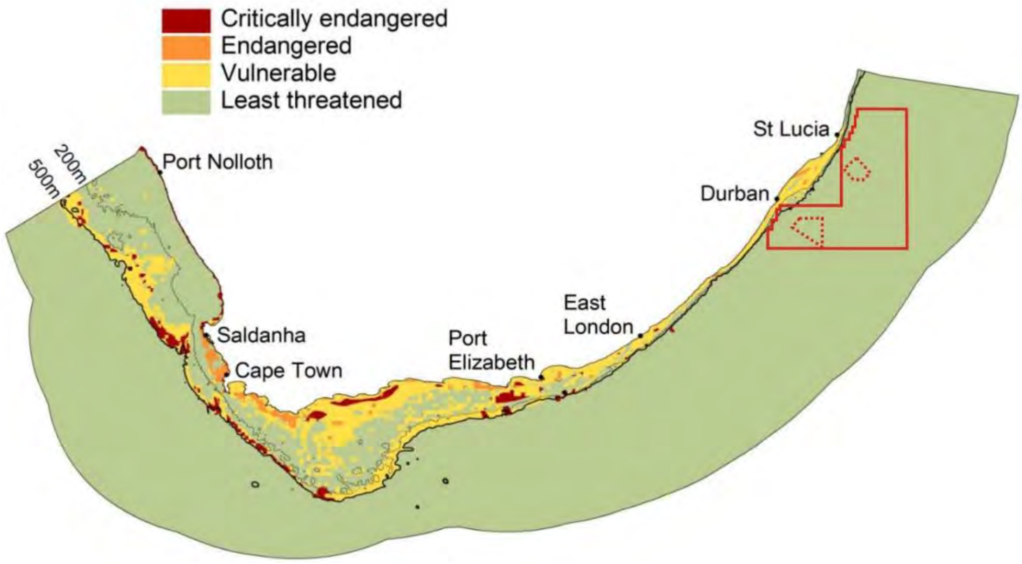
Figure 4.4 ***Coastal and Benthic Habitat Types off the South African East Coast***



Note: Shown on the Figure are Block ER 236 (red polygon) and the areas of interest for well drilling (red dotted line)

Source: Adapted from Sink *et al*. 2012 in Pisces, 2018

Figure 4.5 *The Ecological Threat Status of Coastal and Offshore Benthic Habitat Types off the South African East Coast*



Note: Shown on the Figure are Block ER 236 (red polygon) and the areas of interest for well drilling (red dotted line)

Source: Adapted from Sink *et al*. 2012 in Pisces, 2018

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 4.6*). The main source of the Agulhas Current is 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 Tugela 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). Three eddy types have been identified in the Agulhas Current (Gründlingh, 1992):

Table 4.1 Eddy Types Identified in the Agulhas Current

Type	Description
Type I	These are meanders that comprise smaller shear/frontal features to a depth of at least 50 m, which dissipate over a period of days
Type II	These are meanders comprising the large clockwise loops generated within the Natal Bight. These loops are explained below: • The extremely transient Natal Pulse occurs when meanders move in a southward flow offshore, enabling sluggish and occasional northward flow to develop close inshore (Schumann, 1988); • 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).
Type III	These are meanders, which are the larger meanders that originate north of St Lucia.

Source: Pisces, 2018

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 and 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 4.6*).

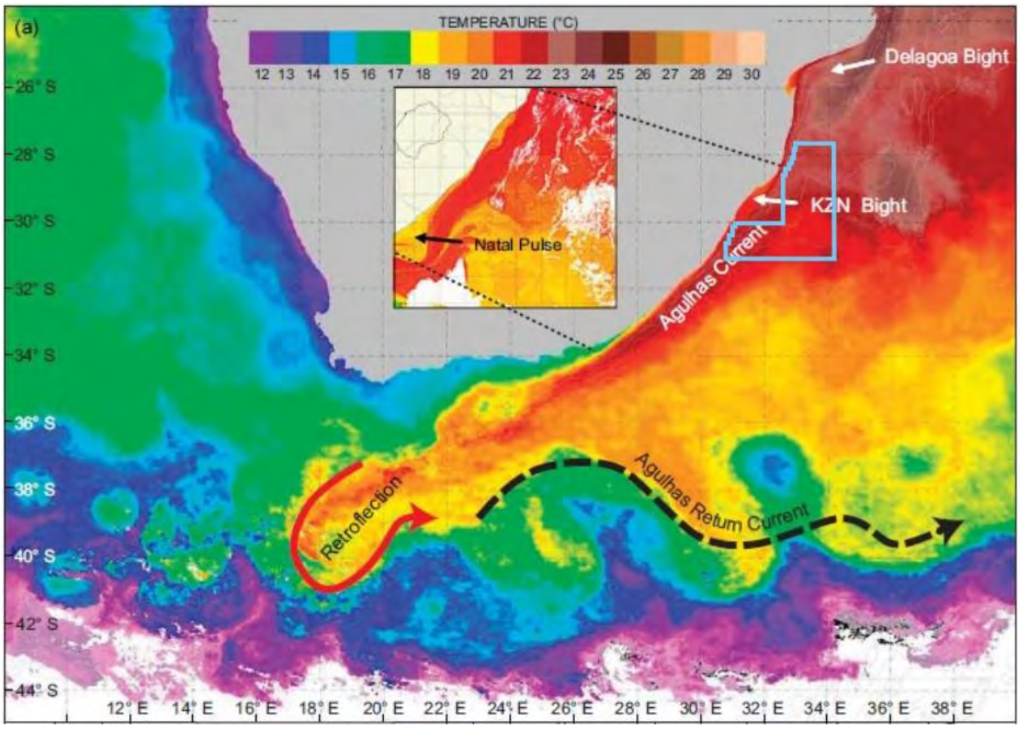
In common with other western boundary currents, a northward (equatorward) undercurrent, termed the Agulhas Undercurrent, is found on the continental slope of the East Coast at depths of between 800 m and 3,000 m (Beal & Bryden, 1997).

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 Tugela 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 because of the bathymetric arrangement of the Natal Bight (Gill & Schumann 1979; Schumann 1986; 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). 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 location of the area of interest is offshore and to the east of the Tugela Banks, which suggests that nutrient concentrations will be comparatively low.

Figure 4.6 The Predominance of the Agulhas Current in Block ER 236



Note: Shown on the Figure is Block ER236 (pale blue outline)

Source: Adapted from Roberts *et al.* 2010 in Pisces, 2018

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 and 21° C in winter (Schumann, 1998). Temperatures decrease further offshore of the core waters, and thus across most of the Block ER 236.

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 4.7 and Figure 4.8*)

In the sea areas off Durban, the majority of swells are from the South and South-southwest, with the largest attaining in excess of 7 m.

During summer and autumn, some swells also arrive from the east (*Figure 4.9*). 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.

In the AII along the South Coast, westerly winds predominate in winter, frequently reaching gale force strengths. During summer, easterly wind directions increase markedly resulting in roughly similar strength/frequency of east and west winds during that season (Jury, 1994). The strongest winds are observed at capes, including Agulhas, Infanta, Cape Seal, Robberg and Cape Recife (Jury & Diab 1989). Calm periods are most common in autumn (CCA & CSIR 1998).

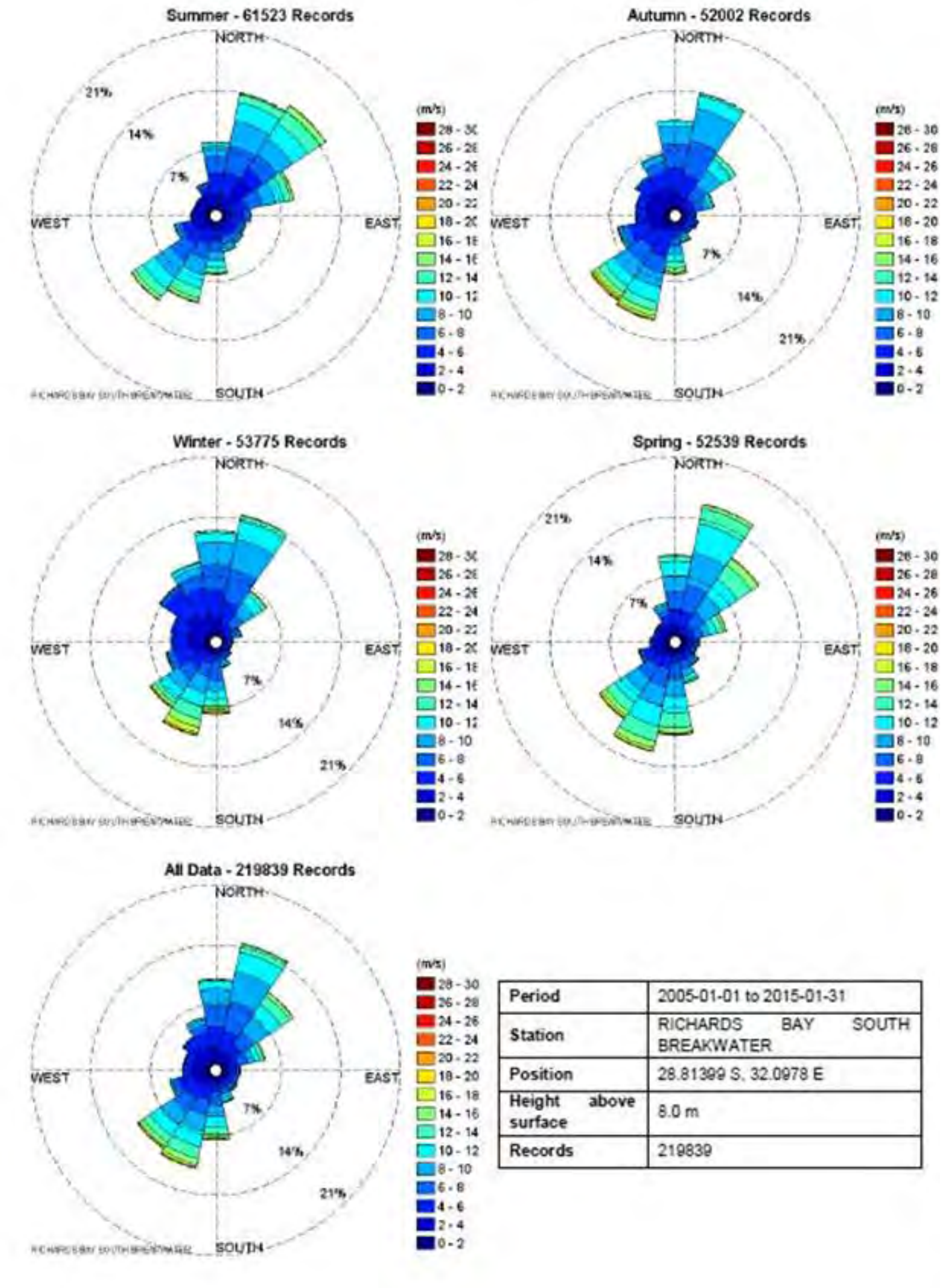
Wind-driven upwelling occurs inshore along the South Coast, especially during summer when easterly winds prevail (Schumann *et al*. 1982; Walker 1986; Schumann 1998). Such upwelling usually begins at the prominent capes and progresses westwards (Schumann *et al*. 1982; Schumann 1988), and can result in temperature changes of up to 8° C within a few hours (Hutchings 1994).

Intensive upwelling of Indian Ocean Central Water occurs periodically over the shelf and shelf edge, along the inner boundary of the Agulhas Current (Schumann 1998). This process is primarily due to frictional interactions between the Agulhas Current and bottom topography (Hutchings 1994), and is most intense at the eastern boundary of the South Coast, where the cold bottom layer breaks the surface. Such shelf-edge upwelling largely defines the strong thermocline and halocline topography of the Agulhas Bank region, particularly in summer.

A cool ridge of upwelled water that extends in a north-east (NE) – south-west (SW) direction over the mid-shelf regions between the shelf-edge upwelling and inshore waters close to the coast (Swart & Largier 1987; Boyd & Shillington 1994; Schumann 1998), dividing the waters of the Agulhas Bank into the two-layered structure in the inshore region and a partially mixed structure in the eastern offshore region.

On the South Coast, the majority of waves arrive from the south-west quadrant (Whitefield *et al*. 1983), dominating wave patterns during winter and spring (Carter & Brownlie, 1990). Waves from this direction frequently exceed 6 m (Swart & Serdyn 1981, 1982) and can reach up to 10 m (Heydorn 1989). During summer, easterly wind-generated 'seas' occur (Heydorn & Tinley 1980; Heydorn 1989; Carter & Brownlie 1990).

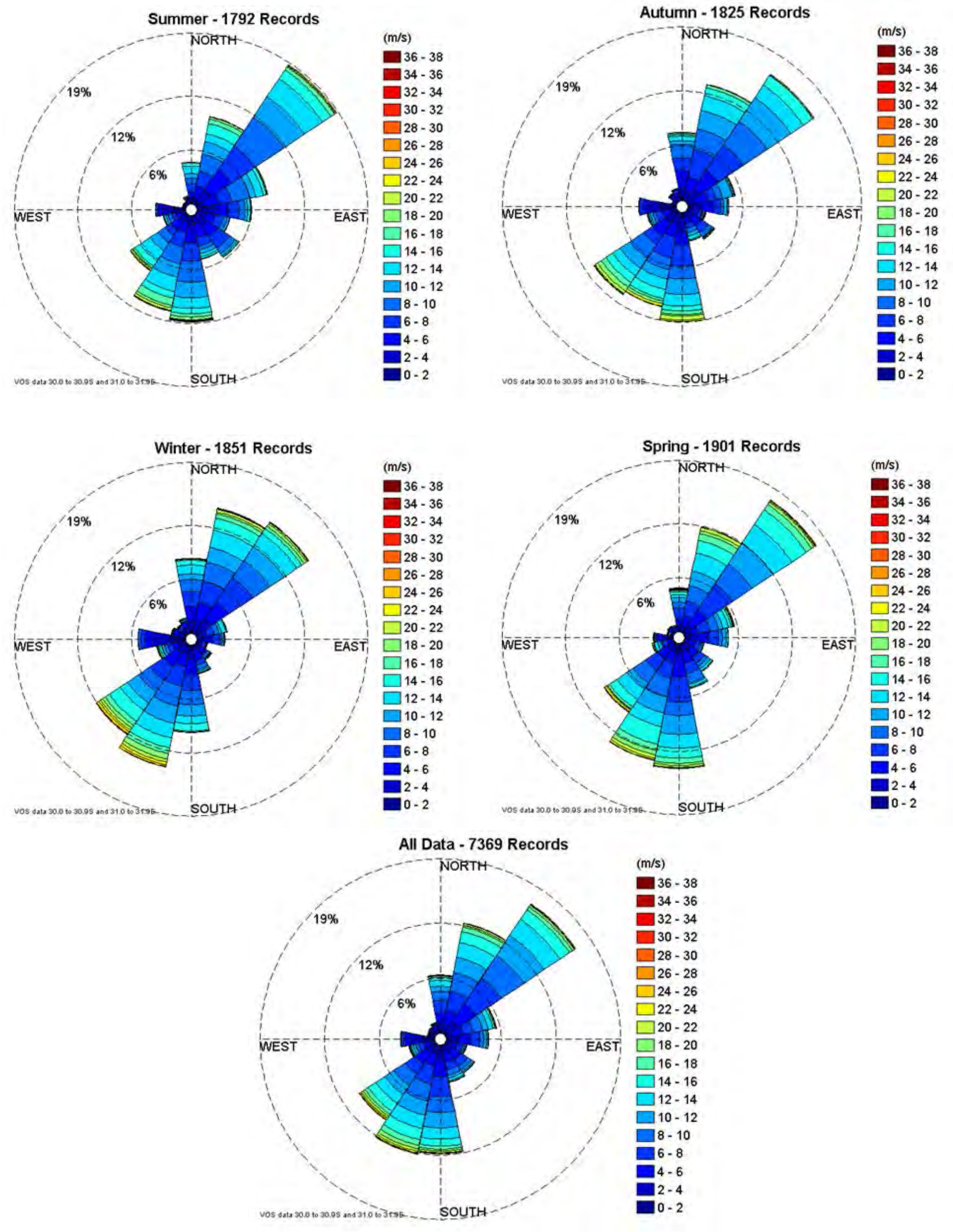
Figure 4.7 VOS Wind Speed vs Wind Direction for Richards Bay Breakwater (28.8°S and 32.1° E)



Period	2005-01-01 to 2015-01-31
Station	RICHARDS BAY SOUTH BREAKWATER
Position	28.81399 S, 32.0978 E
Height above surface	8.0 m
Records	219839

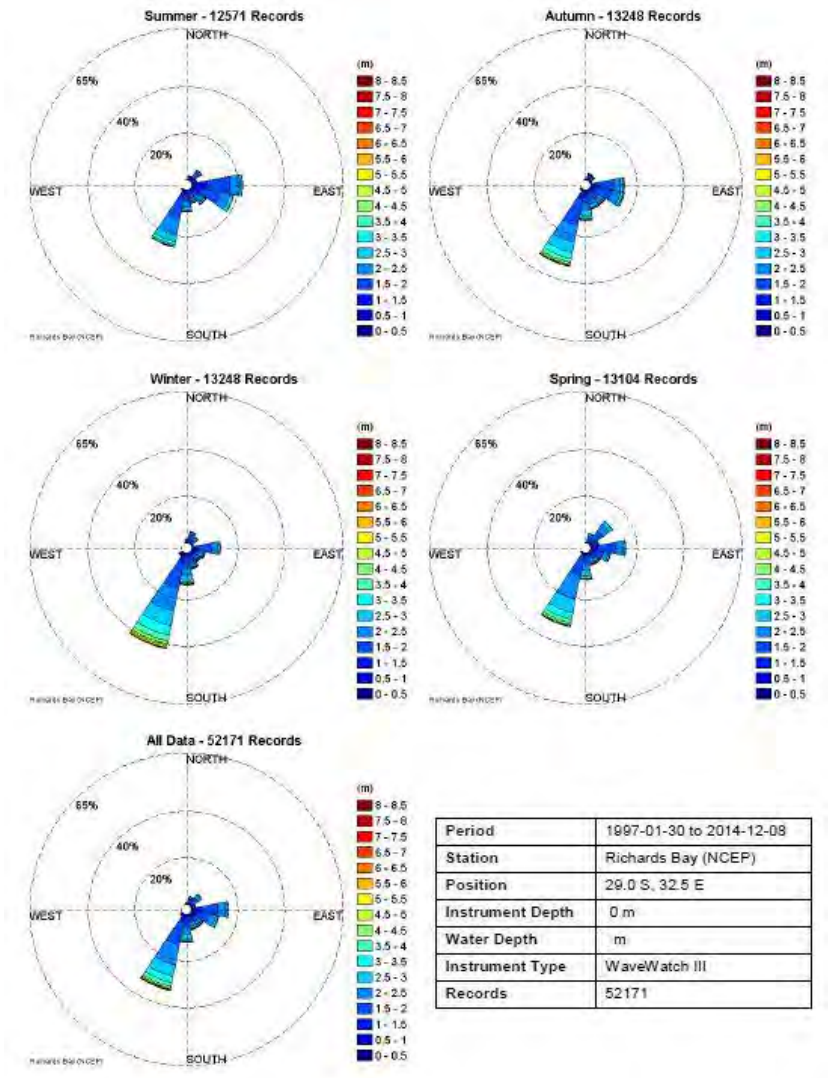
Source: 1960-02-15 to 2012-04-13; 4,515 records in Pisces, 2018

Figure 4.8 *VOS Wind Speed vs Wind Direction for Port Shepstone (30.0° to 30.9° S and 31.0° to 31.9° E)*



Source: CSIR 1960-02-15 to 2012-04-13; 7,369 records in Pisces, 2018

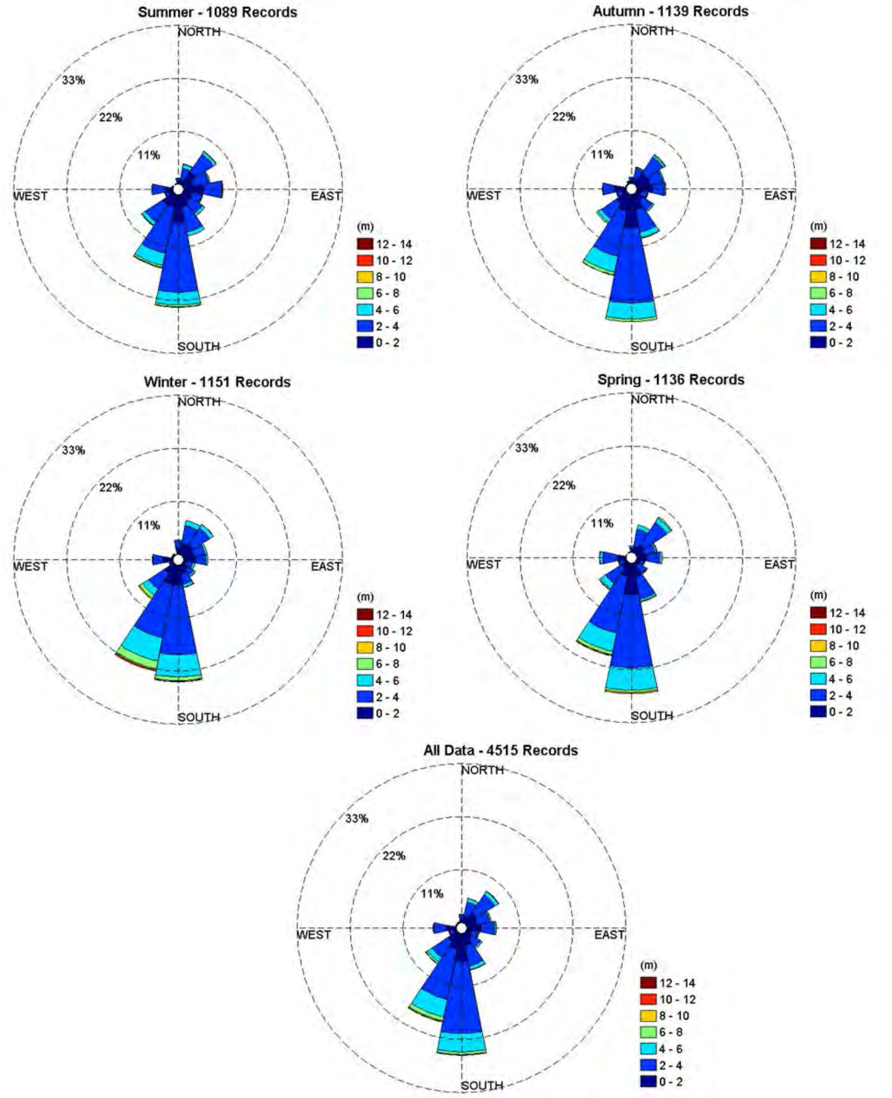
Figure 4.9 VOS Wave Height (Hmo) vs Wave Direction for a Deepwater Location Offshore of Richards Bay (29.0°S and 32.5° E)



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

Source: CSIR 1960-02-15 to 2012-04-13; 7,369 records in Pisces, 2018

Figure 4.10 VOS Wave Height (Hmo) vs Wave Direction for Port Shepstone (30.0° to 30.9° S and 31.0° to 31.9° E)



Source: CSIR 1960-02-15 to 2012-04-13; 4,515 records in Pisces, 2018

Nutrients

Nutrient inputs on the Tugela Banks are thought to originate from a combination of an upwelling cell off Richards Bay, the Tugela 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), but the quantity and regularity of this nutrient supply remains unknown. 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 Tugela Banks is thought to be pronounced given that nutrient supply from upwelling events is limited (Lamberth *et al*., 2009). 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 are 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 Tugela River may thus have cascade effects on ecosystem functioning of the Tugela Banks, with far-reaching consequences for the sustainability of local fisheries (commercial and subsistence).

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.

4.3.3 Biological Environment

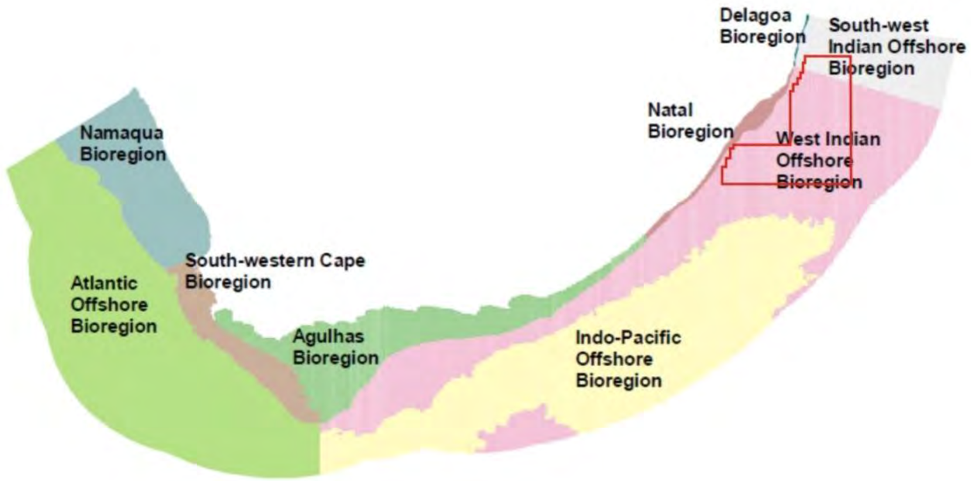
Biogeographically, Block ER 236 and the area of interest falls into the West Indian Offshore bioregion (*Figure 4.11*) (Lombard *et al*., 2004). The offshore areas comprise primarily deep water benthic habitats and the water body. Due to limited opportunities for sampling, information on the pelagic and demersal communities of the shelf edge, continental slope and upper and lower bathyal are largely unknown.

Consequently, much of the information on the baseline environment provided below relates to the inshore (shallow waters prior to where the shelf of the Thukela Bank starts dropping off, on average less than 50 m water depth) and continental shelf (water depths less than 200 m[1]) regions, which fall within the Natal Bioregion (*Figure 4.11*).

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.

[1] The shelf break occurs at approximately the 200 m isobath with a relatively steep slope towards the sea.

Figure 4.11 *The South African Inshore and Offshore Bioregions in Relation to Block ER236*



Note: Shown on the Figure is Block ER236 (red polygon)

Source: Adapted from Lombard *et al*. 2004 in Pisces, 2018

Phytoplankton and Ichthyoplankton

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity in KZN inshore areas, with chlorophyll a concentrations ranging between 0.03 and 3.88 µg/l (Carter & Schleyer, 1988; see also Coetzee *et al*., 2010).

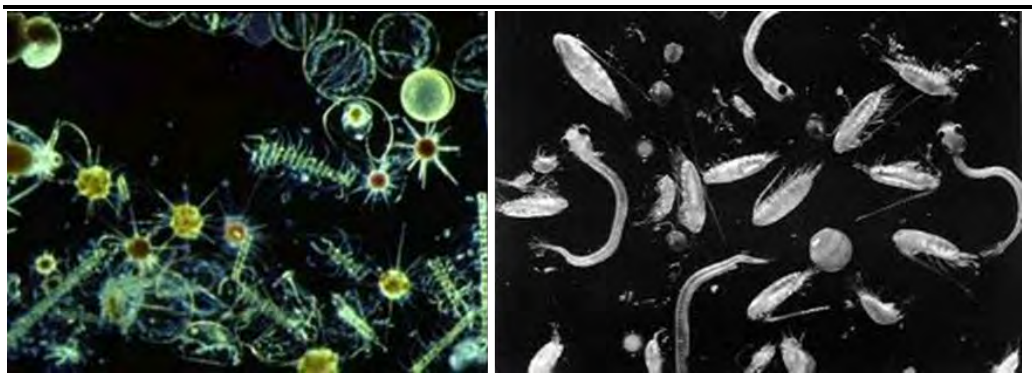
Further offshore and in Block ER236, the pelagic environment is characterised by very low productivity, with the low variability in water-column temperature resulting in very low frequency of chlorophyll fronts. Phytoplankton, zooplankton and ichthyoplankton (fish eggs) abundances in Block ER236 are thus expected to be extremely low.

In contrast, on the Tugela Bank, short-term increases in productivity are associated with localised upwelling (Oliff, 1973). Continental shelf waters support greater and more variable concentrations of zooplankton biomass (*Figure 4.11*) 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).

The nutrient-poor characteristics of the Agulhas Current water are reflected in comparatively low primary productivity along the Eastern Cape Coast, 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 (the area off and north of Port Elizabeth) phytoplankton concentrations are usually higher than further west (the Agulhas bank and surrounding area), comprising predominantly large cells (Hutchings 1994). This eastwards increase in *chlorophyll a* concentrations determines the increase in the biomass of mesozooplankton from approximately 0.5 to approximately 1.0 g C/m^2 in the west to approximately 1.0 to approximately 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 4.12 Phytoplankton and Zooplankton Associated with Upwelling Cells on the Tugela Bank.



Source: left, photo: hymagazine.com, right, photo: mysciencebox.org)

Ichthyoplankton

Pilchard (*Sardinops sagax*) eggs occur, primarily, in waters less than 200 m, outside Block ER236, along the Eastern Cape and the southern KZN 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 japonicus*) eggs were reported in the water column during December as far north as St Lucia (Anders, 1975).

Numerous other fish species (eg squaretail kob and various sciaenids (snapper, sin croaker, beareded croaker)) use the Tugela 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).

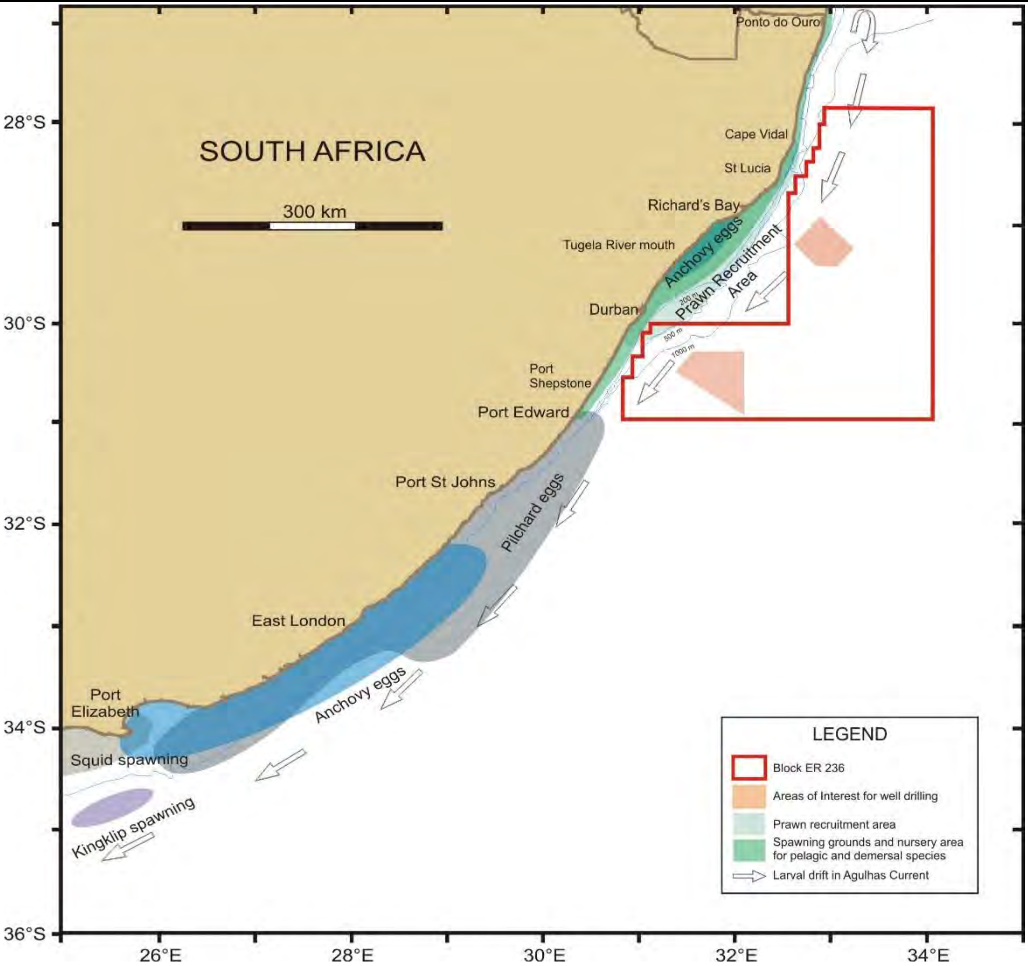
The Tugela Banks are also known to serve as a nursery area for the endangered scalloped hammerhead shark, slinger and black mussel cracker (CBD, 2013), and five species of dasyatid rays (Fennessy, 1994b).

The Banks serve as a spawning area for (amongst others) bull shark, sand tiger shark, black mussel cracker and king mackerel 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* and garrick *Lichia amia*) undertake spawning migrations along the inshore areas of the coast into KZN waters during the winter months (Van der Elst, 1976, 1981; Griffiths, 1988; Garratt, 1988).

Many of the species listed have been identified as either 'threatened' by IUCN (2017) 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 are subsequently dispersed southwards by the Agulhas Current (Connell, 2010) (*Figure 4.13*), with juveniles occurring on the inshore Agulhas Bank (Van der Elst, 1976, 1981& Garret, 1988). Likewise ichthyoplankton is confined primarily to waters less than 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 area of interest is in water depths of more than 500 m and therefore ichthyoplankton abundance is likely to be low. As can been seen in *Figure 4.13,* the area of interest is offshore of major fish spawning and migration routes.

Figure 4.13 *Major Fish Spawning, Nursery and Recruitment Areas along the KZN Coast in Relation to Block ER236*



Note: Shown on the Figure on Block ER 236 (red polygon) and the areas of interest (orange square)

Source: Pisces, 2018

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'. 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 to 30 km and are typically pursued by Great White Sharks, Copper Sharks, Common Dolphins (*Figure 4.16*, right), Cape Gannets and various other large pelagic predators (www.sardinerun.co.za, O'Donoghue *et al*., 2010a, 2010b, 2010c).

The sardine run occurs along the continental shelf (overlapping with the spawning area indicated in *Figure 4.13)* inshore of Block ER236 and the area of interest.

A high diversity of pelagic Teleosts (bony fish) and Chondrichthyans (cartilaginous fish) are associated with the numerous inshore reefs and shelf waters inshore of Block ER236, in the AII. Many of the fishes are endemic to the Southern African coastline and form an important component of the commercial and recreational line fisheries of KZN.

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of Block ER236 are the large migratory pelagic species, including various tunas (*Figure 4.14*, left), billfish (*Figure 4.14*, right) and sharks (the great white shark (*Carcharodon carcharias)* and the whale shark (*Rhincodon typus*)), many of which are identified as either 'threatened' by IUCN (2017) or listed as priority species for conservation primarily due to overfishing. Tuna and swordfish (*Xiphias gladius*) in particular 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 4.14 ***Large Migratory Pelagic Fish that Occur in Offshore Waters***

Note: Longfin Tuna (Left) and Blue Marlin (Right)

Source: www.samathatours.com; www.osfimages.com

Coelacanths

Coelacanths are a rare order of demersal fish that includes two species of the genus Latimeria: the West Indian Ocean coelacanth (*Latimeria chalumnae*) (also known as the African coelacanth), which is primarily found near the Comoro Islands off the east coast of Africa, and the Indonesian coelacanth *(Latimeria menadoensis)*.

Until recently, African coelacanths were thought to only occur in depths of 120 to 300 m, in the sediment-poor, steep volcanic drop-off caves of the Comoros Islands, to the east of Mozambique. However, the discovery of a group of coelacanths in the relatively shallow waters (90 to140 m depth) of a submarine canyon off the Greater St Lucia Wetland Park (GSLWP) World Heritage Site in November 2000 (Venter *et al.,* 2000), demonstrated otherwise.

Since then, captures have been made in bottom trawls and deep-set gillnets off the coasts of Kenya (De Vos & Oyugi, 2002) and Tanzania (Nyandwi, 2006; Benno *et al*., 2006) where of a series of 10 to15 m high terraces between 70 and140 m depth (Benno *et al.,* 2006) has been observed in the north, and submarine depressions interpreted as canyons have been observed at depths of 400 m in the south (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) and Kenya (2001: De Vos & Oyugi, 2002) were reported to have been captured over predominantly sandy, low-relief seabed.

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

- They require caves and overhangs in steep drop-offs in which to shelter;
- They are sensitive to temperatures above 21°C;
- Being slow swimmers (approximately 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 have been undertaken as part of the African Coelacanth Ecosystem Project (ACEP). 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 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.

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, were identified along the northern KwaZulu-Natal coastline.

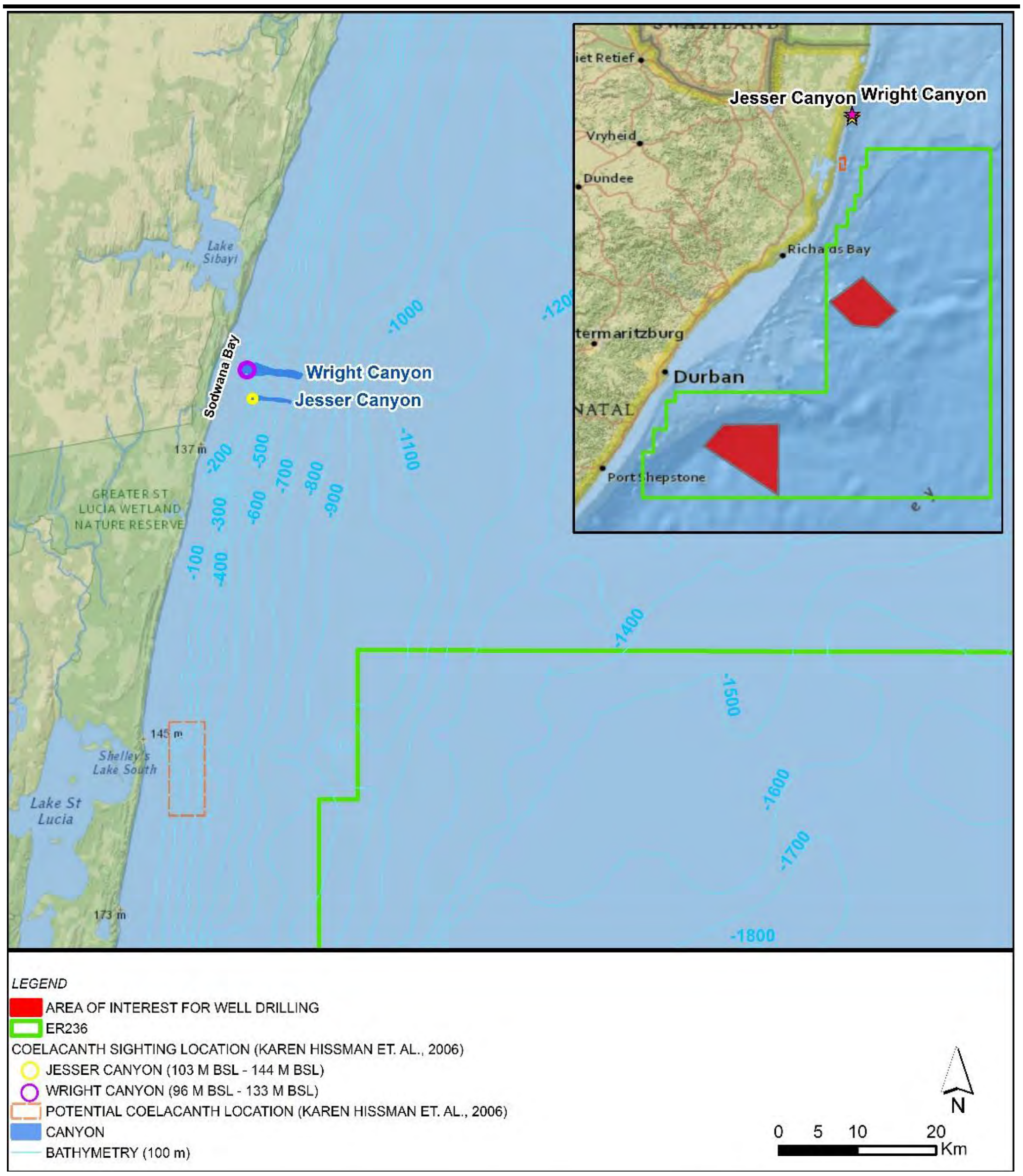
The canyon heads breach the relatively narrow (2 to 4 km) shelf at depths of 90 to 120 m, and their thalwegs (bottoms) have depths of several hundred metres. The northern margins of the canyon heads are typically steeper and more stable than the southern margins. Stratified sedimentary rock outcrops occur as cliffs and intermittent sandy terraces at depths of between 40 to 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 (approximately 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 to 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.

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 Bay were confined to the narrow belt (90 to 140 m depth) in the canyons where caves, overhangs or broken boulder areas offering shelter were abundant (*Figure 4.15)*. 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 Canyon complex (Hissman *et al.,* 2006). In the Comoros, a home range might extend for about eight kilometres. Some of the Sodwana Feeder Valley 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.

Figure 4.15 Location of the Jesser and Wright Canyons, in the Sodwana Canyon Complex, where Coelacanths were Discovered



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 to 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.

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 to 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 Feeder Valley 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 to 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 to 20 °C isotherms typically lie at between 100 to 140 m depth, which is approximately 100 m shallower than in the Comoros (200 to 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 to 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 corresponds with the depths at which the Sodwana Feeder Valley 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.

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 Bay, although the density and diversity of fish at the canyon edges and within the caves is high (Hissmann *et al.,* 2006). Transmitter tracking experiments off Sodwana Bay indicated nocturnal activity between 70 to 130 m, which was at or above the depth of the daytime refuges, and the depth at which potential prey species were most abundant.

The abundance of planktivorous species along the Kwazulu-Natal 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 constitute 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 Feeder Valley canyons habitat is estimated to be three to four times higher than in similar coelacanth habitat in the Comoros (Heemstra *et al.,* 2006b).

Block ER236 in perspective

Block ER236 overlaps with two canyon systems (*Figure 4.3)*, namely the Tugela and Goodlad Canyons, which lie in close proximity to the southern and northern areas of interest. It should be noted that no drilling activities will take place in the canyons.

The Tugela 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 approximately 600 m depth with the thalweg ending in the Natal Valley at approximately 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 approximately 1,500 m. With increasing distance from the continental shelf, and increasing depth, the canyon increases in width and relief. The Tugela 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 feeder valley 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 Tugela 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 Tugela Canyon region suggests that temperatures in the canyon heads at depths of 600 m they 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 Tugela and Goodlad Canyons are unlikely to offer suitable habitat for coelacanths.

Reef Communities (coral reef)

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. To the north of Block ER236, the Maputaland Coral Reef system, which extends from Kosi Bay to Leven Point (27°55'40"S, 32°35'40"E), constitute the southernmost coral-dominated reefs of Africa (UNEP-WCMC, 2011). South of the iSimangaliso Wetland Park (St Lucia), reef habitat is provided by rock outcrops, although both hard and soft corals still occur.

Both reef types are characterised by diverse invertebrate and ichthyofaunal biota of Indo-Pacific origin (*Figure 4.16*, left). The coral reef habitat also provides shelter and a food source for the highly diverse Indo-Pacific reef fish community. Both the coral-dominated reefs off Sodwana Bay (to the north of Block ER236) and the sandstone reefs off Durban and the KZN South Coast (inshore of Block ER236) are popular amongst divers for their wealth of invertebrate and fish diversity.

Figure 4.16 The Reefs of KZN and the Annual Sardine Run

Source: www.sa-venues.com; www.sea-air-land.com

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 there (Findlay, 1989; Findlay *et al*., 1992; Ross, 1984; Peddemors, 1999; Best, 2007) (*Table 4.2*). Seals occur only occasionally in the form of vagrant Cape fur seals (*Arctocephalus pusillus pusillus*) (CSIR, 1998).

The offshore areas have been particularly poorly studied in which case almost all available information from deeper waters (>200 m) is based on historic whaling records, and information on smaller deep water species is particularly poor.

There are 36 species of cetaceans that are likely to be found within Block ER236. Of the 36 species, according to the South African Red List Assessment, the Antarctic Blue whale (*Balaenoptera musculus intermedia*) is 'critically endangered', the Indo-Pacific humpback dolphin (*Sousa chinensis*), fin whale (*Balaenoptera physalus*) and sei whale (*Balaenoptera borealis*) are considered 'endangered' and the Ifafi-Kosi Bay sub-population of the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), Sperm whale (*Physeter macrocephalus*) and the inshore population of Bryde's whale (*Balaenoptera brydei*) are considered 'vulnerable' (Child *et al*., 2016). Altogether nine species are listed as 'data deficient' underlining how little is known about cetaceans, their distributions and population trends (Pisces, 2018).

The distribution of whales and dolphins on the East Coast can be split largely into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found to be associated with the shelf (200 to 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 thousands of kilometres. The most common species within the Block ER236 (in terms of likely encounter rate not total population sizes) are likely to be the common bottlenose dolphin (*Tursiops truncatus Figure 4.17,* left), Indo-pacific bottlenose dolphin (*Tursiops aduncus*), short-finned pilot whale (*Globicephala macrorhynchus*), Indo-Pacific humpback dolphin (*Sousa chinensis, Figure 4.17*, right) and humpback whale (*Figure 4.18*, 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 4.17 The Bottlenose Dolphin and the Indo-Pacific Humpback Dolphin

Source: www.fish-wallpapers.com; www.shutterstock.com

Baleen whales that are found 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 whale. Most of these species occur in deeper pelagic waters, with only occasional visits into the shallower shelf waters. These species show some degree of migration either to, or through, Block ER 236 when en route between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds.

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, the species of key stakeholder concern (humpbacks and southern right whales) are discussed in further detail below.

Humpback whales (*Megaptera novaeangliae*)

Humpback whales (*Figure 4.18*, 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 and exhibit a widespread seasonality in occurrence along the South African east coast (Best, 2007).

Humpback whales and their migration patterns have been studied for a number of years, showing a strong bimodal seasonality in the presence of humpback whales on South Africa's eastern coast, with peaks in abundance in June/ July and September corresponding with their northward and southward migration respectively (Findlay *et al*. 2011). However, in 2013, a study by Banks made observations of migrations extending further north than previously recorded, with 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).

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).

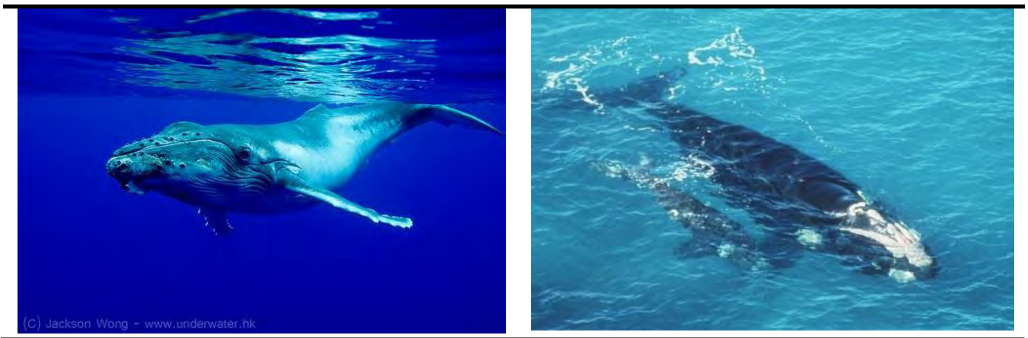
As indicated in Banks (2013), the highest concentrations of humpback whales in or near Block ER236 can be expected in June to July and October to December. Humpback whales are least likely to be present in or near Block ER236 from Febuary to March.

Southern right whales (Eubalaena australis)

The Southern African population of southern right whales (*Figure 4.18*, 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 less than 2 km from shore; Best, 1990; Elwen & Best, 2004).

While in local waters, southern right whales are found in groups of 1 to 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.
Southern right whales will pass through Block ER236 in July and August and again on their southward migration in October/November.

Figure 4.18 The Humpback Whale and the Southern Right Whale



Source: www.divephotoguide.com; www.aad.gov.au

Odontocetes

The Odontocetes 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).

Table 4.2 Marine Mammals Likely to be Encountered in Block ER236

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	Weekly	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	Data Deficient
Indo-Pacific humpback dolphin	*Sousa chinensis*	Yes		Year round	Monthly	Endangered	Near threatened
Long-finned pilot whale	*Globicephala melas*		Yes	Year round	<Weekly	Least Concern	Data Deficient
Short-finned pilot whale	*Globicephala macrorhynchus*		Yes	Year round	<Weekly	Least Concern	Data Deficient
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	Data Deficient
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	Data Deficient
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

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.	IUCN Conservation Status	Global IUCN Status
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	>Winter	Monthly	Least Concern	Data Deficient
Dwarf minke	*Balaenoptera acutorostrata*	Yes		Year round	Occasional	Least Concern	Least Concern
Fin whale	*Balaenoptera physalus*		Yes	MJJ & ON	Occasional	Endangered	Endangered
Antarctic Blue whale	*Balaenoptera musculus intermedia*		Yes	MJJ	Occasional	Critically Endangered	Endangered
Sei whale	*Balaenoptera borealis*		Yes	MJ & ASO	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	Data Deficient
Humpback	*Megaptera novaeangliae*	Yes	Yes	AMJJASOND	Daily	Least Concern	Least Concern
Southern right	*Eubalaena australis*	Yes		JJASON[1]	Daily	Least Concern	Least Concern

[1] Codes are referring to the months names starting from J=January to D=December

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*), hawksbill (*Eretmochelys imbricata*) and loggerhead (*Caretta caretta*).

Loggerheads and leatherbacks nest along the sandy beaches of the northeast coast of KZN, 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 are globally important populations in terms of conservation of these species.

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 4.19*), whereas leatherbacks travelled greater distances (more than 300 km) and beyond the borders of the MPA. Consequently, a southward extension of the MPA has been proposed in order to include a greater portion of the core range of inter-nesting leatherbacks and provide better protection.

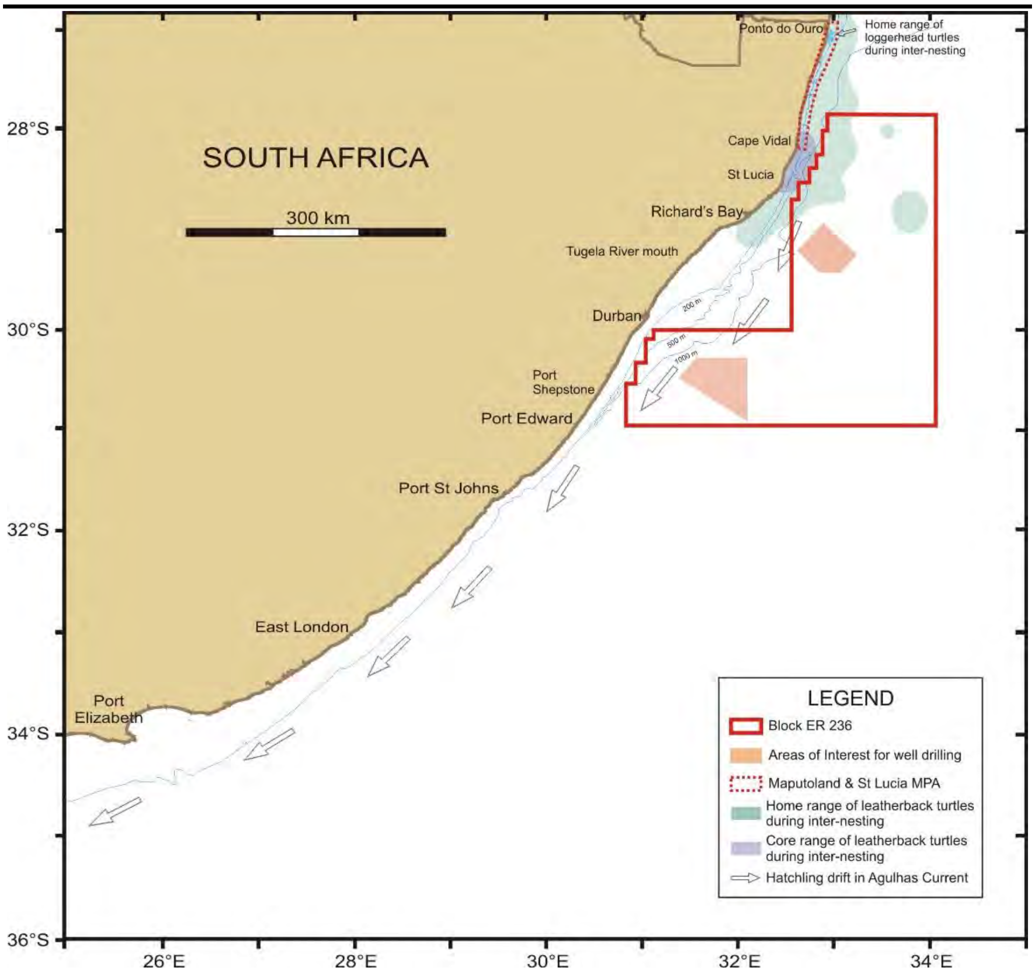
The inshore regions of the northern portion of Block ER236, coincide with the inter-nesting migrations for leatherbacks, but the area of interest lies offshore of the inter-nesting range. Both species are thus likely to be encountered in Block ER236 during their foraging migrations.

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 approximately 100 (loggerheads) or approximately 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.

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. Leatherback and loggerhead 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).

Figure 4.19 The Home and Core Ranges of Loggerheads and Leatherbacks during Inter-Nesting



Note: Shown on the Figure are the Marine Protected Area (spotted red line) and the areas of interest (orange polygons) within Block ER236 (red line).

Source: Oceans and Coast, unpublished data

Seabirds

The East Coast provides few suitable breeding sites for coastal and seabirds with only three species (Grey-headed gull, Caspian tern and Swift tern) (*Figure 4.20*) recorded to breed regularly along the coast (CSIR, 1998). In the offshore environment of Block ER236, 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 in the inshore areas Block ER236, particularly in the vicinity of larger estuaries (Richards Bay, St Lucia).

In the AII along the South Coast South, 60 species are likely to occur. South Coast seabirds can be categorised into three categories: 'breeding resident species', 'non-breeding migrant species' and 'rare vagrants' (Shaughnessy 1977; Harrison 1978; Liversidge & Le Gras 1981; Ryan & Rose 1989). Fifteen species breed within the South Coast region (*Table 4.3*), including Cape Gannets (Algoa Bay islands), African Penguins (Algoa Bay islands), Cape Cormorants (a small population at Algoa Bay islands and mainland sites), White-breasted Cormorant, Roseate Tern (Bird and St Croix Islands), Swift Term (Stag Island) and Kelp Gulls.

Table 4.3 Breeding Resident Seabirds Present along the South Coast

Species name	Common name	Global IUCN Status
Haematopus moquini	African black oystercatcher	Near Threatened
Spheniscus demersus	African Penguin	Endangered
Phalacrocorax carbo	Great Cormorant	Least Concern
Phalacrocorax capensis	Cape Cormorant	Near Threatened
Phalacrocorax neglectus	Bank Cormorant	Endangered
Phalacrocorax coronatus	Crowned Cormorant	Least Concern
Phalacrocorax lucidus	White-breasted Cormorant	Not assessed
Morus capensis	Cape Gannet	Vulnerable
Larus dominicanus	Kelp Gull	Least Concern
Larus cirrocephalus	Greyheaded Gull	Least Concern
Larus hartlaubii	Hartlaub's Gull	Least Concern
Hydroprogne caspia	Caspian Tern	Vulnerable
Sterna bergii	Swift Tern	Least Concern
Sterna dougallii	Roseate Tern	Least Concern
Sterna balaenarum	Damara Tern	Near Threatened

Source: adapted from CCA & CMS 2001

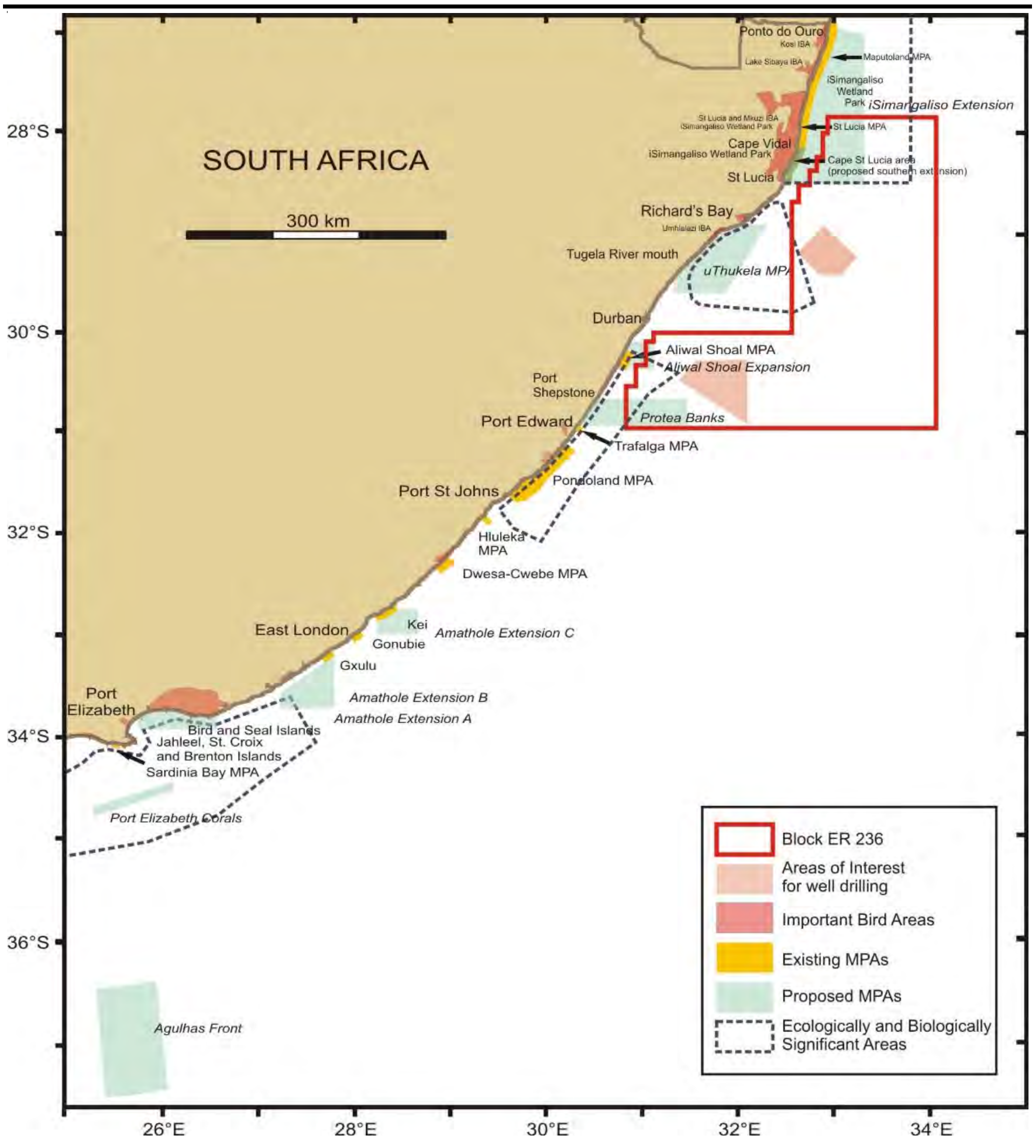
Figure 4.20 ***Typical Plunge-Diving Seabirds on the East Coast are the Swift Tern (Left) and the Cape Gannet (Right)***

Sources: www.johanngrobbelaar.co.za; www.oceanwideimages.com

4.3.4 Marine Protected Areas

Although no existing protected areas fall within the project's ADI, there are a number of protected areas within the projects potential AII (particularly the area in which the impact of unplanned events may be felt). *Figure 4.21* shows the existing and proposed marine protected areas in relation to the ADI (ie the northern and southern areas of interest and the AII (includes the entire Block ER 236 and extends down the East Coast to East London).

Figure 4.21 Protected/Potentially Sensitive Areas in Relation to Block ER236



Note: Shown on the Figure are Important Bird Areas (IBAs), proposed and existing Marine Protected Areas (MPAs) and Ecologically and Biologically Significant Areas (EBSAs) in relation to Block ER 236 (red polygon)

Source: Pisces, 2018

Declared Marine Protected Areas (MPA's) in the Area of Indirect Influence (AII)

In the AII, there are three declared MPAs within KZN's boundaries and four along the Eastern Cape coastline. None of the existing MPA's overlap with the ADI (*Figure 4.21*).

Maputaland and St Lucia Marine Reserves

The Maputaland and St Lucia Marine Reserves form a continuous protected area stretching 150 km from the Mozambique border to approximately 1 km south of Cape Vidal and approximately 5.5 km out to sea. They are components of the iSimangaliso Wetland Park (*Figure 4.21*).

No fishing is allowed in the Sanctuary Zone between beacon N5 at Red Cliffs and beacon N6 at Leven Point, extending approximately 5.5 km due east from the high-water mark. In the Restricted Zones, which lie to the north of beacon N5 at Red Cliffs and to the south of beacon N6 at Leven Point, respectively, shore anglers may catch fish, and skiboat anglers and spearfishers may catch pelagic bony fish.

The area off St Lucia was selected as an MPA because it is an important area for leatherback turtles, which nest on adjacent beaches and forage offshore with tracking data reflecting turtle habitat use well beyond the three nautical mile (approximately 5.5 km) boundary of the existing St Lucia and Maputaland MPAs. Threatened seabirds drive the importance of remaining areas although linefish of conservation concern also contribute to importance of the area.

The MPA protects a large number of turtle nesting sites; the migration of whales, dolphins and whale-sharks offshore; coelacanths in the submarine canyons; and a considerable number of waterfowl associated with the iSimangaliso Wetland Park, including large breeding colonies of pelicans, storks, herons and terns.

Other Declared MPAs in the Area of Indirect Influence (AII)

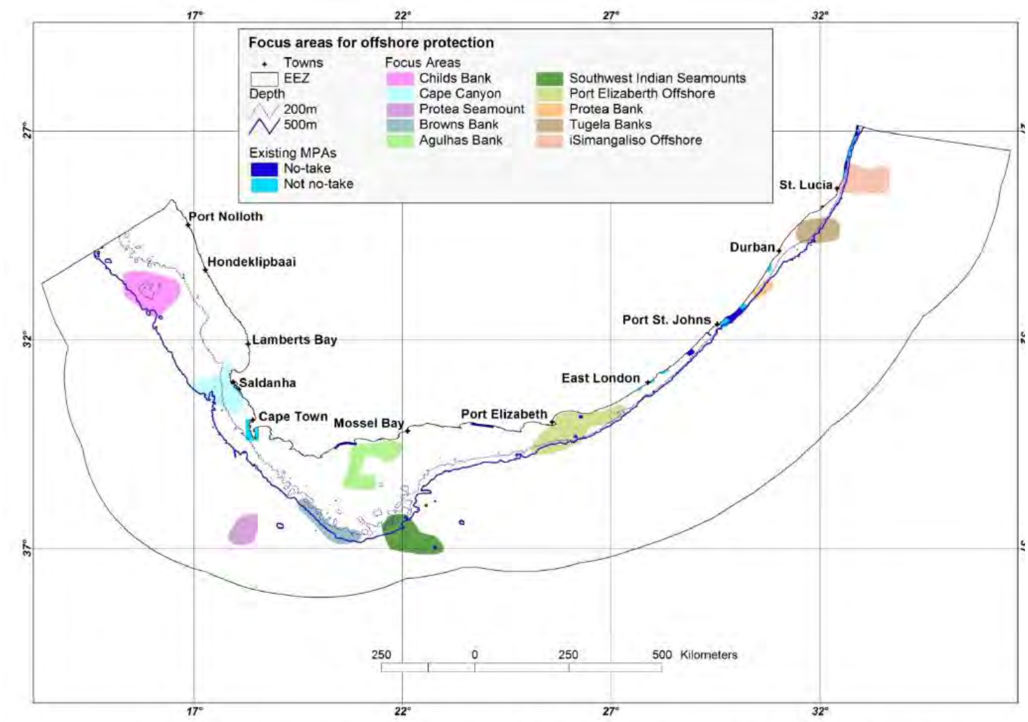
Other declared MPAs in the AII include the the Amathole MPA (in the vicinity of East London) and the Dwesa-Cwebe, Hluleka and Pondoland MPAs (located on the Wild Coast) (*Figure 4.21*).

Proposed Expansion Areas for Offshore Biodiversity Protection in the Area of Indirect Influence

The Offshore MPA Project (SANBI, 2011) aimed to support the implementation of the National Protected Area Expansion Strategy (Government of South Africa, 2010), which highlighted the need to establish specific offshore MPAs and to provide suitable protection of inshore systems within South Africa. Priority areas for different types of objectives were explored during this project and it is recognised that protection may be apportioned between different types of spatial management including different zones of MPAs but also other types of spatial management.

To this end, 22 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 (*Figure 4.22*). Those within the Project Area are shown in *Figure 4.21*. Although Block ER236 overlaps with the proposed Protea Banks, Aliwal Shoal and iSimangaliso Wetland Park MPAs, there is no overlap of the areas of interest for well drilling with the proposed protection areas.

Figure 4.22 Focus Areas for Offshore Protection



Source: SANBI, 2011

Other Offshore Protection Areas in the Area of Indirect Influence

Hope Spots

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 adjacent to the southwestern corner of Block ER236, approximately 250 km southwest of the area of northern interest for well drilling and approximately 75 km inshore and west of the southern area of interest.

iSimangaliso Offshore: World Heritage Site

The iSimangaliso Wetland Park is recognised as a wetland of international importance under the Ramsar Convention and has been designated a World Heritage Site in terms of the World Heritage Convention Act (No. 49 of 1999). The iSimangaliso Wetland Park covers an area on 324 441 ha, including 230 km of coastline from Kosi Bay (bordering Mozambique) to south of Maphelane and approximately 5.5 km out to sea.

The Park is governed by the National Environmental Management Protected Areas Act (No. 57 of 2003), and under Section 48(1) no person may conduct commercial prospecting or mining activities within a World Heritage Site.

In addition, Section 50(5) states that no development is permitted in a World Heritage Site without prior written approval from the management authority, namely iSimangaliso Wetland Park Authority.

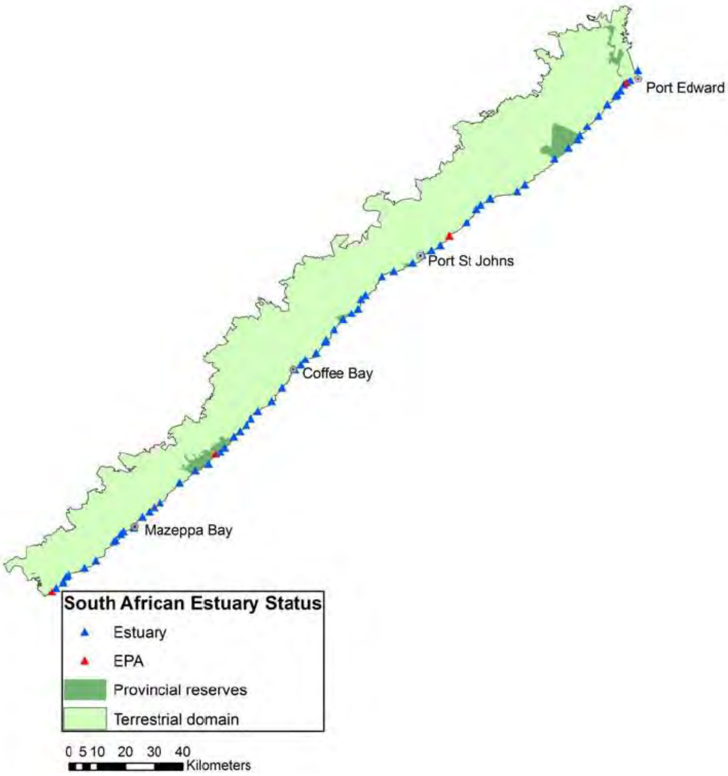
4.3.5 Other Sensitive Environments in the Area of Indirect Influence

Estuaries

There are some 188 estuaries located along the East Coast region, between Gonubie (near East London) and Isipingo (near Durban). *Figure 4.23* below shows the location of estuaries and estuary protected areas (EPAs) located along the 'Wild Coast', within the Eastern Cape coastal region. These are included as they could potentially be impacted in the event of an accidental event.

Estuarine environments can be are considered valuable habitats, as they provide essential ecosystem services, such as nursery functions to coastal fisheries, freshwater flows to the marine environment, replenishment of nutrients and organic material to coastal habitats, flood and sea storm protection, carbon sequestration, safe bathing areas and cultivation of plants for biofuels without freshwater (Van Niekerk & Turpie, 2012). They are also considered to be resilient systems by nature, because their dynamic nature means that fauna and flora that inhabit these ecosystems are generally adapted to living in conditions of extreme change. As such, those species that can tolerate the estuarine environment are often very successful and abundant in their chosen environment (eg sand/mud prawns, mullet and bottom feeding fish or fish that eat plankton).

Figure 4.23 *Estuaries along the Wild Coast. The Estuaries in Red are Estuary Protected Areas (EPAs)*



Source: Reyers & Ginsburg, 2005.

A large proportion of the Estuaries along the East Coast (particularly those found along the 'Wild Coast' (1)) have been identified nationally as being of high biodiversity and ecological importance (ie the Mngazana and Mbashe estuaries). This relates to the pristine nature of many of the estuaries found along this coastline. In particular, Mngazama estuary (found along the 'Wild Coast') has been rated in the top 20 estuaries in South Africa, while another nine have been rated within the top 50 estuaries in South Africa (Reyers & Ginsburg, 2005). *Table 4.4* provides a list of the key estuaries of the 'Wild Coast' in terms of their overall conservation importance.

Table 4.4 *Key Estuaries of the Wild Coast*

Estuary	Type	Size (ha)
Mngazana	Permanent	224.9
Mbashe	Permanent	132
Mtata	Permanent	168.8
Mzimvubu	River mouth	151
Xora	Permanent	150.6
Nxaxo/Ngqusi	Permanent	159.5
Great Kei	Permanent	222.4
Mzamba	Permanent	70.94

(1) The 'Wild Coast' is a section of the coast of the Eastern Cape, South Africa. The region stretches from East London in the south to the border of KwaZulu-Natal in the north.

Estuary	Type	Size (ha)
Mtentu	Permanent	52.93
Qora	Permanent	89.63
Mtakatye	Permanent	116.8
Mdumbi	Permanent	76.07
Mntafufu	Permanent	24.07
Mbotyi	Temporary	50.39
Nqabara	Permanent	109.7
Qolora	Temporary	22.9
Mtamvuna	Temporary	63.53
Mnenu	Temporary	90.52
Ntlonyane	Temporary	41.34
Msikaba	Permanent	15.13

Limited research has been undertaken in recent years to determine the biodiversity make-up of the estuaries found within this coastal region. In this regard, the National Biodiversity Assessment (Van Niekerk & Turpie, 2012) acknowledges that existing research is outdated and that new studies urgently need to be undertaken in a once-off effort that is comparable with that of earlier surveys. Despite this, a short summary of the key biophysical elements associated with the Mngazana Estuary (one of the key estuaries located in the proposed Transkei area), is provided below.

Mngazana Estuary

The Mngazana Estuary is a permanently open estuary that is located south of Port St Johns, along the Eastern Cape coastline. The full length of the estuary is approximately six kilometres, subject to tidal exchanges (USAID, 2005). The estuary itself is regarded as one of the most important estuaries in the Eastern Cape, as it forms part of a 140 hectare stand of mangroves, which have been identified to comprise the third largest stand in South Africa.

The Mngazana Estuary is host to a diverse number of both invertebrate and fish communities. This includes temperate, tropical and subtropical species, predominating in the lower, middle and head reaches, respectively(De Wet 2004). Three species of Red Data listed crabs were identified in the estuary (Sgwabe *et al*., 2004). Over 100 species of birds have been recorded, including rare species such as the Mangrove kingfisher (Sgwabe *et al*., 2004). The vegetation of the Mngazana Estuary comprises a number of plant communities, with the mangrove swamp as the main feature. There is also sea-grass and salt-marsh communities, with dune forests along the east bank of the estuary mouth.

4.4 SOCIO-ECONOMIC BASELINE

The project is located off the coast of the KwaZulu-Natal (KZN) Province, and will be supported by an onshore logistics base in either the Port of Richards Bay or the Port of Durban.

Most of the activities associated with the project will take place offshore, with the exception of activities associated with the onshore logistics base. During routine operations, the socio-economic impacts of the project (both positive and negative) will be limited as most of the activity will take place offshore.

As such, this socio-economic baseline is focused on the local municipalities in which the logistics base may be located, eThekwini Metropolitan Municipality and the City of uMhlathuze Local Municipality. These municipalities are considered the ADI. The AII includes the local municipalities along the coastline from the City of uMhlathuze Local Municipality to the Buffalo City Local Municipality, listed in *Table 4.5*. A summary of high-level indicators for these municipalities is included in *Annex D*. *Figure 4.24* and *Figure 4.25* present the municipalities in KZN and the Eastern Cape.

In the event of an accidental spill, effects may be felt along the East Coast through KZN and the Eastern Cape, which could affect marine and coastal-based livelihoods such as fisheries, (both commercial and subsistence) and the tourism sector. A description of the fisheries sector is included in *Section 4.4.3*, and further information around tourism is presented in *Section 4.4.2.*

Table 4.5 Local Municipalities within the AII

Local Municipalities in KZN	Local Municipalities in Eastern Cape
uMfolozi Local	Mbizana Local
uMlalazi Local	Ingquza Hill Local
Ray Nkonyeni Local	King Sabata Dalindyebo Local
Umdoni Local	Nyandeni Local
Umzumbe Local	Port St Johns Local
KwaDukuza Local	Great Kei Local
Mandeni Local	Mbhashe Local
	Mnquma Local

Figure 4.24 KZN Municipalities

Source: ERM, 2018

Figure 4.25 Eastern Cape Municipalities

Source: ERM, 2018

4.4.1 *Baseline Description of Local Municipalities*

Administrative Structure

The Provincial government is responsible for providing the strategic vision and framework for the Province. They are responsible for ensuring cooperation and collaboration between municipalities and that each municipality performs their respective functions. In turn, each of the District Municipalities is responsible for the preparation of a spatial development framework and for the overall provision of services and infrastructure within their District. The district municipalities are further divided into local municipalities.

Local municipalities are responsible for developing an Integrated Development Plan (IDP), which is aligned with the strategic vision of the province, and sets out a road map for achieving local socio-economic development.

Provincial Context

The project is located off the coast of the KZN Province, the third smallest province in South Africa, covering an area of 94,361 km^2. KZN has the second largest population of the South African provinces, with a total of 11,065,240 people.

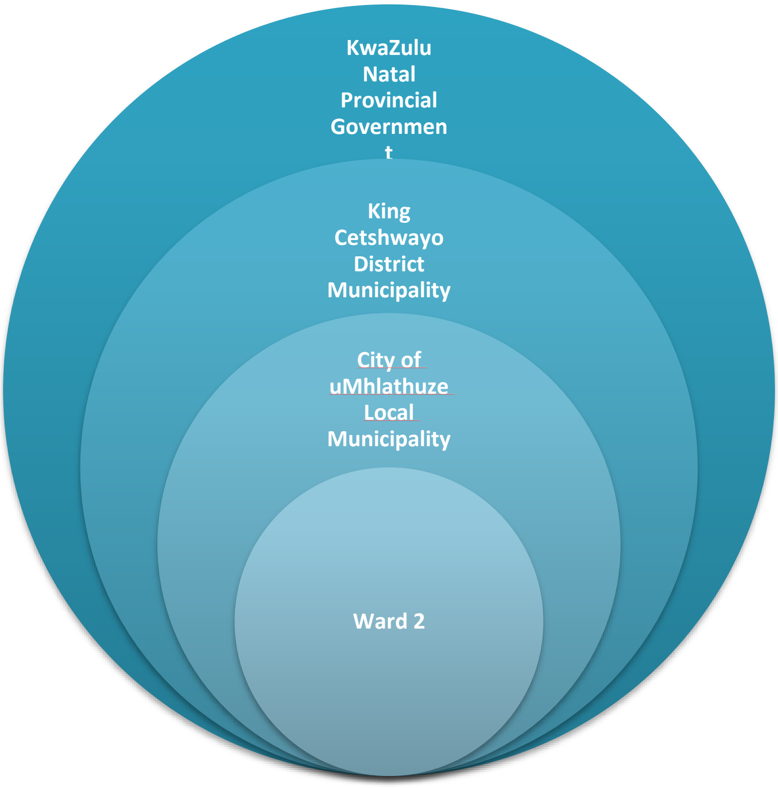
It borders Mpumalanga and the Free State on the west and the Eastern Cape to the south west. It also borders, Lesotho, Swaziland and Mozambique. Pietermaritzburg is the capital city, whilst Durban is the largest city, and considered the economic centre of the Province. Other major cities and towns in KZN include Richards Bay, Port Shepstone, Newcastle, Escourt, Ladysmith and Richmond. *Figure 4.24* shows the municipalities within the province.

The tourism industry plays an important part the KZN economy with popular destinations including the coastal towns along the coast, as well as the mid-lands and the Drakensberg Mountains.

King Cetshwayo District Municipality and the City of uMhlathuze Local Municipality

The Port of Richards Bay is located in the City of uMhlathuze Local Municipality (uMhlathuze Local Municipality), which falls into the King Cetshwayo District Municipality (KCDM). The KCDM is one of the eleven district municipalities within the KZN Province. It has a total of five local municipalities namely: City of uMhlathuze, Umlalazi, Nkandla, uMfolozi and Mthonjaneni Local Municipalities (King Cetshwayo District Municipality IDP, 2018/19 – 2021/22). The onshore logistics base will be located in Ward 2. *Figure 4.26* shows the administrative structure of the respective levels of government.

Figure 4.26 Administrative Structure



Source: uMhlathuze Municipality SDF, 2017/2018; Ward Delimitation 2016

KCDM is located in the north eastern region of KZN, covering a total of 8,213 km^2. It has the third highest population in the KZN Province with an estimated total of 971,135 people. The District is home to the largest deep water port on the African continent ie the Port of Richards Bay.

The Port of Richards Bay handles over 75 million tons of cargo per annum, which is double the capacity of the Port of Durban to the south. In light of the above, the Port of Richards Bay has played a significant role in developing the manufacturing sector in the region, thus enabling it to be a large contributor to the economy and gross geographic product (uMhlathuze Municipality SDF, 2017/2018).

However, the KCDM has various challenges, including rural communities which are poverty stricken, a lack of basic services such as water and sanitation and unemployment (uMhlathuze Municipality SDF, 2017/2018).

Population Demographics

The uMhlathuze Local Municipality has a population of 410,465 people according to the 2016 community survey (StatsSA). This number has grown by 22.73 percent since the last census in 2011.

Using the survey conducted in 2011, it was calculated that the uMhlathuze Municipality has a household size of approximately 3.95 people for an estimated total of 103,915 households (uMhlathuze Municipality SDF, 2017/2018). Comparative information around the population for the district and local municipality is provided in *Table 4.6*.

Table 4.6 Population Summary

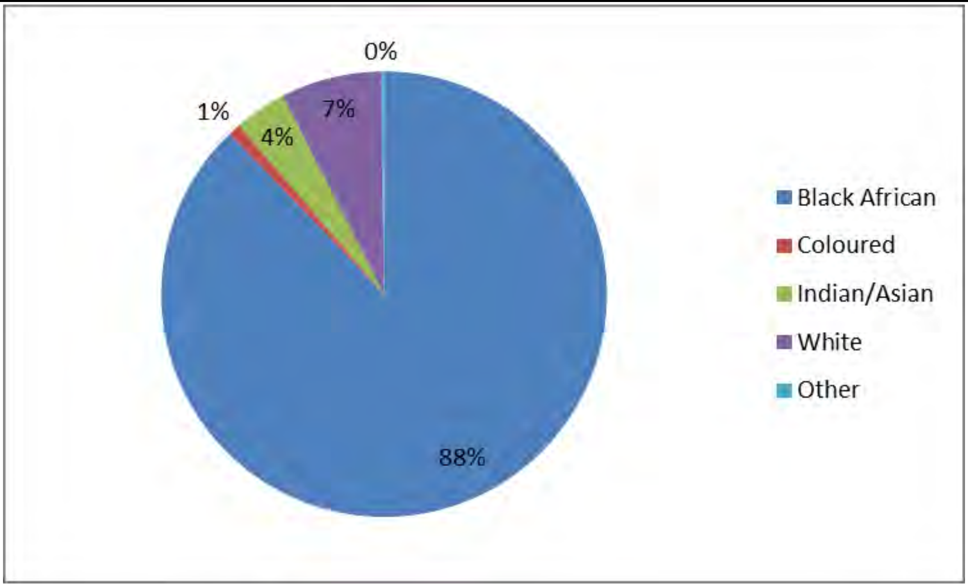
Year	Administrative Area Name	Size	Population	Growth Percentage
2011	King Cetshwayo District Municipality	8,213 km²	907,519	
2011	City of uMhlathuze Local Municipality	1,233 km²	334,459	
2016	King Cetshwayo District Municipality	8,213 km²	971,135	7.01
2016	City of uMhlathuze Local Municipality	1,233 km²	410,465	22.73

Source: uMhlathuze Municipality SDF, 2017/2018

According to the 2011 census, Black Africans are the majority population group making up 87.7 percent of the population. White people make up 7.3 percent, while the other population groups make up the rest as shown in *Figure 4.27*.

isiZulu is the dominant language spoken in the uMhlathuze Local Municipality with 78.7 percent speaking the language (StatsSA, 2016).

Figure 4.27 Ethnic Composition in the City of uMhlathuze Local Municipality



Source: StatsSA 2016

Local Economy and Livelihoods

The uMhlathuze Local Municipality and KCDM economies are both primarily driven by the Port of Richards Bay, which is one of the two largest and busiest ports on the African continent. This area contributes a total of 16.7 percent towards the KZN Gross Domestic Product (GDP).

The main activities being undertaken in the uMhlathuze Local Municipality include large-scale industrial activities including coal terminals, aluminium smelters, as well as mining, paper mills, forestry, production of materials handling equipment and fertiliser and special chemicals production (uMhlathuze Municipal IDP, 2012/2017).

Unemployment

The unemployment rate in the uMhlathuze Local Municipality is estimated to be 40 percent (uMhlathuze Municipal IDP, 2012/2017). This comprises people who are unemployed but seeking employment, as well as those who are not seeking employment. According to the IDP, the unemployment issue is as a result of the lack of skills, which is largely attributed to the apartheid regime where a system was created that excluded the majority of the population from receiving quality education, but directed them to semi-skilled or unskilled labour instead (uMhlathuze Municipal IDP, 2012/2017).

Education

An uThungulu (KCDM) Quality of Life Survey conducted in 2009 illustrated that a larger percentage of the population was noted to have reached secondary education (30.52 percent). Only 22.41 percent reached grade 12 and a smaller 8.45 percent make it to tertiary level education (uMhlathuze Municipal IDP, 2012/2017). A pattern is seen in the District where the level of education decreases whilst the demand for skills increases.

Social Infrastructure and Services

Water and Sanitation

The City of uMhlathuze receives funding from the Municipal Infrastructure Grant (MIG). This funding is used for water (70 percent) and sanitation (30 percent) services. This funding, however, was found to be ineffective in improving sanitation services in the area. A total of 86.37 percent of the households in the uMhlathuze Local Municipality has access to basic RDP [1] level water services, whereas 57.91 percent have access to basic level sanitation services.

(1) Reconstruction and Development Programme (RDP)

Waste

An estimated 53.5 percent of households have their waste removed by the local authority or a private company at least once a week. There is a large number of households that rely on their own refuse dumps, (38.4 percent) and a small percentage relies on communal dump alternatives (2.6 percent) (StatsSA, 2016).

Energy

The uMhlathuze Local Municipality has no backlog of households waiting for services in terms of energy supply in the area. The regulator has enforced a grid code, which provides guidelines and rules governing how Municipalities are to create and maintain electrical infrastructure assets. All energy distributors are to comply with the Distribution Grid Code as part of their licence (uMhlathuze Municipal IDP, 2012/2017).

Health

Within the uMhlathuze Local Municipality, there are four hospitals and 23 health clinics. The IDP identified a need for additional health facilities in remote Traditional Authority areas.

The KCDM had an HIV prevalence of 38.5 percent in 2012 in the age groups 15 to 45 years, up from 33.4 percent the previous year (District Health Plan 2015/2016). This is significantly higher than the prevalence rate in KZN (25 percent) and South Africa (18 percent). The uMhlathuze Local Municipality IDP notes that there is a lack of clear and reliable data regarding HIV/ AIDS at a local municipal level, but that it is clear that it is a serious problem.

It is further noted that the Tuberculosis (TB) cases in both the KCDM and the uMhlathuze Local Municipality are high, with TB being the leading cause of death in the KCDM (District Health Plan 2015/2016).

eThekwini Metropolitan Municipality

Administrative Structure

The onshore logistics base for the project may be situated in the Port of Durban, which is located in the eThekwini Metropolitan Municipality, Ward 32. *Figure 4.28* shows the administrative structure of the respective levels of government.

eThekwini Metropolitan Municipality (eThekwini Municipality) is a category A municipality which is located on the East Coast of South Africa, occupying an area of approximately 2,297 km^2 and comprises a population of 3,555,868 people (eThekwini Municipality IDP, 2016/2017).

eThekwini Metropolitan is bordered by three district municipalities namely: iLembe to the north, uGu to the south and uMgungundlovu to the west (SDF, 2016/2017). It is characterised by its hilly topography and many gorges and ravines. It also houses one of Africa's most well managed and busiest ports, the Port of Durban. Durban is the largest city in KZN with just over one third of its total population, and it is the third largest city in the country (StatsSA, 2016).

Figure 4.28 Administrative Structure

Source: eThekwini Municipality IDP, 2016/2017; eThekwini Ward Map - 2011 Ward Boundary

Population Demographics

The population of eThekwini Municipality is approximately 3,555,868 people (eThekwini Municipality IDP, 2016/2017). The population is spread in such a way that the most concentrated region is the central and north planning regions. The outer west region however, which comprises the largest surface area (approximately 78,438 ha) only houses 11 percent of the total Municipality's population. The northern region houses 33 percent of the Municipality's population, and the central region houses 34 percent of the total population (eThekwini Municipality SDF, 2016/2017).

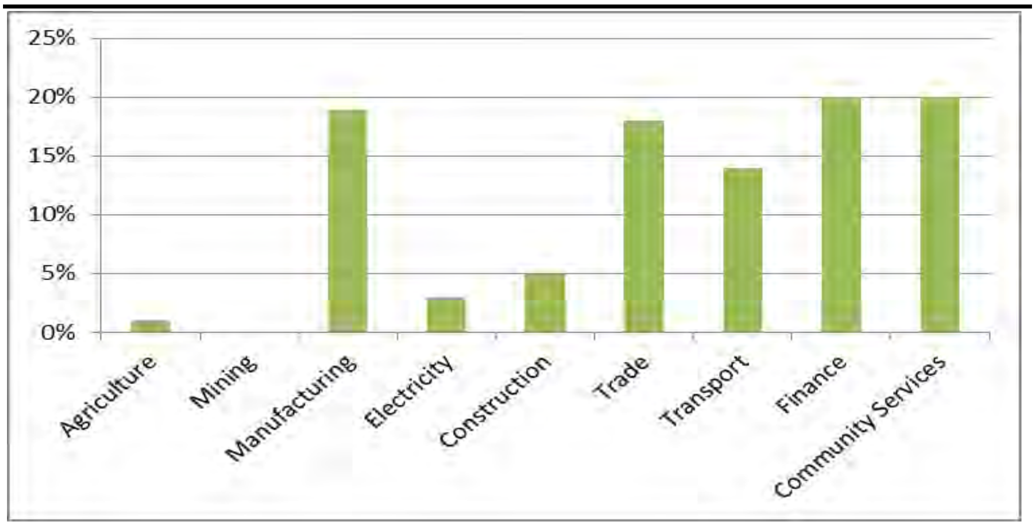
The gender profile in the eThekwini Municipality represents a larger percentage of females (51 percent) to males (49 percent). The majority of the population falls within the 0– 29 age range, whereas the 60 – 70 age range constitutes a very small percentage of the population (eThekwini Municipality SDF, 2016/2017).

Local Economy and Livelihoods

According to the Quarterly Labour Force Survey by Statistics South Africa, the eThekwini municipal region was recorded to have the lowest unemployment rate in the second quarter of 2015 with only 16 percent of the region being unemployed (eThekwini Municipality IDP, 2016/2017). This region employs approximately 9 percent of the national population. Currently, eThekwini Metropolitan makes up 57.1 percent of the Provincial Gross Domestic Product (GDP), and 1 percent of the national GDP (eThekwini Municipality IDP, 2016/2017).

The sectors contributing the most to the eThekwini Municipality economy is the Finance and Community Services sectors (20 percent each), with Agriculture contributing the least with 1 percent (eThekwini Municipality IDP, 2016/2017). The figure below illustrates the sectoral composition of the GDP in the eThekwini Metropolitan Municipality.

Figure 4.29 Sectoral Composition of GDP in 2014: eThekwini Metropolitan Municipality

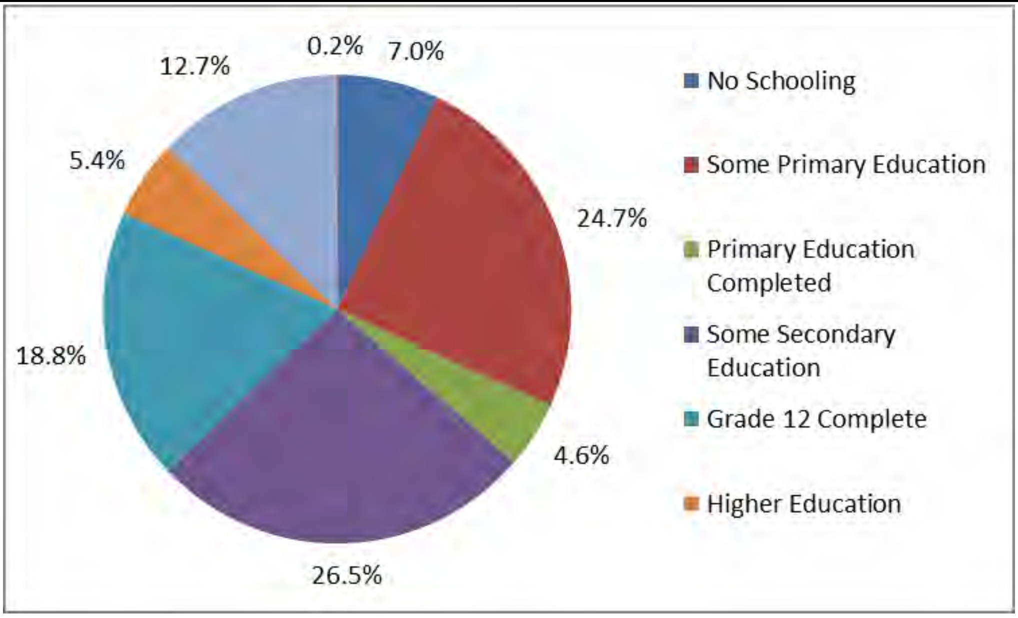


Source: eThekwini Municipality IDP, 2016/2017

Education

According to the eThekwini Spatial Development Framework (2016/2017), 29 percent of the eThekwini Metropolitan Municipality has some secondary education, while, only 8 percent has tertiary level education. *Figure 4.30* below illustrates the educational breakdown within the eThekwini Municipality.

Figure 4.30 Education Profile within eThekwini Metropolitan Municipality



Source: eThekwini Municipality SDF, 2016/2017

Social Infrastructure and Services

Water and Sanitation

Approximately 933,121 households were recorded to have access to water services in 2014/2015 at the Municipality. This marks 98.65 percent coverage across the region. The eThekwini Municipality currently maintains and manages 327 water storage facilities.

Energy

The portion of houses with no connection to electricity has decreased by 6.1 percent between the period of 2011/2012 and 2014/2015. The eThekwini Municipality aims to sustain this growth through the maintenance and handling of 152 major substations within the derestriction. In addition, the Municipality manages 31 waste water treatment plants, and 300 pump stations which have enabled it to reduce the sanitation backlog by 24 percent over a 5 year period.

Health

The prevalence of HIV/ AIDS in the eThekwini Municipality is high, as it is in the rest of South Africa (18 percent) and KZN (25 percent). Tuberculosis (TB) is recognised as the leading opportunistic infection amongst HIV positive persons with approximately two thirds of HIV infected persons co-infected with TB.

In 2009 a total of 43,739 new and retreatment cases (both HIV positive and HIV negative) were registered in the eThekwini Municipality, making it one of the districts with the highest number of TB cases in South Africa. However the treatment rate in the eThekwini Municipality is high and treatment rates have improved from 70.8 percent in 2011 to 79,5 percent in 2013 (eThekwini Municipality IDP).

Key challenges relating to health service provision in the eThekwini Municipality are:

- High rate of HIV/AIDS and TB.
- High teenage pregnancy rate.
- Sexual abuse in children less than sixteen years.
- Abuse of chemical substances (drugs and alcohol). Lobby for change in the legislative framework.
- High incidence of injuries and trauma.
- Inequitable distribution of resources towards an urban bias.
- Only 66 percent of eThekwini residents have access to primary level care facility within a 5km access distance.
- Primary Health Care services are considered an unfunded mandate for the municipality however there are ongoing negotiations to improve funding.
- The number of Environmental Health Practitioners (EHPs) remains below the expected norms, however, the municipality has a multi-year funding plan to increase these numbers starting with the employment of 35 EHPs in the 12/13 financial year.
- Challenges with professional ethics and management capacity.

4.4.2 *Tourism*

Tourism is an important sector in the South African economy, and directly contributed 2.9 percent to South African gross domestic product (GDP) in 2016 (StatsSA). The tourism sector employed 686,596 people in 2016, 4.4 percent of South Africa's 15.8 million workers (StatsSA).

Tourism plays an important role in the local economy along the East Coast of South Africa. People are attracted to the pristine coastal areas and much what draws people to the coast is the recreational activities associated with the coastal and marine environment, such as fishing, surfing, driving.

Tourism along the Kwa-Zulu Natal coast is well established and tourism infrastructure such as accommodation and restaurants are in place and easily accessible.

In contrast, tourism along the Wild Coast is underdeveloped, and challenges to the tourism sector include poor road quality (especially the access roads from the N2 to the various Wild Coast destinations) and a lack of accommodation (Fuller Frost & Associates, 2010). It is recognised that there is potential for tourism development along the coast and that the protection of natural assets is important in promoting tourism. Travel and tourism employed 32,917 people directly in the Eastern Cape in 2014 (https://www.ujuh.co.za/eastern-cape-tourism-industry-is-boosted-by-domestic-travellers/).

Block ER236 is located from 20 km offshore and the Area of Interest is over 60 km offshore. The project will have a limited impact of tourism activities during routine operations. There is a possibility that the offshore recreational boat-based fishing activities could be affected if they travel offshore and into Block ER236.

Tourism in the Area of Direct Influence

eThekwini Municipality

Tourism is a key contributor to local economic development. Local communities have been recognised to play an important part in the tourism development, since, in most cases, they are the major supplier of goods and services to tourists (eThekwini Municipality, 2014).

The Tourism in eThekwini report (eThekwini Municipality, 2014) estimated the number of tourist arrivals in Durban to be 15.5 million visitors in 2012. Of those visitors, 260 009 were foreign overnight tourists and 175 428 were foreign day visitors. Furthermore, 1.9 million of these visitors were domestic overnight trips, while 13.1 million were domestic day trips (eThekwini Municipality, 2014).

UMhlathuze Local Municipality

The tourism sector has been identified as a priority area for economic development in the uMhlathuze Local Municipality. The main tourism assets that have been identified for potential contribution to the local economy include the beaches, various events, preservation of heritage sites, conservation areas and the estuary south of the Port. The region has been recognised as a provincial tourism priority and the IDP recognises that there is potential to develop the sector in the future. However, the IDP does acknowledge that there is limited opportunity to support economic growth while considering the needs for conservation and development.

Tourism in the Area of Indirect Influence – Kwa-Zulu Natal

uMfolozi Local Municipality

The tourism sector has been identified as an economic development area for the Richards Bay Industrial Development Zone (RBIDZ), which falls into this Municipality. The main tourism assets in the municipality include the rich coastal forests, nature reserves, and culture and heritage sites. The N2 is a major tourism route that connects areas in the north such as Lake St. Lucia, to Margate towards the South. The Municipality has identified additional developments that can contribute to the sector such as eco –tourism and the Hluhluwe-uMfolozi Game Reserve. The IDP notes that the tourism sector is an important contributor to the GDP of the Local Municipality.

uMlalazi Local Municipality

The tourism sector is being promoted due to the vast historical and cultural significance in the municipality. The main tourism assets include the famous Zulu Heritage Route R66, pristine beaches, natural rain forest and Zulu heritage, which can contribute to the long-term development of the sector. The IDP notes that the tourism sector has great potential for growth and the municipality has identified the need to improve and develop the tourism sector.

KwaDukuza Local Municipality

The location of the Municipality is considered to a contributing factor to the development of the tourism sector as it is located between two port cities, Durban and Richards Bay. The location provides for the development of multiple tourism initiatives based on the coastal assets.

The main tourism assets include the blue flag beaches, recreational activities, tourism events estuary areas, forested areas and heritage sites. The IDP notes that the recreational activities are a key driver for tourism in the municipality. It further states that the sector is growing in the local economy and is central to long-term growth.

Mandeni Local Municipality

The tourism sector is considered to contribute to the local economy in this Municipality due to its strategic location along the N2 National Development Corridor and trade route mid-way between the provincial economic hubs of Durban and Richards Bay. The main tourism assets includes the Tugela River, Quarry stones, nature reserves and the Indian Ocean. The municipality includes a long stretch of coastal land with economic potential for eco – tourism, commercial and industrial development. The IDP notes that the municipality has potential to develop the sector in the long term and has opportunities for industrial development with the Dube Trade Port and the Richards Bay SEZ.

Ray Nkonyeni Local Municipality

The tourism sector is considered to be one of the main features of the local economy which includes services, agriculture and manufacturing. The main tourist assets include beaches, good infrastructure and urban centres such as Margate and Port Shepstone. The Municipality has a number of beaches that meet international standards as accredited blue flag beaches (managed in South Africa by WESSA). The entire coast line alone the South Coast is a primary tourism attraction, thus largely driving the Municipality's economy. While the Oribi Gorge provides more organised and well marketed products and services in the Municipality, it is Margate that contributes the most towards Municipal tourism from a revenue perspective, approximately 37 percent (SDF, 2017). Margate has many holiday resorts, holiday homes and tourist related establishments, and consequently consists of more holiday makers than residents. It has been noted that the tourism occupancy demand is seasonal where summer receives an 80 percent occupancy, autumn 79 percent, spring accounts for 70.8 percent, and winter receives 72.2 percent occupancy (SDF, 2017).

Umdoni Local Municipality

The Municipality is considered a tourism hub of the south coast which contributes to economic development. The key tourist assets include estuaries, dunes, sandy beaches and rocky shores. The IDP notes that the tourism sector is considered a large contributor to employment, poverty reduction and protection of the natural and cultural heritage of the Municipality.

Umzumbe Local Municipality

The tourism sector is concentrated largely within the coastal towns, which over time have become popular destinations. The main tourist assets included rich history, popular tourism destinations and natural features. According to the IDP, the Municipality is considered to be able to contribute to the economic development of small businesses and that the natural resources should be protected from harm and ensure continued use while balancing development needs.

Tourism in the Area of Indirect Influence – Eastern Cape

Mbizana Local Municipality

The tourism sector has been identified as undeveloped in the Municipality and is considered a key economic driver in the future. The main tourist assets include the unique cultural attributes, natural attractions and layers of heritage in the region. The IDP notes that the tourism sector has been identified as a priority area in the Local Economic Development Strategy. It further notes that there are plans to attract investors to invest in the Municipality for sustainable job creation and further develop the sector.

Ingquza Hill Local Municipality

The Municipality has potential for developing a community based tourism industry due to its unique attractions. The Wild Coast represents an international destination potential, provided the infrastructure, accessibility and safety/security environment are improved. The tourism industry, which is potentially the major contributor to the trade output, remains poorly developed and underexploited. The recent adoption of a Tourism Sector Plan represents a milestone towards the implementation of a turnaround strategy in this sector.

Port St Johns

The main tourist assets in the Municipality include natural features such as hills, dunes, rivers, and the mountainous terrain that meet picturesque beaches. The IDP notes that the town of Port St Johns is considered to have potential for development in the service industry, tourism and government sectors.

Nyandeni Local Municipality

The Municipality has a 20 km coastal belt, which stretches from Mthatha Estuary in the southwest to Mnenu Estuary in the northeast. The main tourism assets include the forests, areas designated for nature conservation, estuaries, wildlife and Hluleka Game Reserve. The IDP notes that there is high tourism potential, especially for eco- tourism. Poor roads and a lack of accommodation are currently a challenge.

King Sabata Dalindyebo Local Municipality

The tourism sector in the region includes tourist attractions like Coffee Bay and Hole-in-the-Wall. The coastal area has been identified as a tourism node of the municipality. The main tourism assets include the coastal forests, dune and mangrove forests as well as a pristine wild coast. The Nelson Mandela and Mvezo Museum have potential for tourism in the area. The IDP notes that there are various initiatives that seek to develop the sector such as the Kwatshezi Development Plan has been crafted to reshape the Coffee-Bay and make it an attractive destination.

Great Kei Local Municipality

The tourism sector is geographically concentrated on the coastal area and is marketed through a well-established brand. The main tourism assets include heritage sites, coastal areas and variety of businesses. The IDP notes that the tourism sector should be developed further.

Mbhashe Local Municipality

The main tourist assets in the Municipality are the heritage sites and the main routes leading heritage sites.

Heritage sites include the graves of deceased Kings, forts and other memorials. The poor condition of the roads limits visits by tourists and has been noted in the IDP as an area to develop the tourism sector further and contribute to long-term economic development.

Mnquma Local Municipality

The Municipality is strategically located along N2 and is a gateway to the Wild Coast. The main tourist assets include the beaches, rocky shores, estuaries, and dunes and coastal vegetation, Bawa Falls, Gcuwa Dam, and Cebe Campsite, walking trails connecting Kei Farm, Qolorha, and Jacaranda Ship Wreck in Ngcizele. The IDP notes that the due to the multiple attractions the tourism sector can contribute to the local economy.

Ndlambe Local Municipality

The tourism sector is focused on providing a safe destination for tourists. The main tourists assets are the nature reserves, game reserves, beach and marine, hunting, agri-tourism, and farm stays. Heritage-based attractions include buildings heritage, art and literature.

The IDP notes that the region has significant environmental value that needs to be protected and that can contribute to future tourism development.

4.4.3 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 commercial fisheries are regulated and monitored by DAFF (previously managed under the Department of Environmental Affairs: Directorate: Marine and Coastal Management). 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. In summary, the sector comprises the following:

- 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 ocellatus*), 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 percent of these are actively targeted by commercial fisheries, which comprise 90 percent of the landed catch.

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. There are more than 230 [(1)] small-scale fishing communities on the South African coastline, ranging in size from small villages to towns. Small-scale fisheries commonly use boats but occur mainly close to the shore.

Description of Commercial Fishing Sectors and Fisheries Research Surveys

The fishing sectors that overlap with Block ER236 or may potentially be affected by the project activities are described in this section.

(1) DAFF. 2016. Small-Scale Fisheries. A guide to the small-scale fisheries sector. http://small-scalefisheries.co.za/wp-content/downloads/SSF%20Booklet%20English.pdf

Large Pelagic Long Line

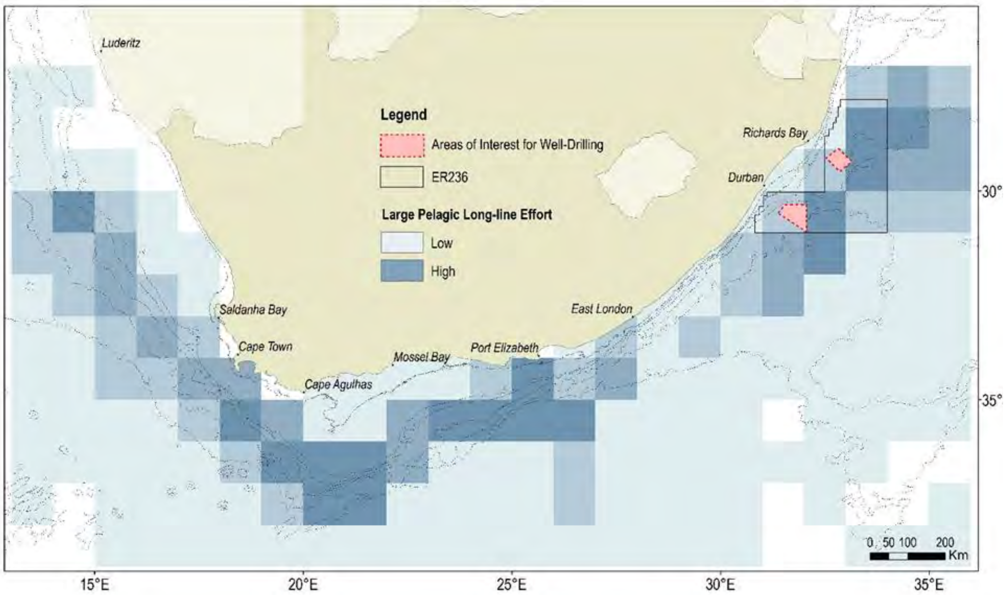
Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African Exclusive Economic Zone (EEZ) by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) 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 long-liners, 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.

The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore. As indicated in *Figure 4.31*, the Block ER236 coincides with the spatial distribution of pelagic long-line fishing effort.

Figure 4.31 Spatial Distribution of National Pelagic Long-line Fishing Effort



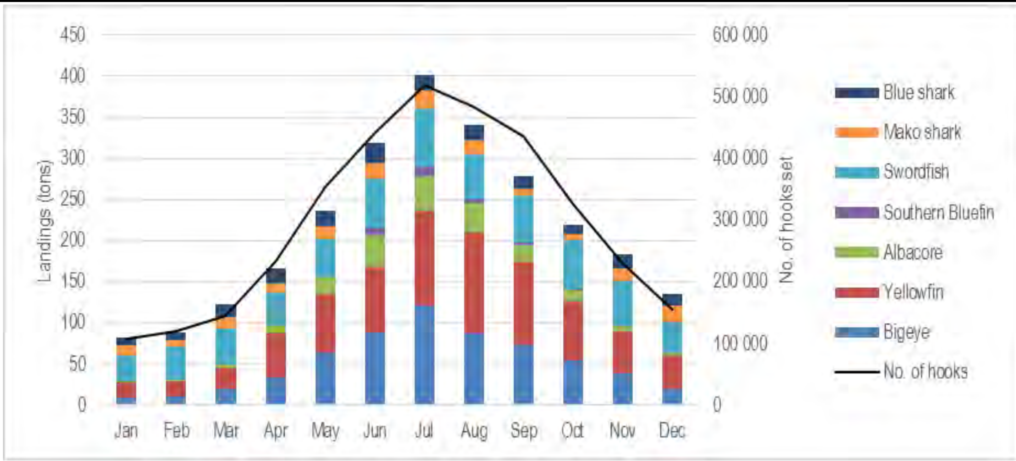
Note: The fishing effort is expended by the long-line sector targeting large pelagic species in relation to ER236 and the proposed areas of interest

Source: Capmarine, 2017

The fishery operates year-round with a relative increase in effort during winter and spring (*Figure 4.32*). Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications.

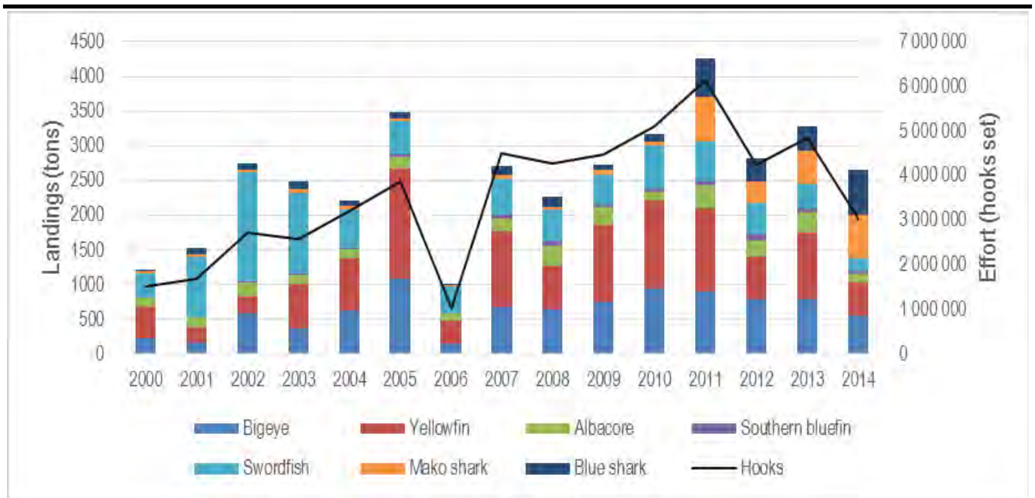
Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE (Punsly and Nakano, 1992). During the period 2000 to 2014, the sector landed an average catch of 4,527 tons and set 3.55 million hooks per year. Catch and effort figures reported by the fishery for the years 2000 to 2014 are shown in *Figure 4.33*

Figure 4.32 Intra-Annual Variation of Catch and Effort Recorded by the Large Pelagic Long-Line Sector (Average Figures for the Period 2000 – 2014)



Source: Capmarine, 2017

Figure 4.33 Inter-Annual Variation of Catch Landed and Effort Expended by the Large Pelagic Longline Sector (2000 - 2014).



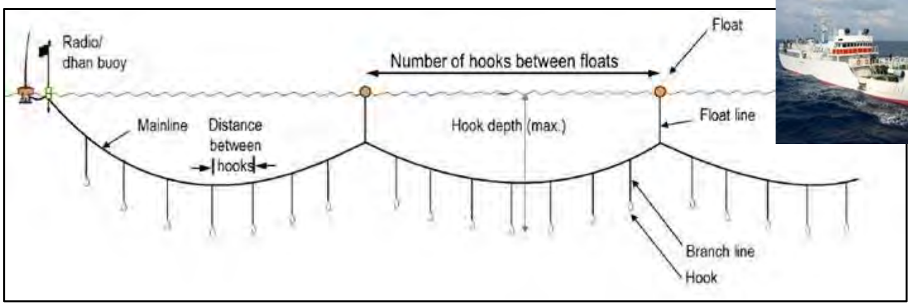
Source: Capmarine, 2017

Gear consists of monofilament mainlines of between 25 km and 100 km in length which are suspended from surface buoys and marked at each end (see *Figure 4.34*). As gear floats close to the water surface, it can present a potential obstruction to surface navigation.

The main fishing line is suspended about 20 m below the water surface via dropper lines connecting it to surface buoys at regular intervals. Up to 3,500 baited hooks are attached to the mainline via 20 m long trace lines, targeting fish at a depth of 40 m below the surface. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a dahn buoy and radar reflector, which marks the line position for later retrieval.

Lines are usually set at night, and may be left drifting for a considerable length of time (up to 18 hours) before retrieval, which is done by means of a powered hauler at a speed of approximately one knot. During hauling, vessel manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped and hauled in at a later stage.

Figure 4.34 Typical Configuration of Long-Line Gear Targeting Pelagic Species (Left)



Note: This figure also includes a photograph of mainline with dropper line and trace line (upper right) and photograph of typical high seas long-line vessel (upper right).

Source: Capmarine, 2017

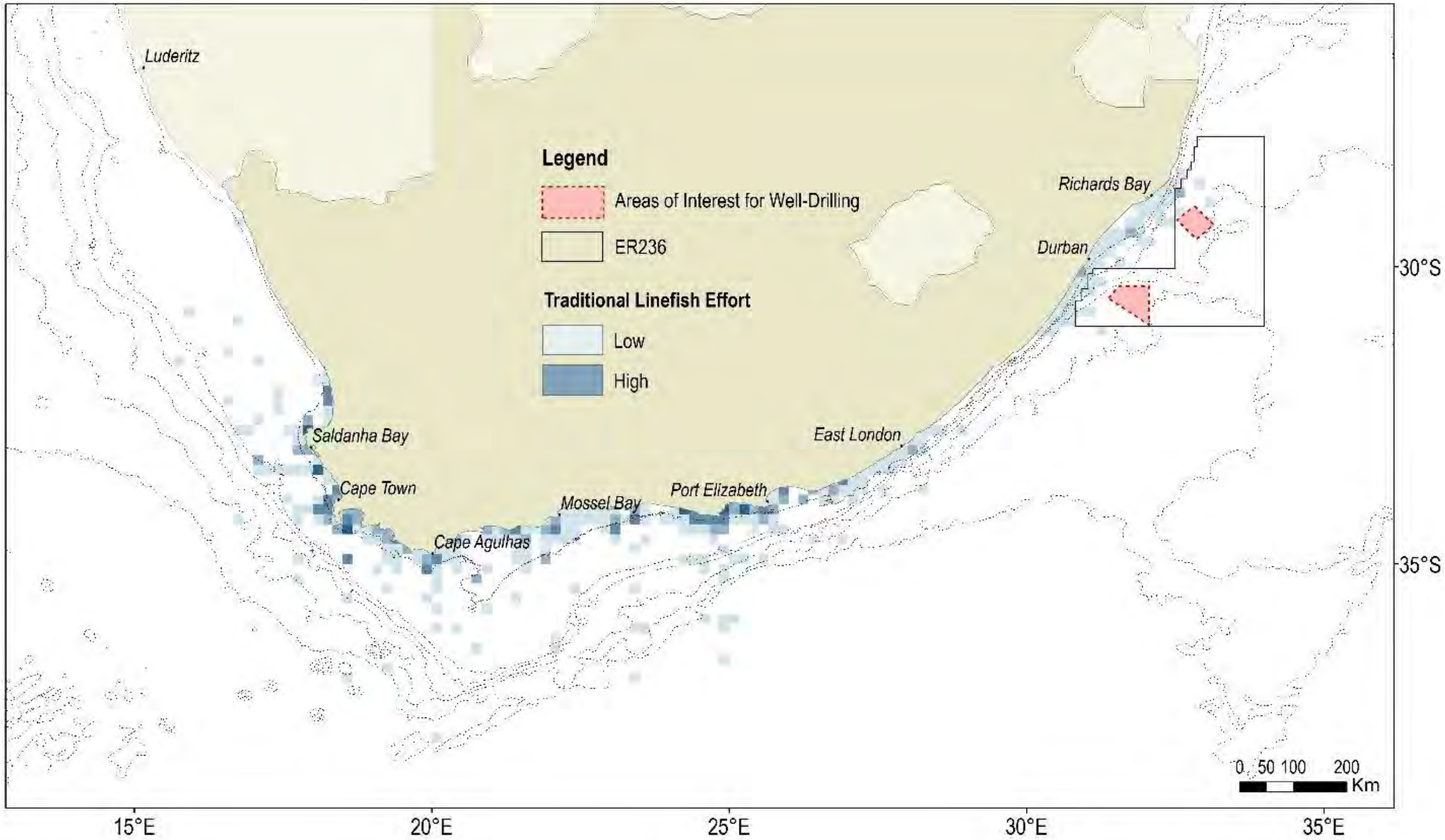
Traditional Line Fish

The traditional line fishery is the country's third most important fishery in terms of total tons landed and economic value. It is a long-standing, nearshore fishery based on a large assemblage of different species. 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*). The fishery is widespread along the country's shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast *(Figure 4.35)*.

Effort is managed geographically with the spatial effort of the fishery divided into three zones. Most of the catch (up to 95 percent) 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 generally range up to a maximum offshore distance of about 70 km, although fishing at this outer limit and beyond is sporadic (C. Wilke, pers. comm[1]). The spatial distribution of line-fishing effort coincides with inshore areas of Block ER236.

[1] Mr C. Wilke (christopherW@daff.gov.za) is the chief technician at DAFF and is the principle contact for linefish data collation.

Figure 4.35 Spatial Distribution of Fishing Effort Expended by Traditional Line-Fish Sector



Source: Capmarine, 2017

Crustacean Trawl Fishery

South Africa's crustacean trawl fishery operates exclusively within the province of KZN. The fishery consists of inshore and offshore sectors, which differ according to their targeted species, areas of operation and gear types. 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. There are currently five vessels operating within the inshore grounds with another two vessels restricted to working in the offshore grounds only.

The KZN prawn trawler fleet comprises steel-hulled vessels ranging in length from 25 to 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.

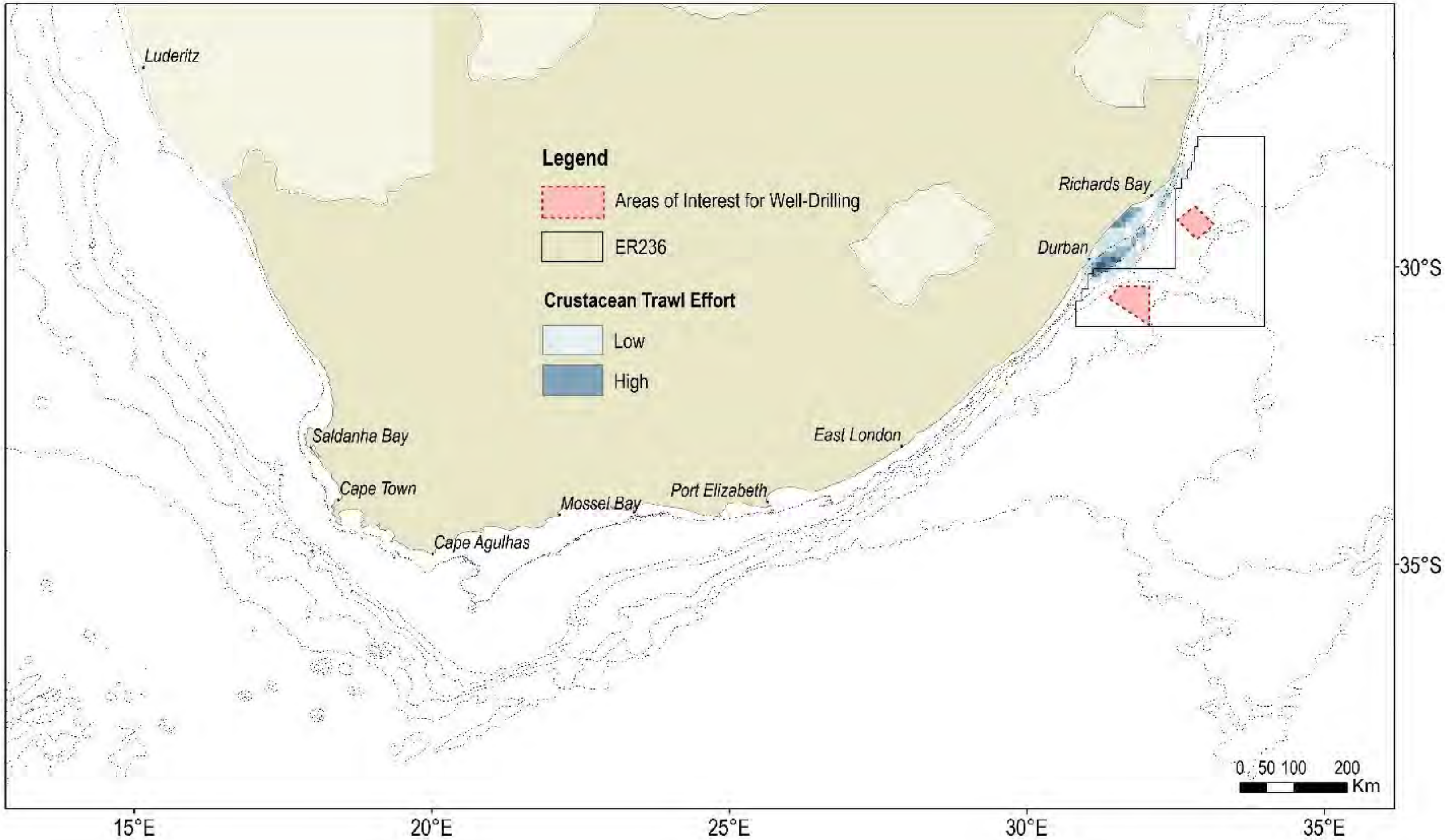
The inshore fishery is based on white prawns (*Fennereopenaeus indicus*), tiger prawns (*Penaeus monodon*) and brown prawns (*Metapenaeus monoceros*) which occur on the shallow water mud banks along the north-eastern coast of KZN. There are few areas within the habitat distribution of penaeid prawns that are suitable for trawling due to the steep drop off of the continental shelf on the East Coast. The inshore fishery operates on the Tugela Bank in water depths of up to 50 m and within 10 nautical miles (approximately 18.5 km) of the shore. There is a seasonal closure of the Tugela Bank grounds in order to minimise 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 percent prawn species, while approximately 10 percent 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 (12.9 km) 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.

Figure 4.36 indicates the location of fishing grounds in relation to the Block ER236. There is a potential overlap of the crustacean trawl fishery with the Block ER236.

Figure 4.36 Spatial Distribution of Effort Expended by the Crustacean Trawl Fishery



Source: Capmarine, 2017

Small-Scale Fisheries

Small-scale fishers fish to meet food and basic livelihood needs, and may be directly involved in harvesting, processing and distribution of fish for commercial purposes. These fishers traditionally operate on nearshore fishing grounds, using traditional low technology or passive fishing gear to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually a single day in duration and fishing/harvesting techniques are labour intensive.

The equipment used by small scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps. Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities. In the Eastern Cape and KwaZulu-Natal, small-scale fishers live predominantly in rural areas.

Small-scale fisheries resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner in line with the ecosystems approach. The Department of Agriculture Policy for the Small Scale Fisheries Sector in South Africa proposes that certain areas on the coast be prioritized and demarcated as small-scale fishing areas. In some areas, access rights could be reserved exclusively for use by small-scale fishers. The community, once they are registered as a community-based legal entity, could apply for the demarcation of these areas and should conflict arise, it should be referred to conflict resolution under the Policy. The Policy also requires a multi-species approach to allocating rights, which will entail allocation of rights for a basket of species that may be harvested or caught within particular designated areas.

DAFF recommends five basket areas as shown in *Table 4.7.*

Table 4.7 Small-scale Fishery "Basket" Areas

Basket Area	Coastline	Number of Resources
Basket Area A	The Namibian border to Cape of Good Hope	57 different resources
Basket Area B	Cape of Good Hope to Cape Infanta	109 different resources
Basket Area C	Cape Infanta to Tsitsikamma	107 different resources
Basket Area D	Tsitsikamma to the Pondoland MPA	138 different resources
Basket Area E	Pondoland MPA to the Mozambican border	127 different resources.

The small scale fishery sector operates in "nearshore" waters (not likely to extend beyond 3 nm from the coast (approximately 5.5 km) and, therefore, would not directly coincide with the proposed drilling areas.

Small-scale fisheries are divided up into four categories, namely:

- Subsistence linefishery;
- Kosi Bay traditional trap;
- Illegal gill and seine net; and
- Beach invertebrates.

Each of these are described in more detail below.

<u>Subsistence Linefishery</u>

Subsistence fisheries refer to fisheries where people harvest fish or other marine organisms in close proximity to where they live as a means to meet their basic needs of food security (Branch *et al*. 2002). Generally these fishers' fish along the sea or estuary shore and they cannot afford vessels of any type. Gears are often old, second-hand or home-made rods and reels or hand-lines and the fishers usually collect their own bait (such as mussels, red bait, mole crabs or sand prawns). These fishers seldom catch enough fish to sell and most fish caught are for personal or family consumption to supplement their diet. In occurrences where large catches are made, the surplus may be sold or bartered.

Clark *et al*. (2002) estimated that there were approximately 21,641 households along the KZN coast involved in subsistence fishing. However this is believed to be a substantial overestimate as Dunlop (2011), showed that "true" subsistence linefishers made up a relatively small percentage (3-6 percent) of the total number of shore fishers, which was estimated at approximately 65,000 in 2010 (Dunlop 2011), ie the best estimate is between 2,000 and 4,000 subsistence linefishers. Approximately 2,500 people from 23 KZN communities participate in seven types of fisheries. In 2012, through established local fishing co-management structures, formal applications were received for fishing rights (exemption permits) for 938 subsistence linefishers from 12 recognised subsistence fishing communities including: Kosi Bay, Mabibi, Mbila/Sodwana Bay, Sokhulu, Nhlabane/Mbonambi, Port Durnford, Mpembeni, Amatikulu, Nonoti, Umgababa, Mfazazana/Mthwalume and Nzimakwe/Port Edward.

In terms of the annual amount of food harvested, it is estimated that the subsistence shore fishery harvests approximately 23 t of linefish in the marine and estuarine environments per annum (Mkhize 2010, Kyle 2013c, WIOFish 2013). Based on the estimates made by Dunlop (2011), the total subsistence linefish catch for the seashore was in the region of 16 t per annum.

Due to the nature of the subsistence shore fishery and the fact that many participants are not formally permitted, total effort is extremely difficult to estimate. Based on the results from Dunlop (2011) best estimates for the marine subsistence shore linefishery would be between 24,000 and 48,000 fisher-days per annum.

Limited information is available regarding the economic value of the subsistence linefishery. Reported value of the total annual catch ranges from R150,000 (Mkhize 2010) to R920,000 (based on figures cited in WIOFish 2013).

Kosi Bay Traditional Trap

Traditional traps are used in the Kosi lakes system extending from just inside the estuary mouth into the Makhawulani, Mpungwini and Nhlange lakes. These traps have been in operation in the Kosi Lakes for many generations. The traps are semi-permanent and are constructed to direct fish into a basket from which they cannot exit. The traps mostly target fish that move at night from the lakes to the ocean. They are caught in the baskets during the night and are speared and removed by the fishers in the morning.

There are approximately 150 fishers active in the fishery (WIOFish 2013). In 2012 there were an estimated 64 392 fish caught in the traps weighing approximately 66 t (WIOFish 2013). Fishers obtained approximately R50 per kg for their catch in 2012 (WIOFish 2013). The total income from the catch would therefore be approximately R3.3 million.

Rocky Shore and Sandy Beach Invertebrate Fishery

Small-scale/subsistence fishers living along the KZN and Wild Coast collect a variety of organisms including both mobile and sessile invertebrates living on intertidal rocks and sandy beaches. Harvesters living south of the iSimangaliso Wetland Park collect mostly mussels off the rocks and there is some illegal collection of rock lobsters (*Panulirus* spp). There are approximately 300 fishers in the iSimangaliso Wetland Park but this may be an over-estimation as fishers may collect more than one type of target organism. Invertebrate collectors living along the remainder of the KZN coast number approximately 256 and the number of illegal lobster fishers is unknown.

Total catches (2011) for the various components of the small-scale invertebrate fishery as reported in WIOFish (2013) are mangrove crabs (8 043 kg), ghost crabs (200 kg), mole crabs (100 kg), mixed invertebrates (1700 kg) and mussels (9000 kg).

A total of 470 small-scale intertidal fisher exemption permits were applied for in 2013. The number has been steadily increasing since 2007. The increase can indicate either new entrants to the fishery or higher compliance by existing fishers of the interim fishery regulations.

Fishers have few costs except for the purchase of collection tools such as knives, scrapers, screwdrivers and hoes and, in some cases, transport to their fishing grounds. The real value of this fishery was that it often offered the ability for some of the poorest people living along the coast to collect good quality food, especially in the time before substantial social grants.

Illegal Gill and Seine Net

Illegal gill and seine-netting has been taking place in a number of KZN rivers, estuaries and freshwater impoundments since at least the early 1950s (Mann 1995, 2003, Kyle 1999, 2003). Monofilament gill-net is s*et al*ong estuary margins, across estuary channels, into estuarine lakes or across river channels targeting a range of different fish species. The length of net can be between 10 and 1000 m and from 2 to 4 m wide. Most netting was carried out on foot but more recently and particularly in larger estuaries such as Lake St Lucia, primitive home-made boats are used to set the nets. The seine-nets used in this fishery range from properly made nets with a weighted footrope, a buoyed float-line and a bag with a cod-end, to simple pieces of shade cloth that are dragged through the water.

Seine-netting is an active method of fishing normally done by swimming the net out and pulling it into shore during the day with the main target being swimming prawns (Penaeidea). This should not be confused with the legal beach seine and drag net fisheries. Many of the people involved in these net fisheries are unemployed/ rural people living in close proximity to estuarine systems. However, as it is an illegal fishery, much of the netting now being carried out is commercially motivated and well organised by poaching syndicates with fish buyers coming into rural areas with freezers in vehicles to purchase the fish and/or prawns which are then sold at nearby and distant markets.

The main estuarine systems where illegal gill-netting is taking place include Kosi Bay, Lake St Lucia, Umfolozi/Msundusi, Lake Nhlabane, Richards Bay Harbour, Mhlatuze, Umlalazi, Amatikulu/Nyoni, Thukela, Zinkwazi, Umgeni and Durban Harbour (Beckley *et al*. 2000). Due to its illegal nature, estimates of total catch from this fishery are not available.

During 2012 EKZNW anti-poaching patrols removed and destroyed a total of approximately 26 km of illegal gill and seine-nets from Lake St Lucia, as well as 56 boats. Many more kilometres of netting were removed from other estuaries.

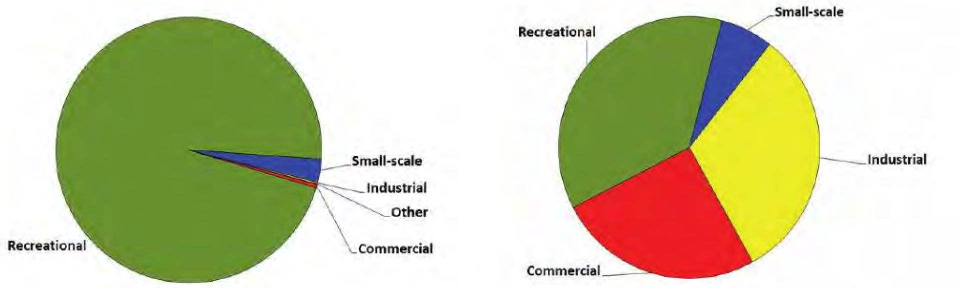
Recreational Fishery

The recreational sectors that are active off the KZN coastline comprise shore-based, estuarine and boat-based line fisheries as well as spearfishing. Net fisheries for recreational purposes include cast, drag and hoop net techniques. Overall, recreational fisheries account for the most fishers in the province.

In terms of catches, the industrial fisheries contribute the most to the total catch for KZN but this is followed closely by the recreational fisheries and commercial fisheries (see *Figure 4.37*).

A description of each is presented below with information derived from the special publication on KZN's marine and estuarine fisheries produced by the Oceanographic Research Institute (2014), in conjunction with Ezemvelo KwaZulu-Natal Wildlife (EKZNW).

Figure 4.37 Proportion of fishers that contribute to overall participation in KwaZulu-Natal (left) and proportion of fisheries that contribute to total catch in KwaZulu-Natal (right) (ORI, 2014)



<u>*Shore-Based Line Fishery*</u>

Shore-based fishing (angling), is a recreational activity that takes place from the shoreline, using a hook and line. The fishery is open access and widely distributed along the entire KZN coastline (Dunlop & Mann 2012). This makes it accessible to a wide variety of communities, ranging from subsistence fishers to recreational/social and competitive anglers (Dunlop & Mann 2012). Shore-based fishing has a long-standing historical presence in the province, and easy access and relatively low gear and entry costs make recreational shore fishing the largest marine fishery in KZN in terms of the number of participants (Brouwer *et al*. 1997; McGrath *et al*. 1997; Dunlop 2011). In 2009/10, the total number of recreational shore anglers active in the fishery was estimated at between 41,283 and 68,087 anglers (Dunlop & Mann 2012). It was also estimated that between 8,463 and 13,958 shore anglers (20.5%) visit KZN annually from other provinces or countries (Dunlop & Mann 2012).

A wide variety of fish species are targeted, including shad (*Pomatomus saltatrix*), karanteen (*Sarpa salpa*) and blacktail (*Diplodus capensis*), with a limited amount of overlap in the species captured from the shore and in the offshore boat-based linefishery (Dunlop & Mann 2012). Catch per unit effort (CPUE) for the KZN shore fishery in 2009/10 was approximately 0.82 fish per angler-day or 0.32 kg per angler-day (Dunlop & Mann 2012). This amounts to approximately 263 t of fish per annum based on the estimates of total shore angling effort and CPUE (Dunlop & Mann 2012).

Total shore angling effort was calculated to be 779,382 to 843,702 angler-days per annum in 2009/10 (Mann *et al*. 2008; Dunlop & Mann 2012).

The most recent economic survey of the KZN shore fishery was conducted by Dunlop (2011) in 2009-10. Based on the estimated total catch of 263 t and the wholesale (first point of sale) value of linefish at that time (ie approximately R30/kg), the total value of the catch was estimated at R7.9 million.

Estuarine Linefishery

Estuaries are highly productive and dynamic ecosystems providing an important nursery habitat for juvenile fish and feeding grounds for some adult species. Recreational estuarine fishing in KZN occurs in four major estuarine systems, namely Durban harbour (Guastella 1994, Pradervand *et al*. 2003), Richards Bay harbour (Everett & Fennessy 2007, Beckley *et al*. 2008), Lake St Lucia (Mann *et al*. 2002) and Kosi Bay (James *et al*. 2001). Anglers predominantly use light tackle to fish from the estuary shore and from small boats in water depths not exceeding 25 m in harbours and seldom exceeding 5 m in St Lucia and Kosi Bay.

The overall participation in the KZN recreational estuarine fishery as a whole is estimated to be 50 000 anglers (Lamberth & Turpie 2003). Catch composition varies according to location but consists of spotted grunter, dusky kob (*Argyrosomus japonicas*), Natal stumpnose, mullet (Mugilidae), riverbream/perch (*Acanthopagrus vagus*) and a variety of other species. In 2012, EKZNW recorded an overall shore-based CPUE for the estuarine fishery of 0.06 fish.angler-1.hour-1 (Maggs *et al*. 2013). Total annual recreational catch retained in the four major systems is approximately 85,000 fish (approximately 103 t) (James *et al*. 2001, Mann *et al*. 2002, Pradervand *et al*. 2003, Everett & Fennessy 2007, Beckley *et al*. 2008) and total recreational angling effort in the four major estuarine systems is approximately 850,000 angler hours per year (James *et al*. 2001, Mann *et al*. 2002, Pradervand *et al*. 2003, Everett & Fennessy 2007, Beckley *et al*. 2008). Fish may not be sold; however, based on the estimated total catch and the value of fresh fish of approximately R40/kg (2014, first point of sale), the landed catch is worth R4.1 million. Lamberth and Turpie (2003) estimated the overall economic contribution of the estuarine shore-based recreational sector in KZN at R84.5 million per year.

Boat-Based Fishery

The marine recreational boat-based fishery comprises various types of vessels from paddleskis (also known as fishing-skis) to large harbour-based vessels >10 m. However, the most common vessel used for recreational offshore fishing along the KZN coast is the skiboat. Skiboats are compact, trailer-able, beach-launched vessels 5-10 m long, usually powered by twin outboard engines and are more affordable, fuel efficient and cheaper to run than large, harbour- based vessels (Penney *et al*. 1999).

These vessels are launched at beach launch sites and from harbours and give access to most offshore areas along the KZN coast (Dunlop & Mann 2013). Due to the recreational nature of the fishery, a large range of fishing gear is used depending on the target species. When bottom fishing for reef fish, sturdy fibreglass rods and Scarborough type reels are preferred, very similar to those used by commercial fishers. When targeting game fish (the most commonly targeted species), expensive graphite trolling rods fitted with multiplier reels will be used while trolling lures or live bait are used at varying depths depending on the species being targeted. A wide variety of pelagic and demersal reef fish species are caught (approximately 78 species), including yellowfin tuna (*Thunnus albacares*), slinger (*Chrysoblephus puniceus*), dorado (*Coryphaena hippurus*), black musselcracker (*Cymatoceps nasutus*), eastern little tuna (*Euthynnus affinis*), blue emperor (*Lethrinus nebulosus*), chub mackerel (*Scomber japonicus*) and Englishman (*Chrysoblephus anglicus*) (Dunlop & Mann, 2013). There is considerable overlap in the species captured between the recreational, charter and commercial sectors of the offshore boat-based linefishery (Dunlop & Mann 2013).

The total number of recreational boat fishers participating in the KZN offshore boat-based linefishery was estimated at between 7,662 and 9,991 anglers in 2009/10, operating from an estimated 2,448 to 3,192 boats (Dunlop & Mann 2013). In addition, there are a minimum of 650 active participants in the paddleski fishery annually (Mann *et al*. (2012). CPUE during a 2009/10 survey was 8.58 fish per boat outing, or 15.0 kg per boat outing and the total annual catch was estimated at 457 t per annum (261,132 fish per annum) (Dunlop & Mann 2013).

During 2012 there were approximately 26,913 recreational boat launches undertaken for the purpose of recreational fishing along the KZN coast (Mann *et al*. 2013) with an addition estimated number of 6,685 paddleski launches made annually (Mann *et al*. 2012).

The most recent economic survey of the KZN recreational boat-based linefishery was conducted by Dunlop (2011). Based on the estimated total catch of 457 t and the wholesale (first point of sale) value of linefish at that time (ie approximately R30/kg), the total value of the catch was approximately R13.7 million.

Cast Net Fishery

This recreational fishery is active in the shallow regions of estuaries, harbours and the intertidal zone of beaches (WIOFish 2013) with a quota system of cast net licences that are endorsed by EKZNW for use on specific estuaries. Fishermen operate from the shore, throwing a small circular net, weighted at the circumference, in such a way that the cast net spreads out on the water and sinks, entrapping fish.

In 2012, 1,233 annual cast net permits and an additional 113 temporary permits were issued in KZN (ICS 2013). The total fishing effort in KZN is unknown. A total of 182 cast netters were encountered on 102 EKZNW shore patrols conducted in 2012 (ICS 2013). The potential economic value of this fishery is unknown as there is no information on total catch.

Drag Net Fishery

This small recreational fishery is conducted in estuaries using a drag net to capture juveniles of several penaeid prawn species (WIOFish 2013). A vessel may not be used (Tomalin 1995). In 2012, a total of 169 drag net permits were issued, and an additional 155 permits purchased in the previous year were still valid in 2012 (ICS 2013).

There is no reliable catch information for this fishery, but total annual catch is estimated to be less than 100 kg (ORI, 2014). Catches made in this fishery may not be sold and are mainly used for bait.

Hoop Net Fishery

This recreational fishery targets small baitfish and squid in harbours and estuaries of KZN (Tomalin 1995). Animals are collected using a net that is attached to a hoop at the end of a pole. The fishery was suspended from 2005 to 2009, but in 2010, hoop net permits were again sold in KZN (ICS 2013). Based on permit sales at KZN post offices, a total of 302 fishers bought 81 annual and 221 temporary hoop net permits in 2012. A further 77 hoop net permits sold in 2011 was also still valid in 2012 (ICS 2013). There is no information on fishing effort. The potential economic value of this fishery is unknown as there is no information on total catch.

4.4.4 Recreational Coast and Ocean Uses

Recreational use of the East Coast and Wild Coast marine environment involves both consumptive and non-consumptive uses. The former involves coastal and boat-based users removing marine resources for their own consumption (e.g. recreational fishing, refer to *Section 4.4.2* for a description of recreational fishing*)*, while the latter involves users making use of the marine environment without removing any marine resources from the area.

Consumptive Uses

Consumptive uses of marine resources along the East Coast includes recreational shore and boat-based anglers (Brouwer *et al*., 1997), spearfishers (Mann *et al*, 1997), divers collecting subtidal invertebrates, and exploiters of intertidal organisms. The recreational use of marine resources along the East Coast and Wild Coast typically occurs within inshore waters in the vicinity of coastal towns and holiday resorts, and is closely linked to tourism.

As the northern area of interest is located a minimum of 62 km offshore and the southern area of interest a minimum of 65 km offshore, it is unlikely that the proposed exploration drilling activity will interfere with onshore recreational users. There is however a possibility that the offshore recreational boat-based fishing activities could be affected if they travel offshore and into the Block ER236.

Non-Consumptive Uses

Non-consumptive utilisation of the marine environment along the East Coast and the Wild Coast includes water sports such as surfing, boat sailing, power boating, diving, and nature watching and beach recreation. The use of the coastal and marine environment is a big driver for tourism along the coast (as described in *Section 4.4.1*).

As noted above, Block ER236 is located from 20 km offshore and thus sailing/ boating activities are unlikely to occur within Block ER236. However, there is a possibility of encountering sailing vessels passing into or out of South African waters.

4.4.5 Marine Traffic

A large number of vessels navigate along the East Coast on their way around the southern African subcontinent. The majority of this boat traffic, including commercial and fishing vessels, remains relatively close inshore on the East Coast. North- and south-bound cargo vessels usually remain over the mid-shelf (100 m isobath). In contrast, tankers and bulk carriers remain further offshore, unless needing to move inshore to avoid extremely rough conditions that develop in the Agulhas Current. Block ER236 may overlap with the routes taken by tankers and bulk carriers. The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Richards Bay or the Port of Durban. Important East Coast commercial harbours include Port Elizabeth, East London, Durban and Richards Bay.

4.4.6 Underwater Cultural Heritage

South Africa has a rich and diverse underwater cultural heritage. 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 2,400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s. This 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.

In addition to historical shipwrecks, the record of South Africa's long association with the sea is much broader and extends far back into prehistory.

This element of our maritime and underwater cultural heritage is represented around the South African coast by thousands of pre-colonial shell middens and large numbers of tidal fish traps, which reflect prehistoric human exploitation of marine resources since the Middle Stone Age, more than 150,000 years ago. 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.

Submerged Prehistory

Global sea levels have fluctuated substantially on at least three occasions during the last 500,000 years. As with modern sea level change, these changes have been the result of increased and decreased polar glaciation tied to global climatic patterns. 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, Weichselian glaciation, the sea was more than 120m lower than it is today (Van Andel 1989).

The lower sea levels of the Weichselian (c. 115,000 - 11,700 years ago) and earlier Saalian (c. 352,000 - 130,000 years ago) and Mindel (c. 478,000 - 424,000 years ago) glaciations would at times 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. 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 80,000km² in extent during the successive glacial maxima (Fisher *et al* 2010). *Figure 4.38* below gives an indication of the extent of the continental shelf exposure during the second to last glaciation.

Figure 4.38 Possible extent of the South African Continental Shelf c. 137,000 Years Ago during the Saalian glaciation

Source: Franklin *et al*, 2105
Note: Approximate location of Kleinzee marked by the red star.

The exposed continental shelf was quickly populated by terrestrial flora and fauna, and also by our human ancestors who were dependant on these resources. 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 Late 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).

Shipwrecks

On Christmas Day 1497, the coast in the vicinity of what is now Durban was sighted by a small Portuguese fleet under the command of Vasco da Gama and named Terra Natalis in commemoration (Axelson 1973). Da Gama's was the first European maritime incursion into the Indian Ocean and his success in reaching of India four months later laid the foundation for more than 500 years of subsequent European maritime activity in the waters of the south western Indian Ocean.

The Portuguese and other European nations who followed their lead into the Indian Ocean 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 (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.

European maritime activity along the KwaZulu-Natal (KZN) coast was, until the establishment and expansion of colonial settlement in the Cape and Natal colonies, largely transitory in nature, with most maritime traffic transitting these waters, en route elsewhere. There were, nevertheless, from the very start, numerous shipping casualties along the adjacent coast, the earliest recorded on the KZN coast being the Sao Joao, a Portuguese nau wrecked at Port Edward in 1552, south of Block ER236 (Axelson 1973; Burger 2003).

As is clear from the available shipwreck records for the KZN coast, the bulk of these casualties occurred close inshore, with relatively few of the recorded losses occurring in deeper waters, further from the coast. Reasons for this are varied but include the fact that early European shipping, with rudimentary charts and navigational technology, would have hugged the coast. The later presence of a port at Durban would have drawn vessels sailing in deeper waters in towards the coast - during World War I, for example, when Durban became an important port for taking on coal bunkers - where shipping hazards are greater than further offshore (Ingpen 1979).

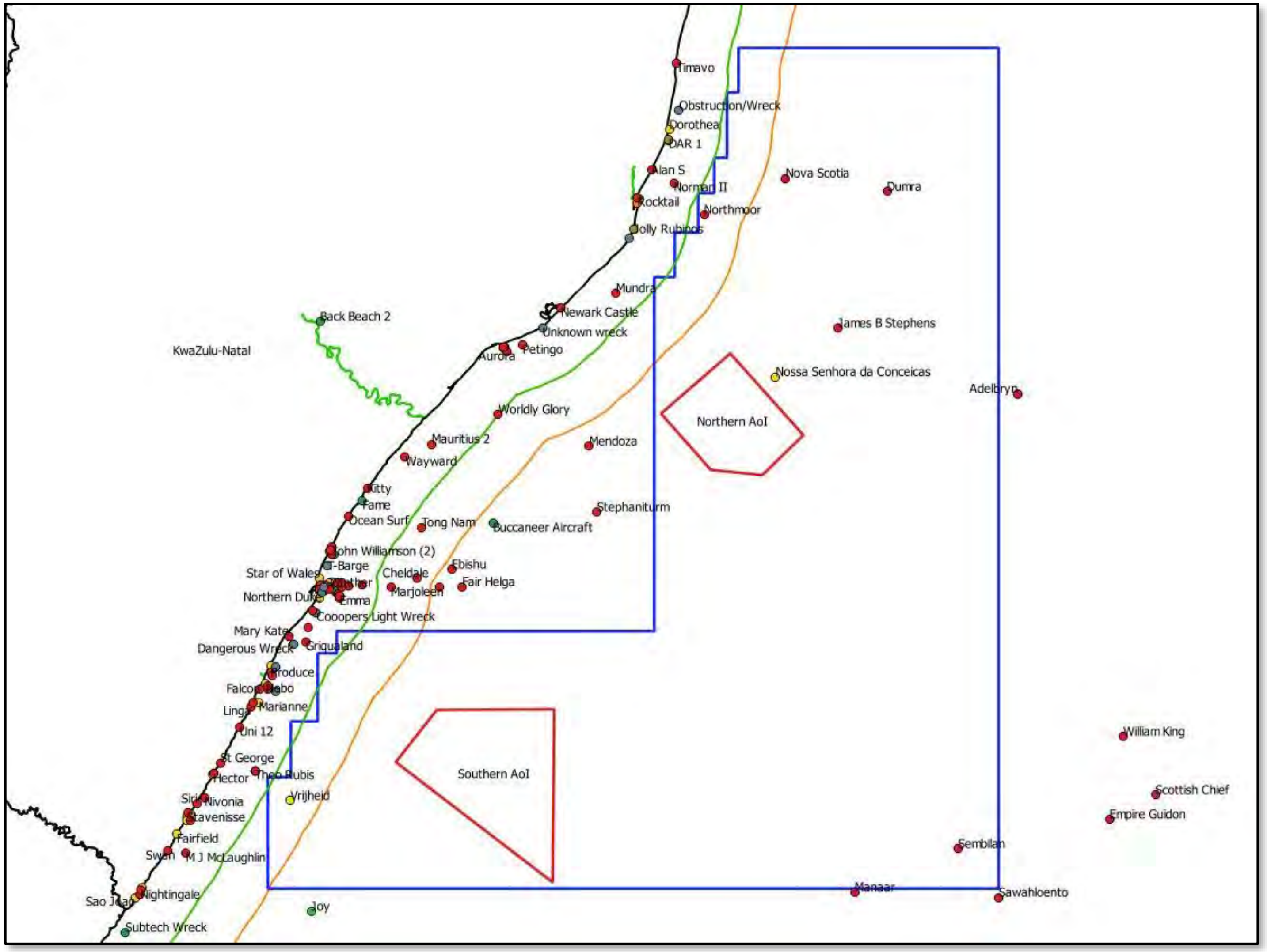
In the broader study area defined for this assessment, there are records of seven maritime losses. Based on their given positions none of these wrecks are located within either of the two Areas of Interest for exploration drilling, although the level of confidence in the available positions is generally low.

All but two of the wrecks are 20th century losses related to German and Italian U-boat activity in the approaches to the Mozambique Channel during World War II. The remaining two wrecks are sailing vessels that date from the second half of the 19th century.

The details of the seven known wrecks are as follows:

- Dumra – British motor vessel, 5 June 1943;
- James B Stephens - merchant steamship, 8 March 1943;
- Northmoor - steam cargo vessel, 17 May 1943;
- Nossa Senhora da Conceicas - Portuguese vessel (possible slave ship), 29 May 1869;
- Nova Scotia - passenger steamship, 28 November 1942;
- Sembilan - Dutch steamship, 17 April 1943; and
- Vrijheid - Dutch brig, 30 April 1883.

Figure 4.39 Locations of Shipwrecks off the East Coast of South Africa



Note: The limit of South African territorial waters and the maritime cultural zone are shown in green and orange respectively. The positions of the seven wrecks discussed in the report below are shown within the study area defined by the limits of Block ER236.

In its response to the draft Scoping report, SAHRA mentioned the possibility that the wreck of the steamship *Waratah*, which went missing without a trace in 1909, may be in the study area. The last reported sighting of a vessel believed to be the *Waratah* took place in very heavy weather on the evening of 26 July 1909, roughly 180 miles south of Durban. Other reports suggested she sank off the Mbashe River in the former Transkei, and bodies and wreckage possibly associated with the *Waratah* were found as far south as Mossel Bay (Smith 2009). Although there was speculation at the time of her disappearance that the *Waratah* was disabled and afloat, searches of the sea both the north and south of the coast of the former Transkei found no trace of her. It is most likely that the *Waratah* sank in the area she was last seen, in the vicinity of the Mbashe River, although recent geophysical surveys have not located the wreck (Brown, 2016). It is unlikely that the wreck is located within the proposed Areas of Interest for the exploration drilling.

As stated above, however, gaps in South Africa's underwater cultural heritage record mean that the potential does exist for currently unknown or unrecorded wrecks to be present within the study area.

4.4.7 Mineral and Petroleum Prospecting and Exploration Rights and Activities

Exploration activities are being undertaken in neighbouring oil and gas blocks including the following Exploration Rights:

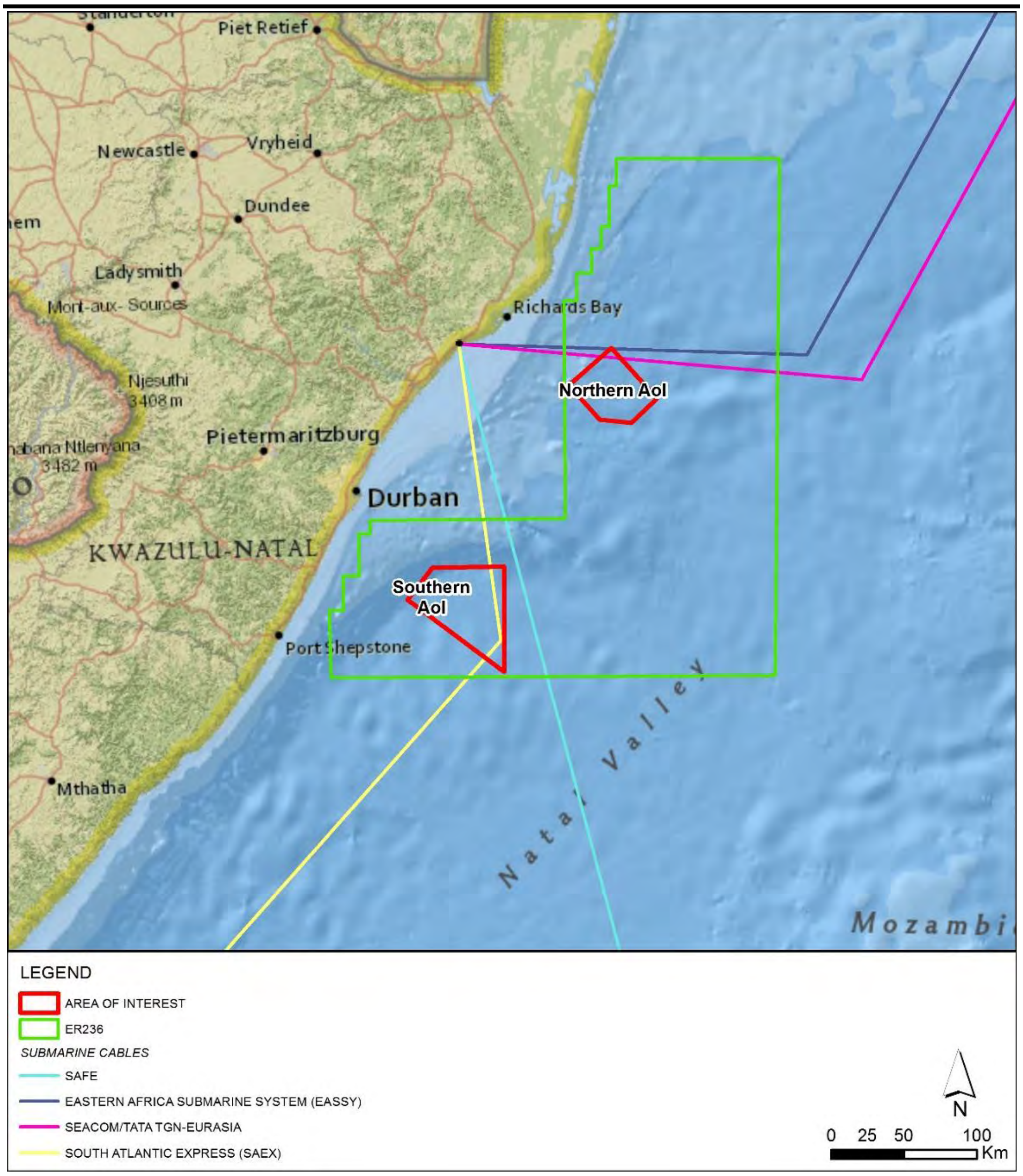
- Tugela South operated by EMEPSAL to the north-west.
- DeepWater Durban operated by EMEPSAL to the south.
- Silverwave deepwater block to the east.

No mineral prospecting activities are currently being undertaken within Block ER236, which is situated in deep water. Although some mineral prospecting has taken place in South African waters, commercially viable ore has not been found.

4.4.8 Submarine Cables

There are a number of submarine telecommunications cable systems in South African waters (*Figure 4.40*). The SAExpress, SAFE, EASSy and Seacom cables land at Mtunzini, located approximately 40 km south of Richards Bay. All four cables pass through Block ER236.

Figure 4.40 Submarine Cables



4.5 SUMMARY OF KEY SENSITIVITIES

Table 4.8 Summary of Key Sensitivities

Feature	Description
Seabed features and benthic habitat	• The northern area of interest for well drilling lies offshore, east of the Natal Bight in >1,500 m water depth. • The southern point of the northern area of interest overlaps with a portion of the Goodlad Canyon. It should however be noted that no drilling will be undertaken within the canyon. • The Goodlad Canyon lacks connectivity to the shelf and are too deep to be able to provide suitable habitat or food sources for coelacanths and therefore it is unlikely that coelacanths will be found in this canyon.

Feature	Description
	• In the northern area of interest for well drilling, Southwest Indian Upper and Lower Bathyal benthic habitats (habitats occurring on the seabed) are found, whereas Southern Indian Lower Bathyal benthic habitat dominates in the southern area of interest, both of which have been assigned an ecosystem threat status of 'least threatened' in the SANBI 2011 National Biodiversity Assessment. • The benthic communities within these habitats are generally the same throughout the southern African East Coast region, differing only by seabed type and/or depth zone.
Coelacanths	• Coelacanths are a rare order of fish known to inhabit canyons in the western Indian Ocean. They were recorded in a submarine canyon off St Lucia in November 2000 (Venter *et al*., 2000). • Coelocanths were also recorded off Sodwana Bay at depths ranging between 90 to 140 m in the canyons where abundant shelter was offered by structures such as caves, overhangs or broken boulder areas (Hissman *et al*., 2006). • The Tugela and Goodlad Canyons lie in close proximity to the southern and northern areas of interest for drilling respectively. Together with the fact that these canyons lack connectivity to the shelf, and suitable food sources are likely to be limited at the depths of these canyons, it is suggested that the Tugela and Goodlad Canyons are unlikely to offer suitable habitat for coelacanths. Additionally, no drilling will be done within canyons.
Deep Water Corals	• The occurrence of deep water corals in Block ER 236 and the areas of interest are unknown.
Whales and Dolphins	• There are 36 species of whales and dolphins (cetaceans) that are likely to be found within Block ER236. Of the 36 species, the Antarctic Blue whale is 'critically endangered', the Indo-Pacific 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 IUCN South African Red Data book List Assessment. • The most common species within the area of interest (in terms of likely encounter rate, not total population sizes) are likely to be the common bottlenose dolphin, Indo-pacific bottlenose dolphin, short-finned pilot whale and humpback whale. • ER236 lies within the migratory route of Humpback (Least Concern) and Southern Right (Least Concern) whales. o Southern right whales will pass through Block ER236 in July and August and again on their southward migration in October/November. o Humpbacks have a bimodal distribution off the East coast, 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. The calving season for Humpbacks extends from July to October, peaking in early August.

Feature	Description
Marine Turtles	• Five species of turtle are known to occur along the East Coast: leatherback, which is most frequently sighted, and the loggerhead, green, olive ridley and hawksbill turtles. In the IUCN Red listing, the hawksbill turtle is described as 'Critically Endangered', green turtle is 'Endangered' and leatherback, loggerhead and olive ridley are 'Vulnerable' on a global scale. • Both the leatherback and the loggerhead turtle nest on the beaches of the northern KZN coastline (St Lucia, iSimangaliso) between mid-October and mid-January. Hatchlings are born from mid-January through to mid-March when the Agulhas Current is warmest. Once hatchlings enter the sea, they move southward following the Agulhas Current and are thought to remain in the southern Indian Ocean gyre for the first five years of their lives. • The inshore regions of the northern portion of Block ER236, coincide with the inter-nesting migrations for leatherbacks, but the area of interest lies outside of the inter-nesting range. • Leatherback and loggerheads are likely to be encountered in Block ER236 during their foraging migrations.
Marine Protected Areas (MPAs)	• There are no existing MPAs that overlap with the areas of interest for drilling. • Although Block ER236 overlaps with the proposed Protea Banks MPA and the proposed extension of the iSimangaliso Wetland Park MPA, there is no overlap of the areas of interest for drilling with proposed MPAs. • It should be noted that sections of the original ER236 which overlapped with the existing iSimangaliso and Aliwal Shoal MPA's were relinquished during the Exploration Right renewal process in 2016.
Fish spawning, nursery and recruitment areas	• The areas of interest are offshore of the major fish spawning and migration routes and ichthyoplankton abundance is likely to be low. • The sardine run along the Eastern Cape coast and up to southern KZN is inshore of the area of interest. • Pilchard eggs are inshore of the area of interest.
Large Pelagic Long Line Fishing	• The area of interest overlaps with the long line fishing area which targets primarily tuna but also swordfish.
Marine Traffic	• The Project Area may overlap with the routes taken by tankers and bulk carriers. The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Durban or Richard's Bay. • Important East Coast commercial harbours include Port Elizabeth, East London, Durban and Richards Bay.
Recreational users	• The recreational use of marine resources along the East Coast typically occurs within inshore waters in the vicinity of coastal towns and holiday resorts.

5 PUBLIC PARTICIPATION

5.1 PUBLIC PARTICIPATION OBJECTIVES

Public consultation is an inclusive and culturally appropriate process, which involves sharing information and knowledge, seeking to understand the concerns of others and building relationships based on collaboration. It allows stakeholders to understand the risks, impacts and opportunities of the project in order to achieve positive outcomes.

The public participation process is designed to provide information to and receive feedback from I&APs throughout the EIA process, thus providing organisations and individuals with an opportunity to raise concerns, make comments and suggestions regarding the proposed project. By being part of the assessment process, stakeholders have the opportunity to influence the project layout and design, input into mitigation measures and technical solutions as well as the Plan of Study for the EIA Report.

The main objectives of public participation are:

- To ensure that adequate and timely information is provided to those potentially affected by the project;
- To provide these groups with sufficient opportunity to voice their opinions and concerns; and
- To ensure that comments are received in a timely manner so that they can be taken into account in project decisions.

5.2 LEGISLATIVE CONTEXT

Public participation with regards to EIA's in South Africa is determined by the principles of the National Environmental Management Act (NEMA) (Act 107of 1998, as amended) and elaborated upon in 'GN 657: Guideline 4: Public Participation' (Department of Environmental Affairs, 2017), which states that: "*Public participation process" in relation to the assessment of the environmental impact of any application for an environmental authorisation, is defined in terms of National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) as a process by which potential interested and affected parties are given opportunity to comment on, or raise issues relevant to, the application.*"

Public participation is required for an Environmental Authorisation process in terms of the EIA Regulations GN R.982 (December 2014, as amended).

Section 23, sub regulation (1)(a) of the NEMA EIA Regulations as amended in 2017 states that:

"The application must within 106 days of the acceptance of the scoping report submit to the competent authority –

*(b) a notification in writing that the [**environmental impact report inclusive of any specialist**] reports, and an EMPr, will be submitted within 156 days of [**acceptance of the scoping report**] receipt of the application by the competent authority, as significant changes have been made or significant new information has been added to the environmental impact assessment report or EMPr, which changes or information was not contained in the reports consulted on during the initial public participation process contemplated in sub regulation (1)(a), and that the revised environmental impact assessment report or EMPr will be subjected to another public participation process of at least 30 days."*

Section 21(2) states that- *"Subject to regulation 46, and if the findings of the scoping report is still valid and the environmental context has not changed the submission of a scoping report as contemplated in sub regulation (1) need not be complied with —*

(a) in cases where a scoping report was accepted as part of a previous application for environmental authorisation and the application has lapsed or was refused because of insufficient information;

(b) on condition that regulation 16 is complied with and that such application is accompanied by proof that registered interested and affected parties, who participated in the public participation process conducted as part of the previous application, have been notified of this intended resubmission of the application prior to submission of such application;"

In line with the above, ERM are seeking to commence the new EIA process with the submission of an amended application form and the release of the draft EIA Report for comment. All I&APs registered on the stakeholder database have received notification of the new EIA process currently being initiated. Details regarding stakeholder notifications have been provided in *Table 4.9* below.

5.3 *PUBLIC PARTICIPATION ACTIVITIES*

Table 4.9 details the public participation tasks that have been undertaken by ERM to date.

Table 4.9 Public Participation Tasks

Activity	Description and Purpose
Pre-Application Activities (2017)	
Preparation of a preliminary stakeholder database	A preliminary database was compiled of authorities (local and provincial), Non-Governmental Organisations, neighbouring landowners and other key stakeholders (refer to *Annex B of the final Scoping Report*). This database of registered I&APs will be maintained and updated during the ongoing EIA process.
Preparation and Distribution of a Background Information Document (BID)	BIDs (in English) were distributed via email/post to all I&APs on the stakeholder database on the 15 September 2017. See *Annex B of the final Scoping Report*. The BID provides an introduction to the project and the EIA process.
Advertisement of the Project	The project was advertised in four newspapers; the Mercury (in English) and Isolezwe (in Zulu) with distribution around Durban, and the Zululand Observer and Ilanga Newspaper (in Zulu), with distribution around Richards Bay. The dates of distribution were as follows: • The Mercury – 18 September 2017 • The Zululand Observer – 18 September 2017 • Ilanga (advert in isiZulu) – 21 September 2017 • Isolezwe (advert in isiZulu) – 21 September 2017 See proof of advertisement in *Annex B of the final Scoping Report*.
Erection of Site Notices	Site notices were placed at the following locations: eThekwini Municipality libraries: • Durban North; • Durban Central Lending; • Amanzimtoti; • Warner Beach; • Isipingo Beach; • Umkomaas; and • Tongaat Beach. uMhlathuze Local Municipality: • Richards Bay Municipality; and • Richards Bay Library. • Entrance to the Port of Richards Bay.
Development of an Initial Comments and Response Report	All comments received during the initial consultation period were recorded into a Comments and Response Report. Refer to *Annex C of the final Scoping Report*.

<table>
<tr><th>Activity</th><th>Description and Purpose</th></tr>
<tr><td colspan="2">Scoping Phase (January to March 2018)</td></tr>
<tr><td>Release of draft Scoping Report for Public Comment</td><td>On 22 January 2018, the draft Scoping Report was released for public comment and was made available online and in the following libraries:

• Durban Public Library
• Richards Bay Public Library
• Port Shepstone Public Library

On the same day, an advert was published in four newspapers; The Mercury (in English) and Isolezwe (in Zulu) with distribution around Durban, and The Zululand Observer and Ilanga Newspaper (in Zulu), with distribution around Richards Bay. Notifications were also sent to all stakeholders on the database.

The comment period started on 22 January 2017 and ended on 1 March 2018. All comments received by 5 March 2018 were included in the final Scoping Report.

*It should be noted that an earlier version of the Draft Scoping Report was released for comment on 27 October 2017. Due to a change in project scope, a notification was sent out on 7 November 2017 to notify stakeholders that the report would be re-released for a full 30 day comment period in early 2018.</td></tr>
<tr><td>Public Engagement Meeting</td><td>A total of three Public engagement meetings were held in the following locations:

• Richards Bay (The Richards Hotel) – 6 February 2018
• Durban (Tropicana Hotel) - 7 February 2018; and
• Port Shepstone (Port Shepstone Country Club) – 8 February 2018.

Stakeholders were notified about the public meetings through the notification distributed on 22 January 2018. A reminder to stakeholders about the public meetings was distributed on 5 February 2018.

These meetings were held to present the proposed project and solicit input from stakeholders into the scoping process. As a result of the concerns raised during the public meetings, the Non-Technical Summary (NTS) of the Scoping Report was revised and translated into isiZulu. The isiZulu version of the NTS was then placed on the project website on 22 February 2018. The public comment period was then extended for a week from 22 February 2018 to give the public an opportunity to comment on the isiZulu version.

An additional (fourth) follow up meeting was held, upon request of the South Durban Community Environmental Alliance (SDCEA) on 28 February 2018 at the Austerville Community Hall with the presence of isiZulu language translator. ERM had prepared and distributed a letter of response to the follow up meeting with SDCEA attendees.

This letter aimed to address issues raised during the Durban public meeting (on 7 February 2018), which were not</td></tr>
</table>

Activity	Description and Purpose
	responded to in detail during the meeting due to time constraints. As a result of the concerns raised during the meeting of 28 February, the comment period was further extended until 5 March 2018 to enable the public to comment on the letter of response prepared. Presentation, attendance registers and meeting notes were included in *Annex B of the final Scoping Report*.
Submission of final Scoping Report	Notification that the final Scoping Report was submitted to PASA was distributed to stakeholders on 9 March 2018.
EIA Phase (March to September 2018)	
Notification of open house meetings	Ahead of the release of the draft EIA Report, on 28 May 2018 registered I&APs were notified that open house meetings would be held in the week of 11 to 15 June 2018. Due to unforeseen delays in the preparation of the draft EIA Report, stakeholders were notified on 4 June 2018 that the open house meetings had been postponed.
Notify of lapse of EIA Application	On 13 August 2018 all registered I&APs were sent a notification informing them that the EIA Application had lapsed, and that Eni intend to initiate a new EIA process for the project.
EIA Phase under New EIA Application	
Release of draft EIR and EMP for Public Comment	In September 2018, an English version of the draft EIA Report and EMPr (this document) will be made available to stakeholders and the relevant authorities, for a 30-day comment period. An isiZulu and isiXhosa version of the Executive Summary will also be made available. A notification will also be sent to all registered I&APs on the stakeholder database. This letter will inform I&APs that a new EIA Application has been submitted to PASA and that the EIA process will recommence, and will invite I&APs to comment on the draft EIA Report. Newspaper adverts will be placed in local newspapers notifying stakeholders of the availability of the draft EIA Report for review and inviting them to public meetings. All comments received, along with responses will be included in the final EIA Report.
Public Engagement Meetings	Open house meetings will be held during the EIA phase comment period in order to communicate the findings of the EIA process to stakeholders. EIA Phase meetings will be held in Richards Bay, Durban, and Port Shepstone as before, with additional meetings in East London and Port Elizabeth. As requested at the Scoping Phase meetings, an isiZulu translator will be present at meetings in KZN during the EIA phase public meetings. An isiXhosa translator will be present at the meeting in the Eastern Cape.
Notification of Environmental Authorisation	I&APs will be notified of the Environmental Authorisation and the statutory appeal period.

5.4 SUMMARY OF COMMENTS RAISED DURING SCOPING PHASE

All comments received from Interested and Affected Parties (I&APs) during the Scoping consultation period were recorded into a Comments and Response Report (CRR) (Refer to *Annex B of the final Scoping Report*).

Eni and ERM jointly, provided responses to the comments and issues raised by I&APs where possible during the respective public meetings. Eni provided technical responses on the drilling activities and ERM responded on questions on the scoping phase and the EIA process. A summary of the key issues raised can be seen below.

Table 4.10 below provides information on key comments and questions raised by the stakeholders during the public engagement period and meetings held.

Table 4.10 Summary of Key Comments Raised during the Draft Scoping Report Consultation

Topic	Issue
The stakeholder engagement process	Stakeholders felt that the stakeholder engagement process is not inclusive of all affected areas along the coast. Furthermore, the methods used to notify the public of the project and public meetings were regarded as insufficient.
The scoping phase having excluded certain environmental issues from the EIA process	Stakeholders raised questions regarding the potential impacts that the proposed project will have on the marine environment. Stakeholders were concerned that these impacts have not being included in the scoping report and have been overlooked.
The role of ERM and the independence of the specialists	There were concerns raised about the role of ERM and the independence of the specialists from the client (Eni) and whether the report findings would not be biased towards Eni.
Employment opportunities	Stakeholders were interested in knowing whether there would be job opportunities available for the local communities from the project and whether training would be provided where necessary for skilled labour.
Maritime Heritage	The South African Heritage Resources Agency raised a concern that the exploration drilling activities could disturb cultural heritage material present on the seabed, particularly historical shipwrecks.
Impact of accidental oil spill on marine-based livelihoods	Stakeholders were concerned over the impact of an oil spill on marine based livelihoods in the area.
Impact of accidental oil spill on worker health and safety	Stakeholders were concerned that due to the drill site being located a significant distance offshore, which by implication makes timeous intervention in event of mishap very problematic and the consequences to worker health and safety.
Impact of drilling on MPAs	Stakeholders raised concerns over the impact of exploration drilling on the MPAs.
Response time to a spill	Stakeholders raised concerns about the capacity of South Africa to respond to a spill timeously and wanted to know how Eni will respond to an event and who is the responsible.

6 IMPACT ASSESSMENT METHODOLOGY

6.1 INTRODUCTION

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 for planned activates. The methodology for accessing the risk significance of unplanned activities is described in *Chapter 8* of this report.

6.2 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 report are described in *Table 6.1*.

Table 6.1 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 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** - impacts are predicted to be of short duration and intermittent/occasional. **Short term** - impacts that are predicted to last only for the duration of the drilling and well testing phase, i.e. 6 months or less. **Medium term** - impacts that are predicted to extend beyond the drilling phase but not longer than three years.

		Long term - impacts that will continue beyond three years but within 10 years. **Permanent** - impacts that cause a permanent change in the affected receptor or resource or ecological process, and which endures beyond 10 years.
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, ie within 500m of drilling well (exclusion zone). **Local** - impacts that are limited to the project site and within the block. **Regional** - impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystems, ie extend to areas outside the block. **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.

6.3 *DETERMINING IMPACT MAGNITUDE*

Once impacts are characteristed 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.

The scale of the Magnitude (from Negligible to Large) is evalauted by the EIA team using professional judgment 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.

6.3.1 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 Large 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 Medium 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.

6.3.2 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.

6.4 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. 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 6.2* 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 6.2* and *Table 6.3* present the criteria for deciding on the value or sensitivity of biological and socio-economic receptors.

Table 6.2 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 (e.g. 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 e.g. 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.

Table 6.3 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.

6.5 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 *Figure 6.1*.

Figure 6.1 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 6.1* provides a context for what the various impact significance ratings signify.

Box 6.1 ***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. 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.

6.6 *MITIGATION POTENTIAL AND RESIDUAL IMPACTS*

A key objective of an EIA process is to identify and define socially, environmentally, 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 *Figure 6.2*. The priority is to first apply mitigation measures to the source of the impact (i.e. 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 *Figure 6.2.*

Figure 6.2 *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/Minimize on Site:
Add something to the design to abate the impact (eg pollution control equipment).
Abate/Minimize 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 (as amended in 2017) the following additional items will be considered in the assessment of impacts and risks identified:

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

This will inform the residual impact significance.

6.7 *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.

6.8 *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 (e.g. 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.

7 *ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF PLANNED ACTIVITIES*

7.1 *INTRODUCTION*

The identification of potential environmental and social impacts of the project's planned activities during the Environmental Impact Assessment (EIA) process are described in this *Chapter*, together with the mitigation measures for impact prevention, mitigation and control. The criteria used to evaluate impacts and assign significance are included in *Chapter 6*. Impacts have been assessed essentially through an objective exercise to determine what could happen to environmental, social and health receptors as a consequence of the project activities.

7.2 *IDENTIFICATION AND SCREENING OF KEY IMPACTS*

During the Screening and Scoping Phase of the EIA process, the EIA team identified the key environmental and social impacts, between the planned and unplanned project activities and environmental or social resources and receptors, which require further evaluation.

During the Scoping Phase stakeholder engagement, these key impacts were discussed and new impacts were raised by stakeholders. These issues were then used to update the summary of the potentially significant impacts from the Scoping Phase and are provided in *Table 7.1.* The key impacts associated with unplanned/ accidental events are assessed in *Chapter 8.*

The impacts considered potentially significant by the project Team and stakeholders are evaluated further in this report. The impacts considered non-significant are discussed briefly and scoped out of the detailed assessment. Non-significant issues are presented in *Table 7.2.*

In addition to addressing the potential impacts from the project activities, this section also provides an early indication of key considerations for the project activities together with the mitigation measures for impact prevention, mitigation and control. The criteria used to evaluate impacts and assign significance are included in *Chapter 6*.

Table 7.1 Potential Impacts from Planned Activities

No.	Issue	Activities	Scoping Results
1	**Planned Activities**		
1.1	Climate change	Burning of fossil fuels	There are climate change implications from the burning of fossil fuels by the project vessels. The significance of this impact is assessed in *Section 7.3.1* below.
1.2	Seawater and sediment quality degradation /contamination and impacts on marine fauna	Wastewater discharges from the drillship, supply and support vessels	Operational discharges from the drillship and all the other project vessels could have an impact on the water quality of the area and therefore potentially impact fish, marine mammals and turtles present in the Project Area. Due to stakeholder concern, the significance of this impact is assessed in *Section 7.3.2* below.
		Disposal of excess cement	Already mixed excess cement will be disposed of overboard. The cementing of the casing (steel pipe) into the well is required to ensure the safety of the well and avoid a blowout and oil spill. The presence of excess cement slurry that has already been mixed is unavoidable during operation and it will be disposed of overboard to avoid damages to lines, cement unit and tanks. The amount of excess slurry will be minimised as far as possible. Contaminant concentrations in seawater would be expected to return to background levels rapidly, with the assistance of currents and the mixing capacity of the water body (the assimilative capacity of water would be expected to minimise any impacts) and therefore have limited impacts on marine fauna. The significance of this impact is assessed in *Section 7.3.3* below.
		Drilling	The impact of drilling on the seabed will be very localised and short-term, limited physical impact to the seabed due to tophole (first sections) drilling, cuttings discharge, residual WBM and excess cement. The significance of this impact of drilling on the seabed is assessed in *Section 7.3.3* below.
		Disposal of cuttings to the seafloor and overboard during drilling	Cuttings discharged both at the seabed (prior to the installation of the riser) and overboard (after the installation of the riser) will generate a plume of sediment which would disturb the marine habitats, benthic communities and marine fauna present in the Project Area. The significance of this impact is assessed in *Section 7.3.4* below.
1.3	Disturbance of marine organisms	• Drillship and vessels noise due to dynamic positioning and moving • Noise from drilling activities (including well logging) • Light pollution from drillship and vessels	Scoping determined that the underwater noise generated during the drilling works, including well logging and the presence of vessels and drillship could lead to disturbances to marine habitats and fauna. The significance of this impact is assessed in *Section 7.3.5* to *7.3.7* below.

No.	Issue	Activities	Scoping Results
1.4	Disturbance to fishing (commercial and subsistence)	• Drillship, supply, survey and support vessels transit to and from the Richards Bay/Durban Port • Presence of drillship at drilling location (including 500 m exclusion zone) • Wellhead abandonment	Both the Port of Richards Bay and the Port of Durban are large, commercial, high traffic ports and, as such, the additional vessel traffic for this project will be non-significant and will not be a major change from the current status quo in terms of impact to fishing, supply and goods shipping activities. Large pelagic long-line activities overlap with both areas of interest and may therefore be impacted by the presence of the drillship at the drilling location and the enforcement of the 500 m exclusion zone. The extent to which fishing activities could be interrupted or placed at risk as a result of the drilling, vessel activities and wellhead abandonment is assessed in *Section 7.4.2* and *Section 7.4.4* below.
Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping			
2	**Planned Activities**		
2.1	Maritime Heritage	Exploration drilling	The South African Heritage Resources Agency raised a concern that the exploration drilling activities could disturb cultural heritage material present on the seabed, particularly historical shipwrecks. Due to the known presence of shipwrecks in the Project Area, the significance of this impact is assessed in *Section 7.4.4* below.
2.2	Local employment / income generation	Employment of labour and allocation of jobs Training / capacity building of local people	Eni has estimated that in the order of 10 direct jobs will be created for locals by this project. The project will use local labour as far as possible based on their existing skills and provide new employees with appropriate training. Based on feedback from stakeholders during the scoping phase, the impact of employment creation is assessed further in *Section 7.4.1* below.
2.3	Abandonment of the wellhead on the seabed	Disturbance to demersal fishing activities	PASA raised concerns over the impact of the wellhead being decommissioned (plugged and abandoned) and left on the seabed to demersal fishing. Therefore an assessment was conducted in *Section 7.4.3* below

Table 7.2 Non-Significant Impacts

No.	Impact	Activities	Scoping Results
1	**Planned Activities**		
1.1	Community Health, Safety & Security	Interactions of foreign/ migrant workers with local residents	Although Scoping determined that the project will employ workers during all the phases of the project, due to the nature of the work, the majority of the employees onboard the drillship will be expatriate staff who may transit through Durban or Richards Bay for a short period of time. Shore base employees are likely to be mainly current employees of existing logistics companies based in these areas. Given the short-term nature of the project and the limited workers to be employed this impact was considered not significant and will not be assessed further.
1.2	Local economy	Trade with local suppliers for food, fuel, water, hotel, waste treatment and other supplies	Scoping determined that the project will result in trade with local suppliers for food, fuel, water, hotel, waste treatment and other supplies. This may result in a positive impact, however given the short-term nature of the benefit and the large-scale suppliers who likely be utilised this impact was considered not significant and will not be assessed further.
1.3	Degradation of air quality	Vessels and helicopter atmospheric emissions Power generation on the drillship during drilling Bunkering	A reduction in air quality from the vessel and helicopter activities, power generation and bunkering are not expected to be significant in a regional context, or to cause human health impacts due to the temporary nature of the project, the well mixed air shed of the offshore environment and the distance of the project site to shore. Therefore this impact was considered not significant and will not be assessed further.
1.4	Community Health, Safety & Security	Noise from helicopters	The noise generated by helicopters for crew transfers will be over the Port of Richards Bay or Durban; helicopters will not fly over residential areas and therefore this impact was considered not significant and will not be assessed further.
1.5	Increase in non-hazardous and hazardous wastes disposal	Disposal of non-hazardous and hazardous wastes generated by the project activities at onshore disposal sites	The project will result in an increase in both non- hazardous (eg: kitchen waste and scrap metals) and hazardous (eg engine lubricants and filters) waste generated in the area. Wastes will be transported by vessels to the onshore supply base in Richards Bay or Durban for temporary storage prior to off-site disposal. Solid non-hazardous waste will be disposed of at a suitably licensed waste facility. Hazardous wastes will be treated/ disposed of at a licensed waste treatment/ disposal facility. Therefore, this impact was considered not significant and will not be assessed further.
1.6	Fresh water supply	Provision of drinking water for the crew on all vessels Storage of water at onshore base	Water will be provided via a reverse osmosis plant onboard the project vessels and where required, bottled water may be provided. Therefore, this impact was considered not significant and will not be assessed further. Water stored at the onshore base for water supplies for the onshore staff will be sourced from the local municipality and will not have a significant impact.

No.	Impact	Activities	Scoping Results
1.7	Marine pollution and impacts on marine fauna (e.g. invertebrates, fish, larvae, marine mammals and turtles)	Discharge of well clean-up and well testing water	Following cessation of drilling activities, contaminant concentrations in seawater would be expected to return to background levels rapidly, with the assistance of currents and the mixing capacity of the water body (natural dispersion, dilution and assimilative capacity of water would be expected to minimise any impacts) and therefore have limited impacts on marine fauna. Control measures will be included in the EMPr. Impacts of well clean-up and testing water on water quality and marine fauna are therefore not expected to be significant and will not be assessed further.
		Well logging: Logging while Drilling (LWD) and wireline logging (radioactive sources).	There will be no discharges to the environment from well logging and therefore there will be no interaction with the environment. Therefore, this impact was considered not significant and will not be assessed further.
		Vertical Seismic Profiling (VSP log) -	The VSP log will consist of one to three shots and will be of a very short duration per well (instants for shot and a few hours for acquisition). Prior of the execution of VSP log, follow JNCC guidelines including perform a pre-shooting search for marine mammals will be conducted by a marine mammal observer on board. The short-duration of the activity combined with the implementation of the JNCC guidelines means that the impact will not be significant and will not be assessed further.
1.8	Toxicity and bioaccumulation effects of seawater sweeps and high viscous pills on the seabed and impacts on marine fauna	Disposal of seawater sweeps and high viscous pills to the seafloor during riserless drilling	The sweeps and high viscous pills are a solution prepared with fresh or seawater and bentonite viscosifer, a non-toxic, insoluble and inert natural phyllosilicate clay with limited presence of caustic soda as pH and alkalinity control. The sweeps and high viscous pills to be used for hole cleaning during drilling the initial sections of the well will not contain spotting fluids or lubricating hydrocarbons, and the impacts of discharges of these drilling fluids in terms of toxicity and bioaccumulation are therefore not expected to be significant and will not be assessed further.
1.9	Disturbance of seabed geology	Drilling	The impact of drilling of the geology will be very localised to the drilling location and where the drill bit will penetrate the seabed geology. Therefore, the impact was not considered significant and will not be assessed further.
1.10	Increased hard substrata on the seabed	• Placement of wellhead on the seabed • Discharge of residual cement during riserless stage • Abandonment of wellhead on seabed	The impact of increased hard infrastructure on the seabed is highly localised and has a neutral impact on benthic biodiversity. Therefore, the impact was not considered significant and will not be assessed further.
1.11	Visual	Drillship	The drillship will be located more than 60 km offshore and it will not be seen from the shore. Therefore, this impact was considered not significant and will not be assessed further.
2	**Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping**		
2.1	Impact of drilling on MPAs	Exploration drilling	Stakeholders raised concerns over the impact of exploration drilling on the MPAs. The proposed areas of interest do not overlap with current or proposed MPAs and therefore this impact has been assessed as not significant.

7.3 *PLANNED OPERATIONS: KEY ENVIRONMENTAL IMPACTS*

The following sections present the evaluation of the impacts from the planned activities that were identified during scoping and stakeholder engagement as potentially significant.

Potentially significant impacts to the environmental receptors are assessed below and include:

Table 7.3 Summary of Environmental Impacts Assessed

Impact	Section
Impact of Project Greenhouse Gas Emissions on Climate Change	7.3.1
Impact of Operational Discharges from Project Vessels on Marine Fauna	7.3.2
Impact on the Physical Disturbance of the Seabed Sediments and Benthic Fauna from Pre- Drilling and Drilling Operations	7.3.3
Impact on Marine Fauna from Disposal of Drilling Muds and Cuttings from the Drillship	7.3.4
Disturbance of Marine Fauna by Underwater Noise Associated with Drilling Operations	7.3.5
Disturbance of Marine and Avian Fauna by Helicopter Noise Associated with Drilling	7.3.6
Disturbance of Marine Fauna and Avian by Light Associated with Drilling	7.3.7

7.3.1 *Impact of Project Greenhouse Gas Emissions on Climate Change*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, climate change is likely to have a significant impact on the South Africa's economy (Madzwamuse, 2010). In particular, health, agriculture (particularly maize production), plant and animal biodiversity, water resources and rangelands are the most vulnerable sectors to climate change.

Climate change constitutes a key concern in South Africa. Mean annual temperatures have increased by at least 1.5 times the observed global average of 0.65°C over the past five decades and extreme rainfall events have increased in frequency (WIREs Clim Change, 2014).

South Africa's current per capita CO_2 emissions are high (8.3 tonnes/person) as compared with other countries on the African continent and, to some extent globally (average 4.8 tonnes/person) and as a result, climate change mitigation has been a focus for a number of years. The current total annual CO_2 emissions in South Africa are 468 Mega tonnes of CO_2 (Global Carbon Atlas, 2018, WIREs Clim Change, 2014).

Table 7.4 below summarises the project activities that will result in greenhouse gas emissions.

Table 7.4 Summary of Project Activities that will result in Greenhouse Gas Emissions

Activity phase	Activity
Mobilisation	Atmospheric emissions will be released from the exhaust of the drillship and vessels while in transit. However, the impact of these emissions are temporary as the drillship will be constantly moving. Therefore, these emissions are of Negligible significance and have not been assessed further.
Operations	The main sources of air emissions (continuous or non-continuous) resulting from offshore drilling activities include: • Exhaust gas emissions produced by the combustion of gas or liquid fuels in pumps, boilers, turbines, compressors and other engines for power and heat generation on the offshore vessels including the drillship, supply and standby vessels and helicopters. This can be the most significant source of air emissions from offshore facilities. • Fugitive emissions associated with leaking valves, tubing, connections etc. and hydrocarbon loading and unloading operations. • If well testing is conducted, it may be necessary to flare or vent off some of the oil and gas brought to the surface. Flaring and venting is also an important safety measure used to ensure gas and other hydrocarbons are safety disposed of in the event of an emergency, power or equipment failure or other plant upset conditions. The flow periods and rates will be limited to the minimum necessary to obtain the required reservoir information during the well test. It is anticipated that a maximum well test time for this project will be approximately 20 days.
Demobilisation	Atmospheric emissions will be released from the exhaust of the drillship and vessels while in transit. However, the impact of these emissions are temporary as the drillship will be constantly moving. Therefore, these emissions are of Negligible significance and have not been assessed further.

The main sources of atmospheric emissions will be from the drillship and other vessels (i.e. supply and standby vessels) involved in the drilling operation. The principal expected atmospheric emissions from the drilling activities include carbon dioxide (CO_2), methane (CH_4), oxides of nitrogen (NOx), sulphur dioxide (SO_2), carbon monoxide (CO) and volatile organic compounds (VOC). Many of these compounds are known to have the potential to contribute to a number of environmental processes and impacts including acidification (acid rain), the formation of low level ozone, and local air pollution.

Table 7.5 indicates predicted total greenhouse gas (GHG) emissions from vessels and helicopters during drilling operations. The emissions from flaring, during well testing have not been quantified in *Table 7.5* as the characteristics of the well in terms of pressure, flow rate and pressure are unknown and will only be determined while the well is being drilled.

As can been seen in *Table 7.5*, it is estimated that approximately 3,599 tonnes of fuel will be burnt by the Project vessels and helicopters resulting in approximately 13.1 Kt of GHG (CO_2, CH_4, N_2O) emissions, of which CO_2, is the largest component, being emitted to the atmosphere during the drilling operations (up to 71 days).

Table 7.5 Predicted Total Atmospheric Emissions from Vessels during Drilling Operations

	Gaseous emission	Drillship	Supply Vessel	Helicopter	Total	CO_2 equivalent
Consumption (tonnes)		2,580	994	25	3,599	
Emissions (tonnes)	CO_2	9,355.08	3,604.33	76.20	13,035.61	13,035.61
	N_2O	0.07	0.03	6.62E-4	0.10	30.85
	CH_4	0.36	0.14	3.31E-3	0.50	10.47
Total CO_2 equivalent			**13,076.92**			

Source: Calculated using SANGEA software http://www.api-sangea.org/

The client has committed to the following inbuilt compliance and control measures:

- Compliance to MARPOL 73/78 Annex VI regulations regarding the reduction of NOx, SOx and GHG emissions from vessel engines;
- All diesel motors and generators will undergo routine inspections and receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere;
- Leak detection and repair programmes will be implemented for valves, flanges, fittings, seals, etc.; and
- If well testing is conducted for the disposal of test fluids, only the minimum volume of hydrocarbons required for the test will be flowed and well-test durations will be reduced to the extent practical.

Significance of Impact

The **magnitude** of the impact on climate change due to GHG emissions from the project activities during the drilling phase is assessed to be **Negligible** as CO_2 emissions generated by the project equate to only 0.0003 percent of the total CO_2 emissions for South Africa. The **sensitivity** is assessed as **High** due to South Africa's vulnerability to climate change.

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact from the project's contribution to climate change will be **Negligible** (*Table 7.6*).

Mitigation and Management Measures

The following mitigation and management measures will be implemented for the project to minimise the air emissions:

- If well testing is conducted for the disposal of test fluids, an efficient test flare burner head equipped with an appropriate combustion enhancement system will be selected to minimize incomplete combustion, black smoke, and hydrocarbon fallout to the sea. Volumes of hydrocarbons flared should be recorded [1]:

- Use of a low sulphur fuel, if available; and

- Implementation of a maintenance plan to achieve efficient performance.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact from the project's contribution to climate change will remain as **Negligible** (*Table 7.6*).

[1] Based on IFC Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development, June 2015.

Table 7.6 Significance of Impacts Related to Climate Change

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Medium (partially reversible)	
Loss of resource	Low	
Magnitude	Negligible	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	High	High
Significance of Impact	**Negligible**	**Negligible**

7.3.2 Impact of Operational Discharges from Project Vessels on Marine Fauna

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 3*, the operational waste discharges from the vessels would primarily take place at the well locations and along the route taken by the support vessels between the drillship and either Durban or Richard's Bay. The drilling activities would be located in the offshore marine environment, approximately 62 to 65 km offshore, far removed from any sensitive coastal receptors (e.g. bird colonies or turtle nesting sites), but could still directly affect migratory pelagic species transiting through both areas of interest for drilling.

The taxa most vulnerable to waste discharges in the Project Area are turtles, pelagic seabirds, large migratory pelagic fish, and both migratory and resident cetaceans. Many of which are considered globally 'Critically Endangered' (eg Southern Bluefin tuna), 'Endangered' (e.g. whale shark, Fin, Blue and Sei whales), 'Vulnerable' (e.g. Leatherback turtle, short-fin mako, whitetip sharks, sperm whale) or 'Near threatened' (e.g. blue shark).

However, all of the operational discharges from the project vessels described above are low in volume, do not contain toxic or persistent chemicals and are rapidly dispersed. Therefore, wastewater discharges from the project vessels are considered to pose limited threat to the environment or the identified biological receptors described above.

Proposed Project Activities and Inbuilt Control and Compliance Measures

The table below summarises the vessel activities that will result in operational discharges to sea.

Table 7.7 Summary of Vessel Activities that Discharge Operational Wastes to Sea

Activity phase	Activity
Mobilisation	Transit of drilling units and support vessels to the drill site
Operations	Drilling and support vessels operations
Demobilisation	Drilling unit / support vessels leave drill site and transit to Port or next destination

These project activities, including inbuilt compliance and control measures, are described further below:

- **Deck drainage**: all deck drainage from work spaces is collected and piped into a sump tank on board the drilling unit to ensure MARPOL 73/78 Annex I compliance (15 ppm oil in water). The fluid will be analysed and any hydrocarbons skimmed off the top prior to discharge. The oily substances will be added to the waste (oil) lubricants and recycled or disposed of on land at an appropriate waste disposal facility.
- **Sewage**: sewage discharges will be comminuted and disinfected. In accordance with MARPOL 73/78 Annex IV, the effluent must not produce visible floating solids in, nor cause discolouration of, the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination before the treated effluent can be discharged into the sea. The discharge depth is variable, depending upon the draught of the drilling unit / support vessel at the time, but would not be less than 5 m below the surface.

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

- **Food (galley) wastes**: food wastes may be discharged after they have been passed through a comminuter or grinder, and when the drilling unit is located more than 3 nautical miles (± 5.5 km) from land. Discharge of food wastes not comminuted is permitted beyond 12 nautical miles. (± 22 km). The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a standard drilling unit is expected to be <0.5 m^3.

- **Detergents**: detergents used for washing exposed marine deck spaces are discharged overboard. The toxicity of detergents varies greatly depending on their composition, but low-toxicity, biodegradable detergents are preferentially used. Those used on work deck spaces will be collected with the deck drainage and treated as described above.

- **Cooling Water:** electrical generation on drilling units is typically provided by large diesel-fired engines and generators, which are cooled by pumping water through a set of heat exchangers. The cooling water is then discharged overboard. Other equipment is cooled through a closed loop system, which may use chlorine as a disinfectant. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines.

- **Opening and closing of Blowout Protector (BOP):** A further operational discharge is associated with routine well opening and closing operations. As part of these operations, based on the BOP manufacturer technical specification and recommendations for test, the subsea BOP stack elements will vent between 500 to 1,000 litres per month of water-based hydraulic fluid into the ocean at the seafloor.

It is the intention of Eni to ensure that the proposed drilling activities are undertaken in a manner consistent with good international industry practice, including ISO and API standards. All the vessels used for supporting drilling operations (standby, supply vessels and drilling ship) will comply with the applicable requirements in MARPOL 73/78 Annex I, Annex IV, Annex V.

Significance of Impact

The potential impact of such operational discharges from the drillship would include reduced physiological functioning of marine organisms due to the biochemical effects on the water column, increased food source for marine fauna due to discharge of galley wastes potentially leading to fish aggregation around the drillship and increased predator-prey interactions.

Given the offshore location of both the areas of interest for drilling, waste discharges are expected to disperse rapidly and there is no potential for accumulation of wastes leading to any detectable long-term impact. The majority of the discharged wastes are not unique to the project vessels, but rather common to the numerous vessels that operate in or pass through South African coastal waters daily.

As volumes discharged would be low, any associated impacts would be of low intensity and limited to the drilling location over the short-term.
For support vessels travelling from Durban or Richard's Bay, operational discharges would likewise be restricted to the immediate vicinity of the vessel over the short-term.

The potential impact on the marine environment of such operational discharges from the project vessels will be limited to the well site over the short-term. Combined with their non-toxicity, high biodegradability and low persistence means the **magnitud**e of the impact will be **Small**.

Based on the environmental baseline conditions as discussed above, the **sensitivity** of the receptors in the region is **Low**.

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of operational discharges from the project vessels on marine fauna will be **Negligible** (*Table 7.8*).

Mitigation and Management Measures

In addition to compliance with MARPOL 73/78 regulations regarding the various operational discharges from vessels mentioned above, the following management measures are recommended to reduce wastes at the source:

- Implement a waste management system in accordance with Eni's Waste Management Guidelines that addresses all wastes generated at the various sites, shore-based and marine. This should include:
    - Separation of wastes at source;
    - Recycling and re-use of wastes where possible;
    - Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation); and
    - Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.

Residual Impact

Based on the implementation of the proposed management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the residual impact from wastewater discharges from the project vessels on marine fauna will remain as **Negligible** (*Table 7.8*).

Table 7.8 Significance of the Impact of Wastewater Discharges from Project Vessels on Marine Fauna

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
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**

7.3.3 *Impact on the Physical Disturbance of the Seabed Sediments and Benthic Fauna from Pre- Drilling and Drilling Operations*

Description of the Baseline Environment and Sensitive Receptors

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. The benthic fauna inhabiting unconsolidated sediments of the outer shelf and beyond into the abyss are poorly known. With little sea floor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy.

The benthos of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. As deep-water corals tend to occur in areas with low sedimentation rates (Mortensen *et al.* 2001), these benthic suspension-feeders and their associated faunal communities are likely to show particular sensitivity to increased turbidity and sediment deposition associated with drilling. Exposure of deep water corals to drilling solids can result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification (Rogers, 1999).

It is currently unknown whether benthic fauna sensitive receptors (deep water corals) occur in the two submarine canyons within the boundaries of the Block and in the Tugela and Goodlad canyons, which are located to the immediate south of the northern area of interest and some 30 km northeast of the southern area of interest.

For this reason, eni has implemented a commitment to avoid the canyons (i.e. no drilling will take place in the canyons) as a conservative measure to avoid any direct impact to possible sensitive receptors inside canyons.

Proposed Project Activities and Inbuilt Control and Compliance Measures

The table below summarises the project activities that may physically disturb the seabed sediments.

Table 7.9 Summary of Project Activities that Physically Disturb the Seabed Sediment and Benthic Fauna

Activity phase	Activity
Mobilisation	N/A
Operations	Pre-drilling Remotely Operated Vehicle (ROV) seabed survey
	Drilling activities (including localised removal of sediments and smothering)
	Discharge of cuttings and residual cement at the seabed
	Removal of BOP
Demobilisation	N/A

These activities are described further below:

- During pre-drilling surveys, a ROV is deployed to obtain video footage of the seabed at the proposed well location. Although the standard operating procedure is not to land or rest the ROV on the seabed, the ROVs thrusters can stir up the soft or silty sediments when operating close to the seabed.

- The current well-design parameter is to have at seabed a hole diameter of approximately 42 inches (107 cm) during spudding. The penetration of the seabed by the drill bit during the riserless phase would physically disturb a surface area of 0.91 m^2, and displace deeper sediments (~400 m^3 of rock cuttings) into a conical cuttings pile around the wellhead.

- During the drilling of the well(s), the primary discharge from the drillship would be the drill cuttings. For the current project, these are expected to comprise muds and sands ranging in size from 0.02 mm to 60 mm. The chemistry and mineralogy of the rock particles reflects the types of sedimentary rocks penetrated by the bit.

- Cuttings from lower-hole sections (drilled with WBM /NADFs) are lifted up the marine riser to the drilling unit and separated from the drilling fluid by the onboard solid control systems. The solids waste stream is fluidised with seawater and discharged overboard through the caisson, which is typically located a few metres below the sea surface. In the order of 220 m^3 (583 MT) of cuttings will be discharged from the drillship, which has been modelled to predict the impact (Refer to *Annex D*).

- Should there be spent WBM remaining at the end of the drilling operation, this will either be stored onboard and shipped to shore for reuse/ recycling / disposal or will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- The NADF muds will be recovered and stored onboard and shipped to shore for disposal. The NADF drill cuttings will be routed through a vertical cuttings dryer (centrifuge type equipment) to remove residual liquids for reuse. The NADF retained on drill cuttings will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- During riserless operations, after a casing string is set in a well, specially designed cement slurries are pumped into the annular space between the outside of the casing and the borehole wall. To ensure effective cementing, an excess of cement is usually used.

- During the riser phase at the end of cement job activities, residual cement slurry from lines and tanks will be discharged overboard.

- Before demobilisation, the well(s) will be plugged (cement plug), tested for integrity and abandoned, irrespective of whether hydrocarbons have been discovered in the reservoir sections. The plug will create a permanent barrier to avoid future fluid release from the well bore and across any reserve sections. Residual cement slurry in cement lines will be discarded overboard.

- All the proposed drilling operations will be undertaken by Eni in a manner consistent with good international industry practice.

Significance of Impact

Disturbance of seabed sediments and benthic fauna due to ROV surveys (including site survey prior to start operations)

Disturbance of seabed sediments during pre-drilling and drilling ROV surveys/operations (survey inspection and monitoring of seabed conditions to identify possible environmental sensitivities, e.g. deep water corals, present in the well location area prior to start any drilling operations, and ROV wellhead/BOP routinely inspection) could potentially increase turbidity of the near-bottom water layers. This may place transient stress on sessile and mobile benthic organisms, by negatively affecting filter-feeding efficiency of suspension feeders or through disorientation of mobile species due to reduced visibility (Clarke and Wilber 2000). However, in most cases sub-lethal or lethal responses occur only at concentrations well in excess of those anticipated due to resuspension of sediments by ROV thrusters.

The impact of increased turbidity and suspended sediment concentrations would be extremely localised (a few metres around the ROV and/or ROV flight track) and would persist only over the very short term (hours or minutes, based on sediment consistency). Impacts to benthic organisms are temporary and the **magnitude** of any potential adverse effects on sessile benthos would be **Negligible**.

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, the disturbance of and reduction in benthic biodiversity due to increased turbidity can be considered Negligible, and no cumulative effects on higher order consumers is expected and therfore the **sensitivity** is evaluated to be **Low**.

As general operative operations, ROV operators want to avoid the contact with seabed to avoid any damages to the equipment, for this reason the contact of ROV with seabed is a rare unwanted event. Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of increased turbidity from ROV operations on the seabed sediments and benthic fauna will be **Negligible** (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna due to drilling

Drilling of exploration wells within the two areas of interest in the Project Area would result in the direct physical disturbance and removal of sediments during tophole drilling activities, potential changes in sediment characteristics and condition.

The immediate effect of the physical disturbance and removal of seabed sediments on the benthos depends on their degree of mobility, with sedentary and relatively immobile species likely to be physically damaged or destroyed during the disturbances associated with well drilling.

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, this disturbance of and reduction in benthic biodiversity can be considered Negligible, and no cumulative effects on higher order consumers are expected and therfore the **sensitivity** is evaluated to be **Low**.

The physical disturbance and/or removal of unconsolidated sediments and their associated benthic macrofaunal communities during drilling and spudding is unavoidable, but the impact would be extremely localised and persist only over the short term and would be of **Small magnitude**.

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of drilling on the seabed, sediments and benthic fauna will be **Negligible** (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna from the disposal of drill cuttings and muds

The discharge of cuttings at the seabed would have both direct and indirect effects on benthic faunal communities in the vicinity of the well head and within the fall-out footprint of the cuttings plume discharged from the drillship.

Disturbance of seabed sediments would result in direct damage to, and disturbance of, the invertebrate benthic communities living on the seabed or within the sediments.

The cuttings discharged at the seabed during the spudding of a well will form a highly localised spoil mound around the wellbore, thinning outwards. The main impacts associated with the disposal of drilling solids would be smothering of sessile benthic fauna (such as corals), physical alteration of the benthic habitat (changes in sediment properties) in the immediate vicinity (<200 m) of the well.

Studies (Neff *et al.* 1992; Ranger 1993; Montagna & Harper 1996; Schaanning *et al.* 2008), have found that changes in diversity and abundance of macrofaunal communities in response to deposited cuttings are typically detected within a few hundred metres of the discharge, with recovery of the benthos observed to take from several months to several years after drilling operations had stopped.

Mobile benthic infaunal species are able to burrow or move through the sediment and some infaunal species are able to move vertically through overlying deposited sediment thereby significantly affecting the recolonisation and subsequent recovery of impacted areas. Due to the high natural variability of benthic communities in the region, the structure of the recovering communities would likely be highly spatially and temporally variable.

The results of the cuttings dispersion modelling studies undertaken as part of this project (ERM, 2018a) largely confirm the reports of international studies that predicted that the effects of discharged cuttings are localised (Perry 2005).

The cuttings discharged at the seabed were predicted to create a cone in the order of 1,000 mm thickness close to the wellbore, thinning outwards to a thickness of 5 mm at a radius of < 50 m (total area of 0.008 km^2), regardless of the well position (N1, N2 and S) or whether minimum or maximum average monthly current conditions were considered. Areas of deposition of < 5 mm thickness were mainly isolated to within a 100 m radius of the wellhead, although isolated deposition extended to distances well beyond 1 km, primarily down-current of the well. The maximum area of deposition > 50 m (the threshold thickness adopted by the modelling study) remains restricted to an area of less than 0.003 km^2 at each location.

Although the variations in current direction between the well locations and between the minimum and maximum average monthly current condition scenarios modelled result in different directional spread of the particles, the overall footprint deposition > 1 mm covers a maximum total predicted area that extends approximately 7 km^2 around the well site. The differences apply primarily for the settlement patterns of the finer fractions (< 0.2 mm), which would remain in the water column for longer.

The large depths at the well sites in combination with the strong current speeds therefore result in a high dispersion of the discharged drill cuttings. This is, however, offset by the relatively low deposition thicknesses (<5 mm) predicted for distances beyond approximately 50 m from the well location.

Relatively rapid recolonisation of benthic fauna can thus be expected (see for example Kingston 1987, 1992; Trefry *et al.* 2013), with subsequent bioturbation playing an important role in the physical recovery of the seabed (Munro *et al.* 1997).

Exposure of deep water corals to drilling solids can result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification. Note it is currently unknown if deep water corals are in the Block and if they are found the drilling location will be re-assessed.

The smothering effects resulting from the discharge of drilling solids at the wellbore is assessed to have an impact of **Small magnitude** on the benthic macrofauna of unconsolidated sediments in the cuttings footprint. In both cases, the impact is localised and recovery of benthic communities is expected within a few years (2 to 5 years).

Due to the benthic macrofauna's rapid ability to recover and recolonise the area their **sensitivity** is evaluated to be **Low.** As discussed above, if deep water corals are found to be present in the Project Area their **sensitivity** to smothering from drilling solids is **High.**

Based on the analysis provided above and the assumption that the compliance and control measures described above are implemented, the significance of the impact of drilling cuttings and muds due to smothering on benthic macrofauna and deep water corals will be **Negligible** and **Moderate,** respectively (*Table 7.10*).

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of drilling cuttings and muds on benthic macrofauna and deep water corals due to smothering will be **Negligible** to **Minor**, *respectively* (*Table 7.10*).

Disturbance of seabed sediments and benthic fauna from cement disposal at the seabed

The discharge of residual cement during cementing would result in the physical disturbance of the seabed sediments and accumulation of cement on the seabed, where it will dissolve into the water column.

During riserless operations, the excess cement (100 m^3 in the worst case) emerges out of the top of the well onto the cuttings pile, where (depending on its mix) it either does not set and dissolves slowly into the surrounding seawater, or if it remains in a pile, may act as a habitat (reef) for colonisation by epifauna and may attract fish and other mobile predators (Buchanan et al., 2003).

Considering the available area of similar habitat on and off the edge of the continental shelf in the West Indian Offshore bioregion, the disturbance of and reduction in benthic biodiversity due to cementing can be considered Negligible, and no cumulative effects on higher order consumers is expected and therefore the sensitivity is evaluated to be ***Low.***

Disturbance and smothering of benthic fauna due to the release of excess cement around the wellbore is of **Small magnitude** as the cement would be discharged in an area already affected by drill cuttings.
Any potential impacts would be extremely localised (i.e. confined to the wellbore footprint) and would persist only over the short term. Based on the analysis provided above, the significance of the impact of cement on the seabed, sediments and benthic fauna will be **Negligible** (*Table 7.10*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to benthic communities:

- Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site;

- Ensure drill site is located more than 500 m from any identified vulnerable habitats;

- Use high efficiency solids control equipment to minimize liquid content on cuttings, maximize reuse and recycle of drilling mud, reduce the need for fluid change out and minimise the final amount of residual spent mud;

- Maximize re-use and re-cycle of used WBM and NADF for different drilled section and for drilling other wells;

- Minimize spent WBM discharge to sea; avoid NADF mud discharge;

- Regularly maintain the onboard solids control system.

- Reduce excess of cement slurry during riserless drilling;

- Monitor cement returns and will terminate pumping if returns are observed on the seafloor; and

- Implement procedures for ROVs that stipulate that the ROV does not land or rest on the seabed as part of normal operations.

Residual Impact

Based on the implementation of the proposed mitigation and management measures below, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of pre-drilling, drilling activities on the seabed sediments and benthic fauna will remain as **Negligible** (*Table 7.10*).

Table 7.10 Significance of the Impacts of the Physical Disturbance of the Seabed sediments and Benthic Fauna due to Pre- Drilling (ROV survey) and Drilling Activities

Characteristic	Impact of ROV Operations on Benthic Faun	Residual Impact of ROV operations on Benthic Faun	Impact of Drilling on Benthic Faun	Residual Impact of Drilling on Benthic Faun	Impact of Disposal of Muds and Cuttings at the Seabed on Benthic Fauna	Residual Impact of Disposal of Muds and Cuttings at the Seabed on Benthic Faun	Impact of Disposal of Muds and Cuttings at the Seabed on Deep Water Corals	Residual Impact of Disposal of Muds and Cuttings at the Seabed to Deep Water Corals	Excess Cement Impact on Benthic Faun	Excess Cement Residual Impact on Benthic Faun
Extent	Local	Local	Local	Local	Local	Local	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term	Short-term
Scale	Negligible	Negligible	Small	Small	Small	Small	Small	Small	Small	Small
Reversibility	High (fully reversible)		High (fully reversible)		High (fully reversible)		High (fully reversible)		Medium (partially reversible)	
Loss of resource	Low		Low		Low		Low		Low	Low
Magnitude	Negligible	Negligible	Small	Small	Small	Small	Small	Small	Small	Small
Sensitivity/ Vulnerability/Importance of the Resource/Receptor	Low	Low	Low	Low	Low	Low	High	Medium	Low	Low
Significance of Impact	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Negligible**	**Moderate**	**Minor**	**Negligible**	**Negligible**

7.3.4 *Impact on Marine Fauna from Disposal of Drilling Muds and Cuttings from the Drillship*

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, due to the offshore location of the areas of interest, the abundance of phytoplankton and pelagic fish and invertebrate fauna is likely to be very low. Being dependent on nutrient supply, plankton abundance is typically spatially and temporally highly variable and is thus considered to have a low sensitivity. Higher productivity with associated development of detritivore-based food-webs that support demersal fish species can, however, be expected in the vicinity of the submarine canyons.

It is currently unknown whether sensitive receptors (such as corals and coelacanths) occur in the submarine canyons within the Block, which are located to the immediate south of the northern area of interest and some 30 km northeast of the southern area of interest. No drilling operation will be performed in these canyons.

Proposed Project Activities and Inbuilt Control and Compliance Measures

- During the drilling of the well(s), the primary discharge from the drillship would be the drill cuttings. Cuttings from deeper (lower-hole) sections, drilled with WBM /NADFs, are lifted up the marine riser to the drilling unit and separated from the drilling fluid by the onboard solid control systems. The solids waste stream is fluidised with seawater and discharged overboard through the caisson, which is typically located a few metres below the sea surface. In the order of 220 m^3 (583 MT) of cuttings will be discharged from the drillship.

- Should there be spent WBM remaining at the end of the drilling operation, this will either be stored onboard and shipped to shore for disposal/recycling or will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

- The NADF muds will be recovered and stored onboard and shipped to shore for disposal. The NADF drill cuttings will be routed through a vertical cuttings dryer (centrifuge type equipment) to remove residual liquids for reuse. The NADF retained on drill cuttings will be discharged overboard through a caisson but only if in compliance with specific standards (Refer to *Chapter 3*).

Significance of Impact

The disposal of cuttings from the drillship would have various direct and indirect biochemical effects on the receiving environment. The direct effects are associated with the contaminants contained in the drilling muds, sweeps and cements used during drilling operations. The indirect effects result from changes to water and sediment quality.

The cuttings themselves are generally considered to be relatively inert, but may contribute small amounts of trace metals and/or hydrocarbons to receiving waters (Neff *et al*. 1987). However, most of the metals associated with cuttings are in immobile forms in minerals from the geologic strata, and their composition will thus resemble that of natural marine sediments. The drilling muds on the other hand, are a specially formulated mixture of natural clays, polymers, weighting agents and/or other materials suspended in a fluid medium. The constituents and additives of the discharged muds may potentially have ecotoxicological effects on the water column and sediments. These are discussed further below.

Toxicity and Bioaccumulation Effects of Excess WBM and Residual NADFs on Drill Cuttings and spent WBM discharge

For the current project, the deeper sections of the well would be drilled using WBM and/or NADF muds to guarantee hole stability and hole cleaning.

WBM (treated wet cuttings and spent mud discharged overboard)
For the current project, it is estimated that some 220 m^3 of WBM cuttings will be discharged overboard through a caisson. The spent WBM will rapidly dissolve and disperse into the surrounding seawater and the cuttings will be deposited to a maximum area of approximately 7 km^2, over the short-term and therefore the impacts are considered of **Small magnitude**.

The primary issues related to the discharge of WBMs include bioaccumulation. Typically, the major ingredients that make up over 90 percent of the total mass of the WBMs are fresh or seawater, barium sulphate (barite), bentonite clay, lignite, lignosulphonate, and caustic soda. Others substances are added to gain the desired density and drilling properties. The sensitivity of receptors is **Negligible**. Therefore the significance of biochemical impacts of WBM on marine fauna will be **Negligible** (*Table 7.11*).

Based on the implementation of the proposed management and mitigation and management measures below, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of WBMs on on marine fauna will remain **Negligible** (*Table 7.11*).

NADF (treated wet cuttings, no spent mud discharged overboard)

In case drilling will necessitate the use of NADF mud, drilling cuttings will be treated as per standard solid control system used for WBM with in addition the use of a dryer to minimize the liquid content. Although most of the drilling fluids would be mechanically separated from the drilling cuttings, some NADF would remain adhered to the cuttings and would therefore reach the ocean. It is estimated that the NADF discharged cuttings may contain up to 5 percent by weight of drilling fluid (ERM 2018a), after treatment. During drilling of the deeper sections of the well, in the order of 38.36 m^3 (29.2 MT) of NADF would be discharged overboard through a caisson, from where they will be redistributed by currents before settling back onto the seabed.

The primary issues related to the discharge of NADFs include bioaccumulation and toxicity. The disposal of mud into the marine environment and its subsequent fate has been extensively investigated through field and laboratory studies (reviewed by Neff, 2005). In general, it has been found that the impacts are not significant in the open marine environment (Thomson *et al*. 2000; Hurley & Ellis 2004). Biological effects associated with the use of NADFs are not typically found beyond 250 to 500 m from the drilling unit (Husky 2000, 2001a; Buchanan *et al*. 2003; IOGP 2016).

The potential for significant bioaccumulation of NADFs in aquatic species is unlikely due to their extremely low water solubility and consequent low bioavailability (OGP, 2003). However, certain hydrocarbons are known to have tainting effects on fish and shellfish.

The potential for significant bioaccumulation of NADFs in aquatic species is unlikely due to their extremely low water solubility and consequent low bioavailability (IOGP, 2016). Therefore, the **sensitivity** of the receptors is assessed as **Low**. Rather than direct chemical toxicity, impacts to sessile marine organisms arise primarily through smothering effects (*Section 7.3.3*) and oxygen depletion due to rapid biodegradation of the base fluid in the sediment.

For the current project, deposition following surface discharges of NADF cuttings were anticipated to be present in a maximum area of approximately 7 km^2, over the short-term (ERM, 2018b). The larger footprint of the surface-discharged cuttings was, however, offset by the relatively low deposition thicknesses (< 5 mm) predicted for distances beyond approximately 50 m from the well location and therefore the impacts are considered of **Medium magnitude**.

Based on the analysis provided above and the assumption that the control measures described above are implemented, the significance of biochemical impacts of NADF on marine fauna will be **Minor** (*Table 7.11*).

Based on the implementation of the proposed mitigation and management below, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of NADF on marine fauna will remain **Minor** (*Table 7.11*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to benthic communities:

- Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site;

- Ensure drill site is located more than 500 m from any identified vulnerable habitats;
- Careful selection of fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential;
- Ensure only low-toxicity and partially biodegradable additives are used;
- Use high efficiency solids control equipment to minimize liquid content on cuttings, maximize reuse and recycle of drilling mud, reduce the need for fluid change out and minimise the final amount of residual spent mud; to maximize reduction of NADF wet content on cuttings, utilize drier system after standard solids control equipment;
- Maximize re-use and re-cycle of used WBM and NADF for different drilled section and for drilling other wells;
- Ensure regular lab test (for toxicity, barite contamination and oil content etc) on board to confirm that drilling cuttings and WBM properties are compliant with limitation prior of discharge overboard;
- Minimize spent WBM discharge to sea; avoid NADF mud discharge; and
- Regularly maintain the onboard solids control system.

Table 7.11 Significance of Biochemical Impacts Related to Drill Cuttings and Muds on Marine Fauna Present in the Water Column

Characteristic	WBM and WBM content on wet cuttings Bioaccumulation Impact	WBM and WBM content on wet cuttings Bioaccumulation Residual Impact	NADF content on wet cuttings (no NADF discharge) Bioaccumulation Impact	Residual NADF content on wet cuttings (no NADF discharge) Bioaccumulation Residual Impact
Extent	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term
Scale	Small	Small	Small	Small
Reversibility	High (fully reversible)		Medium (partially reversible)	
Loss of resource	Low		Low	
Magnitude	Small	Small	Medium	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low	Low	Low
Significance of Impact	**Negligible**	**Negligible**	**Minor**	**Negligible**

7.3.5 *Disturbance of Marine Fauna by Underwater Noise Associated with Drilling Operations*

Description of the Baseline Environment and Sensitive Receptors

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 (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. Thus, anthropogenic sound sources in the ocean can 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 hundreds of kilometres thereby affecting very large geographic areas (Coley, 1994, 1995; NRC, 2003; Pidcock *et al*. 2003). The sound level generated by vessels fall within the 160 to 170dB re 1 µPa range close to the vessel, with main frequencies from 1 to 500 Hz (McCauley, 1994; NRC, 2003).

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 drilling operations fall within the 120 to 190 dB re 1 µPa range at the drilling unit, with main frequencies less than 0.2 kHz, depending on the drill unit and support vessels used (Croft & Li, 2017).

Dynamically positioned vessels are noisier as they produce more noise than the fixed platforms. This is due to additional noise from thrusters and propellers as well as the larger surface area in contact with the water, which produces greater vibration into the water column (Hurley and Ellis, 2004).

The underwater noise generated by well-drilling operations in general and by the current project, thus falls within the hearing range of most fish and marine mammals, and would be audible for considerable ranges (in the order of tens of kilometres) before attenuating to below threshold levels (*Table 7.12*).

Table 7.12 Known Hearing Frequency and Sound Production Ranges of Various Marine Taxa

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

Source: Koper & Plön 2012

Underwater noise generated during the project could affect a wide range of fauna; from benthic invertebrates and demersal species residing on the seabed in the vicinity of the wellhead, to those invertebrates and vertebrates occurring throughout the water column and in the pelagic habitat near the surface.

The taxa most vulnerable to noise disturbance in the Project Area are turtles, pelagic seabirds, large migratory pelagic fish, and both migratory and resident cetaceans many of which are considered globally 'Critically Endangered' (e.g. Southern Bluefin tuna), 'Endangered' (e.g. whale shark, Fin, Blue and Sei whales) 'Vulnerable' (e.g. Leatherback turtle short-fin mako, whitetip sharks, sperm whale) 'Near threatened' (e.g. blue shark) and 'Least concern' (e.g.: Humpback and Southern Right Whales.

Proposed Project Activities and Inbuilt Control Measures

The table below summarises the project activities that will result in underwater noise.

Table 7.13 Summary of Underwater Noise Activities that may Disturb Marine Fauna

Activity phase	Activity
Mobilisation	Transit of drilling units and support vessels to the drill site
Operations	Operation of drilling unit (including VSP log[1]) and support vessels
Demobilisation	Drilling unit / support vessels leaving drill site and transit to port or next destination

The significant activities are described further below:

- The operation of the drillship and support vessels during transit to the drill site, during the proposed drilling activities and during demobilisation will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area

Significance of Impact

The underwater noise from well drilling operations 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).

Behavioural changes may generally include such trends as retreat from noise source, but also in some circumstances attraction to the source itself. In general, mammals have a highly developed and highly specialised hearing system, and there is evidence that noise levels in excess of 90 dB re 1 µPa can cause a behavioural response including escape from the immediate area or high stress. However, available data are not conclusive (Moulton & Richardson, 2000) and often misinterpreted.
There is a lack of definitive evidence regarding the effects of drilling operations on marine mammals; however, the most likely outcome is modified behaviour, which may generally include retreat from the noise source.

Southall *et al* (2007) found that low frequency cetaceans (i.e. large baleen whales) generally start to show avoidance behaviour and other behaviour effects to this type of non-pulsed sound in the 120 and 160dB re 1 µPa between 10 m and 3.5 km from the drillship. The reaction of mid-frequency cetaceans (i.e. dolphin species and toothed whales) to non-pulsed sound were varied and did not clear conclusion about behavioural changes (Southall *et al*, 2007).

[1] The VSP log noise emission has been considered not significant due to very short term duration but an additional precautionary measure has been introduced by the Company and indicated in this section

For another deep well-drilling project off the southern Namibian coast (SLR, 2017), it was estimated that noise from project activities would decrease to below the estimated median ambient background level (100 dB re 1µPa) within a distance of 14 to 32 km from the drill site, depending on the specific vessels used, the number of support vessels operating and the scenario. Maintenance activities represented the worst-case scenario for noise, although this would be expected to occur only for relatively short periods of time (Croft & Li, 2017). The extent of the noise impacts would, however, also depend on the variation in the background noise level with weather and with the proximity of other vessel traffic (not associated with the project).

The effects of underwater noise generated during well-drilling and by the drillship and support vessels on marine fauna is considered to be of **Small magnitude** in the drilling area and for the duration of the drilling campaign. Ultimately there will be no change to the natural ecosystem due to this disturbance as it is only temporary.

Based on the environmental baseline conditions discussed in *Chapter 4*, the **sensitivity** of the receptors in the region in terms of masking impacts from underwater noise is **High** due the presence of species of conservation concern in the Project Area. The **sensitivity** of the receptors in the region is in terms of avoidance impacts from underwater noise is **Low** due to the distance of the drilling from the shore.

Based on the analysis provided above, the impact of underwater noise potentially masking biologically significant sounds is considered of **Minor** significance without mitigation, whereas the impact of underwater noise resulting in avoidance of feeding and/or breeding area is considered **Negligible** without mitigation due to the extreme offshore location of the areas of interest (*Table 7.14*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the underwater impacts to marine fauna:

As far as reasonably practicable, vessels used in the project should incorporate measures to reduce the amount of underwater noise generated as follows:

- Vessels should also undergo regular maintenance regime to reduce noise which include the cleaning of propeller and underwater hull; and

- Prior to VSP log acquisition, as an additional precautionary measure, a qualified marine mammal observer will be available on board of drilling ship and monitor operations

Residual Impact

Based on the implementation of the proposed management measure, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**. The significance of the residual impact of underwater noise generated by drilling on masking biologically significant sounds remains **Minor**, whereas the impact of underwater noise resulting in avoidance of feeding and/or breeding area remains **Negligible** (*Table 7.14*).

Table 7.14 Significance of Impacts of Underwater Noise Generated by Drilling Operations on Marine Fauna

Characteristic	Masking Impact	Masking Residual Impact	Avoidance Impact	Avoidance Residual Impact
Extent	Local	Local	Local	Local
Duration	Short-term	Short-term	Short-term	Short-term
Scale	Small	Small	Small	Small
Reversibility	High (fully reversible)		High (fully reversible)	
Loss of resource	Low		Low	
Magnitude	Small	Small	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium	Low	Low
Significance of Impact	**Minor**	**Minor**	**Negligible**	**Negligible**

7.3.6 Disturbance of Marine and Avian Fauna by Helicopter Noise Associated with Drilling

Description of the Baseline Environment and Sensitive Receptors

Noise generated by helicopters undertaking crew transfers between Durban or Richard's Bay and the drillship could affect seabirds in breeding colonies and roosts on the mainland coast. Low altitude flights over the ocean could also affect marine mammals and turtles in surface waters in the Project Area.

The dominant low-frequency components of aircraft engine noise (10 to 550 Hz) penetrate the water only in a narrow (26° for a smooth water surface) sound cone directly beneath the aircraft, with the angle of the cone increasing in Beaufort wind force >2 (Richardson *et al.*, 1995). The peak sound level received underwater is inversely related to the altitude of the aircraft.

Available data indicate that the expected frequency range and dominant tones of sound produced by fixed-wing aircraft and helicopters overlap with the hearing capabilities of most odontocetes and mysticetes (Richardson *et al.* 1995; Ketten, 1998). Determining the reactions of cetaceans to overflights is difficult, however, since most observations are made from either the disturbing aircraft itself (Richardson & Würsig, 1997), or from a small nearby vessel.

Studies have shown, reactions to aircraft flyovers vary both within and between species, and range from no or an observable behavioural response.

Most studies established that the response resulted from the animals presumably receiving both acoustic and visual cues (the aircraft and/or its shadow).

As would be expected, sensitivity of whales to disturbance by an aircraft generally lessened with increasing distance, or if the flight path was off to the side and downwind, and if its shadow did not pass directly over the animals (Watkins 1981, 1986; Smultea *et al*. 2008). Smultea *et al*. (2008) concluded that the observed reactions of whales to brief overflights were short-term and isolated occurrences were probably of no long-term biological significance and Stewart *et al*. (1982) suggested that disturbance could be largely eliminated or minimised by avoiding flying directly over whales and by maintaining a flight altitude of at least 300 m.

However, repeated or prolonged exposures to aircraft overflights have the potential to result in significant disturbance of biological functions, especially in important nursery, breeding or feeding areas (Richardson *et al*. 1995). Humpback whales were almost completely displaced from East Coast waters during historical whaling activities and have only recently returned on their migrations to calving sites off Mozambique. This species can be observed off the East Coast between May and February, with peak sightings in June and November/December (Banks, 2013).

The level of disturbance would also depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions.

The hazards of aircraft activity to birds include direct strikes as well as disturbance, the degree of which varies greatly. The negative effects of disturbance of birds by aircraft were reviewed by Drewitt (1999) and include loss of usable habitat, increased energy expenditure, reduced food intake and resting time and consequently impaired body condition, decreased breeding success and physiological changes. Nesting birds may also take flight and leave eggs and chicks unattended, thus affecting hatching success and recruitment success (Zonfrillo, 1992).

Differences in response to different types of aircraft have also been identified, with the disturbance effect of helicopters typically being higher than for fixed-wing aeroplanes. Results from a study of small aircraft flying over wader roosts in the German Wadden Sea showed that helicopters disturbed most often (in 100 percent of all potentially disturbing situations), followed by jets (84 percent), small civil aircraft (56 percent) and motor-gliders (50 percent) (Drewitt, 1999).

Sensitivity of birds to aircraft disturbance are not only species specific, but generally lessened with increasing distance, or if the flight path was off to the side and downwind. However, the vertical and lateral distances that invoke a disturbance response vary widely, with habituation to the frequent loud noises of landing and departing aircraft without ill effects being reported for species such as gulls, lapwings, ospreys and starlings, amongst others (reviewed in Drewitt, 1999).

Further work is needed to examine the combined effects of visual and acoustic stimuli, as evidence suggests that in situations where background noise from natural sources (e.g. wind and surf) is continually high, the visual stimulus may have the greater effect. There is an Important Bird Area (IBA) at Richards Bay, potentially within the flight path of aircraft commuting between Richard's Bay airport and the northern area of interest for well drilling.

Proposed Project Activities and Inbuilt Control and Compliance Measures

Crew transfers by helicopter from Richards Bay / Durban to the drill unit, during the operational phase, will generate noise in the atmosphere that may disturb coastal species such as seabirds and seals.

The helicopter operator will comply with the following SA regulations:

- The National Environmental Management: Protected Areas Act (2003) stipulate that the minimum over-flight height over nature reserves, national parks and world heritage sites is 762 m (2,500 ft).

- The Marine Living Resources Act (1998) prohibits aircraft to approach within 300 m of a whale. Therefore, except for when the aircraft lands on or takes off from the drillship and logistics base, the flight altitude would be >300 m.

- The operation of helicopters and fixed-wing aircraft is governed by the Civil Aviation Act (No. 13 of 2009) and associated regulations.

Significance of Impact

Indiscriminate low altitude flights over whales, seabird colonies and turtles by helicopters used to support the drillship could have an impact on behaviour and breeding success. The level of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions and could range from **Small** to **Large magnitude**.

Although such impacts would be localised and short term, impacts would be likely for low altitude flights and may thus have wider ramifications over the range of the affected species. Based on the environmental baseline conditions discussed in *Chapter 4*, the **sensitivity** of the receptors in the region is **High.**

Based on the analysis provided above, the significance of the impact of helicopter noise on marine fauna will be **Moderate** (*Table 7.15*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to disturbance to marine fauna from helicopter noise:

- Pre-plan flight paths to ensure that no flying occurs over IBAs;
- Avoid extensive low-altitude coastal flights (<914 m and within 2 km of the shore);
- The flight path between the onshore logistics base and drillship should be perpendicular to the coast;
- A flight altitude >305 m be maintained at all times, except for when the aircraft lands on or takes off from the drillship and logistics base;
- Maintain an altitude of at least 914 m within Marine Protected Areas;
- Contractors should comply fully with aviation and authority guidelines and rules; and
- Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the residual impact of helicopter noise generated by drilling on marine fauna will be reduced to **Minor** (*Table 7.15*).

Table 7.15 Significance of Impacts of Helicopter Noise Associated with Drilling on Marine and Avian Fauna

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Medium (partially reversible)	
Loss of resource	Low	
Magnitude	Small to Large	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Moderate**	**Minor**

7.3.7 *Disturbance of Marine Fauna and Avian by Light Associated with Drilling*

Description of the Baseline Environment and Sensitive Receptors

The drilling activities would be located in the offshore marine environment, 62 km offshore, far removed from any sensitive coastal receptors (e.g. bird colonies), but could still directly affect migratory pelagic species transiting through both the areas of interest for drilling.

The taxa most vulnerable to ambient lighting in the Project Area are pelagic seabirds, although turtles, large migratory pelagic fish, and both migratory and resident cetaceans may also be attracted by the lights.

Proposed Project Activities and Inbuilt Control and Compliance Measures

The table below summarises the project activities that will result in an increase in ambient light:

Table 7.16 Summary of Project Activities that will Result in Increased Ambient Light

Activity phase	Activity
Mobilisation	Transit of drilling units and support vessels to the drill site
Operations	Operation of drilling unit and support vessels
	Flaring during production tests
Demobilisation	Drilling unit / support vessels leave drill site and transit to port or next destination

These activities are described further below:

- Transit and operation of the drillship and support vessels. The operational lighting of drillship and support vessels can be a significant source of artificial light in the offshore environment; and

- During well testing it may be necessary to vent or flare off some of the oil and gas brought to the surface. Flaring and venting is also an important safety measure used to ensure gas and other hydrocarbons are safety disposed of in the event of an emergency, power or equipment failure or other plant upset conditions. Flaring and venting produces a flame of intense light at the drill unit.

The light impacts from the activities described above would primarily take place at the well location and along the route taken by the support vessels between the drillship and either Durban or Richard's Bay.

Significance of Impact

Although little can be done at the offshore installation to prevent seabird collisions, reports of collisions or death of seabirds on drilling units are rare.

It is expected that seabirds and marine mammals in the area become accustomed to the presence of the installations within a few days, thereby making the significance of the overall impact on these populations negligible. The significance to the populations of fish and squid of increased predation as result of being attracted to an installation's lights is deemed to be **Not significant.**

The increase in ambient lighting in the offshore environment would be of **Negligible magnitude** and limited to the drilling location over the short-term. Due to the far offshore location of both the areas of interest away from most sensitive receptors the **sensitivity** is **Low**.

For support vessels travelling from Durban or Richard's Bay increase in ambient lighting would likewise be restricted to the immediate vicinity of the vessel over the short-term and would be of **Negligible magnitude.** Due to the movement of the vessel from the coast to the offshore location the **sensitivity** of the receptors are **Medium**.

Based on the analysis provided above, the significance of the impact of light from the project vessels on marine fauna will be **Negligible** (*Table 7.17*).

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to disturbance to marine fauna from increased ambient light:

- The lighting on the drilling unit and support vessels should be reduced to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimized; and

- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Injured birds should be humanely euthanized. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of light on marine fauna remains **Negligible** (*Table 7.17*).

Table 7.17 Significance of the Impact of Light from Project Vessels on Marine Fauna and Avian

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Medium (partially reversible)	
Loss of resource	Low	
Magnitude	Negligible	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Low
Significance of Impact	**Negligible**	**Negligible**

7.4 PLANNED OPERATIONS: KEY SOCIAL IMPACTS

Potentially significant impacts to the social receptors are assessed below and include:

Table 7.18 Summary of Social Impacts Assessed

Impact	Section
Creation of Employment Opportunities	7.4.1
Impact of the Presence of the Exclusion Zone on Commercial Fishing Activities	7.4.2
Abandonment: Presence of Wellhead on Marine Activities	7.4.3
Disturbance of Marine Cultural Heritage from Drilling Operations	7.4.4
The No-Go Alternative	7.4.5

7.4.1 *Creation of Employment Opportunities*

Description of the Baseline Environment and Sensitive Receptors

The unemployment rate within the ADI, (eThekwini Metropolitan Municipality and the uMhlathuze Local Municipality) varies, with a high unemployment rate in the uMhlathuze LM (40 percent) and a significantly lower rate in the eThekwini MM (16 percent).

There is an increasing demand for skilled labour in the ADI, however, the skills base remains low. Approximately a quarter of the population have finished secondary school and around eight percent of the population in the ADI have received tertiary education (StatsSA).

Proposed Project Activities and Inbuilt Enhancement Measures

The project is not expected to create employment for people living within the ADI. The drillship will require up to 200 personnel and due to the short-term nature of the work and the necessary expertise and required technical skills, the majority of staff employed will be expatriates.

The preferred option is to utilise existing local vessels and staff for the supply vessels. The number of personnel on the supply vessels will vary based on vessel size and the types of activities they support. It is anticipated that existing vessels and crews will be contracted and no new employment opportunities will be created.

Between five and ten people will be employed temporarily at the onshore logistics base. Some will be existing Eni personnel.

A summary of project activities and employment opportunities is presented in *Table 7.19*.

Table 7.19 ***Summary of Project Activities Linked to Employment Creation***

Activity phase	Activity
Mobilisation	Transit of drilling units and support vessels to the drill site with existing crew.
Operation	Operation of drilling unit and support vessels using existing drillship crews and local support vessels.
	Short term operation of the onshore logistics base in the Port of Durban or Richards Bay.
Demobilisation	Drilling unit leaves drill site and transit to Port or next destination with existing crew. Contracts with local support vessels terminated.

Significance of Impact

The impact of employment creation can be classified as positive and direct. The extent will be local depending on skills capacity and availability. The impact will be short-term for the duration of exploration drilling. For those who are able to secure employment on the project, and for local vessel contractors able to secure a contract with the project, the scale of the impact will be medium and the frequency will be constant for the duration of project.

The **magnitude** of the impact is **Positive**, and the **sensitivity** is **Low** considering that the project will create limited employment opportunities (five to ten at most) within local community and most of the project will be staffed with expatriates. The significance of this impact is assessed as **Negligible** (*Table 7.20*).

Mitigation and Management Measures

The objective of mitigation and management is to optimise opportunities for employment of local people, wherever possible.

- The Project will establish a recruitment policy which prioritises the employment of South African and local residents (originating from the Local Municipality) at the onshore logistics base over foreigners, where they meet the skill base and experience required. Criteria will be set for prioritising local residents and then other South Africans as part of the recruitment process.

- Priority will be given to South African vessel contractors to provide the project with supply vessels and vendor supplies that meet international quality standards for oil and gas operations.

Residual Impact

Based on the implementation of the proposed enhancement measures the **reversibility** of the impact is **High**. There is no loss of resource and, the significance of the impact remains **Negligible** (*Table 7.20*).

Table 7.20 Significance of Impacts Related to Employment Creation

Characteristic	Impact	Residual Impact
Extent	Local	Local to International
Duration	Short-term	Short-term
Scale	Medium	Medium
Reversibility	High (fully reversible)	
Loss of resource	N/A	N/A
Magnitude	Positive	Positive
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

7.4.2 Impact of the Presence of the Exclusion Zone on Commercial Fishing Activities

Description of the Baseline Environment and Sensitive Receptors

As discussed in *Chapter 4*, the only commercial fishery that overlaps with the drilling areas of interest is the pelagic longline fishery. From 2000 to 2014, the sector directed 1.95 percent and 2.32 percent of their total recorded effort in the vicinity of the northern and southern areas of interest, respectively[1]. Catch recorded within the areas amounted to 2.34 percent (46.5 t) and 1.98 percent, (39.2 t) of the total catch, respectively.

The KwaZulu-Natal linefish and prawn trawl fishery overlaps with Exploration Rights Area 236. However, there is no evidence of overlap with the proposed areas of interest for drilling with the areas fished by the linefish and the prawn trawl fishery.

[1] Fishing positions are reported where the deployment of a line commences. Lines with start positions outside the areas of interest for well drilling may extend into these areas. In an attempt to include all affected fishing areas, we have tallied catch and effort reported within and beyond the boundaries of the areas of interest to a distance of 40 km.

The KwaZulu-Natal linefish fishing effort lies at least 10 km and 35 km inshore of the northern and southern areas of interest, respectively, and therefore there is no impact expected on the fishery.

The KwaZulu-Natal prawn trawl fishery is situated at least 35 km and 30 km inshore of the northern and southern areas of interest, respectively, and therefore there is no impact expected on the crustacean trawl fishery.

Proposed Project Activities and Inbuilt Enhancement Measures

The table below summarises the project activities that will result in an impact to the commercial fishing industry.

Table 7.21 Summary of Project Activities that will Impact the Commercial Fishing Industry due to the Presence of an Exclusion Zone

Activity phase	Activity
Mobilisation	N/A
Operation	Presence of 500 m exclusion zone around the drillship
Demobilisation	Abandonment of wellhead(s)[1] on seafloor after plug and abandonment operations

These activities are described further below:

- Operation of the drilling unit: the exclusion of vessels from entering the 500 m safety zone (approximately 0.8 km^2) around a drilling unit poses a direct impact to fishing operations in the form of loss of access to fishing grounds only if the fishing areas for each fishing sector identified overlap. The safety zones aim to ensure the safety both of navigation and of the drilling unit, avoiding or reducing the probability of accidents caused by the interaction of fishing boats and gears and the drilling unit.

- Abandonment of wellhead(s) on the seafloor: exploration and appraisal well(s), prior to the demobilization phase, will be sealed with cement plugs, tested for integrity and abandoned (plug and abandon oprations can be indicated as "decommissioning"). The wellhead, with a height of approximately 3 m and a diameter of 1 m, will remain on the seafloor.

- Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a drilling unit that is engaged in underwater operations is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way.

[1] Impact for wellhead presence assessed separately in the next chapter

- Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), an "exploration platform" or "exploration vessel" used in prospecting for or mining of any substance falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone.

- A notice to mariners and a navigational warning will be issues to mariners, to communicate the location of the drillship and exclusion zone, via the South African Navy Hydrographic Office (HydroSAN). Support vessels with appropriate radar and communications will be used during the drilling operation to warn vessels that are in danger of breaching the exclusion zone.

Significance of Impact

As discussed above the only fishery that is expected to be impacted by the drilling activity is the pelagic longline fishery. The exclusion zone around the drillship will be temporary as when the drillship is finished drilling it will move off station.

The impact of exclusion from the pelagic longline fishing ground during the operational phase of well drilling is considered to be local in extent (limited to the area of interest) and of short-term duration (71 days).

The scale of the impact is determined to be small, since the catch recorded within the impacted area falls in the 1 – 5 percent category (*Chapter 4*). The frequency with which the sector operates in the proposed Project Area is high, as the fishery operates almost continuously all-year-round.
Therefore, the **sensitivity** of the pelagic longline fishers is **Small** and the **magnitude** of the impact is **Medium.**

Based on the analysis provided above, the significance of the presence of the exclusion zone on the commercial pelagic longline fisheries is assessed as **Minor**.

Mitigation and Management Measures

The following mitigation and management measures are recommended to assist in managing the impacts to the commercial pelagic longline fisheries:

- Prior to the commencement of drilling activities the following key stakeholders should be consulted and informed of the proposed drilling programme (including navigational co-ordinates of well location, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m exclusion zone and the movements of support vessels):

    - Fishing industry / associations: SA Tuna Association; and
    - Other key stakeholders: HydroSAN, Ports Authority and SAMSA.

- These stakeholders should again be notified at the completion of drilling when the drilling unit and support vessels are off location.

- Request, in writing, the HydroSAN to broadcast a navigational warning via Navigational Telex (Navtext).

- Distribute a Notice to Mariners prior to the commencement of the drilling operations. The Notice to Mariners should give notice of (1) the co-ordinates of the well location, (2) an indication of the proposed drilling timeframes, (3) an indication of the 500 m safety zone around the drilling unit, and (4) provide details on the movements of support vessels servicing the drilling operation. This Notice to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.

- The lighting on the drilling unit and support vessels should be managed to ensure that they are sufficiently illuminated to be visible to fishing vessels, as well as ensure that it is reduced to a minimum compatible with safe operations.

- Notify any fishing vessels at a radar range of 45 km (24 nm) from the drilling unit via radio regarding the safety requirements around the drilling unit; and

- Abandoned well location, including wellhead location, must be surveyed and accurately charted with the HydroSAN office.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **High** and the degree of the **loss of resource** is **Low**, the significance of the impact to restricted access to fishing grounds will remain **Minor** (*Table 7.22*).

Table 7.22 Significance of Impacts Related to Restricted Access to Fishing Grounds and Damage to Fishing Nets

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	High (fully reversible)	
Loss of resource	Low	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Minor**	**Minor**

7.4.3 Abandonment: Presence of Wellhead on Marine Activities

Description of the Baseline Environment and Sensitive Receptors

After the plug and abandon ("decommissioning") and demobilisation, the vessel won't impact the areas of interest anymore. On the contrary the presence of an abandoned wellhead could impact only those fisheries that direct fishing effort at the seabed (demersal fisheries). Snagging of fishing gear or anchors on a wellhead could pose a risk of damage to fishermen's equipment where fishing grounds overlap with the abandon wellhead. In the case of this project, the abandoned wellhead would be located at a depth of between 1,500 m and 2,100 m in the northern area of interest, and between 2,600 m and 3,000 m in the southern area of interest. Considering there is no demersal fishing activities overlap with the Block and that the water depths of both areas of interest are deeper than 1,500 m, there is unlikely to be any interaction with demersal fishing activities and the wellhead will be left at seabed

The pelagic longline sector does overlap with the area of interest, and vessels operate within much of the area covered by both the northern and southern areas of interest for well-drilling. Due to the nature of the gear used by the fishery and the depth of the wellhead, interaction between the wellhead and gears is not likely to occur.

Proposed Project Activities

Upon demobilisation, exploration well(s) would be sealed with cement plugs, tested for integrity and abandoned. The wellhead, with a height of approximately 3 m and a diameter of 1 m, would remain on the seafloor (*Table 7.23*).

The abandoned wellhead would be located at a depth of between 1,500 m and 2,100 m in the northern area of interest, and between 2,600 m and 3,000 m in the southern area of interest.

Table 7.23 Summary of Presence of the Wellhead on Marine Activities

Activity phase	Activity
Mobilisation	N/A
Operation	N/A
Demobilisation	Abandonment of wellhead(s) on seafloor

Significance of Impact

The impact of the presence of the wellhead after abandonment is considered to be local in extent (limited to the area of interest) and of long-term duration. The scale of the impact is determined to be small, since the interaction between any sea user i.e. deep water trawling and the abandoned wellhead is unlikely.
The frequency with which the sector operates in the drilling areas of interest is low, as there is no deepwater trawling activity currently at the well site. The **sensitivity** of the receptor is **Low** and the **magnitude** of the impact is **Small.**

Based on the analysis provided above, the significance of the presence of the wellhead on marine activities is assessed as **Negligible**.

Mitigation and Management Measures

The abandoned wellhead location must be surveyed and accurately charted with the HydroSAN office.

Residual Impact

Based on the implementation of the proposed mitigation and management measures, the **reversibility** of the impact is **Medium** and the degree of the **loss of resource** is **Low**, the significance of the impact on marine activities will remain **Negligible** (*Table 7.24*).

Table 7.24 Significance of Impacts of the Presence of the Wellhead during Abandonment

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Long-term	Long-term
Scale	Small	Small
Reversibility	Medium (fully reversible)	
Loss of resource	Low	
Magnitude	Small	Negligible
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Negligible**	**Negligible**

7.4.4 *Disturbance of Marine Cultural Heritage from Drilling Operations*

Description of the Baseline Environment and Sensitive Receptors

Global sea levels have fluctuated substantially on at least three occasions during the last 500,000 years. The lower sea levels would have caused large parts of the continental shelf to be exposed as dry land along the narrow continental shelf of west and east coasts of South Africa. Although the most westerly edges of Block ER236 lie in relatively shallow water, the entire block and particularly the two Areas of Interest that will be the focus of the exploration drilling are in water that is too deep for the seabed to have been exposed in the past by glacially driven fluctuations in world sea levels and thus accessible to our human ancestors.

There have been numerous shipping casualties along the adjacent coast, the earliest recorded on the KZN coast being the Sao Joao, a Portuguese nau wrecked at Port Edward in 1552, south of Block ER236 (Axelson 1973; Burger 2003). In the broader study area defined for this assessment, there are records of seven maritime losses. Based on their given positions none of these wrecks are located within either of the two Areas of Interest for exploration drilling, although the level of confidence in the available positions is generally low.

With regard to the potential for encountering a shipwreck – either one of the known wrecks described above or a currently unknown wreck - during the marine-based activities associated with the exploration drilling programme in the two Areas of Interest, this is assessed to be extremely unlikely.

Proposed Project Activities

The drilling operations proposed could potentially disturb the marine cultural heritage including submerged prehistory and shipwrecks. However, the two Areas of Interest are located in water in excess of 1,500m and there is thus no likelihood of any submerged prehistoric archaeological sites or material being encountered in the course of exploration drilling in either of these two areas.

Further to this, there are no known or recorded shipwreck within the two Areas of Interest identified for exploration drilling as part of this project. However, the co-ordinates of the known wrecks within the wider study area are approximate (none having been ground-truthed to remains on the seabed) and these sites may thus not be at the given positions on the seabed. There is thus the potential for some of these wrecks to be within particularly the northern area of interest, or outside of the study area entirely.

Table 7.25 below summarises the project activities that may physically disturb the seabed and sediment, thereby disturbing submerged prehistory or shipwrecks.

Table 7.25 Summary of Project Activities that Physically Disturb the Marine Cultural Heritage

Activity phase	Activity
Mobilisation	N/A
Operation	Drilling activities (including localised removal of sediments and smothering)
	Discharge of residual cement during riserless stage
	Removal of BOP
Demobilisation	N/A

Significance of Impact

The impact on marine cultural heritage resources can be classified as direct and negative. The extent will be localised and the duration will be short-term, for the duration of exploration drilling. The scale of the impact would potentially be large if marine cultural heritage resources were disturbed or damaged by project activities, however, with the lack of heritage resources identified in both areas of interest, scale is determined to be small. Given that there is no known presence of heritage resources in both areas of interest , the frequency is considered remote.

The **magnitude** of the impact is **Small**, and the **sensitivity** is **Low** considering the lack of known cultural heritage resources in in both areas of interest. The significance of this impact is assessed as **Negligible** (*Table 7.20*).

Mitigation and Management Measures

No mitigation measures have been recommended with respect to submerged prehistoric archaeology as it is extremely unlikely that sites or material are present in the study area.

No mitigation is required or proposed in respect of the known wrecks identified as being in the study area as their reported positions suggest that they all lie outside the two exploration drilling Areas of Interest.

Within the areas of interest it is recommended that any pre-drill remote sensing data collected to ground-truth seabed conditions is reviewed to establish whether any shipwrecks are present on the seabed.

Any video footage collected in the vicinity of proposed well locations should be reviewed for evidence of shipwreck material on the seabed.

Should these reviews of data identify wreck material at or near the location of a proposed drill site, micro-siting of the well location and the possible implementation of a drilling activity exclusion zone around the archaeological feature should be sufficient to mitigate the risks to the site.

A chance find procedure must be developed for the project and should any shipwreck material that was not identified by the measures set out above be encountered during the exploration drilling process.

Residual Impact

Based on the implementation of the proposed management measures, the **reversibility** of the impact **Medium** and the degree of the **loss of resource** is **High.** The significance of the impact of marine cultural heritage will remain **Negligible** (*Table 7.26*).

Table 7.26 Significance of Impacts of Drilling on the Marine Cultural Heritage

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	Low (not reversible)	
Loss of resource	High	
Magnitude	Small	Small
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Low	Low
Significance of Impact	**Negligible**	**Negligible**

7.4.5 The No-Go Alternative

Description of the Baseline Environment and Sensitive Receptors

The option not to proceed with exploration or appraisal drilling will leave the areas of the potential drilling sites in their current environmental state, with the oil/gas potential remaining unknown.

Proposed Project Activities and Inbuilt Control and Compliance Measures

The No Go alternative entails no change to the status quo, in other words the proposed exploration drilling activities will not be conducted in ER236.

Significance of Impact

If the well is successful it will have the following positive impacts:

- Local economic impact in term of procurement (direct and indirect), taxes (royalties and other taxes) and salary paid to direct employees and suppliers employees;
- Local employment and job creation both direct employed in O&G activity or along the supply chain of the O&G industry;
- Diversification of the South Africa energy mix;

- Possibility to give access to energy to population (special in rural areas); and
- Decreased reliability on importation from other countries.

The implications of not going ahead with the proposed drilling activities in Block ER236 are as follows:

- Lost future development of oil and gas resources in the drilling areas of interest; and
- If economic oil and gas reserves do exist and are not developed, South Africa's government and community would lose the opportunity to maximise the use of its own oil and gas reserves.

Therefore, the **sensitivity** of the receptor is **Medium** and the **magnitude** of the impact is **Medium.**

The potential impact related to the lost opportunity to further explore oil and gas reserves within their licence area and maximise the use of South Africa's own reserves should they exist is considered to be of **Moderate** significance (*Table 7.27*).

Mitigation and Management Measures

There is no mitigation and management measures necessary to mitigate the impact of the no-go alternative.

Residual Impact

There is no mitigation and management measures necessary to mitigate the impact of the no-go alternative and therefore the residual significance remains **Moderate** (*Table 7.27*).

Table 7.27 Significance of Impacts of the No-Go Alternative

Characteristic	Impact	Residual Impact
Extent	Local	Local
Duration	Short-term	Short-term
Scale	Small	Small
Reversibility	High (fully reversible)	
Loss of resource	Low	
Magnitude	Medium	Medium
Sensitivity/Vulnerability/Importance of the Resource/Receptor	Medium	Medium
Significance of Impact	**Moderate**	**Moderate**

7.5 CUMULATIVE IMPACTS FROM PLANNED OPERATIONS

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.

7.5.1 *Planned Projects and Activities in the Project Area*

The earliest that drilling is expected to take place is in 2019. The drilling of one well is estimated to take approximately 71 days to complete. There are no known planned future projects planned in the Project Area.

The known socio-economic activities (detailed in *Chapter 4*) that may occur in the Project Area are:

- There is a possibility that the offshore recreational boat-based fishing activities travel offshore and into Block ER236;

- The only commercial fishery that overlaps with the areas of interest is the KwaZulu-Natal pelagic longline fishery;

- The KwaZulu-Natal traditional linefish and prawn trawl fishery overlaps with Exploration Rights Area 236 but does not overlap with the areas of interest;

- The Project Area may overlap with tankers and bulk carriers navigating offshore of the East Coast on their way around the southern African subcontinent;

- Block ER236 may overlap with the routes taken by tankers and bulk carriers. The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Richards Bay or the Port of Durban;

- Both the EASSy and Seacom cables may pass through Block ER236; and

- Exploration activities are being undertaken in neighbouring oil and gas blocks, including Tugela South operated by EMEPSAL to the north-west; Deep Water Durban operated by EMEPSAL to the south and Silverwave deepwater block to the east.

7.6 *IDENTIFICATION AND SCREENING OF POTENTIAL CUMULATIVE IMPACTS*

The potential for cumulative environmental and social interactions caused by the project in combination with other planned activities were identified as:

- GHG emissions from the project vessels and their contribution towards climate change in combination with other vessels in the region;

- Underwater noise generation from the project vessels and their contribution to underwater noise in combination with other vessels in the region and the combined impacts on marine mammals; and

- Disturbance to benthos due to oil and gas activities.

7.7 *EVALUATION OF POTENTIAL CUMULATIVE IMPACTS*

A description of the nature of potential cumulative impacts likely to arise from the project in combination with other reasonably foreseeable activities is provided below:

7.7.1 *GHG Emissions*

The GHG emissions from project activities have been calculated and these will contribute to the total GHG emissions by offshore oil and gas facilities/ development activities offshore South Africa, which may have an impact on climate change. The addition of the project activities' GHG emissions to the cumulative levels of GHG in the Project Area will be of **Minor significance**.

7.7.2 *Disturbance to Marine Mammals and Turtles*

Drilling and generator noise aboard the drillship, support vessel and helicopter noise may cause disturbance and/or nuisance to on/off site marine mammals and turtles. Noise will be cumulative in nature due to existing noise caused by marine traffic in the region. Vessel activity will contribute to ambient levels of underwater noise, but even sensitive species (cetaceans and possibly marine turtles and certain fish species) are unlikely to be significantly affected. The addition of the project activities' to the cumulative levels of noise in the Project Area will be of **Minor significance**.

7.7.3 *Disturbance to Benthos*

The primary impacts to benthos associated with the drilling of exploration wells in the West Indian Offshore Bioregion off the coast of KZN, relate to physical disturbance of the seabed, discharges of drilling solids to the benthic environment, the presence of infrastructure remaining on the seabed and associated vessel or drillship presence.

The development of the proposed exploration well(s) in this assessment would impact a maximum cumulative area of ~0.003 km^2 (per well) in the West Indian Bioregion, which can be considered an insignificant percentage of the bioregion as a whole. Cumulative impacts from other hydrocarbon ventures in the area may increase in future.

The cumulative impacts of the proposed drilling of exploration wells off the KZN coast can be considered of **Low significance.**

7.7.4 *Mitigation Options for Cumulative Impacts*

Proposed mitigation measures for the drilling activities as identified in the impact assessment above are adequate to mitigate any potential cumulative impacts from adjacent activities. No additional mitigation measures are required.

8 ACCIDENTAL EVENTS

8.1 INTRODUCTION

An unplanned/ accidental event is defined as 'a reasonably foreseeable incident that is not anticipated to occur as part of the proposed project, but which may conceivably occur as a result of project activities (e.g. vessel accidents and loss of well containment/blowout), but with a low probability'. Accidental events may occur during any phase of the project. This *Chapter*, describes the potential accidental events associated with the project and provides an assessment of the risk significance of the impact on the receiving environment based on an assessment of likelihood vs consequence.

The following accidental events, summarized in *Table 8.1*, were considered non-significant and have not been assessed further in this EIA Report.

Table 8.1 Non-Significant Risks

Activities	Scoping Results
Small oil/chemical spills	The Project vessels shall be required to have the Shipboard Oil Pollution Emergency Plan (SOPEP) in place for all vessels. Small chemical and oil spills onboard the Project vessels will be cleaned up immediately and adhere to the SOPEP and EMPr and therefore the impact of small oil or chemical spills is unlikely to be significant and will not be assessed further.
Ballast from support and supply vessels (potentially international)	All ships that carry ballast water must de- and re-ballast in adherence with the International Maritime Organization (IMO) guidelines and standards governing discharge of ballast waters at sea. The IMO states that vessels using ballast water exchange should, whenever possible, conduct such exchange at least 200 nm from the nearest land and in water of at least 200 m depth. Where this is not feasible, the exchange should be as far from the nearest land as possible, and in all cases a minimum of 50 nm from the nearest land and preferably in water at least 200 m in depth. Based on the implementation of these measures the impact will not be significant and will not be assessed further.
Dropped objects	Dropped objects from the project vessels could lead to significant health and safety risks. This risk however, is managed through industry standards around health and safety, in-built control measures and compliance with Eni's H&S Standards. Mitigation and prevention of these incidents is included in the EMPr for this project to minimise the risk. The significance of this impact is not assessed further is this EIA Report.
Helicopter incidents	Helicopter collisions could have significant health and safety risks. This risk is however, managed through industry standards around health and safety, in-built control measures and compliance with Eni's H&S Standards. Mitigation and prevention of these incidents is included in the EMPr for this project to minimise the risk. The significance of this impact is not assessed further is this EIA Report

The following accidental events were considered to be potentially significant during scoping and are assessed in *Section 8.3*:

- Accidental oil spill due to a blowout;
- Accidental oil spill due to a vessel collision; and
- Accidental release of Non Aqueous Drilling Fluid (NADF) due to the emergency disconnection of the riser occurring during drilling.

A range of design features and control measures have been developed as part of the design planning phase to reduce the likelihood of accidental events. In addition, existing management measures applied by Eni on its other exploration projects to minimise the risk of accidental events will be adopted on this project. These measures are presented in *Section 8.3.5*. All recommended mitigation measures presented in this Section have been incorporated into the Environmental Management Programme (EMPr) for this project (*Chapter 9)*.

8.2 *METHODOLOGY*

8.2.1 *Assessing Significance of Risks*

The methodology used to assess the significance of the risks associated with accidental events differs from the impact assessment methodology set out in *Chapter 6* 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 compliance and control 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, and informed by the results of the various modelling studies undertaken to confirm the extent and duration of an oil spill. In order to determine the potential extent and duration of accidental oil spills (in the unlikely event that they occur) an oil spill modelling study was conducted for this project (*Annex D*).

Definitions used in the assessment for likelihood and consequence are set out in *Box 8.1*.

Box 8.1 *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 oil and gas 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 (*Section 7*) 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 8.2* is used to determine the risk significance for accidental events. The prediction of the risk takes into account the compliance 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 8.2 *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 8.2*.

Box 8.2 *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 (e.g. well design, control measures, preventative maintenance measures, emergency response procedures and training);
- Reducing the consequence (e.g. well capping and containment solutions); and
- A combination of the above.

Recovery/remediation: includes contingency plans and response, e.g.:

- Emergency Response Plan; and
- Oil Spill Contingency Plan.

8.3 ASSESSMENT OF ACCIDENTAL OIL SPILL AND BLOWOUT

8.3.1 *Overview*

The risk of an oil spill (including crude oil and diesel) into the marine environment is inherent in all offshore oil exploration and appraisal projects. The likelihood (probability) of significant oil spills (i.e. those that can reach the coastline or other sensitive areas) is **very low** with most oil spills being very small and having only limited environmental effects.

An oil spill is an unplanned and unwanted event determined by an accidental or emergency situation. The extent, fate and behaviour of the unplanned oil spill could impact the environment if not properly managed. For instance an oil spill generated by a hydrocarbon release during a blowout (an unwanted situation in which an uncontrolled mass of gas and/or oil is released from the well to the surface or to the seabed), is considered an emergency situation and must be immediately managed to reduce the size and scale of spill.

The probability of a blowout is **very low** where the frequency of occurrence is 2.5×10^{-4} (1 in 4,000 wells) for wells drilled (OGP Report, 2010[1])). The industry approach to dealing with potential oil spills is to develop technology and operational procedures to reduce the likelihood of spills (i.e. an unwanted accidental or emergency situation). Catastrophic events such as the blowout of the Macondo well (2010 in GoM - USA) have significantly contributed to the revision and upgrade of international standards (API/ISO) and best practice and the development and the implementation of new technologies in the field. This has resulted in significant reduction of the risk of catastrophic events occurring in the future.

[1] OGP Risk Assessment Data Directory, Report No. 434-2, March 2010.

The industry focus, commitment and effort, in particular for major oil companies like Eni, is to conduct operations with the highest safety standards, in order to perform drilling operations with no risk and harm to the people, the environment and the asset. In order to minimize the residual risk of incidents, strict rules are defined by international standards (API/ISO) and best practice and must be followed by the company, the drilling contractors and all parties involved in drilling operations, including maritime and logistic operations.

To prevent an unwanted oil spill, the industry has defined number of mandatory response, control and management measures and resources that must be implemented during drilling operations. These includes advanced planning of tools that can be used and training of personnel to reduce the severity of impacts in the event of a spill. These tools include the use of subsea BOP (Blowout Preventer), to immediately shut in the well in case of emergency. In addition, the availability of a capping system can provide a backup tool to be used in case of failure of BOP. The new capping system has been developed after the Macondo incident, in which a similar tool has been used to successfully shut-in the well and contain any further spill. The capping system is now an effective option in case of emergency.

All the response procedures form part of an Oil Spill Contingency Plan (OSCP) that must be developed prior to the beginning of the proposed drilling activities. The OSCP shall be reviewed and approved by the South African Maritime Safety Authority (SAMSA) prior to start of drilling. On approval, SAMSA will issue a Pollution Safety Certificate.

8.3.2 Oil Spill Modelling

The purpose of the oil spill modelling is to identify the worst case consequences for a range of spill scenarios and identify the probability of oil impacting the sea surface and seawater column, coastline or nearshore receptors. The oil spill modelling will also support the preparation of the OSCP.

It is important not only to understand the main risks of oil spills associated with exploration drilling including those related to supporting vessels such as vessel collision resulting in a spill , but also the consequences if any spills were to occur. A key element of identifying the consequence of a spill is to understand what is likely to happen to the oil in the marine environment. Oil spill trajectory modelling plays an important role in predicting the spatial extent of an oil spill for a worst case scenario and subsequently quantifying environmental risks from such oil spills.

For this draft EIA Report, oil spill modelling has been undertaken in order to predict the consequences of three spill scenarios. These three scenarios are:

- **Scenario 1** - vessel collision releasing diesel;

- **Scenario 2a** – blowout at the wellhead leading to hole collapse[1];

- **Scenario 2b** – blowout at the wellhead followed by the installation of a capping system (back up system for failed BOP); and

- **Scenario 3** - riser disconnect releasing oil associated with the Non-Aqueous Drilling Fluids (NADF) due to the emergency disconnection of the riser occurring during drilling.

Each spill scenario is run 120 times (iterations) with the spill's start date evenly spaced across a five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories across the different seasons. In each case the worst case scenario has been adopted in the assessment for unplanned events, in line with international requirements.

In addition, modelling of Dissolved Aromatic Hydrocarbons (DAH) was conducted for Scenario 2a and the results are presented in *Annex D*.

A number of assumptions has been made in order to determine the scenarios to be modelled. These include the following:

- The event is completely uncontrolled, with no intervention (unrealistic situation) for avoidance/reduction;

- Primary BOP (Blowout Preventer) closure fails with no response from automatic, primary and secondary response activation systems (rigfloor and toolpusher office panels), and no activation from secondary/tertiary ROV and beacon activation systems (unrealistic situation);

- The use of capping system, a back up tool to be used in case of BOP failure, has been considered in only one scenario (2b) without considering its capability to recover oil and reduce flow rate prior of final installation on top of BOP/wellhead stack and well killing;

- The use of spill/blowout containment or reduction systems (boom, skimmer, tanks etc.) has not been included in the simulation;

- No depletion/reduction in flowrate has been taken into account for the full release period.

The above assumptions depict an improbable situation, however the modelling of the worst case scenario is in line with best practice and is required for the development of the Emergency Response Plan and OSCP.

[1] This is a self-killing event in which the reservoir hole naturally collapses upon itself, thereby terminating the release.

In particular, in the case of an accidental event, an emergency response team (this team will be available at all times during the drilling activities) will be immediately activated, in accordance with the OSCP, to react to the event in order to reduce and contain the scale of the spill and, in case of blowout, shut-in the well.

8.3.3 *Oil Spill Modelling Results*

This section summarizes the main outcomes of the oil spill study. The model input, assessment scenarios and results are described in detail in *Annex D*.

Scenario 1 and 3 were evaluated at two representative locations in the northern area: N1 (Lat. -29.171510347, Lon. 32.773259341), N2 (Lat. -29.361772647, Lon. 32.901946107)) and one representative location in the southern area S (Lat. -30.539622500, Lon. 31.779959861)) of Block ER236.

Scenario 2a and 2b was evaluated at N1 and S, because N1 was considered the worst case as it has a higher risk of shoreline oiling being closest to the coast.

These spill scenarios were modelled in order to simulate the:

- Spill trajectories;
- Potential locations of the surface slicks and their potential to impact wildlife;
- Potential shoreline locations at risk of oiling; and
- Minimum travel time for the slick to arrive at the shoreline.

The three oil spill scenarios modelled are summarized in *Table 8.3*. *Table 8.3* shows the volume released for each scenario, the release depth, the spill and the total simulation duration.

Table 8.3 Release Descriptions

<table>
<tr><th>Scenario</th><th>Description</th><th>Volume Released</th><th>Spill / Simulation Durations</th><th>Release Depth</th></tr>
<tr><td>1</td><td>Diesel Spill – Vessel Accident</td><td>5,000 bbl
(794.9 m³)</td><td>1 hour /
7 days</td><td>N1: 0.5 m
N2: 0.5 m
S: 0.5 m</td></tr>
<tr><td>2 a</td><td>Crude Blowout – Hole Collapse</td><td rowspan="2">Constant Release Rate
N1: 4,717 bpd (750 m³/d)
S: 6,604 bpd (1,050 m³/d)</td><td>7 days/
21 days</td><td rowspan="2">N1: 1,623 m
S: 2,883 m</td></tr>
<tr><td>2b</td><td>Crude Blowout – Cap Install</td><td>20 days/
34 days</td></tr>
<tr><td>3</td><td>NADF release - Riser Disconnect</td><td>N1: 1,867 bbl (296.9 m³)
N2: 2,094 bbl (332.9 m³)
N2: 3,318 bbl (527.5 m³)</td><td>1 hour /
7 days</td><td>N1: 0.5 m
N2: 0.5 m
S: 0.5 m</td></tr>
</table>

From the stochastic (or probabilistic) scenarios performed, worst case iterations were selected describing the largest amount of the water surface area oiled, the most amount of shoreline oiling mass, and the fastest time for shoreline oiling to occur. In line with the 'worst case 'approach, no mitigation measures and clean-up measures were considered in the simulations. This is an unrealistic situation because in reality, were an oil spill to occur, Eni would initiate appropriate response measures to limit the extent and impact of a spill.

Three critical threshold assumptions were used in the design of the models and interpretation of results. These assumptions address critical thresholds for oil slick thickness (as described in *Annex D*), shoreline flux and DAH concentration and relate directly to the ecological effects. *Table 8.4* summarizes these assumptions.

Table 8.4 *Threshold Assumptions*

Assumption	Value	Importance	Source
Significant slick thickness	1.0 µm	Minimum thickness for smothering of aquatic organisms and wildlife. Range of 1-10 µm minimum smothering thicknesses cited in the literature. In this EIA Report the minimum threshold thickness value was defined as 1 µm.	Peakall *et al.* (1985); French- McCay (2009)
Significant shoreline mass flux	100 g oil/m² of shoreline	Provides a lower-limit to delineate significance for impacting wildlife making contact with shoreline deposits.	French-McCay (2009)
Dissolved Aromatic Hydrocarbons (DAH)	5 ppb	Narcosis has typically been attributed to the aromatic hydrocarbons within an oil. Dissolved aromatic 96-hour LC50 values range between 100 ppb and 1,000 ppb. Low Reliability Triggers, concentrations below which no toxic effects would be expected (effectively a No Observable Effects Concentration or NOEC), are assumed to be 10 to 100 times less than the 96-hour LC50. To enable a significant margin of safety, a highly conservative value of 5 ppb was chosen	ANZECC and ARMCANZ (2000) French (2000), French- McCay (2009)

"Significant surface oiling" is defined as any oil having a thickness above the minimum thickness threshold, a value that delineates where oil becomes visible and below which aquatic biota are at near zero risk of smothering from a crude oil (Lewis, 2007).

Research has been undertaken, in order to estimate exposure thresholds for birds and mammals contacting an oil slick. Peakall *et al*. (1985) and French-McCay (2009) found that oil slicks less than 1 µm were not harmful to seabirds; therefore visible oil between 0.1 µm and 1 µm was chosen as the low risk exposure thickness range. Additional studies found that aquatic birds and marine mammals may be affected at slick thicknesses in the range of 10 µm and 25 µm [Engelhardt (1983), Clark (1984), Geraci and St. Aubin (1988), Jenssen (1994), and Scholten *et al* (1996)]. Thus, a moderate exposure threshold is defined as oil with a thickness between 1 µm and 10 µm, while a high exposure threshold is defined as any oil with a thickness above 10 µm. Model output of the surface oiling and arrival time is filtered to remove oil thinner than 1 µm.

For evaluating the potential for oil impacts to birds and wildlife on the shorelines for use in environmental risk assessment studies, French-McCay (2009) published an evaluation of various animals' sensitivity to oil. French-McCay recommended a threshold of 100 g/m^2 as a reasonable value to indicate when a sufficient amount of oil mass per unit area may cause an impact to shorebirds and wildlife on or along the shore.

Summary of Results per Scenario

Scenario 1: A spill of 794.9 m^3 (5,000 bbl) of diesel fuel oil is likely to travel predominantly in the southwest direction with the strong influence of Agulhas Currents parallel to the coastline. It is unlikely that such a spill at any of the three spill locations would carry an oil slick with thickness greater than the minimum smothering thickness (1.0 µm) with potential to impact wildlife to an area within 20 km off South African coastline.

During the modelling of the diesel spill, each spill scenario was run 120 times (iterations) with the spill's start date evenly spaced across the five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories. The worst case for each season was selected and assessed.

In these iterations, the total area on the water surface that was contacted by the minimum smothering thickness for wildlife or higher (1-10 µm), at some point, in the 7-day simulation were 1,896 km^2, 1,684 km^2 and 2,848 km^2 for the releases at N1, N2 and S respectively. These iterations also showed that the total area of the slick on the water surface that was contacted by the high exposure threshold (10.0 µm or higher), at some point, in the 7-day simulation were 210 km^2, 147 km^2 and 243 km^2 for the releases at N1, N2 and S respectively.

In the absence of response efforts, the diesel fuel slick of above the minimum smothering thickness for wildlife (1.0 µm) is able to travel up to a distance of 230 km, 215 km and 320 km from the discharge locations N1, N2 and S respectively. The diesel would be present at these locations in the water column with an oil thickness above the minimum smothering thickness (1.0 µm) for wildlife for up to 3 days, before weathering away into a thinner sheen (*Table 8.5*).

Regions above the minimum smothering thickness for wildlife (1.0 µm) extend as narrow and long streaks parallel to the South African coastline. The locations of shoreline impact from the 7-day diesel spill simulations (simulations undertaken at equally spaced time intervals throughout a historical five year period, which represents a range of hydrodynamic and meteorological conditions), range from the Durban to East London coastlines.

Although no significant shoreline oiling occurs (>100 g/m^2), under the worst case scenario oil, below the significant threshold for wildlife injury, would reach 200 to 370 km stretch of shoreline between Durban and East London. However, the probability of shoreline impact due to a spill at any of the three spill locations is less than 15 %. In the case of a spill event from the two northern well locations, diesel reached a shoreline area near Richards Bay area in the shortest time.

Shoreline stretches south of the Durban area were the earliest to contact diesel in the case of a spill originating from the southern well locations. Regardless of the shoreline oiling threshold, out of the 120 iterations over a five year period, the probability of any shoreline oiling occurring at any shore is 7.5, 3.3 and 15 % of the time for locations N1, N2 and S respectively. In either case, in the absence of response efforts the diesel has the potential to reach shoreline within 3 days. Note that unlike crude oil, diesel fuel is unlikely to form sticky emulsions or tarballs. Shoreline cleanup is often not needed as diesel typically degrades naturally and quickly.

Table 8.5 Summary of Results - Scenario 1 (Diesel spill)

Drilling Location	Criterion 1: Largest Amount of the Water Surface Area Oiled Above 1 µm Threshold (km^2)	Criterion 1: Largest Amount of the Water Surface Area Oiled Above 10 µm Threshold (km^2)	Criterion 2: Most Amount of Shoreline Oiling Mass - Shoreline Length (km)	Criterion 3: Fastest time for shoreline oiling to occur (days)	Probability of Shoreline Contact
N1	1,896	210	205	2.6	7.5%
N2	1,684	147	366	3.3	3.3%
S	2,848	243	336	2.8	15.0%

Source: ERM, 2018b

Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

Scenario 2a - Blowout leading to hole collapse:- In the blowout scenario, the release of crude oil was assumed to be constant at 4,717 bpd (750 m^3/day) from a wellhead at N1 and 6,604 bpd (1,050 m^3/d) from a wellhead at S, for 7 days before the hole collapses and stops the release.

Scenario 2b - Blowout followed by the installation of a capping system:- In the blowout scenario, the release of crude oil was assumed to be constant at 4,717 bpd (750 m^3/day) from a wellhead at N1 and 6,604 bpd (1,050 m^3/d) from a wellhead at S, for 20 days before the installation of the capping system stops the release.

As previously discussed, this is an overestimation of both the rate and quantity of oil that would be released in the unlikely event of a blowout. The oil rises through the water column affected by different currents at the various vertical strata, where the oil either; dissolves, volatilizes, degrades, or remains in the liquid state as a droplet until reaching the surface. On the water surface, a slick is formed.

During the modelling of the blowout event, each spill scenario was run 120 times (iterations) with the spill's start date evenly spaced across the five year period. This provides for a variety of combinations of wind and ocean current combinations to predict the range of potential spill trajectories. The worst case scenario for each season was selected and assessed.

In case of a blowout event, the spill migration will be simulated with real time Metocean data, in order to predict the movement and emergency response team will implement the OSCP to contain/reduce/shut in the spill and so limit possible residual risk for shoreline impact.

The modelling results (refer to *Annex D*) are interpreted in *Table 8.6* below*:*

Table 8.6 Interpretation of Scenario 2a and Scenario 2b Modelling Results

Scenario	Result
Scenario 2a - Blowout leading to hole collapse	• Once the oil surfaces, it generally moves in a south-westerly direction as a widening plume due to the Agulhas current, prevailing near-surface currents and winds. • A slick of minimum smothering thickness for wildlife (1.0 µm) is unlikely (less than 1 % probability) to come ashore before weathering away into a thin sheen. • The maximum total area on the water surface contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during Summer and Autumn, was 401 km^2 (N1 well site) and 3,049 km^2 (S well site). • No regions exceeded the 10 µm high exposure threshold for risks to birds and wildlife. • Significant shoreline oiling (>100 g/m^2) is unlikely (less than 1 % probability) to reach the shoreline. • Should oil reach the shore it would do so within 4 to 6 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring.

Scenario	Result
	• Maximum area of DAH above the conservative 5 ppb threshold for worst case oiling ranged from 2,033 km² (southern well location during summer/autumn) to 324 km² (northern well location during winter/spring).
Scenario 2b - Blowout followed by the installation of a capping system (back up equipment in case of failure of BOP)	• Once the oil surfaces it generally moves in a south-westerly direction as a widening plume due to the prevailing near-surface currents and winds. • A slick of minimum smothering thickness for wildlife (1.0 µm) is unlikely (less than 1 % probability) to come ashore before weathering away into a thin sheen. • At the N1 well site, the maximum total area contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during winter and spring, was 695 km². • At the S well site, the maximum total area contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm occurred during summer and autumn, was 4,386 km². • No regions exceeded the 10 µm high exposure threshold for risks to birds and wildlife. • Significant shoreline oiling (>100 g/m²) is unlikely (less than 1 % probability) to reach the shoreline. • Should oil reach the shore it would do so within 5 to 7 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring.

Source: Interpreted from ERM, 2018b by Pulfrich, 2018
Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

Scenario 3: Riser Disconnect - In the riser disconnect scenario, released base oil travels similarly to the diesel spill scenario, predominantly in the south and southwest directions, and potentially reaching shorelines within 3 days.

The modelling results (refer to *Annex D*) shows that the surface area above the minimum smothering thickness for wildlife (1.0 µm) would be carried to an area within 25 km off South African coastline. In the absence of response efforts, the smothering slick of oil is able to travel over 215 km, 160 km, and 305 km from the release points N1, N2 and S respectively before weathering away into a thinner sheen. The maximum total area on the water surface contacted at some point (120 iterations over a period of 5 years) by a smothering thickness >1.0 µm was 1,232 km² (N1 well site), 870 km² (N2 well site) and 2,050 km² (S well site).

No significant shoreline oiling (>100 g/m²) occurred, although under the worst case scenario oil would reach the shore within 2 to 3 days potentially affecting a shoreline length of 119 km (N1 well site), 249 km (N2 well site) and 186 km (S well site), between Durban and East London. The probability of shoreline impact due to a spill at any of the three spill locations is 8.3 %, 5.8 % and 15 % for N1, N2 and S.

The modelling results (refer to *Annex D*) also showed the surface plumes of elevated Total Suspended Solids would extend up to 6 km down-current of the point of release under maximum average current conditions, but concentrations remain below the ecological threshold of 35 mg/l.

Table 8.7 Summary of Results – Scenario 3 (NADF Release due to Riser Disconnect)

Drilling Location	Criterion 1: Largest Amount of the Water Surface Area Oiled above 1 µm Threshold (km²)	Criterion 1: Largest Amount of the Water Surface Area Oiled above 10 µm Threshold (km²)	Criterion 2: Most Amount of Shoreline Oiling Mass - Shoreline Length (km)	Criterion 3: Fastest Time for Shoreline Oiling to Occur (days)	Probability of Any Shoreline Contact with Oil
N1	1,232	0	119	2.5	8.3%
N2	873	0	249	3.2	5.8%
S	2,046	0	186	2.7	15.0%

Source: ERM, 2018b

Note: this is modelled without the inclusion of any mitigation /containment measures, which represents an unrealistic condition

It is important to repeat here that, in line with international best practice, all the modelling scenarios have been run with the assumption that no oil spill response measures would be implemented and that no mitigating actions would be taken at the point of spillage. Therefore, as this will not be the case, the results of the modelling present the 'worst case' that could result from any particular oil spill. A summary of the modelling results that were used for the assessment are provided in *Table 8.8.*

Table 8.8 Summary of the Oil Spill Modelling Results for all Scenarios

Drilling location	Most Shoreline Oiling (km)	Shortest Time to Contact Shoreline (days	Probability of Shoreline Contact	Max. Area Above 1 µm Threshold (km²)	Max. Area Above 10 µm Threshold (km²)
Diesel spill modelling results summary – Scenario 1					
N1	205	2.6	7.5%	1.896	210
N2	366	3.3	3.3%	1,684	147
S	336	2.8	15%	2.848	243
Crude oil blowout modelling results summary – Scenario 2a					
N1	0	4.25	0	401	0
S	0	5.00	0	3049	0
Crude oil blowout modelling results summary – Scenario 2b					
N1	0	5.75	0	695	0
S	0	5.25	0	4386	0
Riser disconnect modelling results summary – Scenario 3					
N1	205	2.5	8.3%	1,232	0
N2	48	3.2	5.8%	873	0
S	49	2.7	15%	2,046	0

8.3.4 *Likelihood/Probability of a Spill*

The frequency of a release of crude oil from a well blowout from a normal deep-water well is considered rare, with a frequency of incident worldwide being estimated to be 1 in 4,000 wells (2.5×10^{-4}) for exploratory wells drilled where international best practice methods are applied (according to OGP Report 434-02, 2010).

Eni assesses the risk of a well blowout, from the geological factors, tools reliability and human errors, during the well design phase and considers the use of new technology to minimize the risk. By using such an approach, Eni has modelled the impact based on a specific design of its proprietary technologies. This results in a reduction of the blowout probability by up to two orders of magnitude: from 10^{-4} down to 10^{-6}, i.e. 1 in 400,000 wells drilled

8.3.5 *Risk Reduction and Response Measures*

As per OGP (2016), an oil spill assessment should seek to identify measures that:

- Avoid/ reduce the possibility of accidental events occurring, i.e. preventive measures (e.g. BOP, additional barriers);

- Reduce the potential size of spills from actual events, i.e. response/source control measures (e.g. installation capping system and containment solutions); and

- Reduce the consequences if accidental events should occur, i.e. mitigating measures (e.g. oil spill preparedness, plan for high-risk activities during seasons or yearly quarters with lower consequence potential).

Table 8.9 details the avoidance/prevention actions, which will be implemented by Eni during the drilling process as well as the mitigation measures that will be implemented in the unlikely event of a spill.

Table 8.9 Avoidance/Prevention Actions and Mitigation Measures

Barriers and Controls (Avoidance/Prevention Actions)	
Design and Engineering	Prior to start any drilling operation, the Company (Eni) adopts several avoidance and mitigation actions, starting from the design and engineering phases. For instance Eni defines the design (well profile, analysis of expected lithology, temperature and pore pressure analysis, casing and tubing stress analysis, wellhead, BOP and marine riser stress and stability simulations, shallow hazard study etc.) and subsequently the drilling program to be followed during well construction. The drilling program is certified by Eni Headquarters (HQ) to ensure the compliance to Company best practice rules and according to highest international standard and industry best practices. It also details assurance and competency requirements for well engineering and well intervention personnel. The phase of the well design also includes procurement of materials, rig selection and the contractor qualifying process. During drilling operations, the drillship and HQ implement a real time monitoring of drilling parameters in order to reduce the risk of unexpected hydrocarbon influx (kicks) inside the well and so maximize the safety during the construction of the well at different drilled sections.
Multiple Barriers	Eni will adopt, all over the well's construction, the dual barrier principle. In order to minimize the risk of negative and unwanted events (such as a blowout), the well design and the operation procedures, device and equipment, will guarantee the presence of a second barrier in case of failure of the primary barrier. For instance the subsurface pressures above and within the hydrocarbon-bearing strata will be controlled by the use of weighted drilling mud. Mud is the primary barrier during drilling but in case of failure and hydrocarbon influx, the BOP could safely seal around the drillpipe allowing the killing of the well and the weight increase of the mud in order to restore the primary barrier. Another example of double barrier is casing with cemented annulus. Casing, that is designed to withstand a variety of forces, such as collapse, burst or tensile failure, and chemical corrosion, is the primary mechanical barrier to isolate the well from external lithology. In case of failure, the presence of cement in the annulus will provide a secondary containment barrier.
BOP stack	BOP stacks are used to control the pressure of a well through mechanical devices designed to rapidly seal the well (or "shut in") in an emergency. BOP is a piece of equipment with blind rams, which allows you to close the well without drillpipes or casing inside the BOP ("empty"BOP). The BOP can also be configured with redundancy rams, so in case of the failure of the first set, a secondary set of rams are used. These shear rams allow you to close the ram and cut the pipe present inside BOP, in order to allow, if necessary, the safe evacuation of the drilling ship. After the riserless phases, the BOP installation is mandatory. Eni will adopt a BOP with redundancy activation point both at surface (panels located in different position of the rig) and from remote (acoustic activation system, ROV).
Competent Staff	Eni has experienced competent and certified staff who will design the well and conduct operations. Also for well control, all relevant positions (well operations engineers, superintendent, supervisors, driller, toolpusher, drilling safety leader) are certified and periodically trained/tested by IWCF[1] the only independent organisation to develop and administer well control training, assessment and certification programmes on behalf of the exploration and production sector of the oil and gas industry.

[1] IWCF: International Well Control Forum http://www.iwcf.org/

Barriers and Controls (Avoidance/Prevention Actions)	
Testing and Certification	Safety critical equipment will be subject to testing and certification to ensure that it meets design specifications. The well design, drilling and completion plans will go through several stages of review involving experts from Eni and the drilling contractor prior to the commencement of drilling operations.
Response and Recovery (Mitigation Actions)	
Oil Spill Contingency Plan (OSCP)	Despite the prevention measures and management procedures built into the design of the project there is always a risk that a spill can occur. Thus, as standard practice, an OSCP is prepared and put in place at all times during the drilling operation. There are three principal components underpinning an OSCP: • Crisis management (Emergency Command and Control Management); • Spill response, containment and clean-up; and • Well control. Further details are provided in *Chapter 9*.
Emergency Management	The On-scene Commander, normally the OIM off-shore installation manager, will manage emergency on site and ensure the correct application of OSCP, including the guaranteeof the correct communication channel to the Company Representative on board and Emergency Response Room (ERR) as per OSCP
Well Control	Whilst the OSCP defines the approach and strategy required to manage the containment, removal and clean up following a major spill, the well control process is focussed on stopping the source of the leak (e.g. killing the well). A Well Control Contingency Plan (WCCP) will be put in place for each well.
Cap and Containment Equipment (capping system installation as back up of BOP failure)	If the BOP does not successfully shut off the flow from the well, the drillship will disconnect and move away from the well site while crews mobilise a capping system. The capping system will be lowered into place from its support barge and connected to the top of the BOP to contain and control the flow from the well. This will significantly reduce the spill period. All of Eni's wells are designed to allow for capping. In case of a blowout event, Oil Spill Response Limited[1] (OSRL) (for oil spill response equipment) and Wild Well Control[2] (for source control and well killing) will be immediately mobilised. Both Companies provide a support 24/7.
Containment and clean-up equipment	Project vessels will be equipped with appropriate spill containment and clean-up equipment, eg booms, dispersants and absorbent materials. All relevant vessel crews will be trained in spill clean-up equipment use and routine spill clean-up exercises. Logistical arrangements for the integration of additional support would be in place (eg from OSRL/SWIS).

[1] Oil Spill Response Limited (OSRL) is a Global Tier 3 Oil Spill Response Organization, owned by its oil industry member shareholders, for the benefit of its members. OSRL provides immediate response to a Tier 3 Event

[2] Wild Well Control is the world's leading provider of onshore and offshore well control emergency response, pressure control, relief well planning, engineering, environmental, and training services.

8.3.6 *Risk Significance of Oil Spills on Marine and Coastal Habitats and Species*

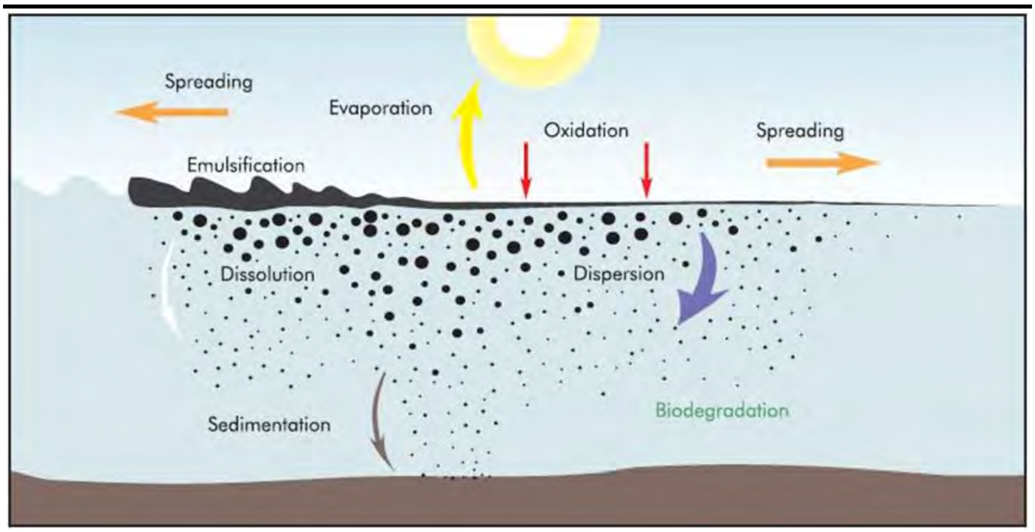
General Description of Effects to the Marine Environment from a Hydrocarbon Spill

Any release of liquid hydrocarbons has the potential for direct, indirect and cumulative effects on the marine environment. These effects include physical oiling and toxicity impacts to marine fauna and flora, localised mortality of plankton (particularly copepods), pelagic eggs and fish larvae, and habitat loss or contamination (CSIR 1998; Perry, 2005).

Various factors determine the impacts of oil released into the marine environment. The physical properties and chemical composition of the oil, local weather and sea state conditions and currents greatly influence the transport and fate of the released product. The physical properties that affect the behaviour and persistence of an oil spilled at sea are specific gravity, distillation characteristics, viscosity and pour point, all of which are dependent on the oils chemical composition (e.g. the amount of asphaltenes, resins and waxes). Spilled oil undergoes physical and chemical changes (collectively termed 'weathering'), which in combination with its physical transport determine the spatial extent of oil contamination and the degree to which the environment will be exposed to the toxic constituents of the released product.

As soon as oil is spilled, various weathering processes (*Figure 8.1*) come into play. Although the individual processes may act simultaneously, their relative importance varies with time (*Figure 8.2*). Whereas spreading, evaporation, dispersion, emulsification and dissolution are most important during the early stages of a spill, the ultimate fate of oil is determined by the longer term processes of oxidation, sedimentation and biodegradation.

Figure 8.1 ***The Weathering Processes Acting on Oil***



Source: ITOPF, 2002

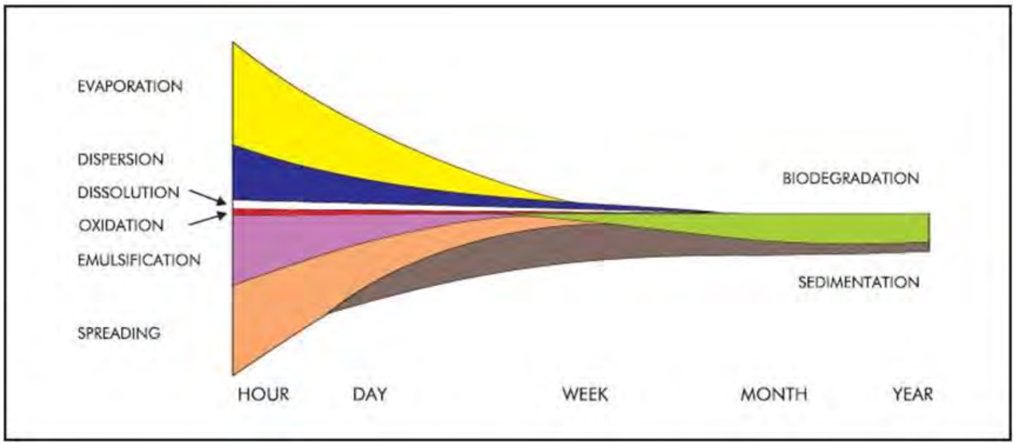
As a general rule, oils with a volatile nature, low specific gravity and low viscosity are less persistent and tend to disappear rapidly from the sea surface (e.g. diesel and light oils). In contrast, high viscosity oils containing bituminous, waxy or asphaltenic residues, dissipate more slowly and are more persistent, usually requiring a clean-up response (e.g. heavy crude oil).
Eni is anticipating the oil viscosity to be light for this project.

Oil spilled in the marine environment will have an immediate detrimental effect on water quality. Most of the toxic effects are associated with the monoaromatic compounds and low molecular weight polycyclic hydrocarbons (also referred to as Dissolved-phase Aromatic Hydrocarbons (DAHs)), as these are the most water-soluble components of the oil.

Oil is most toxic in the first few days after the spill, losing some of its toxicity as it begins to weather and emulsify. The time of year during which a large spill takes place will significantly influence the magnitude of the impact on plankton and pelagic fish eggs and larvae. Should the spill coincide with a major spawning peak, it could result in severe mortalities and consequently a reduction in recruitment (Baker *et al*. 1990). However, spawning and recruitment success is temporally variable and environmental conditions are likely to have a far greater impact than a single large spill (Neff 1991).

Sensitivity of fish eggs and larvae are primarily associated with exposure to fresh (unweathered) oils (Teal & Howarth 1984), with little mortality attributable to exposure to weathered product (Neff 1991). Because of their mobility and ability to avoid floating oil masses and the associated hydrocarbon contamination, adult pelagic fish are considered less at risk from exposure to oil spills than benthic or inshore species.

Figure 8.2 The Fate of a Typical Medium Crude Oil under Moderate Sea Conditions



Source: ITOPF, 2002
Note: Figure showing changes in the relative importance of weathering processes with time - the width of each band indicates the importance of the process.

Surface spills in the offshore environment are unlikely to have an immediate effect on the seabed. However, oil in sediments, as a result of accidental spillage near the coast, or the loss of NADFs and oil-contaminated drill cuttings following emergency disconnection of the riser, can result in physical smothering of the benthos and chronic pollution of the sediments. A wide range of effects of oil on benthic invertebrates has been recorded, with much of the research focussing on the various life stages of polychaetes, molluscs and crustaceans (Volkman *et al*. 1994). However, as tolerances and sensitivities vary greatly, generalisations cannot be confidently made.

Some burrowing infauna (e.g. polychaetes and copepods) show high tolerances to oils, as the weathered product serves as a source of organic material that is suitable as a food source.

Polychaetes in particular can take advantage of bioturbation and degradation of oiled sediments (Scholtz *et al*. 1992). This results in highly modified benthic communities with (potentially lethal) 'knock-on' effects for higher order consumers. Bioaccumulation of petroleum hydrocarbons by fish through oil-contaminated prey and sediments is a well-described phenomenon (CSIR & CIME, 2011).

Volkman *et al*. (1994) suggest that some epifauna produce complex responses to oiling and that bioaccumulation of petroleum hydrocarbons can readily occur in some cases. Sessile and motile molluscs (e.g. mussels and crustaceans) are frequent victims of direct oiling or coating.

Filter-feeders in particular are susceptible to ingestion of oil in solution, in dispersion or adsorbed on fine particles. Chronic oiling is known to cause a multitude of sub-lethal responses in taxa at different life stages, variously affecting their survival and potential to re-colonise oiled areas. Tolerances to oil vary between life stages, with larvae and juvenile stages generally being more sensitive to the water-soluble fractions of oil than adults (Volkman *et al*. 1994; CSIR & CIME 2011).

Impacts of oil on juvenile and adult fish can be lethal, as gills may become coated with oil. Sub-lethal and long-term effects can include disruption of physiological and behavioural mechanisms, reduced tolerance to stress, and incorporation of carcinogens into the food chain (Thomson *et al*. 2000). However, being mobile, fish are likely to be able to avoid a large spill.

Chronic and acute oil pollution is a significant threat to both pelagic and inshore seabirds. Diving sea birds that spend most of their time on the surface of the water are particularly likely to encounter floating oil and will die as a result of even moderate oiling which damages plumage and eyes. The majority of associated deaths are from the properties of the oil and damage to the water repellent properties of the birds' plumage.

This allows water to penetrate the plumage, decreasing buoyancy and leading to sinking and drowning. In addition, thermal insulation capacity is reduced requiring greater use of energy to combat cold. Oil is also ingested as the birds preen in an attempt to clear oil from plumage and may furthermore be ingested over the medium to long term as it enters the food chain (Munro 2004).

The effects of ingested oil include anaemia, pneumonia, intestinal irritation, kidney damage, altered blood chemistry, decreased growth, impaired osmoregulation, and decreased production and viability of eggs (Scholz *et al*. 1992). Furthermore, even small concentrations of oil transferred from adult birds to the eggs can cause embryo mortalities and significantly reduce hatching rate. Oil spills can thus have an effect on birds that may be some distance from the spill site, which can be attributed to the parent's feeding habits. Impacts of oil spills on turtles is thought to primarily affect hatchling survival (CSIR & CIME 2011). It is anticipated that juvenile turtles will be present in the area potentially impacted by an oil spill (Agulhas Current), particularly during January to March. Similarly, little work has been done on the effect of an oil spill on fur seals, but they are expected to be particularly vulnerable as oil would clog their fur and they would die of hypothermia (or starvation, if they had taken refuge on land).

The effects of oil pollution on marine mammals is poorly understood (White *et al*. 2001), with the most likely immediate impact of an oil spill on cetaceans being the risk of inhalation of volatile, toxic benzene fractions when the oil slick is fresh and unweathered (Geraci & St Aubin 1990, cited in Scholz *et al*. 1992). Common effects attributable to the inhalation of such compounds include absorption into the circulatory system and mild irritation to permanent damage to sensitive tissues such as membranes of eyes, mouth and respiratory tract.

Direct oiling of cetaceans is not considered a serious risk to the thermoregulatory capabilities, as cetacean skin is thought to contain a resistant dermal shield that acts as a barrier to the toxic substances in oil. Baleen whales may experience fouling of the baleen plates, resulting in temporary obstruction of the flow of water between the plates and, consequently, reduce feeding efficiency. Field observations record few, if any, adverse effects among cetaceans from direct contact with oil, and some species have been recorded swimming, feeding and surfacing amongst heavy concentrations of oil (Scholz *et al*. 1992) with no apparent effects.

Although there is a very low probability (less than 1 %) of shoreline oiling during a crude blowout, if the oil reaches the coastline it could impact the coastline in the following ways:

- Subtidal zone:
  - Change in community structure with a decrease in species that have a high sensitivity to hydrocarbon spills (e.g: burrowing bivalves and small crustaceans; IOGP,2015) and altered composition of opportunistic species, eg polychaetes, oligochaetes, and sometimes increased algal biomass due to increased nutrient availability in the photic zone. (Houghton, *et al*, (1991); Cabioch *et al* (1978); Corredor *et al* (1990); Dauvin (1987); Lee & Page (1997),).

- Rocky shores:
  - Toxic exposure of rocky shore fauna and flora (molluscs on rocks, algae, echinoderms etc.) leading to direct mortality from smothering by oil or toxic effects through the respiratory or digestive system of organisms. Toxic effects are worsened through the use of dispersants although recovery period is increased.
  - Exposed shores recover more quickly than sheltered shores as strong wave action removes contamination and biota of exposed shores are able to more quickly colonise an impacted shore. (Hawkins *et al* (2002); Edgar *et al* (2003); Smith (1968); Brien & Dixon (1976); Chasse (1978); Teal & Howarth (1984); Edgar & Barrett (2000); Kingston (2002); Laffon *et al* (2006); Mariogomez *et al* (2006).

- Sandy beaches:
  - Toxic exposure and smothering of flora and fauna causing direct mortality of species, particularly species that have a high sensitivity to hydrocarbon spill, such as crustaceans (filter feeders) and amphipods, which can rapidly disappear after an oil spill.
  - Species on high shore beaches often do not have a larval dispersion phase and therefore are not quickly recolonised.
  - Exposed shores recover more quickly than sheltered shores as strong wave action removes oil contamination, and biota of exposed shores are able to more quickly colonise an impacted shore.
  - Decreased species richness is observed in beaches after oil spills with lower diversity of crustaceans, polychaetes, molluscs and insects, but recovery occurs in the short to medium term. (Sanders *et al* (1980); Elmgren *et al* (1983); Dauvin (1987); Gomez Gesteira *et al* (2000); De la Huz *et al* (2005)).

- Estuaries:
  - Natural intrusion of sea water into estuaries can result in ingress of oil entrained in seawater entering these habitats which are critical nursery areas for fish and prawn recruitment as well as foraging areas for birds and habitat for unique estuarine crustaceans such as mud crabs.

- Oil entering an estuary will increase the concentration of aromatic hydrocarbons and therefore the toxicity of the water column with greater effects on aquatic organisms (eg fish and prawns) than in the open sea.

Sensitivity

Being highly toxic, oil from a 'blow-out', a release of oil associated with the NADF riser disconnection or marine diesel released during an operational spill would negatively affect any marine fauna that come into contact with the slick.

The drilling activities will be located in the offshore marine environment, approximately 62 to 65 km offshore, and removed from most sensitive coastal receptors (e.g. bird colonies) or MPAs. However, due to the proposed well(s) being situated within the influence of the strong Agulhas Current, spilled hydrocarbons would be rapidly transported considerable distances parallel to the South African coastline potentially reaching the shore well to the southwest of the proposed well locations.

Depending on the nature and type of the spill, sensitive coastal receptors would thus likely be affected to a greater or lesser degree offshore of East London, as well as the estuaries along that section of coastline.

The benthic fauna inhabiting unconsolidated sediments of the outer shelf and continental slope are very poorly known, but at the depths of the proposed well are expected to be relatively similar, varying only with sediment grain size, organic carbon content of the sediments and/or near-bottom oxygen concentrations. These benthic communities usually comprise fast-growing opportunistic species able to rapidly recruit into areas that have suffered natural environmental disturbance. Epifauna living on the sediment typically comprise taxa which are longer lived and therefore more sensitive to disturbance. No rare or endangered species are known.

In contrast, the benthos of deep-water hard substrata are typically vulnerable to disturbance due to their long generation times. As video footage has identified sensitive communities including sponges, black corals, gorgonians, alcyonarian soft corals and stylasterine lace corals (Sink *et al.* 2006) in submarine canyons off the KZN coastline, the potential occurrence of such sensitive deep-water ecosystems in the ER236 area, and specifically the areas of interest for well drilling, cannot be excluded.

In the offshore environment, the taxa most vulnerable to spills are pelagic seabirds, although turtles, large migratory pelagic fish and both migratory and resident cetaceans may also be affected. Many of these are considered globally 'Critically Endangered' (e.g. Southern Bluefin tuna, coelacanths), 'Endangered' (e.g. whale shark, Fin, Blue and Sei whales) 'Vulnerable' (e.g. Leatherback turtle short-fin mako, whitetip sharks, sperm whale) 'Near threatened' (e.g. blue shark) and 'Least concern' (e.g.: Humpback and Southern Right Whales).

Although it is currently unknown whether coelacanths occur in the deep water submarine canyons near Block ER236, coelacanths are known to occur in the Wright and Jesser canyons in the Sowdana Canyon complex (Hissman *et al.*, 2006) off the Greater St Lucia Wetland Park (GSLWP) World Heritage Site, within caves in the 90 to 140 m depth range. Internationally, coelacanth discovery depths range from 120 m to 300 m. The Tugela canyon head starts at approximately 600 m depth with the thalweg ending in the Natal Valley at approximately 2,800 m (Wiles *et al.,* 2013). The Tugela Canyon differs significantly in morphology from the Wright and Jesser Canyon, where coelacanths have been reported. Although terraces are present which 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.

Potential habitats have been with further potential habitats being located off Lake St Lucia (Hissman *et al*. 2006) and on the continental shelf off the stretch of coastline between Port Shepstone and Port St Johns (Green *et al*. 2006).

Although the areas of interest for well drilling do not overlap with any existing or proposed Marine Protected Areas (MPAs) and Ecologically or Biologically Significant marine Areas (EBSAs), there are numerous MPAs, proposed MPAs, EBSAs and Hope Spots in the Area of Indirect Influence. These include the Amathole MPA in the vicinity of East London, and the Dwesa-Cwebe, Hluleka and Pondoland MPAs located on the Wild Coast. Biota protected within these areas could be impacted by both surface and sub-surface oil slicks following a major blowout .

8.3.7 Risk Significance of an Oil (diesel) Spill on Marine and Coastal Habitats and Species due to Vessel Collision

At any phase of the project (mobilisation, drilling and decommissioning), there is the unlikely possibility that a moderate diesel spill could occur through a vessel collision resulting in a release of diesel into the marine environment. Diesel is a light hydrocarbon and is likely to dissipate rapidly to the atmosphere.

From the results of modelling ***Scenario 1***, a slick resulting from a vessel collision would spread in a south-westerly direction (due to the strong influence of Agulhas Currents) and would be unlikely to reach the shore (probability of shoreline impact due to a spill at any of the three spill locations is less than 15 %).

Dissolved aromatic concentrations may, however, persist in the top few meters of the water column beneath the slick for a number of days, potentially resulting in acute toxicological effects in marine fauna coming in contact with the slick for extended periods.

The magnitude of the potential impact varies depending on the faunal group affected ranging from Low for benthic macrofauna, marine mammals and turtles, to High for seabirds and sensitive coastal/estuarine environments, likely persisting over the medium- to long-term.

The likelihood of such an occurrence taking place would be *Low*. The consequence was assessed as *Moderate* for other marine fauna and *Major* for seabirds. This was based on the low probability of the spill reaching over 200 km of the coastline above the significant shoreline oiling threshold (100 g/m²).

Therefore, the ***risk significance*** (*Table 8.10)* is assessed as ***Minor*** (for other marine fauna) to ***Moderate*** (for seabirds) and the ***residual risk*** therefore has been be ***reduced to As Low As Reasonably Practicable (ALARP).***
These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9*) to be implemented in the unlikely event of a spill.

Table 8.10 Risk Significance of an Oil (Diesel) Spill on Marine and Coastal Habitats and Species from a Vessel Collision

Characteristic	Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Seabirds
Type of Impact	Direct	Direct
Likelihood	Low	Low
Consequence	Moderate	Major
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**

8.3.8 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species due to Blowout

Although unlikely, there is the possibility of a well blowout (uncontrolled release of oil- ***Scenario 2a and 2b***) during exploration.

As depicted in *Section 8.3.3*, the results of the oil spill modelling study indicate that the spill would spread in a south-westerly direction, with a very low probability (less than 1 % chance) of reaching the shoreline, thus being of regional extent for all but benthic macrofaunal communities. Significant oiling (>100 g/m^2) is unlikely (less than 1 % probability) to reach the shoreline. Should oil reach the shore it would do so within 5 to 6 days during the summer/autumn in the areas between Port Shepstone and Port St Johns (N1 and S well sites), and within 4 to 5 days at St Lucia (N1 well site) and Port Edward (S well site) during winter/spring. Dissolved aromatic hydrocarbon concentrations may also persist, for a few days, throughout the water column due as the plume rises from the blowout to the top few meters of the water column beneath the slick. Where threshold concentrations for dissolved aromatics are exceeded close to the blowout, these could could trigger acute toxicological effects in both demersal and pelagic marine fauna.

The DAH trigger threshold has been calculated based on conducting tests, over 96 hours, on marine organisms to identify at what concentration an acute toxicological response is triggered. The DAH 96-hour LC_{50} values range between 100 and 1,000 ppb at which an acute toxicological response may result). These are conservative value as studies have been carried out that indicate that no toxic effects occur at 10 to 100 ppb (ANZECC & ARMCANZ 2000, French 2000). In the modelling study undertaken for this project, an even more conservative value of 5 ppb, a value that there will be no acute toxicological response effect and the results show that the majority of the DAH concentrations are still below the 100 ppb trigger threshold (ERM 2018b).

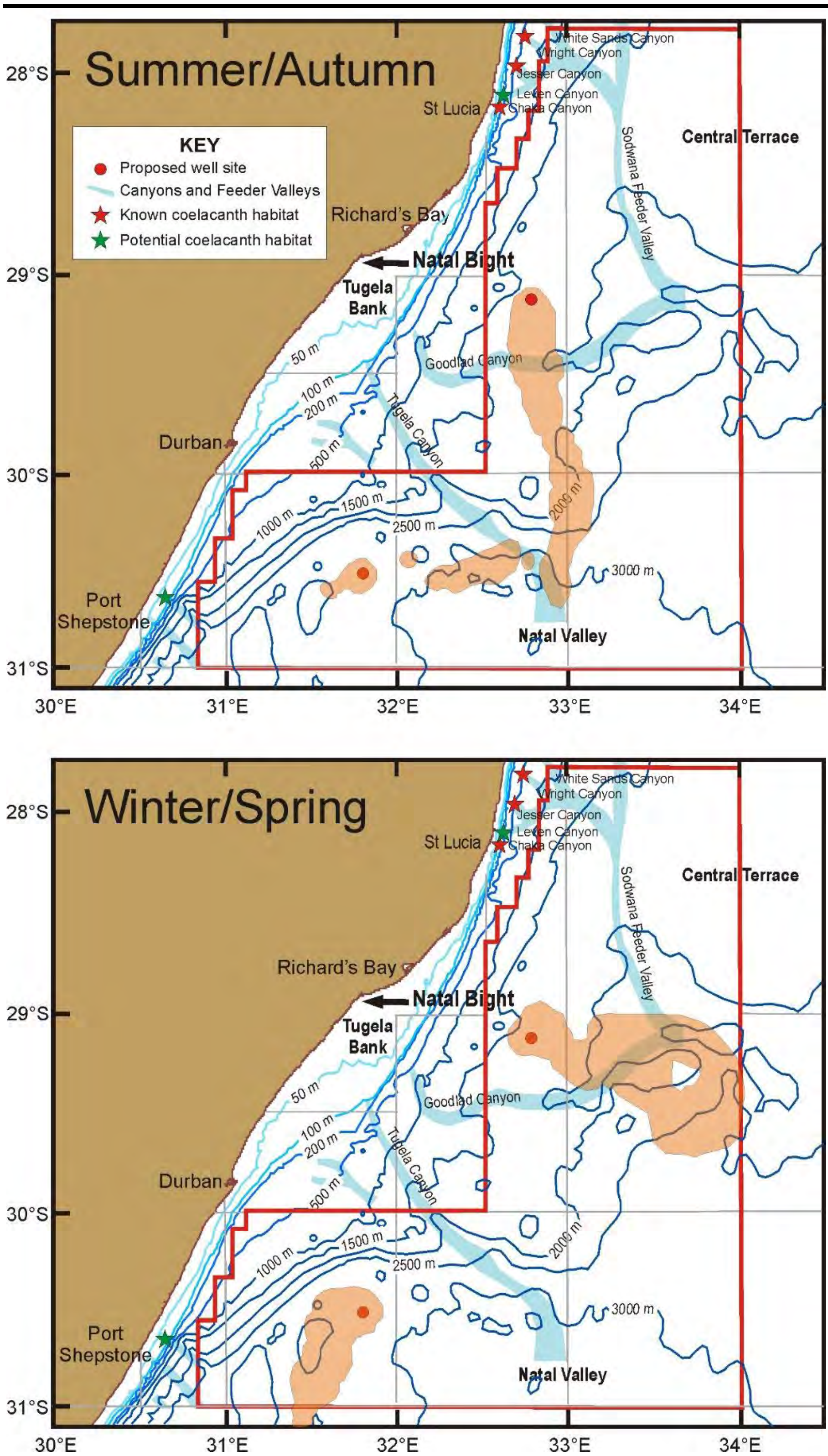
Distributions of current speed and direction indicate that at the northern well site, currents flow towards the west, southwest and south for 89% of the time, with north, north-northwest and northwest flows occurring only 2% of the time. At the southern well site, currents flow towards the west, southwest and south for 83% of the time, with north and north-northwest flows occurring only 3% of the time. Concentrations of DAHs above the threshold would thus affect a larger volume of water and result in longer durations of exposure of aquatic organisms to the dissolved components than the DAH footprints for surface slicks (*Figure 8.3,*ERM, 2018b).

Modelling results indicate that for a blowout at the northern well site in summer/autumn, the DAH plume above the 5 pbb threshold would tend to travel in a southerly direction for approximately 200 km before turning west. The plume travels independently and further than the surface slick and, regardless of depth, was estimated to affect an area of 4,403 km². The plume would cross the Goodlad Canyon at approximately 2,000 m water depth and the Tugela Canyon at between 2,500 m and 3,000 m water depth. The likelihood of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low (2 to 3%). In contrast, the DAH plume from a blowout at the southern well site remains confined to within approximately 30 km west of the well location, only affecting an area of 324 km² *Figure 8.4*, top). The canyons off Port Shepstone would not be affected.

Figure 8.3 ***Current Roses (Distributions of Speed and Directions) across All Depths, 2013-2017 at N1 and S. Arrows depict direction of currents.***

Source: HYCOM

Figure 8.4 Extent of the Modelled DAH Plume



Source: Pulfrich, 2018

Note: footprints >5 ppb (orange shading) from the northern and southern well sites (red dots) during summer/autumn (top) and winter/spring (bottom) in relation to submarine canyons off the KwaZulu-Natal coast.

The map shows that the plume does not extend into the areas known or potential coelacanth presence.

DAH plume footprints for a blowout at the northern well location during winter/spring would tend to travel mostly eastwards for approximately 100 km before turning southwards, affecting an area of some 5,874 km^2.

The plume would cross the deeper portions (>2,500 m) of the Goodlad Canyon and its confluence with the base of the Sodwana Feeder Valley at approximately 2,500 m depth. The probability of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low (2 to 3 %). The DAH plume from a blowout at the southern well site would tend to travel mostly southwest for approximately 100 km, affecting an area of 2,033 km^2 before diluting and degrading away (*Figure 8.4*, bottom). The canyons off Port Shepstone would not be affected. The probability of northward transport of the plume towards the Tugela Canyon was very low. The plumes would again travel independently and further than surface slicks.

The magnitude of the potential impact from the surface slick varies depending on the faunal group affected ranging from Low for benthic macrofauna, fish, marine mammals and turtles, to High for seabirds and sensitive coastal/estuarine environments (including MPAs), likely persisting over the medium to long-term.

Impacts of the spill may cause a substantial change in the population of sensitive species over multiple generations, particularly if the spill occurs during the turtle hatching season (juvenile turtles in the Agulhas current during the January - March) or during seabird moulting season.

When considering the risks of subsurface oiling to coelacanths and coelacanth habitat in particular, the subsurface plume from a potential blowout in both the northern and southern areas of interest for well drilling occur well to the south of the known and potential coelacanth habitat of the GSLWP. Additionally the subsurface plume does not reach potential coelacanth habitat identified inshore of Port Shepstone.

When considering the risks of subsurface oiling to coelacanths and coelacanth habitat in particular, the subsurface plume from a potential blow out in both the northern and southern areas of interest for well drilling are more likely (89 % and 83 %, respectively) to occur well to the south of the known and potential coelacanth habitat off the GSLWP and St Lucia. Although the paths of the plumes cross the Goodland and Tugela Canyons, the overlap occurs where the canyons are in excess of 2,000 m deep and thus well beyond the depths at which coelacanths are known to occur. Based on the distribution of current speeds and direction across all depths, the modelling results predicted that the probability of northward transport of the plume towards the canyons off the GSLWP and off Lake St Lucia was very low as north, north-northwest and northwest flows occur only 2 % of the time.

Similarly, the potential coelacanth habitats on the continental shelf off the stretch of coastline between Port Shepstone and Port St Johns are located well inshore of the anticipated path of the DAH plume (*Figure 8.4*).

It must also be kept in mind that the light oil or gas expected in the well(s) (°API gravity >31.1) is less persistent and droplets would thus dissolve more rapidly and not deposit as readily as heavy oil particles. Should any sedimentation of oil droplets occur in submarine canyons off the KZN coast, concentrations are thus likely to be well below threshold levels.

The likelihood of a blow-out taking place would be *Low*. Given the extent of a spill on the surface and the sensitivity of the species and habitats potentially impacted, the potential consequence of the spill on the surface could be *Moderate* (for other marine fauna) and *Major* (for seabirds). Therefore, the ***risk significance*** for a surface spill is assessed as ***Minor*** (for other marine fauna) to ***Moderate*** (for seabirds) (*Table 8.11)*. These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9)* to be implemented in the unlikely event of a spill.

Given the extent of a spill on the sub-surface (i.e. DAH concentrations) and the sensitivity of the species and habitats potentially impacted, the potential consequence of the spill on the sub-surface could be *Minor* (for seabirds and other marine fauna, including coelacanths). Therefore, the ***risk significance*** for a surface spill is assessed as ***Minor*** (for seabirds and other marine fauna, including coelacanths).) (*Table 8.11)*. These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9)* to be implemented in the unlikely event of a spill.

Taking into consideration the extensive well planning and built-in barriers, capping and containment measures, the magnitude of the spill will be reduced, supplemented with an OSCP, the magnitude of the spill will be reduced, a spill containment will be in place and the ***residual risk*** therefore has been be ***reduced to As Low As Reasonably Practicable* (ALARP).**.

Table 8.11 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species due to Blowout

Characteristic	Surface Risk to Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Surface Risk to Seabirds	Sub-Surface Risk to Invertebrates, fish, larvae, marine mammals and turtles (including species inside MPAs)	Sub-Surface Risk to Seabirds
Type of Impact	Direct	Direct	Direct	Direct
Likelihood	Low	Low	Low	Low
Consequence	Moderate	Major	Minor	Minor
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**	**Minor (ALARP)**	**Minor (ALARP)**

8.3.9 Risk Significance of Loss of Drilling Fluids and Cuttings on Marine and Coastal Habitats and Species due to Emergency Riser Disconnect

At any phase of the project (mobilisation, drilling and decommissioning), there is the possibility that a NADF spill could occur through the emergency disconnect of the riser during drilling activities. During the modelling, the volume of oil within the riser pipe released was estimated to be 1,120 bbls, 1,256 bbls, and 1,991 bbls of base oil at locations N1, N2 and S respectively.

From the results of ***Scenario 3***, a slick resulting from a riser disconnect at the seabed would rise to the water surface and spread in a south-westerly direction (due to the strong influence of Agulhas Currents) and would be unlikely to reach the shore (probability of shoreline impact due to a spill at any of the three spill locations is very low (less than 15 %).

Dissolved aromatic concentrations may, however, persist in the top few meters of the water column beneath the slick for a number of days, potentially resulting in acute toxicological effects in marine fauna coming into contact with the slick for extended periods. Should they occur, impacts would be partially (seabirds) or fully reversible (benthic macrofauna, fish and larvae and marine mammals and turtles

The likelihood of such an occurrence taking place would be *Low*, as it is reported in the oil and gas industry, but rarely occurs. Based on the extent of the spill and sensitivity of the species and habitats potentially impacted, the potential consequence could be *Moderate* and therefore the ***risk significance*** is assessed as ***Minor*** (other marine fauna, including coelacanths) to ***Moderate*** (for seabirds) therefore has been be ***ALARP*** (*Table 8.10*). These ratings take into consideration the in-built prevention/avoidance measures and the mitigation measures (*Table 8.9*) to be implemented in the unlikely event of a spill.

Table 8.12 Risk Significance of an Oil Spill on Marine and Coastal Habitats and Species from an Emergency Riser Disconnect

Characteristic	Invertebrates, fish, larvae, marine mammals and turtles	Seabirds
Type of Impact	Direct	Direct
Likelihood	Low	Low
Consequence	Moderate	Major
Risk Significance	**Minor (ALARP)**	**Moderate (ALARP)**

8.3.10 *Risk Significance of Oil Spills on Marine and Coastal Based Livelihoods (Tourism, Fisheries)*

General Description of Effects to Coastal and Marine-Based Livelihoods from a Hydrocarbon Spill

In the event of an accidental crude oil blowout, (the continuous loss of crude oil from the reservoir), oil will be carried south by the Agulhas Current and possible scenarios have been modelled to determine what areas of coastline would potentially be impacted (*Annex D*). Based on the modelling results, in the unlikely event of an uncontrolled blowout, while there is an unlikley possibility of shoreline oiling from Richards Bay through to East London (in the worst case).

The potential risk significance of a spill on coastal and marine based livelihoods is discussed below in terms of tourism and fisheries.

General Description of Effects on Tourism

The extent of loss of livelihood would depend of the severity of the spill and how long clean-up operations take to complete. A spill could lead to the closure of beaches and limit activities in the coastal and marine environment, resulting in visitors cancelling or deferring their trip, leading to a decrease in tourist numbers.

This in turn would lead to a loss of income for those employed in tourism industry and service industry, which supports tourism. The effect of a spill may be felt temporarily even after clean-up operations are complete as members of the tourism industry may not have been able to market themselves post-spill and will need to rebuild their client base or their brand.

Sensitivity of Tourism Receptors

The tourism industry relies on the pristine natural environment of the KZN Coast and the Eastern Cape Coast, which attracts visitors to the area. Tourism is a key contributor to local economic development and is recognised as a sector that can drive local economic growth. Tourism along the KZN coast is well established and tourism infrastructure such as accommodation and restaurants are in place and easily accessible.

Tourism activities include surfing, scuba diving, recreational fishing, boating and sailing, beach-going, nature walks and more.

In contrast, tourism along the Wild Coast in the Eastern Cape is underdeveloped, and challenges to the tourism sector include poor road quality (especially the access roads from the N2 to the various Wild Coast destinations) and a lack of accommodation (Fuller Frost & Associates, 2010). However, most of the coastal local municipalities in the Eastern Cape highlight tourism as a key area of growth in their respective Integrated Development Plans (IDPs).

It is recognised across the Area of Direct Influence (ADI) and Area of Indirect Influence (AII) that the protection of natural assets is important in promoting tourism. There are numerous activity outfitters in the coastal towns along the Kwa-Zulu Natal and along the Wild Coast who depend on local and international tourists visiting the area for selling their products/ tours. In addition, accommodation and restaurants have been established in response to the increasing demand for such services. The tourism sector creates employment opportunities across a wide range of skills sets, from highly skilled to unskilled labour.

In the event of a spill that results in shoreline oiling, people relying on the coastal and marine tourism sector for their livelihood would be highly sensitive as they rely on pristine conditions of these natural tourism assets. Further, for those employed either directly or indirectly in the tourism sector, it is unlikely that they have alternative livelihood strategies, or means of income generation.

General Description of Effects on Fisheries

The coastal bays and estuarine environments are critical nursery areas for the commercial stocks most, if not all commercial, small-scale and recreational fisheries.

In the event that a crude oil blowout were to occur, the resulting oil slick would not reach the spawning areas for hake, sardine, anchovy and horse mackerel situated on the southern Agulhas Bank nor the additional hake spawning areas thought to exist further eastward off the continental shelf (refer to *Annex D*). Spawn products of linefish species would be affected within the important nursery ground offered by the Natal Bight.

The affected area would not be expected to coincide with squid spawning grounds situated along the inshore areas of the south coast. The impact of the marine diesel and NADF release scenarios would likely only affect spawn product of linefish species advected by the Agulhas Current through the affected area en route to the Agulhas Bank and inshore nursery areas.

Detrimental effects on marine life (and fishing operations) would be likely where oil thickness is above the minimum smothering thickness for wildlife of 1.0 µm (as explained in *Section 8.3.6*). Spawning areas are mostly located inshore (that is on the shelf from the coastline to approximately the 200 m depth contour).

The results of the modelling of different unplanned discharge scenarios described in *Section 8.3.3* indicate the possibility that nearshore, inshore and offshore areas marine environment eastward of East London could be affected by the release of hydrocarbons.

The offshore well drilling areas coincide with the grounds of only one main commercial fishery (large pelagic longline); however the area impacted by a well blowout (Scenario 2a – blowout at the wellhead leading to hole collapse[1] and Scenario 2b – blowout at the wellhead followed by the installation of a capping system) would coincide with fishing grounds of the other fisheries such as large pelagic longline, traditional linefish, south coast rock lobster and crustacean trawl, (based on the affected area described in *Section 8.3.3*).

The result of the modelling indicates that no significant shoreline oiling would occur, and it is therefore, unlikely that the unplanned release of hydrocarbons would affect the operations of the nearshore fisheries (which included commercial, small-scale and recreational net fisheries, the small-scale (subsistence)and recreational line fisheries, and beach/rocky shore invertebrate fisheries).

Regardless of any potentially toxic effect on fish species, operators of fishing vessels would want to avoid polluted areas that contaminate fishing gear and affect cooling water intake systems.

Sensitivity of Fisheries Receptors

In the event of an oil spill reaching fishing grounds, fisheries may be temporarily banned by the regulatory authorities to prevent the introduction of tainted fish into markets. The offshore commercial fishers might, for a period, be forced to suspend fishing operations or temporarily move to other fishing grounds free of oil slicks. While commercial fisheries have the ability to move to other fishing grounds, small-scale and subsistence fishers are typically shore based and exploit resources close to where they live. As such, shore based fishers would not easily be able to find alternative fishing grounds that are not affected by a spill, as they may not have access transport and distances may be too far to cover on foot. Small-scale and subsistence fishers typically lack access to reliable vessels, so they would not be able to seek waters unaffected by a spill.

[1] This is a self-killing event in which the reservoir hole naturally collapses upon itself, thereby terminating the release.

In terms of the annual amount of food harvested, it is estimated that the subsistence shore fishery harvests approximately 23 t of linefish in the marine and estuarine environments per annum (Mkhize 2010, Kyle 2013c, WIOFish 2013). Based on the estimates made by Dunlop (2011), the total subsistence linefish catch for the seashore was in the region of 16 t per annum.

In the event of shoreline oiling, these fishers would have no choice other than to suspend fishing activities.

Communities relying on the small-scale or subsistence fisheries for their livelihood would be highly sensitive as it is often a vital part of their livelihood strategy and the income or food source lost would not easily be replaced.

Recreational fishers make up the largest numbers of fishers in KZN and it was estimated that between 8,463 and 13,958 shore anglers visit KZN annually from other provinces or countries (Dunlop & Mann 2012). The suspension of recreational fishing activity due to a spill would have implications for the tourism industry as described above, it is likely that recreational fishers would divert a planned fishing trip to an area not affected by a spill. Some local recreational fishers will be in a position to access alternative fishing areas via boat or by driving to alternative areas, and the impact from a spill would amount to one of inconvenience rather than an impact of livelihood.

Commercial fisheries are less sensitive to this impact as they have the ability to fish alternative grounds until such time that clean-up operations have been completed.

Mitigation Measures

In additional to the built-in control measures described in *Table 8.9*, Eni will develop a Fisheries Management Plan (FMP), which will be implemented in the event of an accidental spill. The plan will describe suitable livelihood restoration measures Eni will implement for any temporary or permanent loss of livelihood of the local fisheries and related stakeholders.

Risk Significance of Oil Spill Due to Blowout on Coastal and Marine Livelihoods

Results of the oil spill modelling study indicated that the spill would spread in a south-westerly direction, with a low probability of reaching the shoreline (*Table 8.7)* and the oil reaching the shoreline would be below the significant impact threshold of for wildlife injury Shoreline oiling occurs in 6 days or more.

The likelihood of such an incident taking place would be *Low*, however, the potential consequence would be *Major* for the tourism sector and for small-scale and subsistence fisheries.

It would result in a loss of access to income generating activities, livelihoods and food source for an unknown period of time. The **risk significance** as it relates to tourism, small-scale and subsistence fisheries is, therefore, assessed as **Moderate** (*Table 8.11)*.

Recreational fishers will be inconvenienced by a spill as they may have to seek alternative fishing grounds or suspend fishing activities. The consequence would be *Moderate* as it would not result in a loss of livelihood. The **risk significance** as it relates to recreational fisheries is, therefore, assessed as **Minor** (*Table 8.11)*.

For commercial fisheries, the consequence would be *Moderate*, as these fisheries are able to fish in alternative fishing grounds and would not suffer an economic loss to the same extent as small-scale fishers. The **risk significance** as it relates to commercial fisheries is, therefore, assessed as **Minor** (*Table 8.11)*.

Within the in-built controls described in *Table 8.9* and effective implementation of the Emergency Response Plan and OSCP, the magnitude of the spill will be reduced to **ALARP.**

Table 8.13 Risk Significance of Oil Spill on Coastal and Marine Based Livelihoods due to Blowout or Diesel Spill

Risk Significance of Oil Spill on Tourism due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**
Risk Significance of Oil Spill on Small-scale and Subsistence Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**
Risk Significance of Oil Spill on Recreational Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**
Risk Significance of Oil Spill on Commercial Fisheries due to Blowout or Diesel Spill	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**

8.3.11 *Accidental Vessel on Vessel Collision on Community and Workforce Health and Safety*

Description of the Baseline Environment and Sensitive Receptors

A large number of vessels navigate along the East Coast on their way around the southern African subcontinent. The majority of this boat traffic remains relatively close inshore on the East Coast.

The supply vessels may interact with the inshore vessel traffic due to the collection of supplies from the Port of Richards Bay or the Port of Durban. Both Durban and Richards Bay are well established and busy ports, those using the ports are accustomed to high volumes of marine traffic. In the event of a collision, there is a risk of injury or fatalities to crew or passengers on other vessels.

The crew on the drillship and supply vessels will undergo vigorous HSE training and vessels are equipped with navigation and warning systems that enable them to avoid such collisions. All operations during drilling will follow Eni's standards.

It is expected the other vessels operating offshore will also be equipped with navigation and warning systems that enable them to avoid collisions. Some smaller vessels, operating near shore may not have navigation systems.

The planned activities include the use of vessels that will use the same navigation routes to the Port of Richards Bay and Durban. The drillship will be supplied and/or serviced by supply vessels operating out either Port. The movement of supply vessels will take place on a daily basis.

Mitigation Measures

The following mitigation measures will be implemented to manage the risk of vessel on vessel collision.

Project vessels will:

- Distribute a Notice to Mariners prior to the commencement of the drilling operations to inform them of drilling activities, including timing and location thereof;
- Use navigational aids and markings as built-in control measures;
- Project vessels to inform other ships and boats by radio announcements regarding drilling activity location;
- Use of signals, lights and markings on the project vessel(s);

- Enforce a safety/exclusion zone with a 500 m radius around the project vessels; and

- Use of chase vessel to watch for and ward off vessels in the vicinity of the drillship.

Further management measures to manage interaction with non-project related vessels include the following:

- Eni will inform relevant local authorities, fisheries associations and commercial fishermen regarding proposed activities associated with the drillship, including details on timing, location, timing and area of temporary exclusion zone, fishing vessels clearance.

- Eni will develop a compensation plan, which will describe suitable compensation for any temporary or permanent loss due to a vessel collision with non-project vessels.

Risk Significance of Vessel Collision on Community and Workforce Health and Safety

The likelihood of a vessel on vessel collision is *Low*, as it is reported in the oil and gas industry, and rarely occurs. A vessel collision incident could result in serious injury, loss of work time and in a worst case scenario, loss of life. Further, small vessel operators may rely on their vessels as a source of income (small-scale fisheries or boat tours), and damage to or the loss of a vessel would result in the loss of access to income generating activities.

However, taking in-built control measures, compliance with Eni's Health and Safety Standards and the development of a compensation plan into consideration, the consequence of an incident for the Eni workforce is considered *Moderate***.**

The project is does not have any control over implementation of health and safety practices on-board non-project related vessels. The consequences of an incident involving non-project related vessels could therefore be *Major***.**

The **risk significance** for workforce health and safety is assessed as **Minor,** and the **risk significance** for community health and safety is considered **Moderate ALARP.**

Table 8.14 Risk Significance of Vessel Collision on Community and Workforce Health and Safety

Risk Significance of Vessel Collision on Workforce Health and Safety	
Type of Impact	Direct
Likelihood	Low
Consequence	Moderate
Risk Significance	**Minor (ALARP)**
Risk Significance of Vessel Collision on Community Health and Safety	
Type of Impact	Direct
Likelihood	Low
Consequence	Major
Risk Significance	**Moderate (ALARP)**

9 ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

9.1 INTRODUCTION

The aim of the Environmental Management Programme (EMPr) is to provide a set of guidelines and actions aimed at addressing potential environmental risks and impacts associated with the mobilisation, drilling and demobilisation of the Project, and will be included in contract documentation between the Project Company and its contractors. The EMPr also provides assurance to regulators and stakeholders that their requirements with respect to environmental and socio-economic performance will be met, and provides a framework for compliance auditing and inspection programs. It becomes a legally binding document on the Environmental Authorisation of the Project.

9.2 OBJECTIVES

The objectives of the EMPr are to:

- Fulfil the requirements of South African EIA legislation and international Conventions;
- Be consistent with oil and gas industry good practices and Eni South Africa's own Project technical guidelines/standards;
- Outline the appropriate avoidance and/or mitigation options to potential impacts, to ensure that impacts are minimised, after first establishing whether impacts cannot be avoided;
- Provide an implementation mechanism for mitigation measures and commitments identified in the EIA Report;
- Establish a monitoring programme and record-keeping protocol against which Eni South Africa and its contractor's/sub-contractor's performance can be measured and to allow for corrective actions or improvements to be implemented when needed; and
- Provide protocols for dealing with unforeseen circumstances such as unplanned events or ineffective mitigation measures.

9.3 CONTENTS OF AN EMPR

An EMPr needs to fulfil the requirements listed in section 24N of the Act of Environmental Impact Assessment (EIA) Regulations of 2014 (as amended).

Table 9.1 Contents of an EMPr

Legislated Content	Section in this Report
In detail, an EMPr needs to provide the following information:	
• The Environmental Assessment Practitioner (EAP) who prepared the EMPr; and	*Section 9.4*
• The expertise of that EAP to prepare an EMPr, including a curriculum vitae;	*Annex A*
• A detailed description of the aspects of the activity that are covered by the EMPr as identified by the Project description;	*Section 9.5*
• A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	*Section 9.5*
• A description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including:	*Section 9.6*
o Planning and design;	
o Pre-construction activities;	
o Construction activities;	
o Rehabilitation of the environment after construction and where applicable post closure; and	
o Where relevant, operation activities;	
• A description of proposed impact management actions, identifying the manner in which the impact management outcomes will be achieved, and must, where applicable, include actions to:	*Table 9.8*
o Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;	
o Comply with any prescribed environmental management standards or practices;	
o Comply with any applicable provisions of the Act regarding closure, where applicable; and	
o Comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;	
o The method of monitoring the implementation of the impact management actions identified;	
o The frequency of monitoring the implementation of the impact management actions identified;	
o An indication of the persons who will be responsible for the implementation of the impact management actions;	
o The time periods within which the impact management actions must be implemented;	
o The mechanism for monitoring compliance with the impact management actions identified;	
o A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	
• An environmental awareness plan describing the manner in which –	*Section 9.7.1*
o The applicant intends to inform his or her employees of any environmental risk which may result from their work; and	
o Risks must be dealt with in order to avoid pollution or the degradation of the environment; and	
• Any specific information that may be required by the competent authority.	*Section 9.7, to 9.11*

9.4 *DETAILS OF ENVIRONMENTAL ASSESSMENT PRACTITIONER*

ERM was appointed by Eni as the Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment process and application for environmental authorisation for the proposed offshore drilling Project.

ERM and the specialists appointed by ERM have no financial ties to nor are they a subsidiary, legally or financially, of Eni. Remuneration for the services by Eni in relation to the EIA Report (including the EMPr) is not linked to approval by any decision-making authority and ERM has no secondary or downstream interest in the development.

ERM is a global environmental consulting organisation employing over 5,000 specialists in over 150 offices in more than 40 countries. In South Africa, ERM Southern Africa employs over 150 environmental consultants out of offices in Johannesburg, Durban and Cape Town.

The contact details of the EAP for the application are presented in *Box 9.1* below.

Box 9.1 Contact Details of the EAP

Environmental Resources Management Southern Africa (Pty) Ltd.
Postnet Suite 90
Private Bag X12
Tokai
7966

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T +27 21 681 5400 | F +27 21 686 0736
E eni.exploration.eia@erm.com

The core EIA team members and specialists involved in this EIA process are listed in *Table 1.1* below.

Table 9.2 The EIA Team

Name	Organisation	Role	Qualifications, Experience
Ingeborg McNicoll	ERM	Project Director	BSc (Hons) Marine Biology. 35 years' experience
Vicky Stevens	ERM	Project Manager and EAP	MSc (oceanography), 12 years' experience
Lindsey Bungartz	ERM	Social and Stakeholder Engagement Specialist	BSocSc (Hons), 10 years' experience
Dr Andrea Pulfrich	Pisces Environmental Services (Pty) Ltd	Marine Ecology Specialist	PhD (Fisheries Biology), 20 years' experience
Dr David Japp	Capricorn Marine Environmental (Pty) Ltd (CapMarine)	Fisheries Specialists	MSc (Ichthyology and Fisheries Science), 30 years' experience
Ms Sarah Wilkinson			BSc (Hons) Oceanography and Botany, University of Cape Town, 14 years' experience
Dr John Gribble	ACO Associates CC	Maritime Heritage Specialist	BA (Hons), MA Archaeology, 20 years' experience
Michael J. Fichera	ERM	Oil Spill and Drill cuttings modelling Specialist	B.S. in Civil Engineering and an M.E. in Environmental Engineering, 25 years' experience
Mr Stephen Luger	PRDW	Modelling Peer Reviewer	MSc Engineering, 24 years' experience

The CV and details of the Independent Environmental Practitioner are presented in *Annex A*.

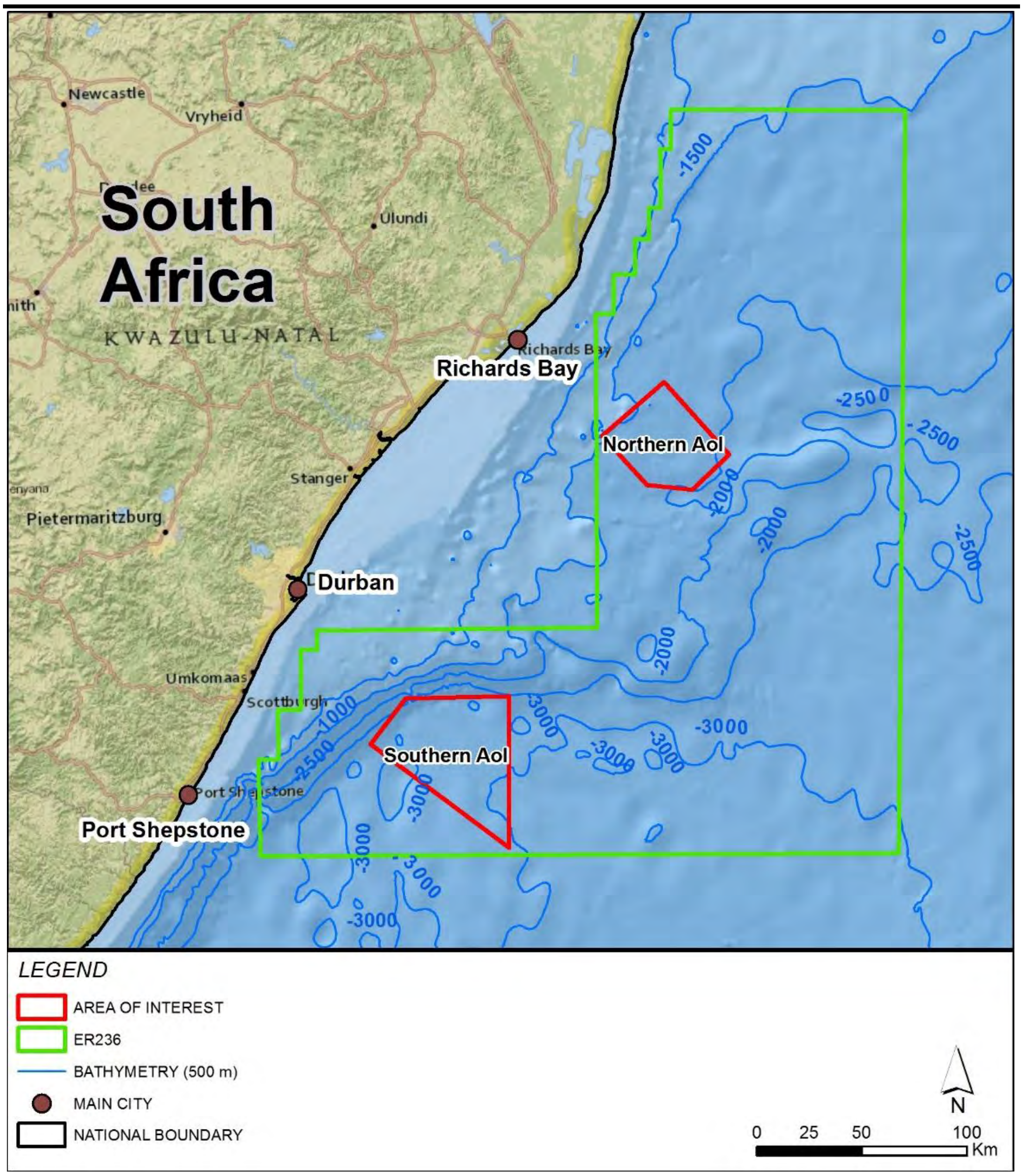
9.5 SITE AND PROJECT DESCRIPTION

Eni South Africa BV (Eni), and Sasol Africa Limited (Sasol) hold an Exploration Right off the East Coast of South Africa. Eni South Africa and Sasol are considering the possibility of conducting an exploration drilling programme in Block ER236 (12/3/236) to assess the commercial viability of the hydrocarbon reservoir for future development.

Eni South Africa proposes to drill up to six wells inside Block ER236, within two areas of interest, to establish the quantity and potential flow rate of any hydrocarbon present.

The drilling of the first exploration well, is planned for some time between November 2019 and March 2020, dependent on drillship availability, amongst a number of other planning requirements. The drilling of one well is expected to take in the order of two months to complete. The time sequence and the number of additional exploration and appraisal wells will be dependent on the results of the first exploration well.

Figure 9.1 Project Location – Offshore South Africa



The drilling of the northern and the southern areas of interest will be undertaken as two separate campaigns, which consist of:

- Up to four wells (two exploration and two appraisal wells) in the northern area of interest, which is located, at its closest point, approximately 62 km from shore, in water depths ranging between 1,500 m and 2,100 m;
- Up to two wells (one exploration and one appraisal well) in the southern area of interest, which is located, at its closest point, approximately 65 km from shore, in water depths ranging between 2,600 m and 3,000 m.
- The expected drilling depth will be between approximately 3,800 m and 4,100 m from the sea surface, through the seabed, to the target depth in the northern area, while around 5,100 m for the southern area.

- Well testing may be conducted on the appraisal wells if they present potential commercial quantities of hydrocarbon.

The co-ordinates of the Block ER236 and the drilling areas of interest are provided in tables below.

Table 9.3 Coordinates of the Block ER236 (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	27°48'30"S	32°52'0"E
B	27°48'30"S	34°0'0"E
C	31°0'0"S	34°0'0"E
D	31°0'0"S	30°49'0"E
E	30°35'0"S	30°49'0"E
F	30°35'0"S	30°55'0"E
G	30°22'24,6"S	30°55'0"E
H	30°22'24,72"S	31°2'0"E
I	30°7'0"S	31°2'0"E
L	30°2'0"S	32°30'0"E
M	28°41'18"S	32°30'0"E
N	28°41'18"S	32°35'20"E
O	28°31'4"S	32°35'20"E
P	28°31'4"S	32°41'30"E
Q	28°21'59"S	32°41'30"E
R	28°21'59"S	32°45'40"E
S	28°13'51"S	32°45'40"E
T	28°13'51"S	32°49'0"E
U	27°58'47"S	32°49'0"E
V	27°58'47"S	32°52'0"E

Table 9.4 Coordinates of the Northern Drilling Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	29° 12' 33,341"S	32° 31' 46.013"E
B	28° 58' 47.34"S	32° 49' 32.73"E
C	29°17'28.529"S	33°8'58.59"E
D	29°26'34.962"S	32°58'11.965"E
E	29°25'22.117"S	32°44'46.372"E

Table 9.5 Coordinates of the Southern Drilling Area of Interest (WGS84 UTM Zone 36S)

Point	Latitude	Longitude
A	30°19' 39.588"E	32° 3' 48.518"E
B	30°58' 35.904"E	32° 3' 25.921"E
C	30°31' 35.022"E	31° 22' 26.396"E
D	30°19' 49.794"E	31° 33' 7.656"E

9.5.1 *Project Components and Activities*

Main Project components include the following:

- Deep Water Drillship: due to water depth in each area of interest, it is anticipated that exploratory drilling will be conducted using a deep water drillship. The deep water drillship will be kept in position using a dynamic positioning system (DPS) which allows for minimal subsea disturbance due to its ability to operate without moorings. A significant benefit to using a drillship is the ease of mobility as it is a self-propelled vessel with the flexibility to move from location to location without the need of transport vessels;

- Exclusion Zone: During the drilling operations, there will be a temporary 500 m safety zone around the drillship, which will be enforced by a standby vessel. The safety zone will be described in a Notice to Mariners as a navigational warning. The purpose of the safety zone is to prevent a vessel collision with the drillship during operations. Under the Marine Traffic Act, 1981 (No. 2 of 1981), an "exploration platform" or "exploration vessel" used in prospecting for or mining of any substance falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone.

- Shore base: an onshore logistics base will be located in either the Richards Bay or Durban, on an existing brownfield site (previously developed land) within the Port or the Industrial Development Zone (IDZ). A final decision will be undertaken after a logistic survey is conducted in the identified areas.

- Supply and standby vessels: for the duration of the drilling operation, the drillship will be supported by Platform Supply Vessels (PSVs), which are general purpose vessels designed to carry a variety of equipment and cargo. These vessels will supply the drillship three to four times a week with drilling muds, cement and equipment such as casing, drill pipe and tubing. They will also remove waste that must be appropriately disposed of on land. The number of firm PSVs has not yet been defined (it is anticipated that there will be two or three).

- Personnel: all shore based personnel will reside locally. The majority of on-shore staff employed will be local if an existing locally based logistics company is evaluated as suitable for operational logistics support and follow up. The drillship will accommodate around 150-200 personnel. The number of personnel on the supply vessels will vary based on vessel size and the types of activities they support. All workers will be provided with health and safety training and Personal Protective Equipment (PPE) suitable for the types of activities.

- Crew transfer: transportation of personnel to and from the drillship will most likely be provided by helicopter operations from Richards Bay or Durban. The drillship will accommodate around 200 personnel. Crews will generally work in 12 hour shifts in 2 to 4 week cycles. Crew changes will be staggered, and in combination with ad hoc personnel requirements. Thus helicopter operations to and from the drillship will occur on an almost daily basis. The helicopter crew will generally work in 10 hour shifts in 2 to 4 week cycles and in accordance with Eni's Aviation Manual.

Infrastructure and services:

- *Freshwater*: the Project will require seawater and some limited industrial water for making the water based drilling muds for the tophole sections of the well and for rig cleaning. This industrial water will be transported from shore. The drinking (potable) water for the drillship will be provided either by reverse osmosis system or by bottled water;
- *Fuel:* the drillship and supply vessels will use marine gas oil during transit, standby and drilling operations; and
- *Food Supplies and Local Services:* a catering company will provide food and beverages to the offshore vessels. Food selection, quantities, and sourcing will be undertaken with support from the shore base.

Project activities associated with drilling include the following phases:

- Mobilisation of the supply vessels to Richards Bay or Durban, operation of the shore-based facilities for handling support services needed by the drillship;
- Drilling of a well;
- Well execution (side track, logging, completion) options;
- Optional well testing;
- Well abandonment; and
- Demobilisation of the drillship, vessel and local logistics base.

All activities will be conducted by Eni in conformity with recognised industry international best practice.

9.6 POTENTIAL IMPACTS ASSESSED

Table 9.6 Potential Impacts from Planned Activities

No.	Issue	Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
1	**Key Impacts Identified from Planned Activities**			
1.1	Climate change	Burning of fossil fuels	**Negligible**	**Negligible**
1.2	Seawater and sediment quality degradation /contamination and impacts on marine fauna	Wastewater discharges from the drillship, supply and support vessels	**Negligible**	**Negligible**
		Physical disturbance to the seabed, sediments and benthic fauna from pre-drilling Remote Operated Vehicle (ROV) surveys	**Negligible**	**Negligible**
		Physical disturbance to the seabed, sediments and benthic fauna from drilling operations	**Negligible**	**Negligible**
		Physical disturbance to the seabed, sediments and benthic fauna from the disposal of excess cement at the seabed	**Negligible**	**Negligible**
		Impact of disposal of muds and cuttings at the seabed on deep water benthos	**Negligible**	**Negligible**
		Impact of disposal of muds and cuttings at the seabed on deep water corals	**Moderate**	**Minor**
		NADF biochemical impacts related to drill cuttings and muds on marine fauna present in the water column	**Minor**	**Negligible**
		WBM biochemical impacts related to drill cuttings and muds on marine fauna present in the water column	**Negligible**	**Negligible**
		Disturbance of marine fauna by the masking of biologically relevant sounds by underwater noise associated with drilling operations	**Minor**	**Minor**
		Avoidance behaviour of marine fauna due to disturbance by underwater noise associated with drilling operations	**Negligible**	**Negligible**
		Impacts of helicopter noise associated with drilling on marine fauna	**Moderate**	**Minor**
		Impact of light from project vessels on marine fauna	**Negligible**	**Negligible**
1.4	Disturbance to fishing (commercial and subsistence)	Impacts related to restricted access to fishing grounds and damage to equipment due to the presence of the wellhead on the seabed	**Minor**	**Minor**
1.5	Abandonment of wellhead(s) on seafloor	Impacts of the presence of the wellhead during abandonment on other marine activities	**Negligible**	**Negligible**
1.6	No-go alternative	Impact of the no-go alternative	**Moderate**	**Moderate**
2	**Additional Relevant Impacts Identified through Stakeholder Engagement during Scoping**			
2.1	Maritime Heritage	Exploration drilling	**Negligible**	**Negligible**

No.	Issue	Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
2.2	Local employment / income generation	Employment of labour and allocation of jobs Training / capacity building of local people	**Negligible**	**Negligible**

Table 9.7 Potential Risks or Unplanned Activities and their Risk Significance ratings

No.	Issue	Impact	Post -Mitigation Significance Rating
1	**Unplanned Activities**		
1.1	Risk significance of oil spills on marine and coastal habitats and species	Hydrocarbon spill from a vessel collision (ie loss of diesel) on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
1.2		Hydrocarbon spill from a vessel collision on marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
1.3		Oil spill due to blowout surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.4		Oil spill due to blowout surface risk to marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
1.5		Oil spill due to blowout - sub-surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.6		Oil spill due to blowout -sub-surface risk to seabirds	**Minor (ALARP)**
1.7		Loss of drilling fluids and cuttings due to riser disconnect on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
1.8		Loss of drilling fluids and cuttings due to emergency riser disconnect on seabirds	**Moderate (ALARP)**
1.9		Loss of drilling fluids and cuttings due to emergency riser disconnect on invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
1.10	Risk significance of oil spills on marine and coastal based livelihoods	Oil spill due to blowout or diesel spill on tourism	**Moderate (ALARP)**
1.11		Oil spill due to blowout or diesel spill on small-scale and subsistence fisheries	**Moderate (ALARP)**
1.12		Oil spill due to blowout or diesel spill on recreational fisheries	**Minor (ALARP)**
1.13		Oil spill due to blowout or diesel spill on commercial fisheries	**Minor (ALARP)**
1.14	Accidental vessel on vessel collision on community and workforce health and safety	Vessel collision on workforce health and safety	**Minor (ALARP)**
1.15		Vessel collision on community health and safety	**Moderate (ALARP)**

9.7 IMPLEMENTATION OF EMPR

The EMPr details the mitigation measures, which must be implemented during the development of the proposed Project and assigns responsibilities for specific tasks. Eni shall ensure that a copy of the approved EMPr and associated approvals are supplied to the Drilling Contractor and is on board the drilling unit and support vessels during the operations.

The EMPr is applicable to all work activities during the planning, operations and decommissioning phases of the proposed activities. As per section 102 of the Mineral and Petroleum Resources Development Amendment Act, 2008 (No. 49 of 2008) (MPRDAA) may not be amended or varied without the written consent of the Minister.

The EMPr should be fully integrated into Eni's Health, Safety and Environment (HSE) procedures to promote:

- Ownership of the plan at the highest level;
- Appropriate resource allocation for implementation of the EMPr; and
- Effective execution of the EMPr.

The ultimate responsibility for the Project's environmental performance lies with Eni, specifically the Managing Director, Project managers and HSE managers. This will involve ensuring that the HSE requirements are applied and that all requirements are met by contractors and subcontractors engaged in work; including monitoring the performance of its contractors as well as the overall Project. Environmental commitments will be incorporated into operational procedures, working practices and overall management procedures. Eni South Africa will be required to track and steward implementation of the EMPr.

9.7.1 *Environmental Awareness Training*

Eni will identify, plan, monitor and record training needs for personnel whose work may have a significant adverse impact upon the environment. Eni recognises that it is important that employees at all levels are aware of Eni's HSSE policy, potential impacts of their activities, and roles and responsibilities in achieving conformance with the policy and procedures. The personnel with responsibilities in specific environmental practices will be adequately trained to ensure effective implementation of the works instructions and procedures for which they have responsibilities. This training will include awareness and competency with respect to:

- General awareness relating to exploration well drilling activities, including environmental and social impacts that could potentially arise from Project activities;

- Legal requirements in relation to environmental performance;

- Necessity of conforming to the requirements of the EMPr, including reporting requirements (ie such as incident reporting);

- Activity-specific training (ie waste management practices); and

- Roles and responsibilities to achieve compliance, including change management and emergency response.

Training would take cognisance of the level of education, designation and language preferences of the personnel. Eni would also require that each of the appointed contractors institute training programmes for its personnel. Each contractor will be responsible for site Health Safety Security & Environment (HSSE) awareness training for personnel working on the Project and for identification of any additional training requirements to maintain required competency levels. The contractor training programme will be subject to approval by Eni and it will be audited to ensure that:

- Training programs are adequate;
- All personnel requiring training have been trained; and
- Competency is being verified.

9.8 SPECIFIC MANAGEMENT PLANS

9.8.1 Emergency Response Plan

An Emergency Response Plan (ERP) is a requirement of the International Finance Corporation (IFC) Performance Standards and EHS Guidelines. This plan will include each stage of the Project lifecycle (mobilisation, drilling and demobilisation) and commensurate with the potential risks and impacts identified in the EIA Report.

The objective of the ERP is to be prepared to respond to accidental and emergency situations in a manner appropriate to the operational risks, and to prevent their potential negative consequences.

9.8.2 Oil Spill Contingency Plan

A Project specific Oil Spill Contingency Plan (OSCP) will be developed by Eni. This plan will be developed in terms of the Nationally adopted Incident Management System for spills and the National OSCP. This plan would instruct employees as to the correct response procedures for any unlikely oil spill that may occur during the exploration drilling operation. This plan of intervention, providing contacts lists and mobilization procedures will be drafted prior to the commencement of drilling activities.

All employees who are affected by the plan would be trained before commencement of drilling and at least one exercise would be held during drilling to confirm preparedness of people and equipment.

The oil spill contingency plan should include or address, but not be limited to, the following:

- Alert procedure;
- Initial / immediate actions;
- Oil Spill Response Options / Strategies;
- Oiled Wildlife Response Plan;
- Roles and responsibilities (including Emergency Directory);
- Response Actions;
- Response termination procedure;
- Oil Spill Modelling Report;
- Oil Spill Risk Assessment (environmental sensitivities and priorities for protection);
- Oil Spill Response Equipment Inventory;
- Response technical guidelines and limitations;
- Response equipment and maintenance / Inspection plan;
- Facilities (including specification) and products (including MSDS manual); and
- Drills and training.

The OSCP shall be reviewed and approved by the South African Maritime Safety Authority (SAMSA) prior to start of drilling. On approval SAMSA will issue a Pollution Safety Certificate. Eni shall provide copies of the plan and the approved Pollution Safety Certificate from SAMSA to the Petroleum Agency of South Africa, and the Department of Environmental Affairs.

9.8.3 Waste Management Plan

A Waste Management Plan (WMP) will be developed before activity start for implementation during the Project activities. The WMP establishes the procedures adopted for the management of waste to be generated during the course of conducting offshore and onshore operations (drilling, vessels trips, onshore support facilities). It covers collection, storage, treatment, transport, disposal, discharge, reporting and data management. The WMP will comply with applicable International Conventions for the Prevention of Pollution at Sea from Ships (MARPOL 73/78).[1]

The following are key recommended measures for the Waste Management Plan Development:

[1] It is the understanding of ERM that a Waste Management Licence is not required.

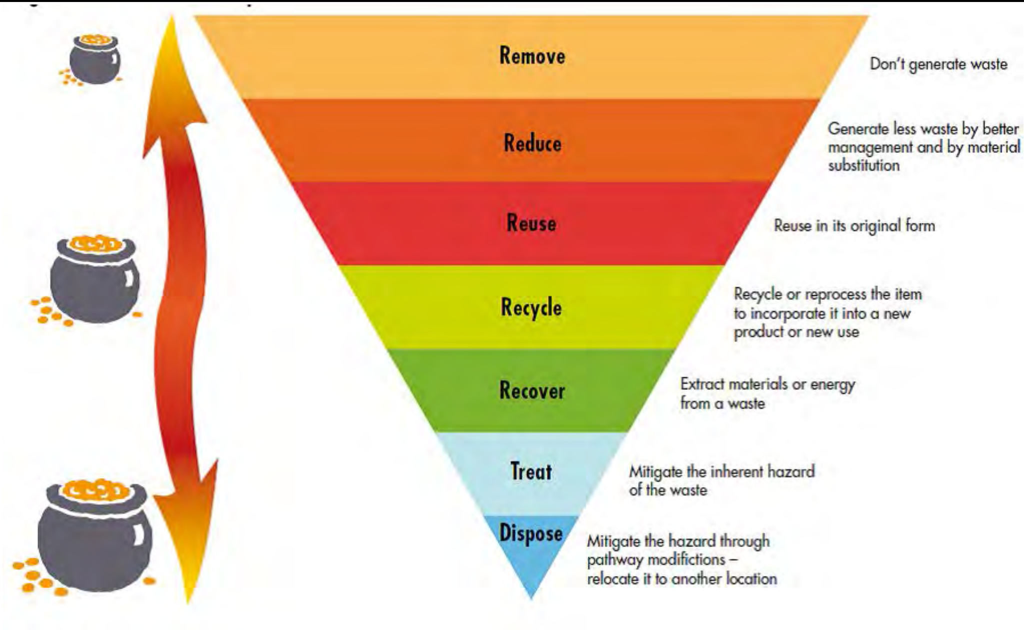
- Waste will be dealt by Eni South Africa in accordance with the waste hierarchy presented in *Figure 9.2* below;

- Suitably approved and fully licensed companies providing waste treatment and disposal services will be selected by review and evaluation in line with international good practice;

- Waste tracking procedures will be defined in the WMP to provide traceability from source of generation to end point; and

- Non-hazardous waste will be segregated and recycled where possible.

Figure 9.2 Waste hierarchy



9.9 *ENVIRONMENTAL MANAGEMENT PROGRAMME COMMITMENTS REGISTER*

This section details the specific management commitments to be implemented to prevent, minimise or manage significant negative impacts and optimise and maximise any potential benefits of the Project. These commitments are presented for the three Project phases; planning, operations and decommissioning phases.

This EMPr Commitments Register (*Table 9.8)* is structured in the following manner so that the mitigation measures have a clear and logical context within which they are designed, implemented, monitored and evaluated:

- Activities;
- Objective;
- Mitigation /Management and Enhancement Commitments;

- Responsibility;
- Timing / Frequency; and
- Requirement for the Close Out Report.

Table 9.8 EMPr Commitments Register

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
A)Planning Phase						
1.	Drilling timing/ scheduling	Drill in a favourable fair weather period to reduce impacts in the unlikely event of a blow-out	Since the probability of shoreline oiling in the unlikely event of a blow-out is significantly influenced by the season in which drilling is undertaken, it is recommended that drilling be undertaken during the summer months.	Eni	Prior to commencement of operation	Confirm drilling period and justify timing
2.	Preparation of subsidiary plans	Preparation for any emergency that could result in an environmental impact	The following plans should be prepared and in place: • A Project-specific OSCP approved by SAMSA. • Eni to provide copies of the approved plan and the Pollution Safety Certificate from SAMSA to PASA and the Department of Environmental Affairs (DEA). • Shipboard Oil Pollution Emergency Plan (SOPEP) for drillship and support vessels as required by MARPOL 73/78. • Emergency Response Plan • South African Search and Rescue (SASAR) Manual. • Waste Management Plan (*Section 9.8.3*). • Ballast Water Management Plan. In addition to the above, ensure that: • Drilling unit has Pollution Safety Certificate(s) issued by the South African Maritime Safety Authority (SAMSA). • There is adequate protection and indemnity insurance cover for oil pollution incidents. • There is a record of the drilling units and support vessels' seaworthiness certificate and/or classification stamp. • The wellheads and BOP are designed to allow for capping system installation.	Eni and Drilling Contractor	Prior to commencement of operation	Confirm compliance and justify any omissions

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Eni should subscribe a contract/s) with contractors specialized in Well Emergency (capping system, killing and relief well during Blow Out) response and oil spill response (e.g. Oil Spill Company Limited (OSRL) and Wild Well Control) for the duration of the exploration drilling programme.			
3.	Stakeholder consultation and notification	PASA and DEA notification	Compile the specific details of each drilling operation into a Drilling Notification document and submit to PASA and DEA. The notification should provide, inter alia, the details on the following: • Drilling programme (timing, co-ordinates and duration). • Contractor details. • Drilling unit and support vessel specifications (including relevant certification and insurance). • Oil Spill Contingency Pal (OSCP). • (ERP).	Eni	30 days prior to commencement of operations or as required by PASA and / or DEA	Confirm that notification was sent to PASA and DEA
4.		Stakeholder notification	• Develop a stakeholder management plan for drilling operations. This plan should include: o Notification of relevant government departments and other key stakeholders of the proposed drilling programme (including navigational co-ordinates of well location, timing and duration of proposed activities) and the likely implications thereof (specifically the 500 m exclusion zone and the movement of support vessels). Stakeholders include: • Fishing industry / associations: • South African Tuna Association. • SAMSA. • South African Navy (SAN) Hydrographic office. • Department of Agriculture, Forestry and Fisheries (DAFF),	Eni	30 days prior to commencement of operations	Provide copies of all correspondence

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Transnet National Ports Authority (ports of Richards Bay and / or Durban). • Adjacent prospecting / exploration and mining / production right holders. o Distribution of a Notice to Mariners prior to the commencement of the drilling operations to inform them of drilling activities, including timing and location thereof. • Any dispute arising with adjacent prospecting / exploration right holders should be referred to the Department of Mineral Resources and / or PASA for resolution.			
5.	Financial provision		Ensure that financial provision is in place to execute the requirements of the EMPr. Financial provision is to be approved by PASA.	Eni	Prior to commencement of operations	Confirm that financial provision for EMPr has been put in place
6.	Permits / exemptions	Compliance with legislative requirements	• If necessary, apply to the South African Heritage Resource Agency (SAHRA) for permission to disturb any cultural heritage material (e.g. shipwrecks) older than 60 years. • Comply with any requirements specified by SAHRA.	Eni	Prior to commencement of operations or when identified	Provide copy of permit / exemption

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
7.	Pre-Drilling Survey	Ensure that well positions will not affect obstacles / installations and sensitive habitats on the seabed	• Use a Remotely Operated Vehicle (ROV) to survey the seafloor prior to drilling in order to confirm the presence or absence of any significant topographic features, vulnerable habitats and / or species (e.g. cold-water corals, sponges) and cultural heritage material (e.g. wrecks) in the area. • Implementation of procedures for ROVs that stipulate that the ROV does not land or rest on the seabed as part of normal ROV operations. • Review ROV footage of pre-drilling surveys to identify potential vulnerable habitats within 500 m of the drill site. • Ensure drill site is located more than 500 m from any identified vulnerable habitats.	Eni/ Drilling/ support vessel contractors	Prior to commencement of operations or when identified	• Copy of permit from SAHRA (if required) • Provide photographic evidence of the seabed condition from ROV coverage
8.	Pre-Drilling Survey	Protect Shipwrecks	• Review any pre-drill remote sensing data collected to ground-truth seabed conditions to establish whether any shipwrecks are present on the seabed. • Should these reviews of the ROV data identify wreck material at or near the location of a proposed drill site, micro-siting of the well location and the possible implementation of a drilling activity exclusion zone around the archaeological feature should be sufficient to mitigate the risks to the site. • A chance find procedure must be developed for the Project and should any shipwreck material that was not identified by the measures set out above be encountered during the exploration drilling process.	Eni/ Drilling/ support vessel contractors	Prior to commencement of operations or when identified	• Copy of permit from SAHRA (if required) • Provide photographic evidence of the seabed condition from ROV coverage
B) Operational Phase						
General Vessel Operations						

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
9.	Use of drilling and supply vessels during all phases	Minimise impact to air quality	• Compliance to MARPOL 73/78 Annex VI regulations regarding the reduction of SOx, NOx, ODS, VOC and emissions from shipboard incineration. • Compliance to MARPOL 73/78, IMO certification and classification of the hazardous area according to EN 60047-10 to allow burns of no hazardous domestic solid waste (paper, carton, wood etc.)on board of drilling ship	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel log book records
10.			• All diesel motors and generators will undergo routine inspections and receive adequate maintenance to minimise soot and unburnt diesel released to the atmosphere. • Leak detection and repair programmes will be implemented for valves, flanges, fittings, seals, etc. • Use of a low sulphur fuel for Project vessels, if available.			
11.		Minimise impact to marine water quality by complying with MARPOL 73/78 requirements.	• Storage of chemical, fuels and oil in bunded areas on board the vessels to contain leaks and spills. • Oil Spill response equipment present on board of drillship and vessels. • Compliance with MARPOL 73/78 standards for all facilities and vessels and equipment with waste water treatment unit for the treatment of domestic wastewater. • Compliance with national and international requirements of wastewater treatment and disposal. • Discharge of all the wastewater effluents from drillship and vessels only after treatment. Equipment of vessels with oil/water separators to treat drainage and bilge water in compliance with MARPOL 73/78 Annex I requirements, that is to a level lower than 15 ppm oil content in water.	Drilling/ support vessel contractors	Throughout vessel operations	• Confirm compliance and justify any omissions • Provide summary of waste record book / schedule and receipts • Report occurrence of minor oil spills and destination of wastes

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
12.			Implement a waste management system in accordance with Eni's Waste Management Guidelines that addresses all wastes generated at the various sites, shore-based and marine.	Drilling/ support vessel contractors/ Eni	Prior to mobilisation	
13.			Route all deck and machinery drainage to: • Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks, e.g. Oil separating/filtering equipment and oil content meter. • Oil residue holding tanks. • Oil discharge monitoring and control system	Drilling/ support vessel contractors	Prior to mobilisation	
14.	Use of drilling and supply vessels during all phases	Minimise impact to marine water quality by complying with MARPOL 73/78 requirements.	The following certificates shall be in place: • A valid International Sewage Pollution Prevention Certificate, as required by vessel class. • International Oil Pollution Prevention (IOPP) Certificate, as required by vessel class.	Drilling/ support vessel contractors	Throughout vessel operations	Confirm compliance and justify any omissions
15.			Discharge food wastes after they have been passed through a comminuter or grinder, and when the drilling unit is located more than 3 nautical miles (± 5.5 km) from land.	Drilling/ support vessel contractors	Throughout vessel operations	Provide summary of garbage record book
16.		Control the spread of non-native invasive species to vulnerable ecosystems	All ships that carry ballast water must de- and re-ballast in adherence with the International Maritime Organization (IMO) guidelines and standards governing discharge of ballast waters at sea.	Drilling/ support vessel contractors	During ballast water discharge, throughout vessel operations	Provide ballast water log book records
17.	Use of drilling and supply vessels during all phases	Protect marine fauna, migratory birds and seabirds by managing noise from the drilling unit and supply vessels transit	Vessels shall undergo a regular maintenance regime to reduce noise.	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel log book records

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
18.	Use of drilling and supply vessels during all phases	Protect marine fauna, migratory birds and seabirds by managing illumination of the drilling unit and supply vessels	• Adopt use of lights compatible with safe operations whenever and, wherever possible, reduction of the intensity and emissions to the surrounding environment. • Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Injured birds should be humanely euthanized. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring)	Drilling/ support vessel contractors	Throughout vessel operations	Provide a summary of the vessel log book records
19.	Use of drilling and supply vessels during all phases	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• Implement refuelling procedures for bunkering. • Use dry break couplings. • Regularly inspect refuelling hoses. • Conduct oil spill response exercises. • Ensure all workers are trained to recognise and report incidents and emergencies. • Select chemicals to ensure low impact to aquatic organism in case of accidental overboard disposal. • Bund and drain hydrocarbon and chemical storage areas to a closed loop system. • Ensure all drainage water passes through an oily water analyser maintained and calibrated (<15 mg/L oil in water) prior to overboard discharge. • Inspect and maintain all chemical / fuel containers including the vessels fuel tanks and mud tanks. • In the case of a small spill implement the SOPEP. • In case of a large spill activate the OSCP and onshore emergency team	Eni and Drilling/ support vessel contractors	Throughout vessel operations	• Record of all spills (Spill Record Book), including spill reports. emergency exercise reports. audit reports • Incident log • Records of staff training

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
20.	Use of drilling and supply vessels during all phases	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	Categorise the likely different quantities of oil spills in the OSCP and agree with the relevant authorities how each categories of spills need to be reported and responded to. Information that should be supplied when reporting a spill includes: • The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company. • Geographic location of the incident, distance offshore and extent of spill. • Prevailing weather conditions, sea state in affected area (wind direction and speed, weather and swell). • Persons and authorities already informed of the spill.	Eni and Drilling/ support vessel contractors	In event of spill	• Record of all spills (Spill Record Book), including spill reports. emergency exercise reports. audit reports • Incident log
21.			• Control and contain the spill at sea, as far as possible and whenever the sea state permits, using suitable recovery techniques to reduce the spatial and temporal impact of the spill. • Where diesel, which evaporates relatively quickly, has been spilled, the water should be agitated or mixed using a propeller boat/dinghy to aid dispersal and evaporation. • Use low toxicity dispersants except within 5 nautical miles offshore or in depths < 30 m to reduce concentrations below most acute toxicity thresholds. • Provide adequate resources to collect and transport oiled birds or sea turtles to a cleaning station.	Drilling/ support vessel contractors	In event of spill	• Record of all spills (Spill Record Book), including spill reports. emergency exercise reports. audit reports • Incident log

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing/ Frequency	Requirement for Close Out Report
22.		Protect marine fauna from accidental collision	• Use anti-collision monitoring equipment and procedures on the drilling unit and supply vessels.	Eni and Drilling/ support vessel contractors	Throughout vessel operations	• Incident log
C) Drilling Phase						
23.	Operation of drillship at drill site	Ensure navigational safety	• Implementation of the stakeholder management plan for drilling operations	Eni	30 days prior to commencement of operations	Provide copies of all correspondence with stakeholders
24.	Operation of drillship at drill site	Ensure navigational safety	• Prevent collisions by ensuring that the drilling unit and support vessels display correct signals by day and lights by night (including twilight), by visual radar watch and standby vessel(s). • Manage the lighting on the drilling unit and support vessels to ensure that it is sufficiently illuminated to be visible to fishing vessels and compatible with safe operations. • Maintain standard vessel watch procedures. • Enforce the 500 m safety/exclusion zone around the drilling unit. • A support vessel, equipped with appropriate radar and communications, is kept on 24-hour standby. • Use flares or fog horn where necessary. • Co-operate with other legitimate users of the sea to minimise disruption to other marine activities.	Drilling/ support vessel contractors	Throughout operation	Provide records of any incidents and interaction with other vessels

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing/ Frequency	Requirement for Close Out Report
25.	Operation of drilling unit at drill site and transit of supply vessels to and from port	Minimise impact to water quality by complying with the requirements of MARPOL 73/78 standards	• Separation of wastes at source. • Recycling and re-use of wastes where possible. • Treatment of wastes at source (maceration of food wastes, compaction, incineration, treatment of sewage and oily water separation). • Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc.	Drilling/ support vessel contractors	Throughout operation	• Confirm compliance and justify any omissions • Provide summary of waste record book / schedule and receipts • Report occurrence of minor oil spills and destination of wastes
26.	Operation of drilling unit at drill site and transit of supply vessels to and from port	Appropriate waste management	• Segregate, classify and store all hazardous waste in suitable receptacles on board in order to ensure the safe containment and transportation of waste. • Provide a specific waste management storage and segregation area at the onshore logistics base. • Dispose of hazardous waste at a facility that is appropriately licensed and accredited • Incineration of non-hazardous waste (paper, wood, carton) using a certified burner.	Drilling/ support vessel contractors/Eni	Throughout operation	
27.	Operation of helicopters	Conserve and ensure the protection of marine and coastal fauna	• The National Environmental Management: Protected Areas Act (2003) stipulate that the minimum over-flight height over nature reserves, national parks and world heritage sites is 762 m (2,500 ft). • The Marine Living Resources Act (1998) prohibits aircraft to approach within 300 m of a whale. Therefore, except for when the aircraft lands on or takes off from the drillship and logistics base, the flight altitude would be >300 m. • The operation of helicopters and fixed-wing aircraft is governed by the Civil Aviation Act (No. 13 of 2009) and associated regulations.	Eni Logistics Manager and Helicopter contractor	All flights to/from drilling unit	• Submit copy of set flight path (including altitude) • Report deviations from set flight paths

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
28.		Conserve and ensure the protection of marine and coastal fauna	• Pre-plan flight paths to ensure that no flying occurs over IBAs; • Avoid extensive low-altitude coastal flights (<914 m and within 2 km of the shore). • Maintain an altitude of at least 914 m within Marine Protected Areas; • Comply fully with aviation and authority guidelines and rules; and • Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.			
29.		Community/ Occupational Health and Safety	• Compliance with Eni's H&S Standards. • Flights to be prohibited in bad weather.			
30.	Spudding	Protect sensitive seabed habitats	• Adjust the well location to avoid spudding on or in close proximity to potential vulnerable habitats (identified in pre-drilling ROV surveys).	Eni / Drilling contractor	Prior to spudding	• Provide photographic evidence of the seabed condition from ROV coverage
31.	Well drilling	Protect sensitive seabed habitats	• Careful selection of fluid additives taking into account their concentration, toxicity, bioavailability and bioaccumulation potential. Ensure only low-toxicity and partially biodegradable additives are used. • Use high efficiency solids control equipment to reduce the need for fluid change out and minimise the amount of residual fluid on drilled cuttings. • Regular maintenance of the onboard solids control package. • Use high efficiency solids control equipment to reduce the need for fluid change out and minimise the amount of residual fluid on drilled cuttings.	Eni/ Drilling contractor	Prior to drilling, throughout drilling, after drilling	• Provide material safety data sheet (MSDS) sheets for chemicals used • Provide volumes of muds, cuttings and cement disposed • Provide photographic evidence of the seabed

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Drilling fluids to be discharged to sea (including residual material on drilled cuttings) must be subject to tests for oil contamination.			condition from ROV coverage
32.			• Minimise excess cement during the initial riserless drilling stage by monitoring (by ROV) for discharges during cementing. • Use only low-toxicity and partially biodegradable cement additives.		Prior to cementing	
33.	Well drilling	Minimise impact to marine water quality and sensitive species	• Eni's specifications for discharge of WBM includes: o Discharge of cuttings via a caisson in >15 m depth. o Discharge of cuttings only in water >30 m depth. o Hg: max 1 mg/kg dry weight in stock barite. o Cd: max 3 mg/kg dry weight in stock barite. o Maximum chloride contraction must be less the four time the ambient concentration of fresh or brackish receiving water. o Ship-to-shore otherwise. • Eni's specifications for discharge of NADF retained on drill cuttings includes: o Discharge of cuttings via a caisson in >15 m depth. o Discharge of cuttings only in water >30 m depth. o Organic Phase Drilling Fluid concentration: maximum residual non aqueous phase drilling fluid (NAF) 5% (C16-C18 internal olefins) or 9.4% (C12-C14 ester or C8 esters) on wet cuttings. o Hg: max 1 mg/kg dry weight in stock barite. o Cd: max 3 mg/kg dry weight in stock barite.	Drilling contractor	Throughout drilling, after drilling	Provide volumes of muds, cuttings and cement disposed

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			o Ship-to-shore otherwise.			
34.	Vertical Seismic Profiling (VSP)	Protect offshore marine fauna	• Undertake a 30-minute pre-start scan (prior to soft-starts) within the 3 km radius observation zone in order to confirm there is no cetacean activity within 500 m of the source. • Implement a "soft-start" procedure of a minimum of 20 minutes' duration when initiating the VSP acoustic source. • The "soft-start" procedure may only commence if no cetaceans have been sighted within the shut-down zone (ie a 500 m horizontal radius from the VSP acoustic source) during the pre- start-up visual scan. • Maintain visual observations within the 500 m shut-down zone continuously to identify if there are any cetaceans present. • Shut down the acoustic source if a cetacean is sighted within 500 m shut-down zone until such time as the animal has moved to a point more than 500 m from the source.	Eni/Drilling contractor	During VSP	Provide records of number of species observed (including abnormal behaviours)
35.	Placement of wellhead on seafloor	Minimise risk of the introduction of non- indigenous invasive marine species	• Ensure all infrastructure (e.g. wellheads, BOPs and guide bases) that has been used in other regions is thoroughly cleaned before use in South Africa. • Avoid presence and spread out of invasive species by the implementation of the ballast water management plan	Contractor	Prior to mobilisation	Confirm compliance and justify any omissions
36.	Well Drilling	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• Fully inspect the BOPs on the drilling unit in accordance with the American Petroleum Industries recommended practices (or equivalent) prior to drilling. • All responsible personnel must be adequately trained in both accident prevention and immediate response.	Eni/Drilling contractor	Prior to and during drilling	Provide relevant certification and / or evidence of BOP inspection and application of risk control system

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Implement monitoring and management measures in accordance with normal well control practise to assist in the detection and control of uncontrolled releases. • Inspect and maintain all chemical / fuel containers including the vessels fuel tanks and mud tanks • Develop a Well Control Contingency Plan (WCCP) for each well.			
37.	Well Drilling	Protect marine fauna and coastal tourism by effective containment of oil, chemicals and fluids	• In the event of a spill, implement the OSCP and ERP • In the event of an oil spill that poses a risk of major harm to the environment immediately notify relevant authorities and emergency team. Information that should be supplied when reporting a spill includes: o The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company. o Geographic location of the incident, distance offshore and extent of spill. o Prevailing weather conditions, sea state in affected area (wind direction and speed, weather and swell). • Persons and authorities already informed of the spill. • Immediately activate and mobilize OSCP ; containment and recovery tools, equipment and personnel (e.g skimmers, booms, dispersants sprays, capping system)	Eni and contractors (including support e stand-by vessels)	In event of medium to large spill	• Record of all spills (Spill Record Book), including spill reports; emergency exercise reports; audit reports • Incident log

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
			• Monitor oil spill movements at sea surface (using meteocean and oil spill modelling data) to predict possible coastline area to be impacted and organize emergency response team nearshore and along coastline			
38.	Use and handling of hazardous materials	Minimise damage to the environment by implementing response procedures efficiently	• Implement OSCP and ERP. • Induction and training (proper use, transfer procedures). • Implement ERP to deal with all chemical spills.	Eni Drilling/ support vessel contractor	In event of medium to large spill	
39.	Transport, Storage And Handling Of Radioactive Devices	Avoid human and environmental exposure to radio- active material	• Comply with necessary regulations and licence requirements for the transport, storage and handling of radioactive devices.	Eni Drilling/ support vessel contractor	Throughout drilling operations	Provide copy of licence(s) and results from routine tests on radioactive sources to determine leak levels
40.	Well testing	Minimise impact to air quality	• Selection of an efficient test flare burner head equipped with an appropriate combustion enhancement system to minimize incomplete combustion, black smoke, and hydrocarbon fallout to the sea. • Record volumes of hydrocarbons flared	Eni/Drilling contractor	During well testing operations	Provide records of hydrocarbons flared
41.	Dropped objects	Community/ Occupational Health and Safety	• Compliance with Eni's H&S Standards • Recover (wherever practicable) objects which are accidentally dropped into the sea.	Eni/Drilling contractor	Throughout drilling, after drilling	• Incident log

Ref no.	Activities	Objective	Mitigation /Management and Enhancement Commitments	Responsibility	Timing / Frequency	Requirement for Close Out Report
D) Demobilisation/Decommissioning Phase						
42.	Abandonment of wells	Isolate permeable and hydrocarbon bearing formations and avoid leakages	• Seal well by inserting cement plugs in the well bore at various levels according to good oilfield practice. • Test well integrity. • Final wellhead and seabed ROV survey after well(s) plug and abandonment ("decommissioning"). • The abandoned wellhead location must be surveyed and accurately charted with the HydroSAN office.	Eni/contractor	On completion of well drilling, after plug and abandonment ("decommissioning") operations	• Provide copies of correspondence with SAN Hydrographer
43.	Transit of drilling unit and supply vessels from drilling location	Ensure navigational safety	Inform all key stakeholders that the drilling unit and support vessels are off location.	Eni	Within four weeks after completion of drilling	Copies of notification documentation required
44.	Transit of drilling unit and supply vessels from drilling location		Dispose all waste retained onboard at a licensed waste site using a licensed waste disposal contractor.	Drilling/ support vessel contractors	When drilling unit / support vessels are in port	Waste receipt required from contractor

9.10 MONITORING

Monitoring will be conducted to ensure compliance with regulatory requirements and the performance objectives specified in the EMPr, as well as to evaluate the effectiveness of operational controls and mitigation measures.

The main objectives of the monitoring programme will be to:

- Gather, record and analyse data required for regulatory and EMPr purposes;
- Verify the predictions and conclusions made in the EIA;
- Identify changes in the environment and receptors;
- Produce information to evaluate environmental performance specified in the EMPr;
- Produce information about emergencies that require an immediate response;
- Obtain information on the actual and potential environmental impacts of exploration activities;
- Use monitoring results as a source of information and as grounds for decision making regarding the design of new mitigation measures; and
- Describe whether and to what extent discharges from exploration activities have had impacts on the marine environment.

Monitoring will include, but not limited to the following:

Table 9.9 Monitoring Activities

No.	Aspect	Criteria to be monitored	Timing / Frequency
1	Sensitive seabed structures and sediments quality	• Hard substrate and rocky outcrops • Type and quantity of benthic fauna • Granulometry, hydrocarbons, metals and heavy metals	Prior to drilling and once during campaign
2	Ballast water prior to arrival on location	• Volume discharged, treatment and location(compliance with MARPOL 73/78 standards	Before/during first de-ballasting in country
3	Drilling fluids	• Volume on board • Volume used • Volume discharged • Toxicity, barite contamination, Organic Phase Drilling Fluid concentration (NADF), chloride concentration (WBM-brine)	Daily during drilling operations

No.	Aspect	Criteria to be monitored	Timing / Frequency
4	Cement	• Volume used and excess of cement discharged overboard/at sea bottom during riserless operations • Monitor cement returns and terminate pumping if returns are observed on the seafloor	During cementing operations
5	Chemicals and hazardous materials	• Cement chemicals and additives • Volume stored • Volume consumed	Daily during drilling operations
6	Drill cuttings	• Volume discharged • Oil content in drill cuttings	Daily during drilling operations
7	Deck drainage /machinery space /bilge water	• Correct operation of oil separating/filtering equipment and oil content meter (compliance with MARPOL 73/78 standards)	Prior to drilling and once during campaign
8	Sewage discharge	• Correct operation of sewage treatment system (compliance with MARPOL 73/78 standards)	At start and once during campaign
9	Galley waste	• Type and volume discharged • Correct operation for discharge (compliance with MARPOL 73/78 standards)	Daily during drilling operations
10	General waste	• Type and volume of waste generated • Type and volume transferred for onshore waste disposal facility • Compliance with waste Management Plan	Daily during drilling operations
11	Hazardous waste	• Volume of waste generated • Volume transferred for onshore disposal • Compliance with Waste Management Plan	Daily during drilling operations
12	Fuel usage	• Type and volume on board • Volume consumed	Daily during drilling operations
13	Accidental oil and chemical spills	• Type • Volume • Compliance with Shipboard Oil Spill Emergency Plan	Daily during drilling operations
14	Radioactive sources	• Correct containment and storage on board and during transportation	At start and once during campaign
15	Vertical Seismic Profiling	• Marine mammals observations and final report • Application of JNCC best practice	During pre-watch period and Continuous during VSP
16	Well (flow) testing	• Volumes of hydrocarbon fluids	Daily during well testing operations
17	Dropped objects	• Establish a hazards database listing: o the type of gear left on the seabed o date of abandonment/loss o location; and o where applicable, the dates of retrieval	Daily during drilling operations
18	Disruption/ interference to fishing/shipping	• Interactions with other vessels (via radio) • Number of grievances/incidents logged	Daily during drilling operations
19	Fauna interaction	• Bird and sea fauna incidents of injury/death • Stray land birds resting on drilling unit	Daily during drilling operations

9.11 *AUDITING*

Section 34 of the Environmental Impact Assessment Regulations (GNR R982/2014) stipulate that a holder of an environmental authorisation must, for the period during which the environmental authorisation and EMPr, and the closure plan, remain valid:

- Audit the compliance with the conditions of the environmental authorisation, the EMPr, and the closure plan; and

- Submit an environmental audit report to the relevant competent authority, ie Petroleum Agency of South Africa (PASA).

Section 34 of the regulations also stipulates that the environmental audit report must be prepared by an independent person with the relevant environmental auditing expertise and must be conducted and submitted to the relevant competent authority at intervals as indicated in the environmental authorisation. These intervals may not exceed 5 years.

An environmental audit report must contain all information set out in Appendix 7 of the Environmental Impact Assessment Regulations.

10 SUMMARY AND CONCLUSION

10.1 INTRODUCTION

The aim of the EIA Report for the proposed exploration drilling programme in Block ER236 (12/3/236) is to provide information to inform decision-making that will contribute to environmentally sound and sustainable development.

The purpose of this report is to provide information and an independent assessment of the project. Thus enabling the Department of Mineral Resources (DMR) to make an accountable and properly informed decision regarding whether or not to grant an environmental authorisation for the proposed development in terms of National Environmental Management Act (NEMA) (Act No. 107 of 1998) Regulations, 2014 (as amended in 2017)..

This report will also assist the DMR to define under what conditions the development should go ahead if authorisation is granted. In considering the nature of the proposed development, it is inevitable that there will be certain negative environmental impacts. However, mitigation measures have been developed for these and can be found in the Environmental Management Programme (EMPr, *Chapter 9*).

The purpose of the exploration drilling activities proposed is to determine whether there are sufficient hydrocarbons under the seabed to warrant further development. Exploration success would result in long-term benefits for South Africa, including access to new energy sources, improved security of supply, in-country investments in a development project (including job creation), increased government revenues, contribution to economic growth and reduced dependence on the importation of hydrocarbons.

Through the EIA process, which included stakeholder and specialist input, ERM has identified and assessed a number of potential impacts relating to the proposed activities. A brief overview of the findings of the EIA process, specifically those with a significance rating greater than Negligible and key mitigation measures are presented below.

With regards to various alternatives considered for the proposed project, the No-Go alternative entails no change to the status quo. This means that the proposed drilling exploration activities would not occur in Block ER236. The option not to proceed with exploration or appraisal drilling will leave the areas of the potential drilling sites in their current environmental state, with the oil/gas potential remaining unknown.

Despite many advances in seismic data acquisition and analysis, currently no alternatives exist to establish the presence of hydrocarbon reserves with certainty other than through exploration and appraisal drilling. No activity alternatives have therefore been assessed.

Although the well locations are still to be finalised based on a number of factors including further analysis of the seismic data; the geological target; and, seafloor obstacles. The impact assessment (*Chapter 7*) considers that the wells could be drilled anywhere within the northern and southern areas of interest. Impacts associated with a logistic base potentially being placed in either Richards Bay or Durban.

Eni's preferred drilling vessel is a drillship due to distance from shore, water depth constraints and its availability, flexibility and ease of mobility. Eni also prefers to treat and discharge cuttings offshore in accordance with international best practice requirements. Lastly, this report assesses the impact of drilling of one well within each area of interest at any time of the year and therefore seasonality has been considered.

10.2 SUMMARY OF IMPACTS IDENTIFIED AND ASSESSED

The impacts assessed as part of this EIA Report were only those, which were considered as potentially significant. All non-significant impacts were scoped out during screening.

10.2.1 Planned Activities

Summarised in this section are the impacts from the planned activities identified to have a significance of Minor and above.

The impacts from planned activities with the highest significance rating, namely those associated with the burning of fossil fuels, the smothering of the seabed habitat from the discharge of drilling muds and cuttings, noise generated by a helicopters, and the no-go alternative are discussed further.

Atmospheric emissions will predominantly come from the drillship and other vessels associated with the drilling operations. The total CO_2 equivalent anticipated to be emitted during the drilling operations is 13,076.92 tonnes. Although localised air pollution is inevitable due to the nature of the project, Enihas committed to certain inbuilt compliance and control measures including the compliance to MARPOL 73/78 Annex VI regulations regarding the reduction of NOx, SOx and GHG emissions from vessel engines.

The main impacts associated with the disposal of drilling solids will be smothering of sessile benthic fauna (such as corals, if present), and the physical alteration of the benthic habitat in the immediate vicinity (< 200 m) of the well. The results of the cuttings dispersion modelling studies undertaken as part of this project (ERM, 2018a) have indicated that the effects of discharged cuttings are localised. The smothering effects from discharged drillings have been assessed to have an impact of Small magnitude on the benthic macrofauna of unconsolidated sediments in the cuttings footprint.

This is because the impact is localised and the recovery of benthic communities is expected within a few years (2 to 5 years). However, if deep water corals are found to be present in the Project Area their sensitivity to smothering from drilling solids is High. Their presence is unknown at these depths and would be evaluated in the ROV planning phase of operations.

Undertaking crew transfers between Durban or Richards Bay and the drillship will generate helicopter noise, which affects seabirds in breeding colonies and roosts on the mainland coast. Low altitude flights over the ocean could also affect marine mammals and turtles in surface waters in the Project Area. During the transfers, the helicopter operator will be required to comply with the necessary SA regulations. In addition to this, mitigation measures associated with the flight altitude and path taken have been proposed to minimise the impact as much as possible.

The No-Go alternative will result in the positive impacts associated with the proposed project not being realised. These positive impacts include, but are not limited to, the diversification of the South African energy mix, decreased reliability on other countries for oil and gas and the generation of local employment and investment Essentially, option of not going ahead with the exploration drilling activities on Block ER236 could result in lost opportunities for the South African economy.

Table 10.1 Summary of Impacts Identified from the Planned Activities (above Minor)

Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
Impact of disposal of muds and cuttings at the seabed on deep water corals	**Moderate**	**Minor**
NADF biochemical impacts related to drill cuttings and muds on marine fauna present in the water column	**Minor**	**Negligible**
Disturbance of marine fauna by the masking of biologically relevant sounds by underwater noise associated with drilling operations	**Minor**	**Minor**
Impacts of helicopter noise associated with drilling on marine fauna	**Moderate**	**Minor**
Impacts related to restricted access to fishing grounds and damage to equipment due to the presence of the wellhead on the seabed	**Minor**	**Minor**
Impacts of the presence of the wellhead during abandonment on other marine activities	**Negligible**	**Negligible**

Impact	Pre-mitigation Significance Rating	Post mitigation Significance Rating
Impact of the no-go alternative	Moderate	Moderate

10.2.2 *Unplanned Activities*

Summarised in this section are the impacts from unplanned activities identified to have a risk significance of Minor and above.

Table 10.2 Summary of Potential Risks or Unplanned Activities and their Significance Ratings

Impact	Post -Mitigation Significance Rating
Hydrocarbon spill from a vessel collision (ie loss of diesel) on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
Hydrocarbon spill from a vessel collision on marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
Oil spill due to blowout surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
Oil spill due to blowout surface risk to marine and coastal habitats and species (seabirds)	**Moderate (ALARP)**
Oil spill due to blowout - sub-surface risk to invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
Oil spill due to blowout -sub-surface risk to seabirds	**Minor (ALARP)**
Loss of drilling fluids and cuttings due to riser disconnect on marine and coastal habitats and species (Invertebrates, pelagic fish and larvae, and for marine mammals and turtles)	**Minor (ALARP)**
Loss of drilling fluids and cuttings due to emergency riser disconnect on seabirds	**Moderate (ALARP)**
Loss of drilling fluids and cuttings due to emergency riser disconnect on invertebrates, fish, marine mammals and turtles (including species inside MPAs)	**Minor (ALARP)**
Oil spill due to blowout or diesel spill on tourism	**Moderate (ALARP)**
Oil spill due to blowout or diesel spill on small-scale and subsistence fisheries	**Moderate (ALARP)**
Oil spill due to blowout or diesel spill on recreational fisheries	**Minor (ALARP)**
Oil spill due to blowout or diesel spill on commercial fisheries	**Minor (ALARP)**
Vessel collision on workforce health and safety	**Minor (ALARP)**
Vessel collision on community health and safety	**Moderate (ALARP)**

The risk of an oil spill (including crude oil and diesel) into the marine environment is inherent in all offshore oil exploration and appraisal projects. The likelihood (probability) of significant oil spills (ie those that can reach the coastline or other sensitive areas) is **very low** with most oil spills being very small and having only limited environmental effects.

The industry approach to dealing with potential oil spills is to develop technology and operational procedures to reduce the likelihood of spills occurring, while at the same time planning appropriate responses to oil spills to reduce the severity of impacts in the event of a spill. The response procedures form part of an Oil Spill Contingency Plan (OSCP).

A range of design features and control measures have been developed as part of the design planning phase of this project to reduce the likelihood of accidental events. In addition, existing management measures applied by Eni on its other exploration projects to minimise the risk of accidental events will be adopted on this project. These measures are presented in *Chapter 9*. All recommended mitigation measures presented in this Section have been incorporated into the Environmental Management Programme for this project (*Section 9)*.

10.3 RECOMMENDATIONS

During this EIA process, certain control measures have been recommended as part of the project to manage the anticipated impacts. These control measures have been recommended, to an extent that is practically possible for Eni without compromising the economic viability of the project. These control measures also ensure that the project is fully compliant with South African Regulations as well as international policies, frameworks and industry best practise during its operations.

Over and above the recommended controls, mitigation and management measures have been drafted and form part of the EMPr developed with this EIA Report.

All mitigations listed in the EMPr are recommended to be implemented during the course of the project to ensure compliance and the potential negative impacts associated with the establishment of the project are respectively mitigated to a level, which is deemed adequate for the project to proceed.

In summary, based on the findings of this assessment and taking into account the benefits this projects poses for the South African economy, ERM is of the opinion that the proposed exploration drilling activities on Block ER236 to determine whether there are sufficient hydrocarbons under the seabed to substantiate further development, should be authorised. This is, however, contingent on the implementation of the mitigation measures and monitoring for potential environmental and socio-economic impacts as outlined in the EIA Report and EMPr being implemented by Eni.

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