TotalEnergies E&P South Africa BV

OFFSHORE PRODUCTION RIGHT AND ENVIRONMENTAL AUTHORISATION APPLICATIONS FOR BLOCK 11B/12B

Closure Plan

REPORT NO. 41105306-359142-12
SEPTEMBER 2023

PUBLIC

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CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

Abbreviation	Explanation
ALARP	As Low as Reasonably Practicable
CA	Competent Authority
CR	Critically Endangered
CGR	Condensate Gas Ratio
DFFE	Department of Forestry, Fisheries, and the Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EBSAs	Ecologically or Biologically Significant Areas
EIA	Environmental Impact Assessment
EN	Endangered
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FEED	Front end engineering and design
FLET	Flow Line End Termination
FSR	Final Scoping Report
GoM OCS	Gulf of Mexico Outer Continental Shelf
GN	Government Notice
GTL	Gas To Liquids
HSE	Health, Safety & Environment
IOGP	International Association for Oil & Gas Producers
MARPOL	The International Convention for the Prevention of Pollution from Ships
MODU	Mobile Offshore Drilling Units
OSCP	Oil Spill Contingency Plan
ROV	Remotely Operated Vehicle
RSA	Republic of South Africa
SAMSA	South African Maritime Safety Authority
SDU	Subsea Distribution Units
SLP	Social and Labour Plan
TEEPSA	TotalEnergies Exploration and Production South Africa B.V.
VSP	Vertical Seismic Profiling
VU	Vulnerable
WBM	Water Based Muds

Abbreviation	Explanation
BOCP	Blow Out Contingency Plan
OBM	Oil Based Muds

UNITS OF MEASURE

Unit	Explanation
°C	Degree centigrade
Hz	Hertz
“	Inch = 2.54 cm
km	Kilometre
km^2	Square Kilometre
m	Metre
mg	Milligrams
MMstb	Millions of standard tank barrels
m/s	Meters per second
Tcf	Trillion Cubic Feet
%	Percentage
kg	Kilogram

DETAILS OF THE SPECIALIST

A comprehensive CV is included in Appendix A.

Details of Specialist	
Name:	Johan Bothma
Contact number:	27 82 803 3882
Email:	Johan.bothma@wsp.com
Company Name:	WSP Group Africa (Pty) Ltd

Qualifications

Specialist Qualifications	
Education:	MLArch PrLArc
Professional affiliations:	SACLAP 20163
Summary of experience:	Director Mine Closure with 18 years consulting experience

DECLARATION OF INDEPENDENCE BY SPECIALIST

I, Johan Bothma declare that I –

- Act as the independent specialist for the undertaking of a specialist section for the TEEPSA Offshore Production Right and Environmental Authorisation Applications for Block 11B/12B;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed;
- Do not have nor will have a vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Undertake to disclose, to the competent authority, any information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document.

DETAILS OF THE APPLICANT

Details of Applicant	
Applicant:	TotalEnergies EP South Africa B.V. (TEEPSA)
Physical address:	3 Biermann Ave, Rosebank, Johannesburg, South Africa
Contact details:	011 778 2000

EXECUTIVE SUMMARY

TotalEnergies EP South Africa B.V. (TEEPSA) appointed WSP Group Africa (Pty) Ltd (WSP) to undertake the Environmental Authorisation (EA) application that is required for the Production Right (PR) application submitted for Block 11B/12B offshore of the south coast of South Africa.

This Closure Plan report (for the purposes of this project hereafter referred to as a Closure Plan, unless specific context requires otherwise) is developed as part of the Environmental and Social Impact Assessment (ESIA) in support of the EA application.

The Closure Plan for Block 11B/12B sets out the requirements of the National Environmental Management Act (NEMA, No. 107 of 1998) Financial Provisioning Regulations 2015, as amended (hereafter referred to as the Financial Provisioning Regulations, 2015) with reference to the National Environmental Management Act (NEMA, No. 107 of 1998) Proposed Regulations Pertaining to Financial Provisioning for the Mitigation and Rehabilitation of Environmental Damage Caused by Reconnaissance, Prospecting, Exploration, Mining or Production Operations GN 2272 (11 July 2022) that will repeal the 2015 Regulations entirely; and are due to come into force on 19 February 2024.

In terms of regulatory requirements, the Closure Plan presents likely scenarios for the plugging and abandonment of the Block 11B/12B exploration and production wells. The activities associated with the scenarios are described together with a summary of the environmental and socio-economic conditions and their implications for these activities. A risk assessment of the closure activities has been prepared to inform the estimate of the closure scenarios costs that are provided.

KEY RISKS AND MITIGATION

A screening level risk assessment was conducted as part of the Closure Plan compilation and the following significant risks have been identified:

- Mobilization of rigging/drill unit and support vessels, travel to and from well site - accidental oil release to the sea due to vessel collisions, rupture, etc. Mitigation measures include:
  - Oil Spill Contingency Plan (OSCP);
  - Training and use of reputable contactors; and
  - Strict implementation of and compliance with operational procedures and controls.
- Unplanned well leakage during plugging and abandonment operations – water hydrocarbon contamination, atmospheric impacts (primary), adverse dispersant impacts (secondary). Mitigation measures include:
  - Well plugging and abandonment (P&A) design as per industry best practice standards;
  - Testing of installed well caps to ensure compliance to performance specifications;
  - Mobilisation of global response companies, Subsea Dispersant Injection (SSDI) kit;
  - Oil spill dispersion modelling to inform OSCP; and
  - Implementation of and compliance with the BOCP.

- Unplanned well leakage during plugging and abandonment operations – impacts on avifaunal species, macrofauna species, plankton as well as on seabed, coral reefs, and associated species. Mitigation measures include:
  - Oil Spill Contingency Plan (OSCP);
  - Training and use of reputable contactors; and
  - Strict implementation of and compliance with operational procedures and controls.
- Compromise of well cap integrity by future exploration drilling by third parties - hydrocarbon contamination of receiving environment. Mitigation measures include:
  - Install a trawl over structure on abandoned well heads to ensure that fishing equipment is not snagged and damaged;
  - Ensure South African Maritime Safety Agency (SAMSA) is notified of any navigational hazards; and
  - Notify SA Navy Hydrograph to include permanent obstruction as a navigation hazard on navigation charts and bathymetric maps.
- A permanent 500 m safety zone proposed by the South African Maritime Safety Authority to be in place around abandoned infrastructures such as, *inter alia*, pipelines and production manifolds. Mitigation measures include:
  - Negotiation with SAMSA to remove the safety zone after closure given the depth of the remaining infrastructure and that no potential hazards to surface activities are expected; and
  - Include abandoned subsea infrastructure as a hazard on navigation charts and bathymetric maps.

CLOSURE COST ESTIMATES

Closure costs for the exploration wells and production infrastructure have been developed to comply with the requirements of the Financial Provisioning Regulations, 2015, as amended. The costs are based on project-specific unit rates and the incorporation of specific requirements from TEEPSA and information sourced from international literature such as the Association for the Advancement of Cost Engineering (AACE) International Classification Standard.

The estimated plugging and abandonment costs for four exploration wells for the Project is approximately **USD 93.5 million;** while the closure costs for production related infrastructure and either three wells (total production capacity during the first ten years), five wells (maximum current planned production capacity), or six wells (should a further production well be required) is approximately **USD 132.0 million**, **USD 175.0 million,** and **USD 196.0 million**, respectively**.**

KEY RECOMMENDATIONS

This closure framework is a live document with a statutory requirement as per the Financial Provisioning Regulations 2015, as amended, for periodic updates to incorporate new information such as an improved understanding of the project engineering design, latest available technology, and new studies on effective closure planning. This will inform the ongoing refinement of the comparative assessment to determine removal or retention of subsea equipment, well abandonment program detailing, improved verification tests to establish integrity, refinement of closure cost, design of the plugging materials, design of over-trawlable structure and amendments to the abandonment and plugging schedule.

1 INTRODUCTION AND SCOPE OF REPORT

1.1 PROJECT BACKGROUND AND LOCATION

TotalEnergies EP South Africa B.V. (TEEPSA), together with its joint venture partners, QatarEnergy, Canadian Natural Resources International South Africa Limited, and a South African consortium, MainStreet 1549, held an Exploration Right (Exploration Right Ref. No.: 12/3/067) over Block 11B/12B, located offshore from the Southern Cape coast, South Africa, which expired in September 2022. TEEPSA has now applied for a Production Right (PR) which was submitted in September 2022. If a PR is granted and if commercial agreements for the sale of the gas onto the domestic market can be achieved, TEEPSA is planning to develop Block 11B/12B.

The Block 11B/12B application area is located offshore the south coast of South Africa and covers approximately 12 000 km2. The closest north-eastern point of the application area is about 75 km offshore from Cape St Francis, whereas the closest north-western point is about 120 km offshore from Mossel Bay (Figure 1-1). Development and production related activities are proposed for the western portion of Block 11B/12B, in the Project Development Area. TEEPSA proposes to conduct further investigations in the eastern portion of the block, referred to as the Exploration Priority Area, including exploration and appraisal drilling, to enable further refinement of the geological and reservoir understanding, as is typical of developments of this nature.

In accordance with the regulatory requirements, TEEPSA must conduct an Environmental and Social Impact Assessment (ESIA) process for undertaking the proposed development and production related activities in Block 11B/12B. WSP Group Africa (Pty) Ltd (WSP) has been appointed by TEEPSA to undertake the ESIA process in support of an environmental authorisation (EA) application. The Final Scoping Report was accepted by the Competent Authority (CA) on 18 May 2023, indicating that the Impact Assessment Phase could commence, and the specialist studies completed.

Closure planning has been done in support of the ESIA process. The objective of this assessment was to determine the environmental and social requirements that would exist at the end of the operational lifespan of the project, and to identify appropriate management and mitigation measures to address the closure-related risks. This report presents the methods and results of the closure planning and associated closure cost estimate in support of the ESIA.

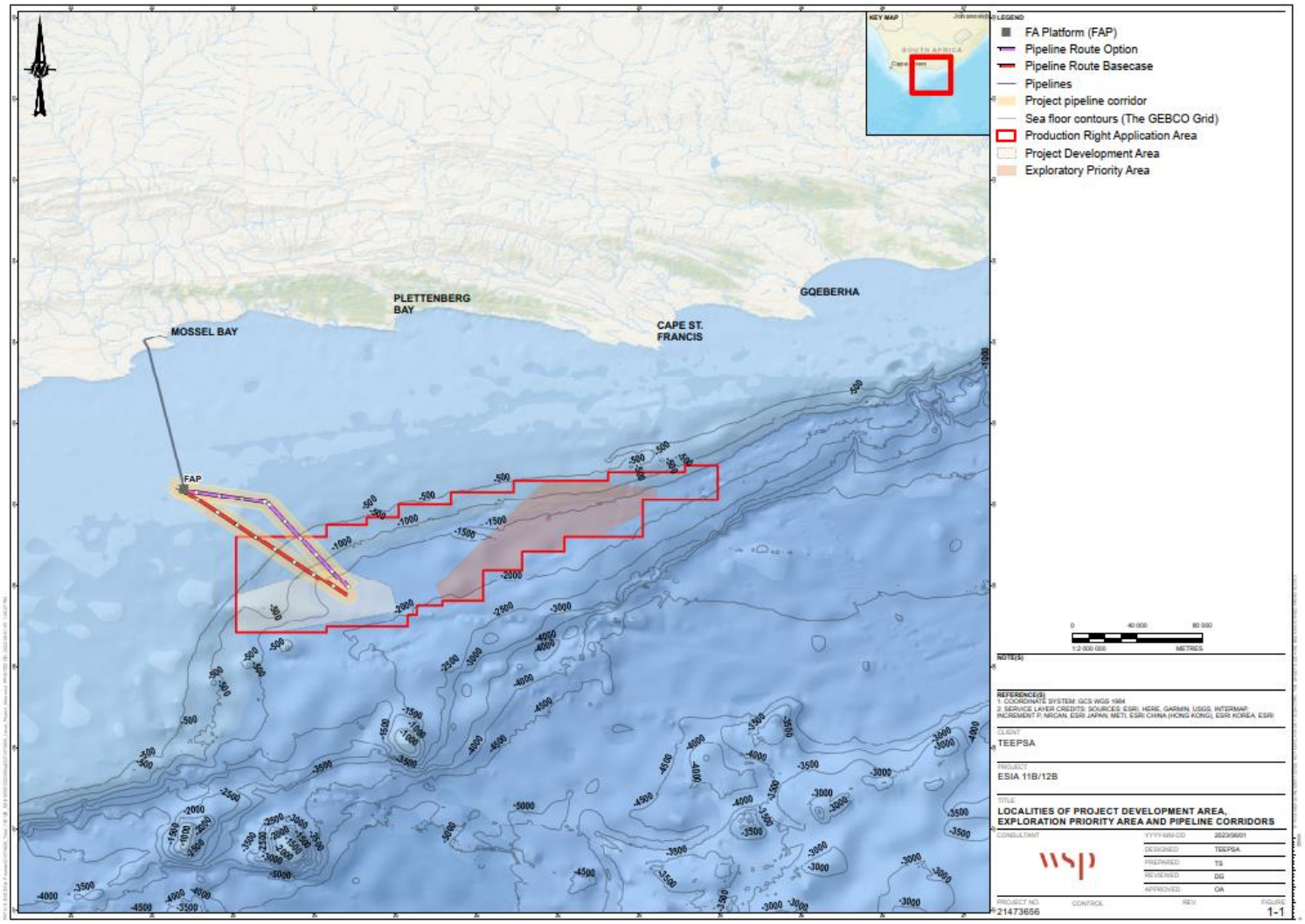

Figure 1-1 - Localities of Project Development Area, Exploration Priority Area, and Pipeline Corridors

1.2 REPORT CONTENT

This document is the Closure Plan for Block 11B/12B and sets out the requirements of the National Environmental Management Act (NEMA, No. 107 of 1998) Financial Provisioning Regulations 2015, as amended, hereafter referred to as the Financial Provisioning Regulations, 2015, as amended, with reference to the National Environmental Management Act (NEMA, No. 107 of 1998) Proposed Regulations Pertaining to Financial Provisioning for the Mitigation and Rehabilitation of Environmental Damage Caused by Reconnaissance, Prospecting, Exploration, Mining or Production Operations
GN 2272 (11 July 2022) that will repeal the 2015 Regulations entirely; and are due to come into force on 19 February 2024.

This Closure Plan report (for the purposes of this project hereafter referred to as a Closure Plan, unless specific context requires otherwise) is developed in support of the Environmental Authorisation (EA) application that is required for the PR application.

The Closure Plan details the following aspects as required by the Financial Provisioning Regulations, 2015, as amended:

- The policy framework for closure, including the requirements for:
  - Final rehabilitation, decommissioning and closure of the production at the end of operational life; and
  - The environmental risk assessment to identify latent or residual environmental impacts which may become known in the future.
- The method for determination of the financial provision as a detailed itemisation of all activities and costs, calculated on the actual costs of implementation of the measures required for:
  - Final rehabilitation, decommissioning and closure (Appendix 4), and
  - The remediation of latent or residual environmental impacts as identified in the environmental risk assessment, if applicable (Appendix 5).

1.3 PROJECT COMPONENTS AND ACTIVITIES

The section below and Table 1-1 provide information regarding these activities and summarises the Project activities and components together with the location and phasing. The following subsections are focused on the Project components considered in this assessment.

Table 1-1 – Details of Project Activities

Aspect	Details
Proposed exploration and appraisal drilling activities (Eastern Portions of Block, Exploration Priority Area)	▪ Mobilisation of drill unit to site. ▪ Drilling of up to four (4) exploration and appraisal wells. ▪ Possible flow testing, Vertical seismic profiling (VSP), well logging for each well drilled. ▪ Plugging and abandonment of each well. ▪ Demobilisation of drill unit from site. ▪ Onshore support.
Proposed offshore surveys (Whole Block)	▪ Mobilisation of specialised vessels for survey work. ▪ Bathymetry and sonar surveys.

Aspect	Details
	▪ Seafloor sampling surveys. ▪ Metocean surveys. ▪ Demobilisation of survey vessels. ▪ Onshore support.
Proposed production development activities (Western Portion of Block, Project Development Area)	
Construction Phase	Offshore
	▪ Mobilisation of drill unit to site. ▪ Drilling of up to six (6)[1] production and appraisal wells and testing. ▪ Installation of Well-heads and Christmas-Trees (XMT). ▪ Laying of deep-water subsea production manifolds and jumpers connecting the wells. ▪ Installation of subsea production pipeline. ▪ Connection of manifolds to the F-A Platform via the production pipeline, riser and umbilical. ▪ Demobilisation of drill unit from site. ▪ Demobilisation of pipeline installation and support vessels.
	Onshore
	▪ Establishment of logistics base within the Mossel Bay port. ▪ Support vessels transport of equipment, bulk materials, and general supplies from shore to drill unit, survey and pipeline laying vessels. ▪ Helicopter flights for ship/shore personnel movement and in emergency events. ▪ Periodic bulk delivery (equipment) from Gqeberha and/or Cape Town port.
Production Operations Phase	Offshore
	▪ Operation of gas field, including subsea infrastructure to supply F-A Platform. ▪ Operation of F-A Platform and associated infrastructure. ▪ Vessel movements for maintenance and inspections of subsea infrastructure and flowlines pigging.
	Onshore
	▪ Movement of support vessels from shore to F-A Platform for transportation of equipment, bulk materials, and general supplies. ▪ Helicopter flights for ship/shore personnel rotation and in emergency events. ▪ Periodic bulk delivery (equipment) from Gqeberha and/or Cape Town port.

[1] At this stage of the engineering design, five production wells will be drilled in the Production Development Area with the option for a sixth well should it be required.

Aspect	Details
Decommissioning Phase	Offshore
	▪ Mobilisation of drill unit to site. ▪ Mobilisation of specialised vessel for survey/ROV work. ▪ Movement of support vessels from shore to drill unit for transportation of equipment, bulk materials, and general supplies. ▪ Helicopter flights for ship/shore personnel movement and in emergency events. ▪ Decommissioning of production manifold, flowlines, umbilical and riser. ▪ Decommissioning of subsea distribution units and power cable(s). ▪ Retrieval of shallow water infrastructure, such as production risers and umbilicals. ▪ Pigging of production flowline incl. subsea tie-in. ▪ Abandonment of wells. ▪ Demobilisation of drill unit and support vessels from site.
	Onshore
	▪ Movement of support vessels from shore to drill unit for transportation of equipment, bulk materials, and general supplies. ▪ Helicopter flights for ship/shore transport. ▪ Salvage of retrieved equipment and shipping to Gqeberha and/or Cape Town port.

1.3.1 EXPLORATION AND APPRAISAL DRILLING RELATED ACTIVITIES – OFFSHORE WESTERN AREA

In addition to the development of the gas field in the western section of Block 11B/12B, TEEPSA intends undertaking exploration and appraisal drilling work to assess the potential for additional hydrocarbons resources. This programme may include:

- Drilling of up to four (4) exploration and appraisal wells in the eastern section of Block 11B/12B. Final site selection of the wells will be based on further detailed analysis of the pre-drilling survey data and the geological target.
- VSP of the well will be conducted. VSP is an evaluation tool that is used when the well reaches target depth to generate a high-resolution seismic image of the geology in the well's immediate vicinity. The VSP images are used for correlation with surface seismic images and for forward planning of the drill bit during drilling. VSP uses a small airgun array, which is operated from the drilling unit. During VSP, receivers are positioned in a section of the well and the airgun array is discharged at intervals. This process is repeated for different stations in the well and may take between 8 to 12 hours per well to complete.

1.3.1.1 Drilling Unit

The choice of technology for well drilling primarily depends on the metocean conditions and the depth of the seabed. Based on the regional metocean conditions and the experience gained in drilling the exploration wells in Block 11B/12B, TEEPSA is likely to semi-submersible drill unit (6th or 7th generation) with a dynamic positioning system suitable for the deep-water offshore environment (Figure 1-2). The final drill unit selection however will be made depending upon availability of suitable drill units at the preferred time.

Figure 1-2 - Example of semi-submersible drilling vessel

A drill unit is a custom-built vessel designed to operate in deep water and dynamic ocean conditions. A semi-submersible drilling vessel is a floating structure of pontoons that, when, at well location, are partially flooded (or ballasted), with seawater, to submerge the pontoons to a pre-determined depth below the sea level where wave motion is minimised. This gives stability to the drilling vessel thereby facilitating drilling operations. The drilling "derrick" is normally located towards the centre of the vessel and well operation is done through the moonpool, with support operations undertaken from both sides of the vessel using fixed cranes. The drilling unit may be supported by one or two tugboats, depending on metocean conditions anticipated for the period of the operations, to keep it on location.

Given the specialised equipment required for deep sea well drilling, the drill unit and supply vessels could mobilise directly to Block 11B/12B from outside South African waters or from a South African port, depending on which drill unit is selected and where it was last based.

Core specialist and skilled personnel would arrive in South Africa onboard the drilling unit and the rest of the personnel will be flown to George, Cape Town or Gqeberha, depending on the onshore base selected. Drilling units are usually supplied with the required technical specialist core team on board.

Drilling materials, such as casings, mud components, cement and other equipment and materials will be brought into the country on the drilling unit itself and/or imported via a container vessel directly to the onshore logistics base from where the supply vessels will transfer it to the drilling unit.

All I&APs, including the Competent Authority (DMRE), SAMSA, local authorities, operators of neighbouring licence blocks, and the commercial and small-scale fishing industry, will be notified prior to commencement of construction activities.

At the end of the drilling operations the drilling unit and supply vessels will demobilise from the offshore licence area and either mobilise to the following drilling location or relocate into port or a regional base for maintenance, repair, or resupply.

1.3.1.2 Well Drilling Sequences

Well drilling will be conducted from a drilling unit described in Section 1.3.1.1 above. The selection of the specific well locations will be based on several factors, including detailed analysis of the seismic and pre-drilling survey(s) data, and confirmed by a Remote Operating Vehicle (ROV) surveying the seafloor for obstacles or the presence of any ecologically sensitive features.

Drilling is undertaken in two stages, namely the riserless and risered drilling stages.

1.3.2 DEVELOPMENT AND PRODUCTION RELATED ACTIVITIES – OFFSHORE WESTERN AREA

The Project Development Area is located approximately 110 km southeast of the existing F-A Platform. The Project development concept comprises wells and a subsea production system (SPS) (Figure 1-3) in the south-west corner of Block 11B/12B to produce gas and associated condensates. The development concept also includes a subsea pipeline to carry the gas and condensate to existing treatment and export facilities on the F-A platform where it will go to shore via the existing pipelines.

Figure 1-3 - Subsea infrastructure typical layout

The proposed development concept will connect up to 6 wells in the Project Development Area via a multiphase pipeline carrying both gas and associated condensates from the wells up to the F-A Platform. From there, it will be carried for further treatment and exporting via the existing PetroSA-operated gas and condensate pipelines onshore.

Any construction, modification, or upgrades at the F-A Platform or of any onshore facility, if required by the off-taker of gas or condensates, will be subjected to a separate EA application.

The production activities programme can be summarised as below:

- Drilling of up to six (6) wells in the Project Development Area.
- Installation of the SPS including pipeline and connection to the F-A Platform.

The riser will remain in place until eventual decommissioning of the F-A platform and is therefore excluded from the 11B/12B closure plan. Figure 1-4 is a schematic diagram of the Project development area cross-section showing the subsea infrastructure layout.

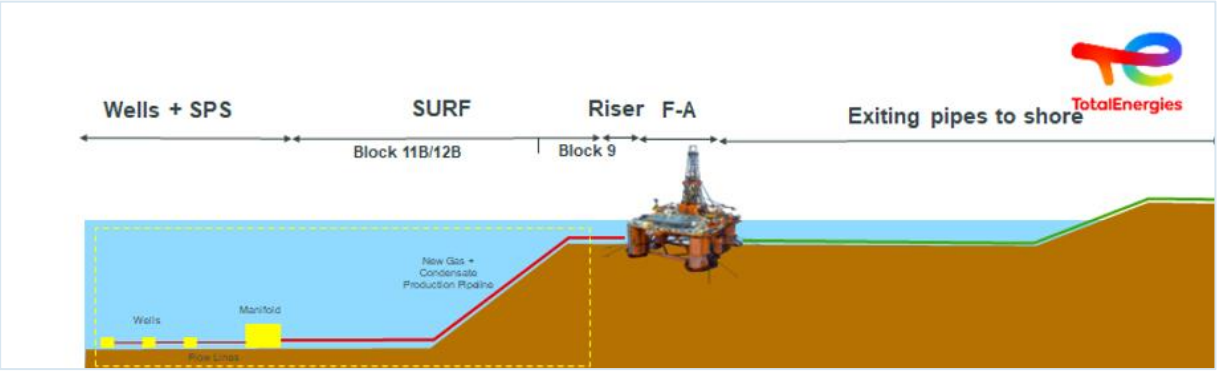

Figure 1-4 - Project Development Area Cross-Section

1.3.3 MARINE SURVEYS

Various offshore surveys and data collection will be conducted in Block 11B/12B subject to identification of specific needs, including sonar surveys.

Sonar surveys will be used to investigate the structure of the seabed (bathymetry) in the vicinity of future wells, if needed. Sonar surveys will be conducted from a vessel and might use multi-beam echo-sounding, single beam echo-sounding, and sub-bottom profiling. Such surveys entail transmitting frequency pulses down to the seafloor to produce a digital terrain model and identify any seafloor obstructions or hazards.

1.3.4 ONSHORE SUPPORT ACTIVITIES AND COMPONENTS

The Project will include a shore base/logistics base to support operations. It will also include a series of support and specialised vessels for specific activities. During drilling activities, support vessels will include supply vessels and tugboats.

Supporting activities will also include helicopter transportation from existing airport facilities to move personnel to and from the offshore facilities.

1.3.5 PROJECT PHASING AND TIMEFRAMES

The Project activities are associated with the timeframes as indicated in Table 1-2.

Table 1-2 - Exploration, development, and production related timeframes

Project Component	Phase	Timeframe	Duration of Activities	No. of wells
Exploration	Mobilisation	To be determined	120 days per well	Not applicable
	Operations, including plugging and abandonment			Up to four (4)
	De-mobilisation			Not applicable

Project Component	Phase	Timeframe	Duration of Activities	No. of wells
Offshore Surveys (for Development and Exploration)	Operations	To be determined	▪ Sonar: 15 – 30 days for 1 survey ▪ Seafloor sampling: 15 – 30 days for 1 survey ▪ Metocean Buoy: 7 – 15 days for deployment for 1 year monitoring	Not applicable
Development	Final well site selection, pipeline alignment selection	To be determined	To be determined	Not applicable
	Construction (including mobilisation)	Year 0	120 days per well	Two (2)
		Year 1	120 days per well	One (1)
		Year 10	120 days per well	Two (2)
	Production	Year 1 to Year 25	-	Year 1 to 10 – 3 wells Year 11 to 25 – 5 wells
	Decommissioning (including plugging and abandonment, and demobilisation)	Year 26	-	Five (5)

1.3.6 WELL PLUGGING AND ABANDONMENT - EXPLORATION AND PRODUCTION WELLS

The purpose of well sealing and plugging is to isolate permeable and hydrocarbon bearing formations. Well sealing and plugging aims to restore the integrity of the formation that was penetrated by the wellbore. The principal technique applied to prevent cross flow between permeable formations is plugging of the well with a properly designed cement mix, thus creating an impermeable barrier between two zones.

Once drilling and logging have been completed, the wells will be sealed with cement plugs, tested for integrity, and abandoned according to international best practices and company rules. Cement plugs will be set to isolate hydrocarbon bearing and/or permeable zones and cementing of perforated intervals (e.g., from well logging activities) will be evaluated where there is the possibility of undesirable cross flow. These cement plugs are set in stages from the bottom up. At least two cement plugs would be installed: i.e., one each for isolation of the deep reservoir and the main reservoir; and a second as a second barrier for the main reservoir.

Typical cement plug formulation (composition) for plugging and abandonment application in South Africa (based on drilling in Block 11B/12B, the exact formulation will depend on the selected contractor providing the services) is presented in Table 1-3. Cement plug formulation is based on

several well conditions and status, viz. depth, fluids in the well, gas or oil reservoir, temperature, etc. As such, it can be adjusted based on the logistics and product availability, without compromising the objectives.

The integrity of cement plugs can be tested by several methods. The cement plugs will be tag tested (to validate plug position) and weight tested, and if achievable then a positive pressure test (to validate seal) and/or a negative pressure test will be performed. Additionally, a flow check may be performed to ensure sealing by the plug. Once the well is plugged, seawater will be displaced before disconnecting the riser and the BOP.

Table 1-3 - Typical Cement Plug Formation

Product	Function	Chemical Definition
G Neat Cement	Binder	Portland Cement Clinker
Fresh Water	Base fluid	Water
NF-6	Anti-foam agent	Glycol
HALAD-344	Fluid Loss agent	Polymer
HALAD-413	Fluid Loss Agent	Polymer
CFR-3L	Polymer	Dispersant (friction reducer)
HR-4L	Retarder	Lignosulfonate
GasCon-469	Bonding Agent	Silica

** Barite may be used as a weighting material for the spacer. However, it is not generally needed when Newtonian fluids (i.e., a fluid in which the viscous stresses arising from its flow are at every point linearly correlated to the local strain rate) are in the wellbore, in which case the spacer would be water.*

The choice of a specific well plugging and sealing design configuration is driven by several factors including locality and depth, geological substrate conditions, access and logistical considerations, and cost. However, regardless of these factors the basic plugging and abandonment configuration consists of a surface plug, two or more barrier plugs (towards potential overburden and reservoir flow zones, respectively), and in some instances filling of a section of the well shaft with concrete or other material (Figure 1-5).

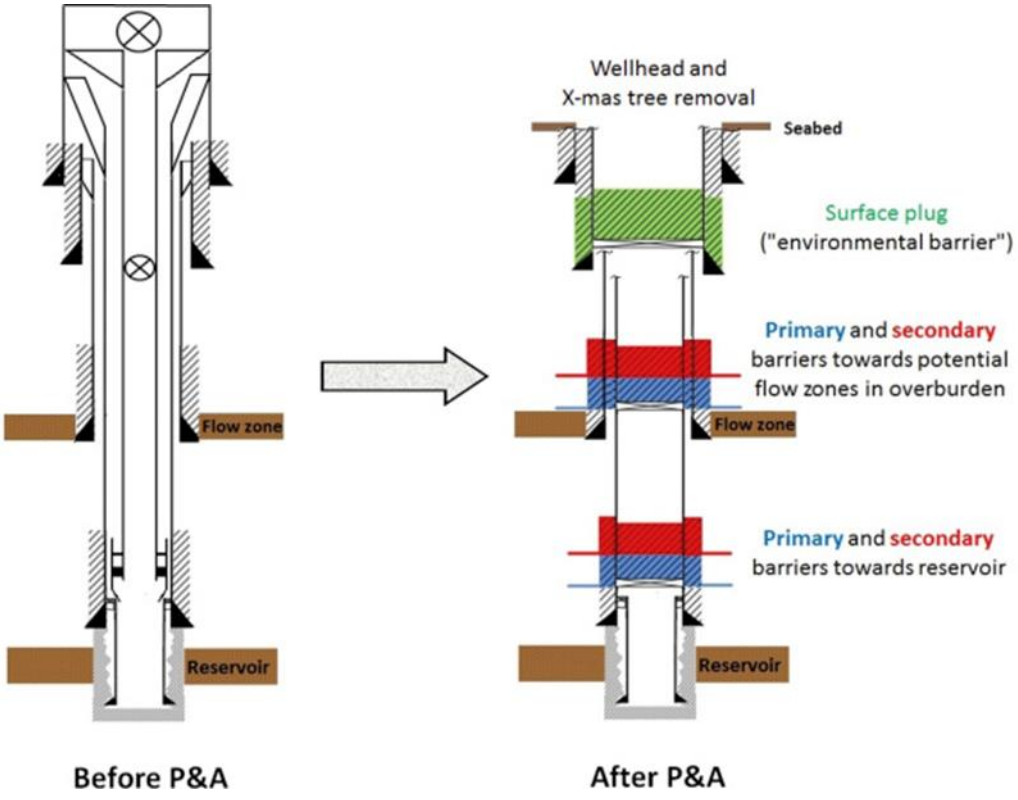

Figure 1-5 - Diagrammatic Example of Typical Well Plug and Abandon Measures (Vralstad, 2019)

Where it is deemed to be safe, based on risk assessment, the wellhead will be left in place on the seafloor and fitted with an over-trawlable abandonment cap (Figure 1-6). The risk assessment criteria will consider factors such as the water depth and use of the area by other sectors, noting that the drilling water depths is well outside that of trawling and most other maritime activities. The over-trawlable cap is estimated to measure approximately 5.2 m x 5.2 m, with a height of 4.4 m. In this regard, it is noted that in developed deep-water fields in the North Sea and Gulf of Mexico (GoM), regulators generally do accept that decommissioned wellheads are left *in situ* without the need for further structures to be added on top. The need for the envisaged cap may therefore be revised at a later stage, after consultation with local regulators and based on specific project considerations, although these structures have been included in the closure planning and costs, as a worst-case scenario. It must be noted that these structures are installed to prevent fishing equipment from becoming entangled or damaged by the well heads, rather than as a protection mechanism for the plugged wells themselves.

Monitoring gauges to monitor pressure and temperature through wireless communication with frequencies between the transmitter and the receiver in the 12.75 to 21.25 kHz range may be installed on wells where TEEPSA will return in the future for appraisal or production purposes. The gauges will be placed and remain under the over-trawlable cap. Monitoring gauges will not be installed on wells which are earmarked for abandonment.

Except for the abandoned wellheads and associated over-trawlable caps, and drilling discharges deposited on the seabed, no further physical remnants of the drilling operation will remain on the seafloor. A final clearance survey check will be undertaken using an ROV. The drilling unit and supply vessels will demobilise from the offshore Block and either mobilise to the following drilling location or relocate into port or a regional base for maintenance, repair, or resupply.

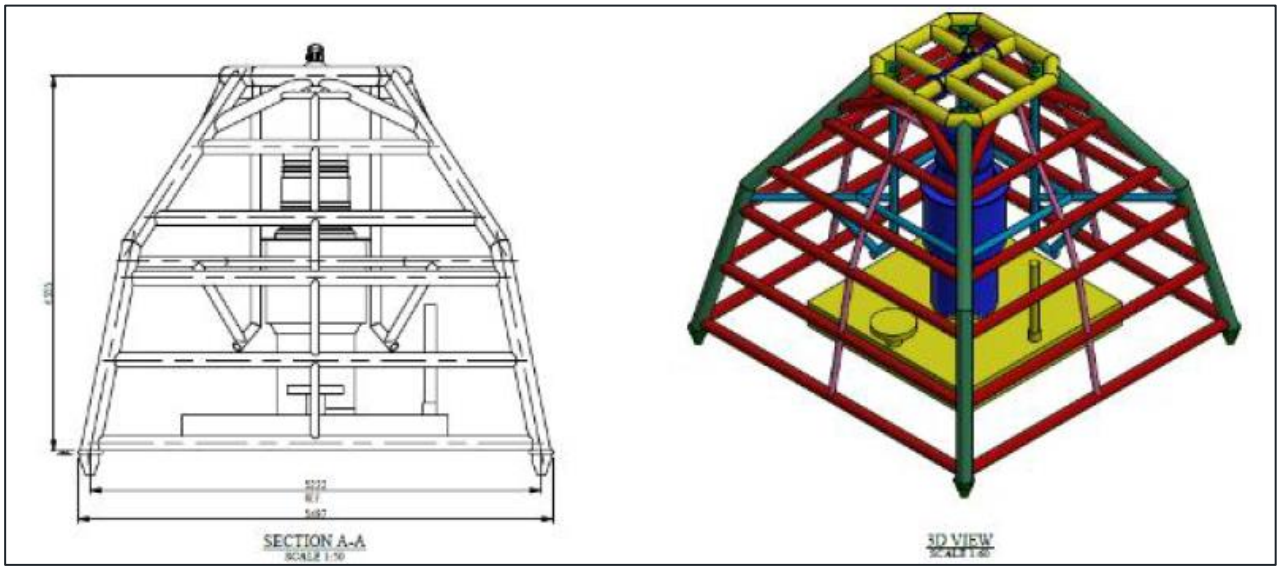

Figure 1-6 - Example of Over-trawlable Cap to be Installed on Wellhead on Sea Floor (image provided by TEEPSA)

1.4 SPECIALIST STUDY SCOPE

1.4.1 CLOSURE PLAN DEVELOPMENT

As required in terms of Section 24P of NEMA, the Environmental and Social Impact Assessment (ESIA) report for oil and gas exploration and production projects must include an estimation of the financial provision required for the decommissioning and closure of the proposed activities, aligned to the Financial Provisioning Regulations, 2015, as amended. The Regulations require a Closure Plan developed for the proposed Project to meet the following objectives:

a) Providing the vision, objectives, targets, and criteria for final rehabilitation, decommissioning and closure (decommissioning) of the project;

b) Outlining the design principles for closure;

c) Explaining the risk assessment approach and outcomes, and link closure activities to risk mitigation;

d) Detailing the closure actions and specific measures that will be taken to mitigate and/or manage identified risks, and describes the nature of latent risks that may need to be monitored and managed post closure;

e) Committing to a schedule, budget, roles, and responsibilities for final rehabilitation, decommissioning and closure of each relevant activity or item of infrastructure, to the extent that this is currently known and feasible for the project, which is currently still at a conceptual level of development;

f) Identifying knowledge gaps and how these will be addressed and filled;

g) Detailing the full decommissioning, plugging and abandonment (closure) costs for the life of project, which will be reassessed at increasing levels of accuracy as the project develops and approaches closure in line with the rehabilitated end state of the project site; and

h) Outlining monitoring, auditing, and reporting requirements.

Although offshore oil and gas projects are subject to the requirements of the NEMA Financial Provisioning Regulations, the wording of the current Financial Provisioning Regulations is heavily slanted towards mining development, which is governed by the same legislation. Existing offshore oil and gas development off the Southern African coast is limited and the application of the legislation to offshore development is also limited as compared to the mining industry. Interpretation and nominal adjustment to individual requirements under the Financial Provisioning Regulations, 2015, as amended, is therefore required to contextualise these in terms of oil and gas projects and is indicated in Section 3.1 of this report.

2 CONSIDERATION OF ALTERNATIVES

Alternatives are defined in in terms of the NEMA, as “different means of meeting the general purpose and requirements of the activity, which may include alternatives to –

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

(b) the type of activity to be undertaken;

(c) the design or layout of the activity;

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

(e) the operational aspects of the activity.”

This section outlines the alternatives to the Project that have been assessed by this specialist study in terms of potential environmental and social impacts in the ESIA.

2.1 CLOSURE RELATED ALTERNATIVES

This section describes the possible decommissioning alternatives for various infrastructural aspects (Table 2-1), specifically addressing those matters listed below. The closure options identified will be reassessed annually, which will include revising and updating the closure environmental risk assessment presented in Section 8, as the production declines and as current knowledge gaps are closed.

The decommissioning related alternatives were determined through the consultation of several documents that are listed in section 5.1. Further to this, client discussions were held to ensure that there is an alignment between TEEPSA and industry best practice.

Table 2-1 – Decommissioning Alternatives

Aspect	Decommissioning Alternative	Description
Shallow water infrastructures (flowline end termination units)	Alternative 1	**Retrieval and/or removal** ▪ Flowline end termination unit located in shallow water will be retrieved ▪ Areas of the ocean floor that may be affected by retrieval activities will be reprofiled to ensure the seabed is integrated with the surrounding area
	Alternative 2	**In-situ decommissioning of shallow water infrastructures** ▪ Abandonment of shallow water infrastructure *in situ* as for deep water infrastructure, to eventually be colonised by reef species
Deepwater infrastructures (production wells, production manifolds,	Alternative 1	**Abandonment of pipelines and other components** ▪ Pipelines: • Pigging and flushing of pipeline • Cutting and plugging the end of each pipeline with a suitable cement plug

Aspect	Decommissioning Alternative	Description
production flowline (pipeline), subsea distribution units (SDU)		• Removal all pipeline valves and other fittings • Burying each end of the pipeline below the seafloor or cover each end with protective concrete mats ▪ Flowlines will subsequently be left on the ocean floor and blanked off at the ends, as the outsides of the pipelines are treated to prevent corrosion ▪ Production manifolds and SDU will be left on seabed, following visual inspection to ensure that they pose no demonstrable harm to the receiving marine environment
	Alternative 2	**Retrieval and/or removal** ▪ Identify infrastructure that has a re-sale/salvage potential, and remove ▪ Pipelines: • Pigging and flushing of pipeline • Ensure the protection of sensitive biological features during removal operations • Plan for transportation of the removed pipe for disposal or salvage ▪ Removal of the production manifolds and the SDU

Most countries indicate that infrastructure associated with oil and gas operations should be completely removed (Schramm et al., 2021). However, several studies explored the concept that oil and gas structures can potentially function as artificial reefs (Claisse, 2014; Fowler & Booth, 2012; Gallaway & Szedlmayer, 2009; Love, 2006; Friedlander, Ballesteros, & Fay, 2014; McLean, Taylor, & Giraldo Ospina, 2019; Schramm K. D., 2020).

According to the International Association of Oil and Gas Producers (2023), artificial reefs are structures that have been submerged on the seabed to deliberately mimic the functioning and characteristics of a natural reef. Schramm et al. (2021) conducted a study to investigate the fish associations with shallow water subsea pipelines compared to surrounding reef and soft sediment habitats. The abovementioned study discovered that the biomass of fish was 20 times higher than soft sediments and similar to that of natural reefs. The overall conclusion of the study was that fish associations and assemblages on pipelines exhibit high ecological and socio-economic values.

Another study by (McLean D. , et al., 2018) indicated that invertebrate larvae have enough of room to settle, adhere, and grow on the hard surfaces of wellheads, which can lead to the growth of marine species and complex habitats. Fish then use these extra habitats for food and shelter, potentially concentrating nutrients that encourage further benthic growth.

Additionally, there are numerous benefits associated with *in situ* decommissioning and this option potentially offers an enhanced solution as compared to removal (Duguid & Geneve, 2022).The benefits of *in situ* decommissioning include (Extracted from (Duguid & Geneve, 2022)):

- Ecological services benefits (e.g., abundant and diverse marine communities, creating a refuge for species of significance);
- Reduced environmental impact (e.g., greenhouse gas emissions associated with removal, disturbing or cutting contaminated materials/impacting ecological receptors, reduced waste to landfill, cross contamination of species by bringing infrastructure onshore);
- Socio-economic development (e.g., benefits to marine users, commercial and recreational fisheries, employment opportunities for regional areas such as biodiversity created at the artificial 'King Reef' in Exmouth); and
- Reduced health and safety risk (e.g., decreased offshore activities decreasing the likelihood of a risk event, human exposure to biological hazards during removal or onshore processing of calcified materials or when dragging long distances).

Conversely to the benefits mentioned above, the following indicate some of the shortcomings associated with the complete removal and retrieval of infrastructure:

- In terms of logistics, the removal process is complex compared to the abandonment process;
- There is potential for disturbance to the ocean floor and potential contamination in surrounding areas;
- Where marine life has colonised infrastructure, these communities will be destroyed during the removal process; and
- Due to the complexity, the removal and retrieval process is expensive.

Notwithstanding the above, commercial activities occur at shallow water depths and in-situ decommissioning of infrastructures could potentially pose risks to fishing activities and other ocean users. Thus, the requirement to remove and retrieve shallow water infrastructure to mitigate potential post-closure risks will be evaluated as further information becomes available. Presently, the financial provisions included in Section 10 assume that deep-water infrastructure will be made safe as required and abandoned, while shallow-water infrastructure will, where feasible, be removed. The closure cost estimates will be updated during future project phases as more detailed project information becomes available, as further elaborated on in Section 10.

3 REGULATORY FRAMEWORK

3.1 SPECIALIST REPORT REQUIREMENTS IN TERMS OF NEMA (FINANCIAL PROVISIONING REGULATIONS CHECKLIST)

This Closure Plan framework was compiled in terms of the requirements for a rehabilitation, decommissioning (plugging and abandonment) and mine closure plan as per the Financial Provisioning Regulations, 2015, as amended. Table 3-1 cross references the relevant sections of the report where these requirements are addressed.

Note that the text in *italics* in the table below is from Appendix 4 of the Financial Provisioning Regulations, 2015. Words that have been struck through and words in square brackets have been amended to reflect the context of a production and exploration well drilling project. Specific mining projects requirements that are relevant to the Closure Plan are cross-referenced in the reference column.

Table 3-1 - Content of Final Rehabilitation, Decommissioning and Closure Plan

Content of Rehabilitation, Decommissioning and Closure Plan	Reference to Section
The final rehabilitation, decommissioning and ~~mine~~ Closure Plan must be measurable and auditable and must include-	
Details of- ■ The person or persons who prepared the plan; ■ The professional registrations and experience of the preparers; ■ The applicant or holder, including but not limited to the name, physical address, postal address and contact details;	Included in the Contents Section in the beginning of this document (Page 1)
The context of the project, including but not limited to- ■ Mineral/s to be or being ~~mined~~ [extracted], ~~mining~~ method, area already being ~~mined~~ [extracted] or to be ~~mined~~ [extracted] in the case of a greenfields site, the backlog in rehabilitation if relevant, annual extraction rate, overall extraction rates, life of ~~mine~~ [operation] and any material information and issues that have guided the development of the plan;	The information used to compile this Closure Plan is included in Section 1.2 and Table 1-2
■ An overview of- • The environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity; • The social context that may influence closure activities and post-[closure] land use or be influenced by closure activities and post-~~mining~~ [closure] land use; and • Other ~~mining~~ [production and/or exploration well drilling] activities within a 20 km radius of the ~~mining~~ [project] area	Refer to Section 6 for the environmental and social context
■ Stakeholder issues and comments that have informed the plan	Refer to Section 9.1

Content of Rehabilitation, Decommissioning and Closure Plan	Reference to Section
▪ The ~~mine~~ [project] plan and schedule for the full approved operations, must include- • Appropriate description of the operations plan • Drawings and figures to indicate how the [project] develops • What areas are disturbed • How infrastructure and structures ~~(including ponds, residue stockpiles etc.)~~ develop during operations	Refer to Sections 1.1 and 1.2
▪ Details of the preferred sustainable end state of the operations including- • The legal and governance framework and interpretation of these requirements for the closure design principles; • A description of the sustainable end state and post ~~mining~~ [operations] economy to be achieved, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context, the regulatory and corporate requirements and stakeholder expectations; • A description and evaluation of alternative closure and post-closure options where these exist, that are practical within the socio-economic context; and • Environmental opportunities and constraints in which the operation is located.	Refer to Section 3 regarding the legal framework. Refer to Section 7.5.4 relating to integrity testing for sustainable abandonment and Section 7.5.6 for integration of the abandoned infrastructure into the receiving environment. Refer to Section 2 for consideration of closure alternatives, and related opportunities and constraints
▪ Findings of an Environmental Risk Assessment and modelling process leading to the most appropriate closure strategy, including- • A description of the risk assessment methodology, including risk identification and quantification, to be undertaken for all areas of infrastructure or activity or aspects for which a holder of a right or permit has a responsibility to mitigate an impact or risk at closure • An identification of indicators that are most sensitive to potential risks and the monitoring of such risks with a view to informing rehabilitation and remediation activities • An identification and modelling of conceptual closure strategies to avoid, manage and mitigate the impacts and risks • A reassessment of the risks to determine whether, after the implementation of the closure strategy, the latent risk has been avoided and / or how it has resulted in avoidance, rehabilitation, and management of impacts and whether this is acceptable to the ~~mining operation~~ [project] and stakeholders • An explanation of changes to the risk assessment results, as applicable in annual updates to the plan; and	Refer to Section 8 for the Environmental Risk Assessment. The initial risk assessment performed as part of this Closure Plan will be regularly revised and updated during operations, based on ongoing industry development and standards and other relevant information
• Design principles for achieving the closure objectives, including the proposed final sustainable end state which is appropriate, feasible and possible to implement and which meets the principles of sustainable development, including- – Descriptions of appropriate and feasible final post-~~mining~~ [operations] land use for the project area; – A map of the proposed final sustainable end state of the land;	Refer to Section 7.2 for the decommissioning vision, targets, and objectives Mapping of the final end state or land use is not applicable, as the project site is offshore and is currently not being

Content of Rehabilitation, Decommissioning and Closure Plan	Reference to Section
– A motivation for the preferred closure option within the context of the risks and impacts that are being mitigated; – A definition and motivation of the closure and post closure period, taking cognisance of the probable need to implement post closure monitoring and maintenance for a period sufficient to demonstrate that the risk threshold criteria have been achieved; and – Details associated with any on-going research on closure options	actively used and will, to the extent possible, be rehabilitated to pre-development conditions. Refer to Section 7.6 for the description of the closure and post closure period and associated monitoring requirements. Refer to Section 12 for recommendations to update the Closure Plan, including ongoing industry development and standards and other relevant research to inform closure options
• Closure actions, including- – A detailed description of the assumptions made to develop closure actions in the absence of detailed knowledge on site conditions, potential impacts, material availability, stakeholder requirements, and other factors for which information is lacking – The development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option, which must include all areas, infrastructure, activities, and aspects, associate with ~~mining~~ [production], for which the ~~mine~~ [operation] has the responsibility, and – The development and implementation of plans to address threats and opportunities and any uncertainties associated with the proposed closure actions, which will be used to identify and define any additional work or research that is needed to reduce the level of uncertainty;	Refer to Sections 7.5 and 7.6 for the closure actions to be implemented at closure, including the underlying assumptions in Sections 10.2.1 and 10.3.1 that underpin the closure cost estimates
• A schedule of actions for the annual rehabilitation plan, and the final rehabilitation, decommissioning and mine closure plan which will ensure mitigation, rehabilitation and management of impacts ~~including pumping and treatment of extraneous water~~ – Linked to the works programme, if green fields, or to the current ~~mine~~ [project] plan, if brownfields, Including assumptions and schedule drivers – Including a spatial map or schedule, showing planned spatial progression throughout operations	Refer to Sections 7.1 and 7.5
• An indication of the organisational capacity that will be put in place to implement the plan, including- – Organisational structure as it pertains to the plan – Responsibilities	Refer to Section 11.1 for the organisational capacity and structure

Content of Rehabilitation, Decommissioning and Closure Plan	Reference to Section
– Training and capacity building that may be required to build closure competence	
• An indication of gaps in the plan, including an auditable action plan and schedule to address the gaps	Refer to Section 12 for identified knowledge gaps
• Closure and risk threshold criteria for each activity for infrastructure in relation to environmental aspects with auditable indicators;	Refer to Sections 7.4 and 8
• The closure cost based on cost estimates for operations, or components of operations as follows- – Costing, calculated using market related figures and the current value of money and no discounting or net present value calculations; – Costs must be calculated for the rehabilitation, maintenance, and long-term monitoring being undertaken on all disturbed areas and associated environmental impacts; – Cost calculations must be based on rehabilitation maintenance and long-term monitoring of activities undertaken by a third party; – Where appropriate, a differentiation between capital, operating, replacement and maintenance costs; – The closure cost estimation must include cost assumptions and auditable calculations of costs per activity or infrastructure; and – Cost estimates for operations, or components of operations as indicated in Table 10-2 – The estimated costs must be expressed for each year based on the rate of extraction and extent of the disturbed area; – The risk modelling and the calculation of the closure cost estimation must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements and any other material developments; – Monitoring, auditing and reporting requirements contemplated in these Regulations; – Schedule of reporting requirements contemplated in these Regulations; and – Motivations for any amendments made to the final rehabilitation, decommissioning and ~~mine~~ closure plan, given the monitoring results in the previous auditing period and the identification of gaps as above.	Refer to Section 10 for the closure cost and methodology undertaken to determine the closure costs

3.2 APPLICABLE LEGISLATION

This section provides an overview of current key legislation and regulations applicable to the Project and closure planning are summarised in Table 3-2. Future legislation is also included for completeness.

Table 3-2 – Regulatory Framework

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
Constitution of the Republic of South Africa (Act 108 of 1996)	Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that: ▪ Prevent pollution and ecological degradation; ▪ Promote conservation; and ▪ Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development	General duty of care towards receiving environment.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	The NEMA, as amended was set in place in accordance with section 24 of the Constitution of the Republic of South Africa. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law, and which may significantly affect the environment, must be considered, investigated, and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.	General duty of care towards receiving environment. Requirement to comply with the closure stipulations of the Financial Provisioning Regulations, 2015, as amended
Marine Traffic Act, 1981 (No. 2 of 1981)	This Act regulates marine traffic in South Africa's territorial waters. It regulates the entry and dropping of anchor within 500 m safety zone of installations.	Regulation of demobilization activities, which will take place once well plugging and abandonment has been completed.
Marine Pollution (Control and Civil	The purpose of this Act is to provide protection of the marine environment from pollution by oil and other harmful substances, by giving power to SAMSA to take steps to	Closure planning activities must not unduly impact on the receiving environment, and all potential environmental impacts resulting from closure phase activities must be appropriately managed and

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
Liability) Act, 1981 (No. 6 of 1981)	prevent harmful substances being discharged from vessels. It is the responsibility of TEEPSA to disclose to SAMSA before the commencement of proposed activities the amounts and types of chemicals that would be used and disposed of during operations.	mitigated, including disposal of wastes and other substances emanating from closure phase activities.
Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986)	This Act regulates pollution from ships, tankers, and offshore installations, and for that purpose gives effect to MARPOL. In terms of the Act, it is an offence to discharge any oil from a ship, tanker, or offshore installation within 12 miles (19 km) off the South African coast. The discharge of oily water or oil and any other substance which contains more than a hundred parts per million of oil is prohibited between 19 – 80 km offshore.	Closure planning activities must not unduly impact on the receiving environment, and all potential environmental impacts resulting from closure phase activities must be appropriately managed and mitigated, including potentially polluting substances generated during well plugging and abandonment, demobilization, and disposal of wastes and other substances emanating from closure phase activities.
Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987)	This Act gives effect to the international convention relating to the Intervention of the High Seas in cases of oil pollution casualties, and to the Protocol relating to Intervention of the High Seas in cases of Marine Pollution by substances other than Oil in South African Waters.	Same as above.
Maritime Safety Authority Act, 1998 (No. 5 of 1998)	This Act provides for the establishment and functions of SAMSA. The objectives of the Act are to: (1) ensure safety of life and property at sea; (2) prevent and combat pollution of the marine environment by ship; and (3) promote South Africa's maritime interests.	Same as above, including regulation of demobilization activities, which will take place once well plugging and abandonment has been completed.
Marine Spatial Planning Act, 2018 (No. 16 of 2018)	This Act provides a framework for marine spatial planning in South Africa; to provide for the development of marine spatial plans; to provide for institutional arrangements for the implementation of marine spatial plans and governance of the use of the ocean by multiple sectors; and to provide for matters connected therewith.	General duty of care towards receiving environment.
National Environmental	NEMA, as amended, implements Section 24 of the Constitution of the Republic of South Africa. Certain environmental	The Financial Provisioning Regulations 2022, as amended, require exploration or production licence applicants and holders to make

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
Management Act (NEMA, No. 107 of 1998) Proposed Regulations Pertaining to Financial Provisioning for the Mitigation and Rehabilitation of Environmental Damage Caused by Reconnaissance, Prospecting, Exploration, Mining or Production Operations GN 2272 (11 July 2022)	principles under NEMA must be adhered to, to inform decision making regarding activities that may affect the environment. Section 24 (1)(a) and (b) of NEMA state: The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law, and which may significantly affect the environment, must be considered, investigated, and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.	provisions for the remediation and rehabilitation of any potential negative environmental impacts that may occur as a result of the proposed activities. These provisions should also include the financial provisioning for the rehabilitation, closure, and ongoing post decommissioning management of environmental impacts. In accordance with the plans and studies submitted as part of the application for an EA, the quantum to be set aside shall be determined through a detailed itemisation of all activities and costs required to implement final rehabilitation and decommissioning and remediation of any latent residual environmental impacts. Additionally, for the next ten years, the holder must make sure that the financial provision is adequate to cover the actual costs of putting these measures into effect. The revised draft amendments for the regulations pertaining to financial provisioning for reconnaissance, prospecting, exploration, mining, or production operations were released for public comment in terms of the National Environmental Management Act 107 of 1998 (“NEMA”) by the Minister of Forestry, Fisheries, and the Environment (Barbara Creecy) on 11 July 2022. Notable aspects of the proposed amendments include the following: • There is an emphasis on rehabilitation being carried concurrently rather than at the operations end of life, additionally, the methodology used to calculate the required financial provision is expected to change significantly from the current methodology being used. Different methodologies to determine the financial provisions will be used for lower risk operations (such as reconnaissance, specific prospecting, and exploration operations, as well as mining for commodities identified as low risk). The determination methodologies applicable to all other regulated operations, which will necessitate more intricate plans and methodologies, will also be provided separately. This change in methodology is anticipated to significantly reduce the

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
		financial provision that some applicants and holders will need to make (Clyde&Co LLP, 2022) • The existing vehicles used to finance the required financial provisions, such as financial guarantees, trusts and cash deposits, are still in place, however, trusts will once again be able to be used for the necessary financial provision during the life of the operations instead of being utilised only for post-closure provisions. The use of guarantees from parent or subsidiary companies has been introduced to applications for exploration and production rights in the oil and gas industry. In addition, a new withdrawal function will be introduced to remove funds from financing to facilitate decommissioning and final closure in the 10 years before the planned final closure of operation (Clyde&Co LLP, 2022) It is important to note that the 2022 Proposed NEMA regulations are currently undergoing public consultation and may further be updated with legislation changes that may have implications on the scope of work and requirements for determining the financial provision required by exploration or production right applicants and holders. These updates and/or changes may have a potential implication on the decommissioning plan and costing in the future however, it is unlikely that any of the changes outlined in the 2022 Proposed NEMA regulations, will have a material impact on the decommissioning plan and costing in the present exploration period of 2023.
Mineral and Petroleum Resource Development Act. 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA is the principal legislation governing prospecting and mining and the exploration and production of oil and natural gas. The Act provides for the equitable access to and sustainable development of mineral and petroleum resources. The MPRDA Regulations (GN R527 of 2004) provide for the application for and issuing of Reconnaissance Permits, Prospecting Rights, Exploration Rights, Mining Rights and Production Rights.	General duty of care towards receiving environment.

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
	Since 8 December 2014, environmental regulation of prospecting, mining, exploration and production and related activities was removed from the MPRDA and transferred to NEMA, as set out in Section 2.2.2 above. As stated above, the Minister of the Department of Mineral Resources and Energy (DMRE) is the competent authority that authorises an application for an Environmental Authorisation, while the Minister of Forestry, Fisheries and the Environment remains the appeal authority for such an authorisation. In terms of Section 102 of the MPRDA, an Exploration Right, Exploration Work Programme and/or Environmental and Social Management Programme (ESMP) may not be amended without the approval of the Minister (of Minerals and Energy).	
Upstream Petroleum Resources Development Bill (B 13—2021)	This bill aims to provide for orderly development of petroleum resources; to provide for equitable access to, and sustainable development of, the nation's petroleum resources; to provide for active State and black persons' participation in the development of the nation's petroleum resources; to provide for a petroleum right that integrates the right to explore and to produce; to provide for the facilitation of acquisition of petroleum geo-technical data; to provide for a controlled application system through licensing rounds; to create an enabling environment for the acceleration of exploration and production of the nation's petroleum resources; to provide for third party access to upstream petroleum infrastructure; to provide for a petroleum right holder to sell a percentage of petroleum to the State for strategic stocks requirements; to designate a state-owned company as an entity responsible for managing the State's carried interest in petroleum rights; to provide for the advancement of national developmental imperatives by the state-owned company through the development of petroleum resources; to provide for the holder of a petroleum right to retain its empowerment status after the	Section 84 speaks to the issuing of closure certificate stating in section 84(1) that the holder of an exploration, production or petroleum right remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance with the conditions of the environmental authorisation and the management and sustainable closure thereof, until the Minister has issued a closure certificate to the holder in terms of this Act. 84. (2) On the written application in the prescribed manner by the holder of an exploration, production, or petroleum right, the Minister may transfer such environmental liabilities and responsibilities as may be identified in the environmental management report and any prescribed closure plan to a person with such qualifications as may be prescribed. 84. (3) The holder of an exploration, production, or petroleum right, or the person contemplated in subsection (2), as the case may be, must apply for a closure certificate upon: (a) the lapsing, abandonment or cancellation of the right in question;

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
	exit of black persons under circumscribed circumstances; to provide for local content as a development strategy to enable skills development, local recruitment and national participation through supply of goods and services; to designate the Petroleum Agency of South Africa as the regulatory authority for the upstream petroleum sector; and to provide for matters connected therewith.	(b) cessation of the exploration or production operation; or (c) the relinquishment of a portion of a block to which an exploration, production or petroleum right relates. 84. (4) An application for a closure certificate must be made to the Petroleum Agency within 30 days of lapsing, abandonment, cancellation, cessation, or relinquishment contemplated in subsection (3) and must be accompanied by the required information, programmes, plans and reports as prescribed. Environmental impacts that are not mitigated during the exploration activities phase must be mitigated during closure. Closure planning activities must not unduly impact on the receiving environment, and all potential environmental impacts resulting from closure phase activities, including potential latent/residual impacts, must be appropriately managed and mitigated in order to receive a closure certificate.
National Environmental Management Act (NEMA, No. 107 of 1998) Financial Provisioning Regulations 2015, as amended	The purpose of these Regulations is to regulate the determine and making of financial provision as contemplated in the Act for the costs associated with the undertaking of management, rehabilitation, and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual environmental impacts that may become known in the future. An applicant or holder of a right or permit must determine and make financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of prospecting, exploration, mining, or production operations.	General duty of care towards receiving environment.
National Environmental Management: Biodiversity Act, 2004	NEMBA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and considers the	Environmental impacts that are not mitigated during the operational exploration activities phase must be mitigated during closure. Closure planning activities must not unduly impact on the receiving environment, and all potential environmental impacts resulting from

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
(Act No. 10 of 2004) (NEM: BA)	management of alien and invasive species. This Act works in accordance with the framework set under NEMA. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: ■ Alien and Invasive Species Lists, 2014 published (GN R.599 in GG 37886 of 1 August 2014) ■ National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations and National list of Ecosystems Threatened and in need of Protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GN R.1002, 9 December 2011)	closure phase activities, including potential latent/residual impacts, must be appropriately managed and mitigated.
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	This Act provides the legal framework for the effective and sustainable management of water resources in South Africa. It serves to protect, use, develop, conserve, manage and control water resources, promoting the integrated management of water resources with the participation of all stakeholders.	General duty of care towards receiving environment.
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM: AQA)	According to the NEM: AQA the Department of Environmental Affairs (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS) (GN R 1210 of 2009). These standards provide the goals for air quality management plans and provide the benchmark by which the effectiveness of these management plans is measured.	General duty of care towards receiving environment.
National Environmental Management: Air Quality Act, 2004 (Act	According to the NEM: AQA the Department of Environmental Affairs (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement	General duty of care towards receiving environment.

Legislation and Guidelines	Details	Specific Implications on Project Plugging and Abandonment
No. 39 of 2004) (NEM: AQA)	of various aspects of NEM: AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS) (GN R 1210 of 2009). These standards provide the goals for air quality management plans and provide the benchmark by which the effectiveness of these management plans is measured.	
National Environmental Management: Waste Act 59 of 2008	This Act aims to reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development; to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith.	Same as above.

Further guidance in terms of closure planning requirements is also included in section 7.4.

4 CLOSURE REQUIREMENTS

4.1 WELL PLUGGING AND ABANDOMENT (P&A) REQUIREMENTS

The mature wellfields of the Northeast Atlantic, United Arab Emirates (Abu Dhabi), South Asian Seas, East Asian Seas, Arctic, United States of America, Latin America, and the Russian Federation have comprehensive legislative requirements and guidance on how to deal with aspects of well plugging and abandonment (P&A). By contrast, offshore oil and gas development around much of the African continent, and specifically Southern Africa, has less well-defined legislative requirements and industry guidance.

The standards set by international guidance can be used to provide context and adopted as appropriate. Table 4-1 to Table 4-3 below reflect P&A requirements for the USA, UK, and Canada, respectively.

Table 4-1 - United Kingdom Summary P&A Requirements (International Association of Oil and Gas Producers, 2017)

Item		Minimum Requirement	Legislation Driving Requirement
Do P&A activities need to be planned in advance		Yes. As soon as the need for well suspension or abandonment is known. Permits to be submitted to BEIS in line with well intervention application requirements.	Petroleum Act 1998
Barrier	Type (material)	Cement is the primary material, but this does not preclude the use of other materials.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996
	Verification	Verification requirements are dependent on the individual well and job design.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996
Plugging Requirements	Reservoir	All zones with flow potential require a minimum of one permanent barrier. Hydrocarbon bearing or over pressured and water-bearing zones require two permanent barriers. Barriers are required to be of 100ft of good cement, set above the zone of flow potential and across suitable caprock.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996
	Intermediate zones	All zones with flow potential require a minimum of one permanent barrier. Hydrocarbon bearing or over pressured and water-bearing zones require two permanent barriers. Barriers are required to be of 100ft of good cement, set above the zone of flow potential and across suitable caprock.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996
	Surface	1 permanent barrier, for shallow zone with flow potential, of 100 ft of good cement.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996

Item	Minimum Requirement	Legislation Driving Requirement
Annular barrier requirements	Good cement bond, minimum 100 ft if previously logged or 1 000 ft above base of barrier if estimated from differential pressures.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996
Casing stump requirements	No guidance provided.	-
Control line and cabling	These should not form part of permanent barriers since they may be a potential leak path.	Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996

Table 4-2 - Canada Summary P&A Requirements (International Association of Oil and Gas Producers, 2017)

Item		Minimum Requirement	Legislation Driving Requirement
Do P&A activities need to be planned in advance		Notification to abandon well to be submitted no later than five working days prior to commencement of activities.	The Accord Acts Submitted to C-NLOPB
Barrier	Type (material)	Cement Mechanical plus cement. Any alternative method that provides an equivalent (or better) degree of security against any formation fluid from flowing through or escaping from the wellbore to that described in these guidelines may be used if such methods are approved by the appropriate Board.	Oil and Gas Operations Act
	Verification	Tagged to confirm depth and pressure tested to at least 3 450 kPa above the fracture pressure, to a pressure differential of not less than 6 900 kPa.	Oil and Gas Operations Act
Plugging requirements	Reservoir	Cement plugs should be at least 100 m if set in open hole and 30 m if set in casing, or if this is not feasible due to wellbore conditions, the plugs should be as long as practicable.	Oil and Gas Operations Act
	Intermediate zones	Cement plugs should be set to isolate any abnormally pressured formations. To plug any lost circulation intervals. To isolate any hydrocarbon zones or potable water zones.	Oil and Gas Operations Act
	Surface	No guidance provided.	-
Annular barrier requirements		Any annulus that is open to a hydrocarbon bearing zone, a discrete pressure zone or a potable water zone should be sealed at the time of well abandonment. This may be accomplished by perforating the casing as close to the zone as practicable and squeezing cement into the annulus.	Oil and Gas Operations Act

Item	Minimum Requirement	Legislation Driving Requirement
Casing stump requirements	Casing stub should be plugged by setting a cement plug across the stub that extends at least 15 m below and 15 m above the stub, or by setting a bridge plug as close as practicable to the top of the stub and setting a cement plug on top of the bridge plug.	Oil and Gas Operations Act
Control line and cabling	No guidance provided.	-

Table 4-3 - United States Summary P&A Requirements (International Association of Oil and Gas Producers, 2017)

Item		Minimum Requirement	Legislation Driving Requirement
Do P&A activities need to be planned in advance		Notification to abandon well to be submitted no later than five working days prior to commencement of activities.	The Accord Acts Submitted to C-NLOPB
Barrier	Type (material)	Cement Mechanical plus cement. Any alternative method that provides an equivalent (or better) degree of security against any formation fluid from flowing through or escaping from the wellbore to that described in these guidelines may be used if such methods are approved by the appropriate Board.	Oil and Gas Operations Act
	Verification	Tagged to confirm depth and pressure tested to at least 3 450 kPa above the fracture pressure, to a pressure differential of not less than 6 900 kPa.	Oil and Gas Operations Act
Plugging requirements	Reservoir	Cement plugs should be at least 100 m if set in open hole and 30 m if set in casing, or if this is not feasible due to wellbore conditions, the plugs should be as long as practicable.	Oil and Gas Operations Act
	Intermediate zones	Cement plugs should be set to isolate any abnormally pressured formations. To plug any lost circulation intervals. To isolate any hydrocarbon zones or potable water zones.	Oil and Gas Operations Act
	Surface	No guidance provided.	-
Annular barrier requirements		Any annulus that is open to a hydrocarbon bearing zone, a discrete pressure zone or a potable water zone should be sealed at the time of well abandonment. This may be accomplished by perforating the casing as	Oil and Gas Operations Act

Item	Minimum Requirement	Legislation Driving Requirement
	close to the zone as practicable and squeezing cement into the annulus.	
Casing stump requirements	Casing stub should be plugged by setting a cement plug across the stub that extends at least 15 m below and 15 m above the stub, or by setting a bridge plug as close as practicable to the top of the stub and setting a cement plug on top of the bridge plug.	Oil and Gas Operations Act
Control line and cabling	No guidance provided.	-

4.2 PIPELINE DECOMMISSIONING REQUIREMENTS

Currently, South Africa does not have any specific guidelines pertaining to the decommissioning of subsea and seabed infrastructures such as, inter alia, pipelines and flowlines. In terms of the decommissioning of pipelines and flowlines associated with the Project, the preferred option is that pipelines are pigged to eradicate potential contaminants after which the pipeline will remain on the seabed (WSP, 2023). This decommissioning action is greatly dependent on the pipeline not exhibiting any negative direct and cumulative impact, which will be inspected and verified prior to abandonment.

Several countries, such as the United States of America, Netherlands, Norway, and Egypt, have an option to decommission offshore pipelines *in-situ* (International Association of Oil and Gas Producers, 2023). For pipelines that remain *in-situ*, the general decommissioning activities entails the following (Code of Federal Regulations, 2012):

- Pipeline pigging;
- Flushing of the pipeline;
- Cutting and plugging the end of each pipeline;
- Removal all pipeline valves and other fittings; and
- Burying each end of the pipeline at least 3 feet below the seafloor or cover each end with protective concrete mats.

For pipelines that are planned for retrieval and/or removal, on a high level, the following apply:

- Pipeline pigging;
- Flushing of the pipeline;
- Plans for transportation of the removed pipe for disposal or salvage.; and
- Plans to protect archaeological and sensitive biological features during removal operations, including a brief assessment of the environmental impacts of the removal operations, if applicable.

According to the Guidelines for Decommissioning, abandonment and restoration of the oil and gas industry assets in Brunei Barussalam (2009), considerations should be given to the following:

- All redundant pipelines should be flushed and cleaned. The lines are also to be purged and plugged with capped ends buried in the sea floor mud; and
- Pipelines running close to coral reefs should be treated (i.e., pigging and flushing) to minimise potential environmental impacts.

5 METHOD OF STUDY

5.1 LITERATURE REVIEW

The development of this Closure Plan was based on the following documents (Table 5-1), refer to Section 13 for the fully referenced document list:

Table 5-1 - Supporting Information

Title	Author	Year
Overview of International Offshore Decommissioning Regulations: Volume 1 – Facilities	International Association of Oil & Gas Producers	2023
Environmental and Social Impact Assessment (ESIA) for the Proposed Offshore Production Right and Environmental Authorisation Applications for Block 11B/12B- Ref No: 12/4/13 PR: Final Scoping Report	WSP Group Africa (Pty) Ltd	2023
TTE Plug and Abandonment criteria and processes to demonstrate compliance	TEEPSA	2022
Study on decommissioning of offshore oil and gas installations: a technical, legal and political analysis: final report	European Commission	2022
221018 Decom List of Equipment_Luiperd Ph1	TEEPSA	2022
ER 12/3/67 – BLOCK 11B/12B - Production Work Program (confidential)	TEEPSA	2022
Decommissioning Research Needs for Offshore Oil and Gas Infrastructure in Australia	Frontiers in environmental science	2021
Fish associations with shallow water subsea pipelines compared to surrounding reef and soft sediment habitats	Schramm et al.	2021
Volume 2: Oil Spill Response Strategy	TEEPSA	2020
TEPSA_2_MPL_HSE_01.01 Grievance management procedure	TEEPSA	2020
The underestimated risks of decommissioning	Clyde&Co - Angela Flaherty	2020
Draft Coastal Management Programme: Second Generation. Moorreesburg	Western Cape Government	2020
Plug & abandonment of offshore wells: Ensuring long-term well integrity and cost-efficiency	Torbjørn Vrålstad	2019
Blowout Frequencies	International Association for Oil & Gas producers	2019

Title	Author	Year
Six key issues underpin successful decommissioning strategy	Anthony Caletka & Casey Carringer	2018
Socio-Economic Profile	Western Cape Government	2017
Overview of International Offshore Decommissioning Regulations: Volume 2 – Wells Plugging & Abandonment	International Association of Oil & Gas Producers	2017
Fish and habitats on wellhead infrastructure on the northwest shelf of Western Australia	McLean et al	2016
Environmental Impacts of the Deep-Water Oil and Gas Industry: A Review to Guide Management Strategies	Frontiers in environmental science	2016
Environmental requirements for projects design and E&P activities GS EP ENV 001	TEEPSA	2015

5.2 SITE PROGRAMME/VISIT

No site verification assessment was conducted was required for this assessment as it is still in the planning phase.

5.3 STAKEHOLDER CONSULTATION

Stakeholder consultation was undertaken as part of the overall ESIA process. The summary of the key issues raised by Interested and Affected Parties (I&APs) is included in section 9.

5.4 DATA USED FOR SPECIALIST REPORT

The data that has been utilized develop the Closure Plan is reflected in section 5.1 above.

5.5 IMPACT ASSESSMENT METHODOLOGY

This section sets out the approach and method for the assessment of impacts for the Project and defines the terminology applied and the steps used to evaluate impact significance. See section 8.1 for the Impact Assessment methodology.

5.6 ASSUMPTIONS, UNCERTAINTIES, OR KNOWLEDGE GAPS

Given the nature of the activities for the Project, certain aspects of the Project are unknown at the time of the preparation of the ESIA and will only be resolved at a detailed design stage or once the project commences. This situation imposes limitations on the information available for the assessment of environmental and social impacts. The approach to addressing the limitations is to create working assumptions that are reasonable and each of the specialists has identified specific limitation and assumptions used in the preparation of the technical studies. The following limitations and assumptions have been identified for the Project as a whole and used in the preparation of the ESIA and associated closure plan:

- The development of an offshore gas field requires the involvement of a number of parties and the Block 11B/12B offshore infrastructure will be developed by TEEPSA. PetroSA will be responsible for operational activities over the lifetime of the Block and the gas and condensate will be purchased by a third party. TEEPSA will be responsible for decommissioning and closure of the offshore infrastructure at the end of production;
- The F-A Platform is owned and operated by PetroSA and is required to process the gas and condensate prior to it being brought onshore. It is assumed that PetroSA will obtain all necessary licenses and permits and will conduct operational activities and planned maintenance in compliance with the license and permit conditions;
- The outcome of ongoing commercial negotiations (including agreements for the sale of the gas) will determine the final use of the gas. Any construction, modification or upgrades to any onshore facility, if required by the off-taker of gas or condensates, will be subjected to a separate EA application;
- The timeframe for the exploration activities is currently not known and could occur at any time within the 15 to 20-year life of the Project;
- The exact location of the production and exploration wells is not known. The production wells will be located in the south-western portion of the block within the Project Development Area, while the exploration wells will be located within the east north-eastern portion of the block, in the Exploration Priority Area. For the purposes of the marine acoustics modelling, drill cuttings discharge modelling and oil spill modelling, locations have been selected based on a number of factors, such as proximity to sensitive receptors, so that the assessment is based on a worst-case scenario;
- The exact alignment of the proposed production pipeline is not known at this stage. A 10 km wide corridor along the length of the proposed production pipeline alignment is considered for assessment purposes. The final pipeline alignment will be confirmed pending the outcome of further bathymetry, geotechnical and benthic surveys within the corridor;
- The location of offshore survey and data collection sites are not yet known but will likely be conducted along the production pipeline corridor and the drilling sites in the Project Development Area and Exploration Priority Area;
- The ESIA considers the assessment of exploration activities in the east north-eastern section of the block but does not aim to identify or assess the impacts or benefits of possible future production activities or outcomes in this section of the block; and
- The battery limit between new and existing infrastructure is at the top of the riser pipe as it connects to the F-A Platform.

Note that specific assumptions pertaining to the financial provision cost estimates are listed in section 10.

6 BASELINE DESCRIPTION

The baseline description in the tables below is extracted and summarised from the Final Scoping Report (WSP, 2023). The information is included to provide context to the plugging and abandonment of wells from an environmental and socio-economic perspective.

6.1 ENVIRONMENTAL BASELINE

Table 6-1 presents a synopsis of the baseline physical and ecological environment in the areas within and surrounding the decommissioning activities. It also identifies the implications for the closure planning process.

Table 6-1 - Baseline Physical and Ecological Environment

Category	Description	Closure implications
Regional ocean characteristics	▪ The Agulhas current that flows from along the east coast of South African is the dominant ocean-scale feature of eastern coastline. As described by Goschen and Schuman, 1990 "…from a position north of East London the Agulhas Current diverges from the coastline as the shelf widens downstream; in the south, the Agulhas Bank reaches a maximum width of about 270 km. In this region the influence of the Agulhas Current is felt over an extensive shelf area." It is considered the second strongest surface current in the world with peak velocities exceeding 3 m/s. The Agulhas current crosses 11B/12B Block from east to west. ▪ Within Block 11B/12B area, the water depth increases significantly from north to south across the Block and the Agulhas current that moves down the coast from the north-east roughly follows the seafloor drop-off and cuts through the Block. Analysis of wave parameter data taken from measurements made on the F-A Platform indicates that extreme wave heights are likely a function of composite wavefronts resulting from south-west deep sea wavefronts coinciding with the short-and medium wave wavefronts refracted by the Agulhas current meanders. ▪ Westerly winds predominate along the South Coast in winter and in spring, whilst southerly wind directions increase markedly in summer, resulting in	Block 11B/12B is located approximately midway between East London and the Agulhas Bank, on average 100 km offshore of the south coast of South Africa. The prevailing ocean conditions will require vessels that are built and equipped to withstand working in highly dynamic oceanic conditions and metocean conditions within Block 11B/12B can be described as a combination of strong currents, strong winds and high waves. Closure activities will have to be aligned with seasons where oceanic conditions are calmest to minimise the risk to the plugging and abandonment activities.

Category	Description	Closure implications
	roughly similar strength/frequency of east and west winds during that season (Jury, 1994, in SLR, 2020). Winds with gale force strengths (winds >60 km/hr) are most common during winter whilst calm conditions are characteristic of autumn.	
Geology	▪ Block 11B/12B is located in the Outeniqua Basin. The Outeniqua Basin is structured by a set of four half-grabens with E-W to NNW-SSE orientation associated depocenters that are called, from east to west, the Algoa, Gamtoos, Pletmos, and Bredasdorp Basins (collectively known as the Outeniqua Basin). ▪ These are bounded by normal faults (i.e., the St. Croix, Port-Elisabeth, Gamtoos, and Plettenberg Faults) and are separated by prominent basement arches (respectively Recife, St. Francis, and Infanta).	Long-term fracturing of substrate surrounding the plugged and abandoned well/s, should this occur, may result in gas/oil leakage and/or compromise the structural integrity of the well casing and plug, which will require monitoring during the operational period to understand if this is a possibility and to determine long-term implications, if any.
Air Quality	▪ Offshore, the main contributors to ambient air pollutant concentrations include long-range transboundary transportation and exhaust emissions from sea vessels.	▪ None
International status	▪ Block 11B/12B is located within the South African Exclusive Economic Zone (EEZ).	▪ None
Biogeographical and marine biodiversity characteristics	▪ According to the most recent biogeographic divisions, Block 11B/12B falls within the Southwestern Indian Ecoregion and the Southwestern Indian upper and lower bathyal ecozones. ▪ The Block 11B/12B area falls within the warm temperate South Coast, a region characterised by high diversity, with components of both the cool temperate and subtropical marine faunas, as well as high levels of endemism (species with distributions restricted to the bioregion). ▪ Large migratory pelagic species are the ichthyofauna most likely to occur offshore in Block 11B/12B, and include various tunas, billfish, and pelagic sharks. ▪ Current information indicates that there two baleen whale species, the humpback whale *Megaptera novaeangliae*, and southern right whale *Eubalaena australis*, within Block 11B/12B. Furthermore, there is	▪ The plugged and abandoned wells and deep-sea infrastructure (such as pipelines) that will be abandoned *in-situ* after clearance of any potential decontamination, will be permanent features on the ocean floor and have the potential to affect oceanic biota. ▪ In the unlikely event of a leak after well abandonment or (worst-case) blow-out during plugging and abandonment activities, the resultant contamination would adversely affect marine biota and ecosystems and therefore requires appropriate industry standard design, implementation and testing of the well plug before abandonment.

Category	Description	Closure implications
	prevalence of common bottlenose dolphins, common dolphins, long-finned pilot whales and sperm whales (Pisces, 2019). ■ According to the International Union for the Conservation of Nature (IUCN) (2021), the humpback (B2 population) and sperm whales are classified as "vulnerable". In addition, majority of the pelagic fish are considered threatened due to overfishing. ■ The IUCN (2021) stipulates that of the 11 shark species likely to occur in Block 11B/12B, five are listed a "endangered" buy the IUCN Red list (the pelagic thresher shark, dusky shark, and whale shark, as well as the shortfin and longfin mako shark), while the great hammerhead shark is listed as "critically endangered".	■ TEEPSA has compiled an Oil Spill Contingency Plan (OSCP) that must be approved by Government prior to implementation for the duration of the production and decommissioning phases, until a Closure Certificate is obtained. ■ TEEPSA is also required to set aside funds as provision for clean-up, rehabilitation and compensation should an emergency event occur.
Sensitive and protected areas	**Marine Protected Areas (MPAs)** ■ The seabed communities in Block 11B/12B are known to exhibit high levels of endemism, and as such, the coastal area in the vicinity of Mossel Bay has been recognised as one of seven areas in the biozone in need of additional protection which has been granted in the form of offshore Marine Protected Areas (MPA) designations. ■ Offshore MPA in close proximity to Block 11B/12B include the Southwest Indian Seamounts MPA to the southwest of the block, and the Port Elizabeth Corals MPA to the northeast. **Ecologically or Biologically significant Areas (EBSAs)** ■ The northern border of Block 11B/12B is adjacent to the Kingklip Corals Ecologically or Biologically Significant Area (EBSA) and lies northeast to the Shackleton Seamount Complex EBSA. ■ Both pipeline alignment options proposed by TEEPSA passes through the southwestern corner of the Kingklip Corals EBSA. **Critical Biodiversity Areas** ■ The pipeline route option proposed by TEEPSA passes through a Critical Biodiversity Area (CBA) Natural area. CBA natural sites are defined as having a natural or near-natural ecological condition with a management objective to maintain the area as it is. ■ (Harris, 2022)expresses that the development of subsea pipelines associated with oil and gas are considered non-compatible within the CBA	■ Areas flagged as sensitive, priority areas, IMMAs, MPAs and Ramsar sites should be avoided during siting of production wells and in the drilling and abandonment of appraisal wells. Selection of the well site will occur during the detailed project planning phase. The spatial extent of the project disturbance footprint will not change after initial well drilling and installation of subsea infrastructure. ■ Sensitive marine areas should be avoided and impact mitigation should take place operationally to avoid residual risks. ■ The spatial extent of the project disturbance footprint will undergo minimal increase after initial drilling operations (year 0 and 1) and installation of subsea infrastructure, including the pipeline to the F-A Platform to include two more wells that will be drilled in year 10 and connected to the existing infrastructure. These will be included in the Closure Plan ■ An oil spill modelling study has been undertaken as part of the ESIA for the Environmental Authorisation for the Project.

Category	Description	Closure implications
	natural area. Preferably, pipeline developments should avoid all CBAs from an environmental perspective. ■ The ESIA Marine ecology and biodiversity study will assess the impact of the pipeline alignments on the designated areas and recommend a preferred alignment **Important Marine Mammal Areas (IMMA)** ■ The areas considered as IMMAs include sites that host vulnerable species or a significant percentage of the members of a species, sites that are important for reproduction or feeding, and sites that are home to a wide variety of species. ■ South Africa consists of three identified IMMAs, the Cape Coastal Waters IMMA, Southern Coastal and Shelf Waters IMMA, and the Southeast African Coastal Migration Corridor IMMA. ■ The north-western corner of Block 11B/12B intersects the Southern Coastal and Shelf Waters IMMA. **Ramsar Sites** ■ A Ramsar site is a wetland that is classified as of international importance under the Ramsar Convention. Several Ramsar sites along the South Coast are adjacent to the 11B/12B Production Right Area. These Ramsar sites include: • De Hoop – approximately 160 km from the Production Right Area, approximately 130 km from the proposed pipe routing, • De Mond – approximately 220 km from the Production Right Area, approximately 200 km from the proposed pipe routing, and • Wilderness Lakes – approximately 130 km from the Production Right Area, approximately106 km from the proposed pipe routing.	The results of the modelling will inform the Standard Operating Procedures (SOP) for plugging and abandonment activities to manage and mitigate risks to sensitive and protected areas.

6.2 SOCIO-ECONOMIC CONDITIONS

Table 6-2 provides the brief description of the socio-economic baseline (WSP, 2023).

Table 6-2 - Socio-economic Baseline

Category	Description	Closure implications
Economic activities	▪ Users of the marine environment around the Project area include commercial shipping, commercial, small-scale and recreational fishing, offshore tourism activities and coastal recreation.	▪ Closure activities are unlikely to have an adverse effect on local services and facilities within the MBLM.
Fisheries (Commercial and small-scale)	▪ Block 11B/12B overlaps commercial fishing grounds and short-term disruption to fishing activities due to temporary exclusion zones being established around working vessel may impact on commercial and small-scale fishers accessing fishing grounds. ▪ Plugging and abandonment activities are of a short duration and the 500 m temporary exclusion zone established around the working vessel will be removed on completion. ▪ Depending on the final closure scenario, the safety zone around the subsea infrastructure will either remain or be removed.	▪ TEEPSA will coordinate with the commercial and small-scale fishers to ensure that any disruption is kept to a minimum. ▪ Prior to commencement of the plugging and abandonment activities, maritime traffic and commercial and small-scale fishers will be notified of the coordinates of the temporary exclusion area.
Tangible and intangible cultural heritage	▪ The intangible cultural heritage related to the coast and sea in the Eastern Cape and Western Cape is vibrant and detailed. For example, as descendants of the Strandlopers, the representatives of the KhoiSan people practised ancient rituals such as cleansing ceremonies at the coastline where traces of fish traps are still visible. ▪ In the event of an oil spill, the impact on tangible and intangible cultural heritage will be extremely high and the local communities will also need to be compensated for damage to and loss of heritage resources.	▪ Customs of the local First Nations and Indigenous Peoples will be respected in planning and executing the closure plan activities. ▪ The Closure Plan risk assessment on which financial provisions for environmental clean-up and reinstatement costs are calculated will be informed by an understanding of the First Nations and Indigenous Peoples customs
Maritime heritage resources	▪ Kiani Satu was a bulk carrier vessel that sank offshore in 2013 while being towed away from the coastline after running aground near Buffels Bay. The wreck of the Kiani Satu is not considered to be a heritage object as it is a recent shipwreck.	▪ Closure activities are unlikely to have an impact on other maritime heritage resources.

Category	Description	Closure implications
Workforce	▪ The contribution of the Block 11B/12B project to the extension of the life of the existing PetroSA facilities will safeguard the contributions that the facility makes to the local economy through direct employment and support of local business. ▪ The Block 11B/12B project is required to contribute to local development through integration of the Social and Labour Plan (SLP) with Municipal Integrated Development Plans (IDP) and Spatial Development Frameworks (SDP).	▪ TEEPSA will likely contract local contractors where the skills and expertise are available, to support local economic empowerment and skills development. ▪ Alternative employment opportunities should be created while the project is operational to ensure that post closure does not result in significant unemployment in the local communities.
Existing and planned maritime uses	▪ Typical maritime uses and anthropic presence within the project area include: • Small scale/artisanal fisheries • Industrial fisheries • Maritime navigation • Tourism and recreational activities • Submarine cables ▪ The shallow and deep-water infrastructure that may be abandoned will be a permanent feature on the ocean floor. ▪ Post-closure, offshore infrastructure left *in situ* will be shown as a hazard on navigation charts and bathymetric maps.	▪ The closure plan will progressively identify the shallow and deep-water infrastructure that may be abandoned and become a permanent feature on the ocean floor.
Onshore activities	▪ A logistics base will be established in Mossel Bay port during Block 11B/12B operations and this area will also support the decommissioning activities, as necessary.	▪ No onshore areas will be affected by decommissioning activities. ▪ Waste material may be discarded an approved waste disposal facility, if appropriate.

7 CLOSURE PLANNING

7.1 CONCURRENT DECOMMISSIONING AND REHABILITATION

The Financial Provisioning Regulations, 2022 require that a concurrent operational rehabilitation plan for new projects is developed and continuously updated during the operational phase. However, the project-related disturbances and impacts will almost exclusively occur during the initial development mobilization, drilling and demobilization phase activities. Thereafter, the well installations, pipelines and other infrastructure, and surrounding areas will essentially remain unchanged for the first 9 years of well production yield (operations) phase, following which two additional wells will be drilled in Year 10 and integrated into the existing subsea infrastructure.

Planned and unscheduled maintenance, modifications and repair are unlikely to result in significant disturbances to the seafloor.

All decommissioning, plugging and abandonment activities will only occur once each respective production and exploration phase has ceased. Therefore, concurrent rehabilitation is not relevant to the Project.

As standard practice, TEEPSA will prepare an OSCP for each drilling operation for approval by SAMSA. The OSCP is the operational internal document prepared and aligned with local and national regulations, including the South Africa's National Oil Spill Contingency Plan (NOSCP), applicable international conventions and internal rules. The primary objective of the OSCP is to identify all possible spill scenarios, level of response requirements and set in motion the necessary actions to stop any discharge of oil and to minimise its effects. (WSP, 2023). It also:

- Provides an emergency notification system, including a standardised format for oil spill notification;
- Describes the escalation monitoring process from Tier 1 to Tier 2 and Tier 3 incidents;
- Outlines the system for command and control of the oil spill response operations and organisation;
- Provides checklists of actions for key personnel during an oil spill; and
- Provides strategy and tactics to respond to the different types and levels of oil spills using local and international resources.

Final clearance survey checks will be conducted using an ROV to ensure that abandoned wellheads and associated over-trawlable caps are removed and no further physical remnants of the drilling operation are left on the seafloor. The drilling unit and supply vessels will demobilise from the offshore licence area and either mobilise to the following drilling location or relocate into port or a regional base for maintenance, repair, or resupply.

7.2 CLOSURE VISION AND OBJECTIVES

The following conceptual closure vision and objectives have been formulated for the Project, to guide the identification of appropriate well plugging and abandonment and infrastructure decommissioning measures, as well as to inform refinement of future planning and design in this regard:

- Closure vision: to return the project site to a condition that encourages ecological processes and functionality to re-establish pre-project conditions and ensure that any elements that remain *in-situ* are rendered safe and pose no demonstrable risk to the environment or people.
- Closure objectives:
  - Ensuring that the wells, once plugged and abandoned, are stable and non-leaking, and will not detrimentally impact marine life or maritime activities/users;
  - Ensuring that other abandoned infrastructures do not pose any risks to the marine life or human activities/users and can in time be naturally integrated into the seafloor landscape; and
  - Safeguarding the long-term functioning of the seabed and marine ecosystems.

7.3 SUMMARY OF PLANNED CLOSURE ACTIONS

The following section presents a synopsis of key infrastructural components and respective abandonment actions for both exploration and production wells.

In terms of exploration wells, once drilling and needed tests have been completed, the exploration well(s) will be sealed with cement plugs and tested for integrity according to international best practices prior to being abandoned. In case of discovery and if deemed relevant, appraisal well(s) can be temporarily abandoned for further re-entry, in this instance, well heads will be left on the seafloor with an over trawl cap designed to allow for trawling activity without damaging trawling gear. For production wells, once production activities have ceased, the wells will be plugged and abandoned in the same manner as for exploration wells.

A summary of the key closure components and actions is provided in Table 7-1 below.

Table 7-1 – Closure Components and Actions

Equipment	Location	Abandonment Action
Production wells	Deep water	Decommissioned and plugged *in situ*
Production manifolds	Deep water	Left on seabed following a visual inspection
Flowline end termination (FLET) units	Deep water	Left on seabed following a visual inspection
Subsea distribution units (SDU)	Deep water	Left on seabed
Production flowline (pipeline)	Deep water / Shallow water	Pigged to remove potential contaminants then left on seabed
Umbilical	Deep water / Shallow water	Disconnected, flushed and laid on seabed for deepwater - retrieved for shallow water
Subsea pig launcher (SPL)	Shallow water	Retrieved
Production riser	Shallow water / FA-Platform	Retrieved (excluded from Block 11B/12B project)
Exploration wells	Deepwater	Decommissioned and plugged *in situ*

7.4 TEEPSA PLUG AND ABANDONMENT CRITERIA

TEEPSA follows best industry standards to ensure well integrity throughout the well life cycle and will apply these to the Project. The industry standards include, but are not limited to (TEEPSA , 2022):

- Environmental requirements for projects design and E&P activities GS EP ENV 001 (2015)
- ISO 16530-1: Standard well integrity life cycle governance
- API RP 90-2 Annular casing pressure management for onshore wells
- NORSOK Standard D-010 well integrity in drilling and wells operations

TEEPSA also relies on several guidelines and generally applies the most stringent ones when it comes to well construction, including:

- The North Sea Oil and Gas UK "*Guidelines for the abandonment of wells" & "Guidelines on qualification of Materials for the abandonment of wells"*
- The BSEE GOM 30 CFR 250.1715 "*permanent plug and abandonment of wells"*

During the well construction phase the plug and abandonment (P&A) requirements are assessed to make sure that the design can accommodate the full range of known environmental conditions that relate to a well and to maintain the integrity and functionality over time. This is done by applying the cap rock principle as described below:

- The "cap rock" principle defines the minimum setting depth of a well barrier required for isolating a flow zone by installing it at a depth in a wellbore that has a formation fracture pressure capable of withstanding the maximum anticipated pressure resulting from the flow zone.

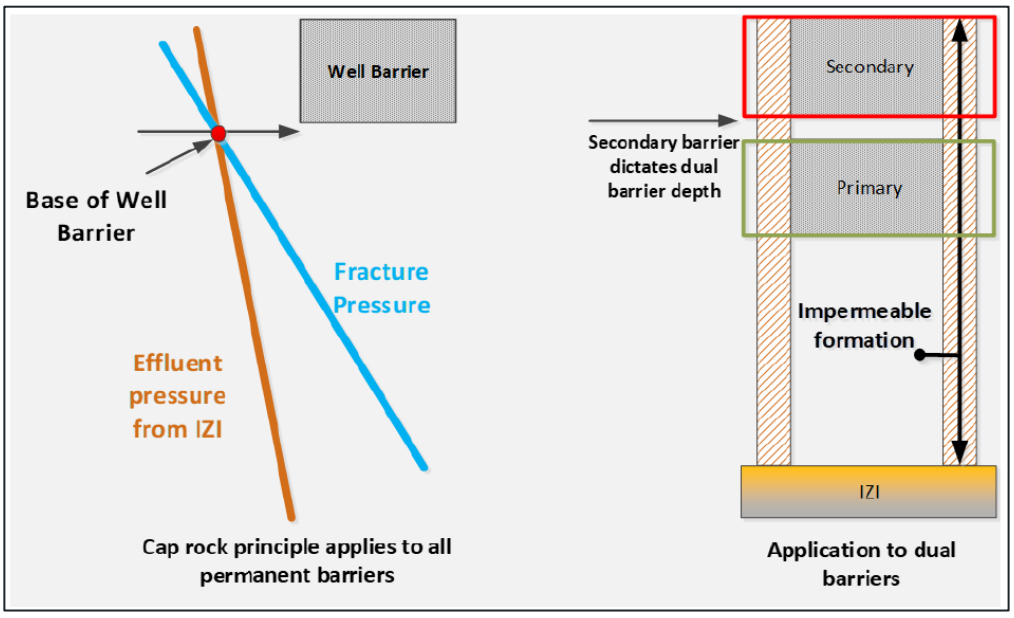

Figure 7-1 - Cap Rock Principle (Extract CR EP FP 424)

For permanent well abandonment, TEEPSA approach is as follows (TEEPSA , 2022):

- All zones with flow potential are identified prior and after well construction process (individual zones to be isolated), each possible flow zone is isolated from each other and from the seabed or from the external environment by permanent well barriers. This applies equally to the inner bore and all the annuli;

- A permanent well barrier would be installed where moveable hydrocarbons or overpressure are present in the lifetime of the abandonment, consists of a cement plug of adequate length set above the potential flow zone with its base following the cap rock principle. A well barrier envelope is built with several barriers elements that must be verified upon installation; and
- The barrier must be permanent over the well life cycle and is therefore designed for the bottom hole environment. Mechanical barriers such as elastomers or metal-to-metal seals used in mechanical plugs and packers are not acceptable as a permanent isolation material unless cased in cement. Cables, flat packs, and control lines can form part of a permanent isolation provided it is demonstrated that a leak path is not introduced over time.

Across the wellbore, several wellbore verified elements must extend across the full section of wellbore to constitute with the original rock an overall well barrier envelope. This applies equally for the primary and secondary well barrier envelope.

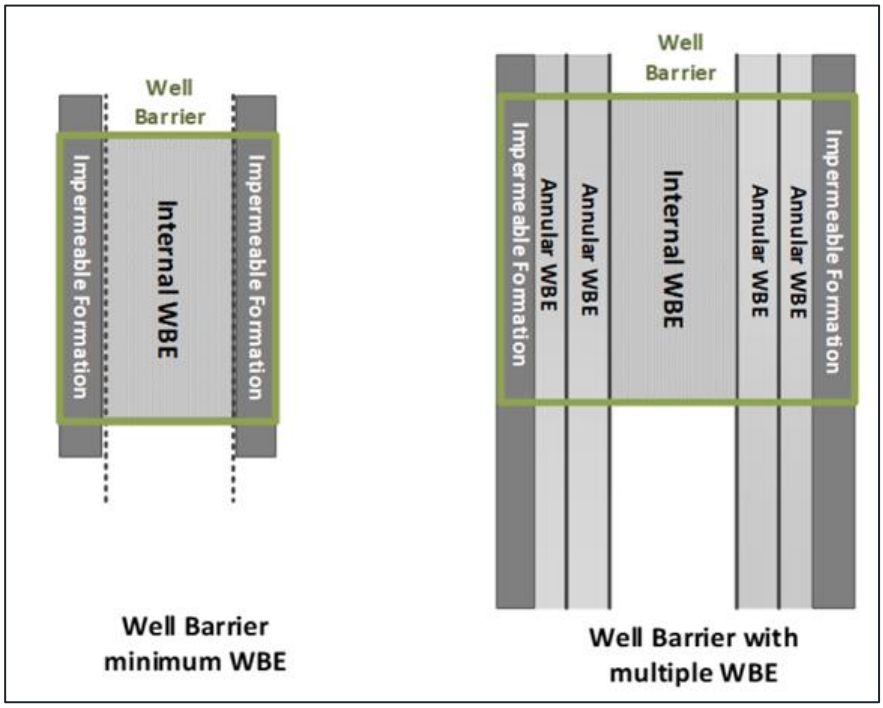

Figure 7-2 - Rock to Rock Well Barriers (extract CR EP FP 424)

Several means are available to test and validate an installed well barrier envelope. Verification methods are described below for the various well barrier elements constituting the overall envelope (TEEPSA , 2022):

- Annular cement wellbore barriers can be verified by:
  - Validation of original records including cement placement and / or original logs considering the subsequent production life of the well;
  - A logging program to assess the cement quality.
- Inside-cement-plug verification:
  - All inside cement-plugs shall be weight tested;

- In addition to weight test, a pressure test would be performed to validate the deepest cased hole plug.

An overview of international offshore decommissioning regulations from the International Association for Oil & Gas producers (IOGP) *(Report 584 dated March 2023 and Report 585 dated July 2017)* describes decommissioning and well plugging and abandonment activities. TEEPSA P&A requirements for well barriers are at a minimum, compliant with regulatory requirement:

- Each individual independent flow zone (IZI) must be isolated from the external environment by two permanent well barriers where movable hydrocarbons or overpressures are present in the lifetime of the abandonment;
- A minimum of one permanent well barrier is installed where no hydrocarbons are present and there is no potential to flow to surface/seabed;

TEEPSA internal rules require that measures (surveys) are put in place when wells are suspected to have identified defects in the final well P&A status (design or verification) or where wells have been confirmed to have sustained abnormal pressures from potential flow zones. Several tools are available to ensure all risks identified are as low as reasonably possible (ALARP) when the well is finally declared as plugged and abandoned.

7.5 GENERAL CLOSURE PROCESS

The actions that comprise well plugging and abandonment and infrastructure closure phase, are indicated in the subsections below.

7.5.1 MOBILISATION

Well plugging and abandonment occurs at the end of production and exploration operations, for which fleet mobilisation has occurred at the commencement of well field development, including:

- Rig (drill unit): third-party mobilisation is required from departure point at the Gulf of Guinea (GoG) to load the equipment on site and perform required custom clearances;
- Support vessels: mobilisation of one or more platform supply vessels (PSV) as well as mobilisation for one or more Healy Lift Platform Supply Vessel (HLPSV) will be required from GoG to load the equipment during custom clearance; and
- Additional logistics and services required during mobilisation include cranes, trucks, and helicopters.

7.5.2 CLOSURE OPERATIONS

- Rig (drill unit): once stationed at the closure site several days of operations at sea are required for terminating and plugging of each of the individual wells;
- Cementing and application of additives as indicated below;
- Rig: rig operation to plug and abandon the wells as well as retrieve flowline end termination units will be required; and
- Additional engineering and fluid studies are required for the rig station keeping and well re-entry.

7.5.3 ABANDONMENT OF WELLS

- Wells are sealed with cement plugs in the well bore at various levels according to good oilfield practice with integrity tests exhibiting acceptable results;
- The drilling, blow-out preventor (BOP) stacks will be retrieved leaving the wellhead at seabed;

- If the site-specific risk assessment concludes there is a danger or risk to other maritime users, the wellheads will be removed. Over-trawl structures are installed to minimise the risk of deep-sea fishing and other equipment becoming entangled and damaged in subsea infrastructure. Conversely, if in consultation with the regulator the over-trawlable cap is deemed redundant due to the drilling water depth, this element may be omitted from the final plug and abandonment configuration;
- Any excess cement, barite and other similar materials onboard the drilling unit is shipped to shore for storage or disposal, or if acceptable to regulator (if proven to be benign and of acceptably limited quantity) may be vented;
- Abandoned well locations are surveyed and submitted to the SA Maritime Safety Agency to ensure the survey data is accurately charted by the SA Navy Hydrographer; and
- Conduct a 50 m x 50 m final clearance survey by ROV to confirm the seafloor state around the well to ensure no dropped equipment and other removable features (e.g., excess cement) remain.

7.5.4 INTEGRITY TESTING

Well plugging and abandonment are undertaken to ensure safe closure of non-producing offshore wells. Wells are sealed, plugged, tested for integrity, and abandoned according to the prescribed standards mentioned above. The goal of these measures is to provide permanent containment of the formation fluids and to prevent migration from the reservoir to the seabed, i.e., isolate permeable and hydrocarbon bearing formations. The principal technique applied to prevent cross flow between permeable formations is plugging of the well with cement, thus creating an impermeable barrier between two zones. Depending on the formations encountered, a well may be plugged at multiple locations. The integrity of cement plugs can be tested by several methods. The cement plugs will be tag tested (to validate plug position) and weight tested, and if achievable then a positive pressure test (to validate seal) and/or a negative pressure test will be performed. Additionally, a flow check may be performed to ensure sealing by the plug.

The leakage of hydrocarbons from an abandoned well can be initiated through a compromised well barrier either by degradation overtime or natural seepage, or both. For the proposed activities up to six wells may be drilled, but only those which encounter hydrocarbon-bearing formations could potentially leak. Although a leak from an abandoned well is unlikely, it could result in the release of considerable quantities oil or gas over time.

7.5.5 RETRIEVAL OF SHALLOW-SEA COMPONENTS

- Flowline end termination units located in shallow water will be retrieved; and
- Areas of the ocean floor that may be affected by retrieval activities will be reprofiled, if necessary, to ensure the seabed is integrated with the surrounding area.

7.5.6 ABANDONMENT OF DEEP-SEA PIPELINES AND OTHER COMPONENTS

- Production flowline (pipeline): receivers installed at the beginning and at the end of each pigging section of the pipeline allowing for the insertion and removal of the pigging units (

- Figure 7-3). Differential pressure is used to propel the unit through the pipeline, to remove impurities and contaminants, that are collected and safely disposed;
- Flowlines are subsequently left on the ocean floor to naturally corrode from the inside, as the outsides of the pipelines are treated to prevent erosion. These features may subsequently form artificial habitats for the establishment of various species (Figure 7-4); and
- Production manifolds and subsea distribution units (SDU) are left on seabed, following visual inspection to ensure that they pose no demonstrable harm to the receiving environment.

7.5.7 LOGISTICS

- The logistical support base will be established at the Mossel Bay port with helicopters flying from George airport to and from the well site, when needed; and
- Removal and final disposal of waste to an onshore licensed landfill site, where appropriate.

Figure 7-3 - Typical Pipeline Cleaning Pig (from https://en.wikipedia.org/wiki/File:NWO-MolchPlastik2.jpg)

Figure 7-4 - An Example of Subsea Steel Infrastructure Supporting Artificial Reef Development (from https://ychef.files.bbci.co.uk/1600x900/p0955jz3.webp)

7.6 PROPOSED MONITORING PROGRAMME

During the production phase, monitoring and auditing of environmental and social performance will be undertaken to confirm adequate implementation of the various Environmental and Social Management Plans (ESMPs) that will be developed to support the construction, operation (production and exploration and appraisal) and closure phases of the Project.

7.6.1 MONITORING

Monitoring is conducted to ensure compliance with regulatory requirements and the performance objectives specified in the ESMPs, as well as to evaluate the effectiveness of operational controls and mitigation measures. The main objectives of the monitoring programme include:

- Identifying changes in the physical, biological, and social environment;
- Producing information about emergencies that require an immediate response;
- Obtaining information on the actual and potential environmental and social impacts of production, exploration, and demobilisation activities;
- Using monitoring results as a source of information and as grounds for decision making regarding the design of new mitigation measures;
- Describing whether and to what extent discharges from production, exploration and demobilisation activities have had impacts on the marine environment; and
- Ensuring that no undue environmental impacts are caused during operations and that would potentially require addressing at closure.

TEEPSA and the contractor HSE staff will implement a formal tracking procedure for investigating cause and identifying corrective actions in response to incidents, HSE and/or social non-compliances. Corrective actions include those intended to improve performance, non-compliances, and non-conformances (WSP, 2023).

7.6.2 POST-WELL ABONDONMENT MONITORING

Generally, monitoring of sealed wells is required only if there is a demonstrable risk of a significant adverse effect on the environment (European Commission, 2022) which would be indicated by monitoring during the operational phase, or if the well is targeted for recommissioning during future production activities. As such, TEEPSA currently does not anticipate the requirement for ongoing monitoring of the well once the seal performance standard requirements have been met.

The exploration and appraisal wells are designed from the onset and by default to either be terminated by final abandonment (data acquisition wells) or temporarily suspended if TEEPSA has targeted a well for re-entry. This may be for further data acquisition or for an exploration well to be converted into a development well.

Exploration wells that are suspended but that may be earmarked for future production may require monitoring during the temporary abandonment phase, to ensure that the temporary plugs remain intact and that no adverse environmental impacts occur during this period. Monitoring gauges to monitor pressure and temperature through wireless communication may be used with frequencies between the transmitter and the receiver in the 12.75 to 21.25 kHz range. The gauges will be placed and remain under the over-trawl cap. Monitoring gauges if installed on wells which are earmarked

for abandonment (WSP, 2023) will not have an impact on the final abandonment, as the well condition will comply with requirements listed in Section 2.1.

However, the wells to be monitored can only be ascertained once the exploration wells have been drilled, and the associated closure planning and costs therefore need to be updated accordingly once this has occurred.

8 CLOSURE RISK ASSESSMENT (CRA)

A screening level Closure Risk Assessment (CRA) was undertaken as part of the preparation of this closure framework. The primary intention of the CRA was to highlight the residual and latent risks that remain, or will manifest, after site relinquishment and to determine the likely financial liability associated with managing these risks in the long term. The management of these risks is important to ensure that the abandoned wells do not pose a pollution risk and that the abandoned wells do not close out options for other maritime uses within and surrounding the well field.

8.1 OBJECTIVES AND METHODOLOGY

The objective of the environmental risk assessment is to:

- Ensure timeous risk reduction through appropriate interventions;
- Identify and quantify the potential latent environmental risks related to post closure;
- Detail the approach to managing the risks;
- Quantify the potential liabilities associated with the management of the risks; and
- Outline monitoring, auditing, and reporting requirements.

The methodology used in the screening level CRA, undertaken as part of the environmental risk assessment, can be summarised as follows (Figure 8-1):

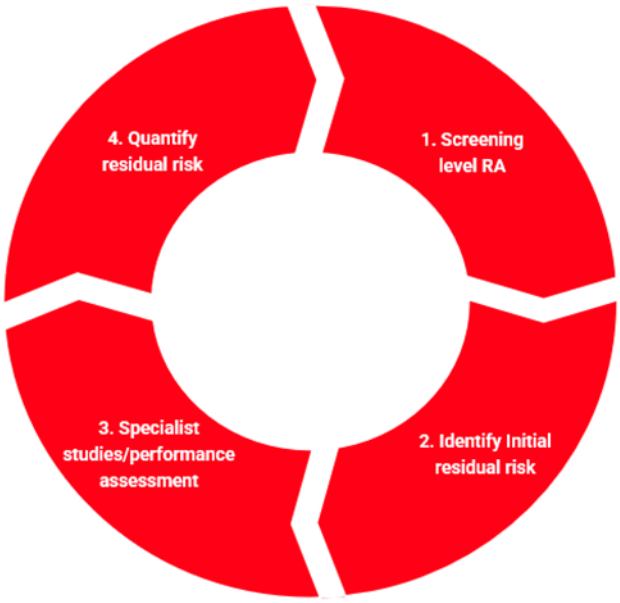

Figure 8-1 - Key Components and Process of Risk Determination

The CRA is based on an Exploration and Production (E&P) universal 6 x 6 matrix which has been provided by TEEPSA (Appendix B). The risk matrix is based on industry best practice and consists of two criteria, probability (likelihood) and consequence, with scales and descriptors that were used for scoring probability and consequences.

Once the probability and consequence scores were determined, the risks were ranked using three levels (Table 8-1). Based on the risk identified and level assigned, mitigation measures/actions were

proposed. Thereafter, new post-mitigation risk levels were identified to rate the risks that might occur after mitigations implementation.

Table 8-1 - Risk Levels

Risk Level	Descriptor
1	First priority, risk level to be obligatorily reduced to Level 2 or 3
2	Tolerable risk level if demonstrated to be ALARP
3	Broadly acceptable risk level

8.2 PLUGGING AND ABANDONMENT RISKS

The probability of a well blow-out occurring during operations, or leakage occurring during plugging and abandonment (P&A) activities, is extremely low. In the South African context, 358 wells have been drilled in the offshore environment to date (based on shapefile provided by the Petroleum Agency South Africa (PASA) in 2021) and no well blow-outs have been recorded to date. Global data maintained by Lloyds Register indicates that frequency of a blow-out from normal exploration wells is in the order of 1.43×10^{-4} per well drilled (WSP, 2023).

Oil spills in the marine environment will have an immediate detrimental effect on local and regional water quality, on marine fauna and possibly on livelihoods and tourism. A large oil spill, assuming the worst-case scenario of oil reaching the coastline, would have a high negative impact on both the physical and biological environment and the socio-economic environment.

TEEPSA is a member of various industry groups and working committees and has access to industry data for blow-out frequencies during drilling or after well abandonment as shown in Table 8-2. Data is taken from the “Statistics, well failures / blow out during operations and after abandonment” publication (International Association for Oil & Gas Producers, 2019). The IOGP compiles well control incidents statistics for lesson sharing to promote learning within the industry and avoid the repetition of errors leading to well release and blow outs.

The reasons leading to wells blowouts or well releases are well documented in publicly available literature. Generally, a potential flow zone not being isolated properly with adequate barriers leading to flow to uncontrolled flow down hole (underground blowouts) or release to environment (surface blowouts).

In terms of subsea exploration and drilled wells, the surface blowout frequency is in the order of magnitude of 1 to 1.3 x 10-3 per drilled well, therefore is considered as extremely low. For plugged and abandoned wells the statistic is even lower. The IOGP reports recommends treating the combined blowout/well release category as low release events for modelling purposes, based on the actual observation leading to these statistics. Two incidents have been reported in wells abandoned in the Gulf of Mexico Outer Continental Shelf (GoM OCS) from 1994 to 2014, and in both cases, reported low flows events, not blowouts.

Therefore, for plugged and abandoned wells, the modelling uses frequency of well release events that is in the order of magnitude of 2.3×10^{-5} per well per year (100 lower than operational blowout events).

Table 8-2 - Blowout and Well Release Frequencies for Offshore Operations in Area Not Operating According to the North Sea Standard

Operation	Category	Well Type	Frequency		Fraction Subsea
Exploration Drilling, shallow gas	Blowout (surface flow)	Appraisal	1.6 × 10-3	per drilled well	0.63
		Wildcat	2.1 × 10-3	per drilled well	0.63
	Blowout (underground flow)	Appraisal	03	per drilled well	1.04
		Wildcat	03	per drilled well	1.04
	Diverted well release	Appraisal	6.2 × 10-4	per drilled well	0
		Wildcat	8.4 × 10-4	per drilled well	0
	Well release	Appraisal	3.4 × 10-4	per drilled well	1.0
		Wildcat	1.3 × 10-4	per drilled well	1.0
Development Drilling, shallow gas	Blowout (surface flow)	-	8.6 × 10-4	per drilled well	0.26
	Blowout (underground flow)	-	3.0 × 10-5	per drilled well	14
	Diverted well release	-	6.6 × 10-4	per drilled well	0
	Well release	-	7.0 × 10-5	per drilled well	0
Exploration Drilling, deep	Blowout (surface flow)	Appraisal	1.3 × 10-3	per drilled well	0.39
		Wildcat	1.5 × 10-3	per drilled well	0.39
	Blowout (underground flow)	Appraisal	1.6 × 10-4	per drilled well	14
		Wildcat	8.4 × 10-4	per drilled well	14
	Diverted well release	Appraisal	3.1 x 10-5	per drilled well	0
		Wildcat	1.1 × 10-4	per drilled well	0
	Well release	Appraisal	5.3 × 10-4	per drilled well	0
		Wildcat	4.2 × 10-4	per drilled well	0
Development Drilling, deep	Blowout (surface flow)	-	3.0 × 10-4	per drilled well	0
	Blowout (underground flow)	-	1.3 × 10-4	per drilled well	14
	Diverted well release	-	03	per drilled well	0
	Well release	-	2.3 × 10-4	per drilled well	0.2

Operation	Category	Well Type	Frequency		Fraction Subsea
Completion	Blowout (surface flow)	-	4.3 × 10-4	per completion	0
	Blowout (underground flow)	-	03	per completion	14
	Diverted well release	-	4.0 × 10-5	per completion	0
	Well release	-	3.5 × 10-4	per completion	0
Wireline	Blowout (surface flow)	-	9.0 × 10-6	per wireline job	0
	Blowout (underground flow)	-	03	per wireline job	14
	Diverted well release	-	03	per wireline job	0
	Well release	-	2.6 × 10-5	per wireline job	0
Workover5	Blowout (surface flow)	-	1.0 × 10-3	per workover	0.19
	Blowout (underground flow)	-	03	per workover	14
	Diverted well release	-	03	per workover	0
	Well release	-	1.3 × 10-3	per workover	0
Production (Excluding External Causes)	Blowout (surface flow)	-	3.3 × 10-5	per well year	0.43
	Blowout (underground flow)	-	4.0 × 10-6	per well year	14
	Diverted well release	-	03	per well year	0
	Well release	-	2.9 × 10-5	per well year	0

8.3 INSURANCE COVERAGE

During drilling operations, an “Operator Extra Expenses” (OEE) policy with a limit of not less than three times the Authorization for Expenditure (AFE) of the well is in place. This policy includes both a Third-Party Liability (TPL) section and a cargo coverage section.

The OEE policy covers the cost of regaining the control of a well under blow-out, the cost of redrilling the well and the cost of pollution clean-up and extends to cover possible leakage during plugging and abandonment activities. TPL covers the liability of the partners for damages, injury, death caused to third parties. Cargo covers the damages to the JV’s drilling equipment whilst in transit or intermediate storage.

Subject to the Terms and Conditions of the policy, insurers will indemnify the assureds up to the policy limit for any incident during 11B/12B drilling operations (TEEPSA , 2022).

8.4 RISK ASSESSMENT RESULTS

The CRA was informed by a screening level review of several industry references (Caletka, 2018) (European Commission, 2022) (Flaherty, 2020) (Melbourne-Thomas J, 2021) (Vralstad, 2019) (Cordes EE, 2016), as well as the FSR (WSP, 2023), to obtain an understanding of the relevant risks and conceptual mitigation requirements for well plugging and abandonment. The preliminary CRA is presented in Table 8-3.

Table 8-3 - Closure Risk Assessment

Risk driver	Risk type	Consequence (unwanted event)	Probability (likelihood)	Consequence rating (severity)	Risk level (pre-mitigation)	Closure action	Probability	Consequence rating	Risk level (post-mitigation)
Well decommissioning operations mobilization and support functions									
Mobilization of rig (drill unit) and support vessels, travel to and from well site	Environmental – Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Impacts of similar nature to those occurring during well drilling mobilization operations: Ship strikes of large mammals, endangered marine species	2	3	**6 (Risk level 3)**	As per well drilling mobilization phase - keep a constant watch from all vessels (Vessel Captain and crew) for cetaceans and turtles in the path of the 'vessel. Alter course and avoid animals when possible - Ensure vessel transit speed between the drill site and port is a maximum of 12 knots (22 km/hr), except within 25 km of the coast where it is reduced further to 10 knots (18 km/hr), as well as when sensitive marine fauna are present in the vicinity - Report any collisions with whales to the International Whaling Commission (IWC) database	1	3	**3 (Risk level 3)**
Mobilization of rig (drill unit) and support vessels, travel to and from well site	Environmental – Physical (air, water and sediment, the atmosphere)	Accidental oil release to the sea due to vessel collisions, rupture, etc.	3	4	**12 (Risk level 2)**	'As per well drilling mobilization phase: - TEEPSA OSCP approved by government - Ensure personnel are adequately trained in both accident prevention and immediate response, and resources are available on each vessel - Obtain permission from Department of Forestry, Fisheries, and the Environment (DFFE) to use low toxicity dispersants. Use cautiously - Ensure adequate training for personnel and resources are provided to collect and transport oiled birds to a cleaning station Ensure offshore bunkering is not undertaken in the following circumstances: • Wind force and sea state conditions of ≥6 on the Beaufort Wind Scale; • During any workboat or mobilisation boat operations; • During helicopter operations; • During the transfer of in-sea equipment; and • At night or times of low visibility	3	3	**9 (Risk level 3)**
Mobilization of rig (drill unit) and support vessels, travel to and from well site	Environmental – Physical (air, water and sediment, the atmosphere)	Discharges, wastes and emissions by sea vessels - Vessel Machinery Spaces (Bilge Water) - Deck Drainage - Sewage and Grey Water - Food (Galley) Wastes - Ballast Water - Detergents	3	3	**9 (Risk level 3)**	As per well drilling mobilization phase: - Vessels provided with equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with MARPOL requirements	1	3	**3 (Risk level 3)**
Well decommissioning (plugging/sealing and capping) operations									

Risk driver	Risk type	Consequence (unwanted event)	Probability (likelihood)	Consequence rating (severity)	Risk level (pre-mitigation)	Closure action	Probability	Consequence rating	Risk level (post-mitigation)
Unplanned well leakage during plugging and abandonment operations	Environmental – Physical (air, water and sediment, the atmosphere)	Primary impacts: - Oil and hydrocarbon contamination floating on water surface - Impact on atmosphere and air quality from evaporated hydrocarbon contamination on water surface Secondary impacts: - Adverse effects of dispersants used to manage leakage i.e., toxicity/bioaccumulation of dispersants, and more rapid spread/extent albeit diffused magnitude of Impact of hydrocarbon contamination	2	5	**10 (Risk level 2)**	- Design of well seals as per industry best practice standards - industry-standard testing of installed well caps to ensure compliance to performance specifications - Contract agreements held with global response companies based in Saldanha Bay, available for global mobilisation by sea/air, should well leakage occur during plugging and abandonment operations - mobilisation of the Subsea Dispersant Injection (SSDI) kit from OSRL - Oil spill dispersion modelling to assess potential impacts on sensitive and protected habitat areas and inform OSCP	1	2	**2 (Risk level 3)**
Unplanned well leakage during plugging and abandonment operations	Environmental – Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	- Impacts on avifaunal species, macrofauna species and plankton - impacts on seabed, coral reefs and associated species	2	6	**12 (Risk level 2)**	- Design of well seals as per industry best practice standards - industry-standard testing of installed well caps to ensure compliance to performance specifications - Contract agreements held with global response companies based in Saldanha Bay and Aberdeen, available for global mobilisation by sea/air, should well leakage occur during plugging and abandonment operations - mobilisation of the Subsea Dispersant Injection (SSDI) kit from OSRL - Oil spill dispersion modelling to assess potential impacts on sensitive and protected habitat areas and inform OSCP	1	2	**2 (Risk level 3)**
Mobilization of rig (drill unit) and support vessels, travel to and from well site, decommissioning activities	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Disruption of and nuisance to marine fauna and avifauna by marine vessels and helicopters during mobilization and stationary decommissioning operations: - Noise pollution from vessels and equipment disturbing marine fauna and avifauna - Light pollution disrupting marine fauna and avifauna navigation	2	2	**4 (Risk level 3)**	As per well drilling mobilization phase: - Noise pollution is likely to be limited during decommissioning as no drilling or seismic testing activity will be undertaken and will be limited to operating vessels and helicopters, no further mitigation anticipated - Similarly, light pollution will be relatively limited by avoiding excessive and unnecessary light at night, and dealing with affected avifauna on a case-by-case basis as per mobilization phase	2	1	**2 (Risk level 3)**
Mobilization of rig (drill unit) and support vessels, travel to and from well site, decommissioning activities	Economic	- Disruption of maritime activities in the vicinity of project operations	1	2	**2 (Risk level 3)**	As per well drilling mobilization phase: - Noise pollution is likely to be limited during decommissioning as no drilling or seismic testing activity will be undertaken and will be limited to operating vessels and helicopters, no further mitigation anticipated - Similarly, light pollution will be relatively limited by avoiding excessive and unnecessary light at night, and communicating with other maritime activities taking place in the vicinity as and when needed	1	1	**1 (Risk level 3)**

Risk driver	Risk type	Consequence (unwanted event)	Probability (likelihood)	Consequence rating (severity)	Risk level (pre-mitigation)	Closure action	Probability	Consequence rating	Risk level (post-mitigation)
Remobilization of contaminated material/contaminants from the sea floor originating from well drilling operations, during plugging/sealing and capping activities	Environmental	Adverse impacts on marine habitats and fauna in the immediate vicinity of well decommissioning activities, including smothering and biochemical effects	2	3	**6 (Risk level 3)**	Pre-emptive mitigation of potential contamination-related impacts during drilling phase to minimize potential long-term impacts, including: - Management and treatment of drill cuttings - On-shore disposal of wastes where required - Use of biodegradable blow-out preventor hydraulic fluids	2	2	**4 (Risk level 3)**
Unlawful/irresponsible offshore disposal of decommissioning-related wastes	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Offshore disposal of decommissioning-related waste or contaminants resulting in adverse impacts on marine habitat and fauna	3	3	**9 (Risk level 3)**	As per well drilling mobilization phase: - Vessels provided with equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with MARPOL requirements	1	3	**3 (Risk level 3)**
Unlawful/irresponsible onshore disposal of decommissioning-related wastes	Environmental - Physical (air, water and sediment, the atmosphere)	On-shore disposal of decommissioning-related waste or contaminants resulting in soil, surface- and groundwater impacts and terrestrial habitat degradation	2	3	**6 (Risk level 3)**	As per well drilling mobilization phase - Establish waste management contracts with reputable service providers including proof of responsible disposal or recycling	1	3	**3 (Risk level 3)**
Permanent presence of well abandonment infrastructure									
Interference of permanent well abandonment infrastructure with deep sea hake fishing activities	Economic	- Snagging of and damage to fishing equipment - Disruption of fishing due to interference of well abandonment infrastructure with target fish species	2	3	**6 (Risk level 3)**	- Install a trawl over structure over abandoned well heads to ensure third-party infrastructure is not damaged - SAMSA instruction to SA Navy Hydrograph Office to mark abandoned infrastructure as a hazard on navigation charts and bathymetric maps	1	3	**3 (Risk level 3)**
Interference of permanent well abandonment infrastructure with other oceanic activities (sea travel, tourism, sea-bed mining)	Economic	Primary impacts: - Damage to vessels Secondary impacts: - Negative impacts on tourism due to deterioration of sense of place, pollution - Constraints to future seabed mining/exploration activities in immediate vicinity of well	1	3	**3 (Risk level 3)**	- Design of well seals as per industry best practice standards - Install a trawl over structure over abandoned well heads to ensure third-party infrastructure is not damaged - SAMSA instruction to SA Navy Hydrograph Office to mark abandoned infrastructure as a hazard on navigation charts and bathymetric maps	1	3	**3 (Risk level 3)**
Localised disturbance of and/or behavioural changes to marine and coastal fauna	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Presence of permanent well abandonment infrastructure on sea floor	1	2	**2 (Risk level 3)**	- Limited physical size of over-trawl structure unlikely to result in Impact on benthic and demersal species	1	2	**2 (Risk level 3)**
Increased biodiversity and biomass on trawl-over cap structure	Material	Long-term chemical degradation and eventual compromise of physical and structural integrity of trawl-over cap	3	2	**6 (Risk level 3)**	- Material selection and design, construction of over-trawl structure to account for oceanic conditions and to be corrosion or deterioration resistant	1	2	**2 (Risk level 3)**

Risk driver	Risk type	Consequence (unwanted event)	Probability (likelihood)	Consequence rating (severity)	Risk level (pre-mitigation)	Closure action	Probability	Consequence rating	Risk level (post-mitigation)
Hard substrate habitat available for colonisation by benthic organisms (potential positive impact)	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Increased biodiversity and habitat provision on well heads and other *in-situ* abandoned infrastructure	3	2	**6 (positive impact)**	N/A	N/A	N/A	N/A
Pipeline cutting and retrieval, and making safe and abandoning of remaining infrastructure									
Spillage of contaminating materials/damage to seabed and associated habitat during pipeline cutting, dismantling, making safe, and retrieval activities	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	Localised detrimental impacts on marine biota, damage to/loss of ecological functionality	3	2	**6 (Risk level 3)**	- Develop and implement SOPs for all pipeline cutting, dismantling, making safe, and retrieval activities and ensure these are appropriately implemented - Ensure all potentially contaminating or damaging substances and infrastructure components are identified and safely removed	1	2	**2 (Risk level 3)**
Post-decommissioning (residual/latent) impacts									
Gas leaking from sealed well through micro-annulus: - Internal cracks, or around the plug at the cement-casing interface, due to micro annuli formation during cement shrinkage or poor mud removal - For the annulus cement, leakages may go through the cement sheath, or around the cement sheath at the cement-casing interface or at the cement-formation interface	Environmental - Physical (air, water and sediment, the atmosphere)	- Oil and hydrocarbon contamination floating on water surface - Impacts on atmosphere and air quality from evaporated hydrocarbon contamination on water surface	2	2	**4 (Risk level 3)**	- Design of well seals as per industry best practice standards - Installation of blow-out preventor in capping design - Industry-standard testing of installed well caps to ensure compliance to performance specifications - Monitoring of temporarily abandoned well until reopened for production or further testing	1	2	**2 (Risk level 3)**
Gas leaking from sealed well through micro-annulus: - Internal cracks, or around the plug at the cement-casing interface, due to micro annuli formation during cement shrinkage or poor mud removal - For the annulus cement, leakages may go through the cement sheath, or around the cement sheath at the cement-casing interface or at the cement-formation interface	Environmental - Biological (marine life, sea birds, corals and benthic fauna and biodiversity)	- Oil and hydrocarbon contamination Impacts to marine and avifaunal species - Oil and hydrocarbon suspension in water impacting plankton and macrofauna species - Impacts on seabed, coral reefs and associated species	3	3	**9 (Risk level 3)**	- Design of well seals as per industry best practice standards - Installation of blow-out preventor in capping design - Industry-standard testing of installed well caps to ensure compliance to performance specifications	1	3	**3 (Risk level 3)**

Risk driver	Risk type	Consequence (unwanted event)	Probability (likelihood)	Consequence rating (severity)	Risk level (pre-mitigation)	Closure action	Probability	Consequence rating	Risk level (post-mitigation)
Compromise of plugged and abandoned well after closure by future exploration drilling by third parties	Environmental - Physical (air, water and sediment, the atmosphere)	- Oil and hydrocarbon contamination of receiving environment if plugged and abandoned well integrity is compromised, depending on the nature and degree of well compromise	1	6	**6 (Risk level 2)**	- Install a trawl over structure over abandoned well heads to ensure third-party infrastructure is not damaged by/interacts with plugged wells - SAMSA instruction to SA Navy Hydrograph Office to mark as abandoned infrastructure as a hazard on navigation charts and bathymetric maps	1	4	**4 (Risk level 3)**
Stakeholder non-acceptance of implemented decommissioning measures	Stakeholders	Perceived impacts on fishing activities, marine ecology and biota	2	3	**6 (Risk level 3)**	- Appropriate public, stakeholder, and regulatory authority consultation - Design of well seals as per industry best practice standards - Implementation of and adherence to appropriate management and mitigation measures - Monitoring of temporarily abandoned well until reopened for production or further testing	1	4	**4 (Risk level 3)**
Establishment of a permanent 500m no-go (buffer) zone around abandoned infrastructures such as, *inter alia*, pipelines and production manifolds	Economic	Significant reduction in commercial activities and potential disruptions to fishing activities	4	5	**20 (Risk level 1)**	-Negotiate with SAMSA to remove buffer zone after closure where depth of remaining infrastructure and no potential hazards to activities on water surface are expected -Retain delineations of abandoned subsea infrastructure on SAMSA mapping so that fishing, cargo and tourism vessels remain aware of their presence	1	4	**4 (Risk level 3)**

9 STAKEHOLDER CONSULTATION

9.1 SUMMARY OF KEY ISSUES RAISED BY I&APS

The following key issues relevant to decommissioning were raised by I&APs during the consultation process for the Scoping phase of the ESIA for the Environmental Authorisation application for Block 11B/12B:

- Monitoring post-production and throughout de-commissioning, to detect gas and oil leakages;
- Financial provision, management, rehabilitation, and remediation of environmental impacts and future residual environmental impacts;
- Abandoning decommissioned infrastructure on the seabed;
- Scope and extent of activities that will be covered by the Closure Plan;
- Requirement of the Closure Plan to be updated in future;
- Relationship between TEEPSA Block 11B/12B project infrastructure, and existing PetroSA infrastructure (noting that the PetroSA Closure Plan strategies and provision for funding to implement their Closure Plan/s are independent of this project);
- Request for greater detail regarding the proposed plugging and abandonment measures for the wells, removal of other infrastructure, as well as post-decommissioning monitoring requirements; and
- Requirements for environmental due diligence and sustainable decommissioning and closure practices to be implemented to ensure that the abandoned infrastructure does not harm the environment or become a burden to the state or taxpayers.

9.2 GRIEVANCE MANAGEMENT PROCEDURE

TEEPSA has a grievance management procedure (ref no. TEPSA_2_MPL_HSE_01.01) dated October 2020. The grievance management procedure is a step-by-step approach for receiving, acknowledging, and registering, reviewing, investigating, and resolving complaints and grievances from all affected stakeholders. The main steps are summarized below, and an example of detailed flow chart is presented in Figure 9-1.

Level 1: Resolution through dialogue with 2 options (TEEPSA, 2020):

- Option 1: Immediate resolution without investigation, with a solution proposed by CLO / HSE and accepted by the Complainant within maximum 7 days, after the official grievance was raised.
- Option 2: No immediate resolution can be found, Investigation is needed; CLO / HSE leads an investigation with support from the Grievance Owner, based on dialogue which shall include but not be limited to meeting face-to-face with the complainant, interviewing appropriate parties, site visits, seeking material evidence. Investigation completed and solution 1 proposed within maximum 15 days, after the official grievance was raised.

CLO / HSE communicates the proposed solution 1 to the complainant in writing.

- If the Complainant agrees on the proposed solution, acceptance form (agreed solution and schedule for implementation of the solution) shall be signed within maximum 15 days after the Grievance is received,
- If the complainant does not accept the solution offered, the grievance is transferred to Level 2.

Level 2: Solution 1 refused by the complainant and resolution requiring involvement and validation from the Grievance Management Committee (TEEPSA, 2020):

The Grievance Management Committee reviews the case and identifies alternative or additional solutions if appropriate.

If a financial commitment is required, the solution is then approved by the General Manager. CLO / HSE communicates the proposed solution 2 to the complainant in writing.

- If the complainant agrees on the proposed solution, acceptance form (agreed solution and schedule for implementation of the solution) shall be signed within maximum 30 days after the grievance is received,
- If the complainant does not accept the proposed solution, the matters is escalated to the Appeal Committee.

Level 3: Solution requiring the intervention of an outside mediator, with a maximum of 45 to 60 days from reception for the complainant to give his/her acceptance or refusal (TEEPSA, 2020):

If the solution 2 proposed by the GMC (level 2) is not accepted by the complainant, the matter is raised to the Appeal Committee within maximum 7 days of the refusal of the solution 2 proposed by the Internal Grievance Management Committee.

The solution is presented for approval to the General Manager / Grievance Manager (or any other the person in the Company to whom s/he has delegated the authority to make the appropriate external commitments).

- If the complainant agrees on the proposed solution, acceptance form (agreed solution and schedule for implementation of the solution) shall be signed within maximum 45 to 60 days after the grievance is received,
- If the complainant does not accept the proposed solution, the Appeal Committee authorises the close out of the Complaint. In the case of complex complaints this may require several meetings of the appeal committee and the proposal of different solutions prior to deciding to close out the complaint. A close out letter will be sent to the complainant explaining Company's decision. HSE closes out the complaint and updates the grievance register. The complaint is then transferred to the Legal department if case of any judicial follow-up.

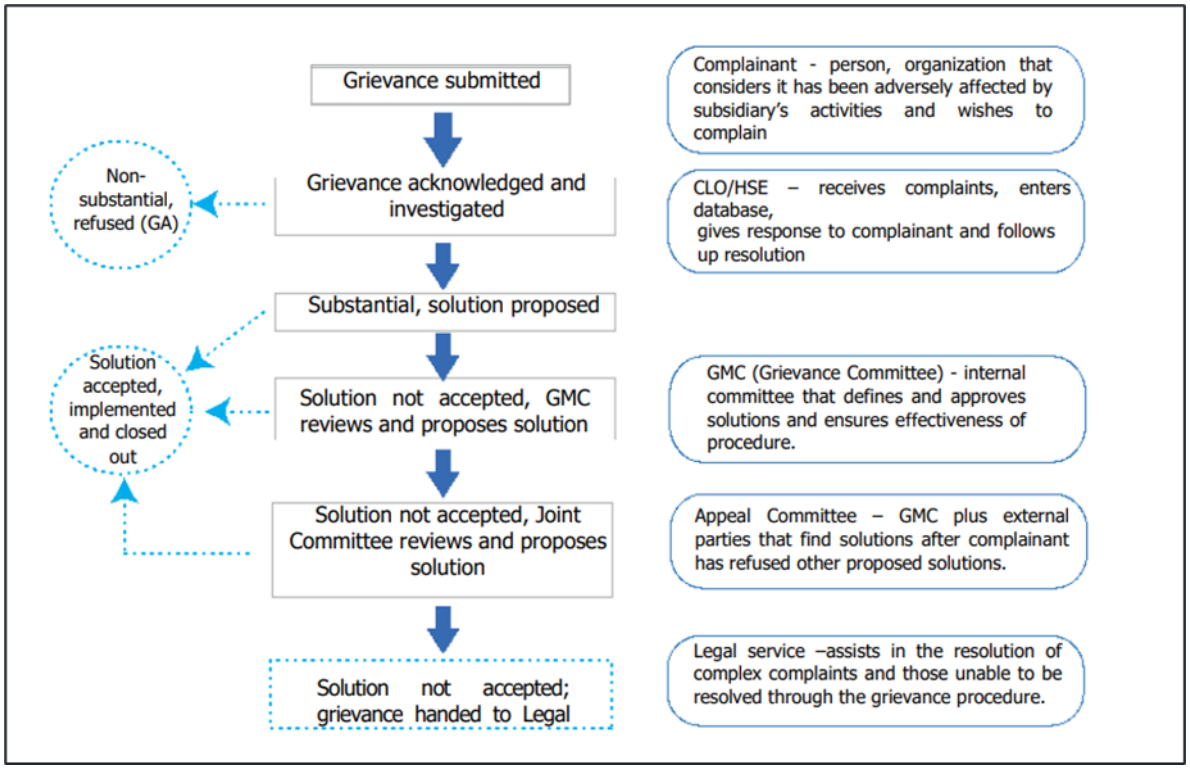

Figure 9-1 - Grievance Management Procedure (TEEPSA, 2020)

10 FINANCIAL PROVISIONING

10.1 METHODOLOGY FOR COST ESTIMATE

The plugging and abandonment cost estimate is aligned with the Financial Provisioning Regulations, 2015 requirements, based on project-specific unit rates, as well as incorporating specific requirements from TEEPSA and information sourced from international literature such as the Association for the Advancement of Cost Engineering (AACE) International Classification Standard.

AACE International produces several recommended practices for the cost management industries and include both generic and industry specific classification systems. Table 10-1 presents the generic classification matrix for AACE International cost estimate classification systems.

Table 10-1 - AACE International Cost Estimate Classification Systems

Estimate class	Level of project definition	End usage	Estimating methodology	Expected accuracy range	Estimate type
Class 5	0% to 2%	Screening or feasibility	Stochastic (factors or models) or judgement	Low: -20% to -100% High: +40% to +200%	Pre-feasibility or screening, conceptual or trade-off study
Class 4	1% to 15%	Concept study or feasibility	Primarily stochastic	Low: -15% to -60% High: +30% to +120%	Feasibility, concept study or advanced conceptual
Class 3	10% to 40%	Budget authorization or control	Mixed but primarily stochastic	Low: -10% to -30% High: +20% to +60%	Preliminary or budget authorization and/or control
Class 2	30% to 70%	Control or bid/tender	Primarily deterministic	Low: -5% to -15% High: +10% to +30%	Definitive, control or bid/tender
Class 1	50% to 100%	Check estimate or bid/tender	Deterministic	Low: -5% High: +10%	Detailed, check estimate or bid/tender

Based on this classification the estimated plugging and abandonment costs are at a Class 4 (Low: -15% to -60%; High: +30% to +120%) level of accuracy.

The closure costs were calculated based on the methodologies provided by the Plugging and Abandonment Methodology and Cost Evaluation developed by TSB Offshore and ICF Incorporated (2016). Note that these costs do not include OSCP or related emergency measures costs which are separately insured.

Further, the decommissioning costs need to align with the requirements of the Financial Provisioning Regulations. While most standard engineering cost estimate classification systems are premised on

the project definition level of accuracy, the level of accuracy required as per Financial Provisioning Regulations, 2015 is a function of the remaining lifespan of an operation (Table 10-2).

Given that production is expected to commence around 2027 should the project proceed, and plateau production levels will continue for approximately 20 years, the decommissioning costs in terms of NEMA should be at -30% to +30%, which is aligned with the current provision estimate.

Table 10-2 – Financial Provisioning Regulations - Estimate Accuracy Level

End of Life of Operation (or Components of Operation) From Year of Assessment	Design Effort	Degree of Accuracy in Cost Estimation
> 30 years	Pre-Conceptual / Class 5 Estimate / up to 2% of complete definition	-50% to + 50%
10 to 30 years	Conceptual / Pre-feasibility / Class 4 Estimate / up to 15% of complete definition	-30% to + 30%
5 to 10 years	Preliminary / Feasibility / Class 3 Estimate / up to 40% of complete definition	-20% to + 20%
Less than 5 years	Detailed Designs / Bid / Tender / Class 2 estimate up to 75% of complete definition	-10% to + 10% (or less)

An initial Preliminary Site Restitution Plan (PSRP) will be developed during the pre-project and Basic/ front-end engineering and design (FEED) phases and is a mandatory document for project Final Investment Decisions (FID). The PSRP is revisited every 5 years to cater for any modifications (i.e., new abandonment techniques, addition of wells or changes in regulations). Moreover, an Asset Restitution Plan (ARP) is initiated around 5 years before the estimated assets Cease of Production date.

The abovementioned plans have an impact on future closure cost updates; therefore, alignment will be required at each respective stage. The closure costs will accordingly be revised and refined during subsequent development phases of the project once more detailed information becomes available. Thereafter annually during the operational phase as required by the relevant Financial Provisioning Regulations, 2015. It should be noted that the frequency of the updates might change based on the Financial Provisioning Regulations enacted in the future.

Future updates will be based on defensible third-party rates and quotations for individual decommissioning actions and will include separate allowances for contingencies (possible oversights/omissions and possible work not foreseen at the time of compilation of the closure costs), project management costs, and further studies required to address knowledge gaps.

Furthermore, plugging and abandonment projects have added risks compared to brownfield projects, including discovery work and unknowns related to corrosion (Caletka, 2018). Allowances for these aspects will therefore be revised as needed, to ensure the respective provisions remain reasonable.

10.2 EXPLORATION WELLS

10.2.1 EXPLORATION PLUGGING AND ABANDONMENT COST ESTIMATE ASSUMPTIONS

The purpose of the financial provisioning for plugging and abandonment of the exploration wells is to protect the State, taxpayers, and the receiving environment, should well closure be required due to a potential unplanned closure event or inadequate closure. If during drilling or operating of an exploration well, TEEPSA due to unforeseen reasons is no longer able to plug the well, a third party would need to intervene on behalf of the Competent Authority to gain control of and plug the well, for which purpose financial provisioning is required.

Current planning by TEEPSA is that the first exploration well will be drilled and subsequently plugged and abandoned. Any additional exploration wells would then be drilled thereafter based on results from the first well. However, for the purpose of the current closure cost estimate, the total cost of plugging and abandoning all four exploration wells including mobilisation and demobilisation requirements were determined.

TEEPSA will ensure that all exploration wells are plugged according to the relevant regulatory and industry requirements. The financial provision has therefore been based on this scenario and has been costed with the assumptions listed in Table 10-3.

Table 10-3 – Exploration Well Plugging and Abandonment Cost Estimate Assumptions

Closure aspect	Assumption
Rig (drill unit)	It is assumed that ten days of third-party mobilisation are required from GoG at 10 knots sailing speed and three days will be required to load the equipment on site and perform a custom clearance
Support vessels	It is assumed that seven days of mobilisation of one platform supply vessel (PSV) will be required from GoG at 14 knots sailing speed with three days to load the equipment with custom clearance. 12 days of mobilisation will also be required for one Healy Lift Platform Supply Vessel (HLPSV) with three days to load the equipment with custom clearance.
Rig (drill unit)	It is assumed that a maximum of 20 days of rig operation to plug and abandon each well will be required
General	Additional logistics, services and equipment required during plugging and abandonment include cranes, trucks, and helicopters
	Cement, additives, and other materials are required during the plugging process
	An over-trawl cap will be supplied and placed over the plugged well
	It is assumed that waste (if any) will be removed to an onshore licensed landfill site
	The well plugging and abandonment crew will subsequently demobilise
Site clearance and material disposal	▪ An allowance was made for site clearance and verification; and ▪ A nominal allowance for material disposal costs was also included

Closure aspect	Assumption
Additional Allowances	Engineering (8%): The costs of project management, engineering and planning for plugging and abandonment, and additional engineering and fluid studies required for well re-entry
	Operator upfront planning and monitoring (4%)
	Weather contingency allowance (30%): Provision for potential disruptions and/or delays caused by inclement weather
Work provision contingency	Provision for other unforeseen cost requirements, noting that historically the actual total plugging and abandonment costs have consistently been found to be about 15% over the estimated cost of the major plugging and abandonment activities

10.2.2 EXPLORATION PLUGGING AND ABANDONMENT COST ESTIMATE

The estimated plugging and abandonment costs for exploration well drilling, inclusive of all four exploration wells, for the Project is approximately **USD 93.5 million,** as summarised in Table 10-4:

Table 10-4 - Exploration Well Plugging and Abandonment Class 4 Cost Estimate

Item	Cost
Mobilization and demobilization costs	$13 451 000
Well plugging and abandonment (four exploration wells)	$68 110 000
Logistics during P&A activities	$11 471 000
Subsea over-trawl structures	$223 000
Site clearance and materials treatment	$201 000
Operator upfront planning and monitoring (4%)	$3 738 000
Total:	**$93 456 000**

*Note – Engineering (8%), weather contingency allowance (30%), and work provision (15%) included in these costs

10.3 PRODUCTION INFRASTRUCTURE

10.3.1 PRODUCTION INFRASTRUCTURE CLOSURE COST ESTIMATE ASSUMPTIONS

As for the exploration activities, the financial provisioning for the closure of the production infrastructure is based on the need to protect the State, taxpayers, and the receiving environment, should unplanned closure of the production facility be required. The basis for calculating the quantum to be provided for is again based on the requirement to address all potential closure related considerations once the infrastructure has been constructed, noting the “green fields” nature of the project.

The “base-case” production closure costs computation is predicated on all five production wells and associated production infrastructure. Additional scenarios for the first ten years of production (three wells) and inclusion of a potential additional production well (six wells) are also included.

The closure costs estimate can be reviewed annually based on the production works programme, to include full production capacity at the time as required, and thereby ensuring that adequate and appropriate financial closure cover remains in place.

Table 10-5 outlines the assumptions that have been considered for the financial provision associated with the plugging and abandonment of production wells.

Table 10-5 – Production Infrastructure Closure Cost Estimate Assumptions

Closure aspect	Assumption
Rig (drill unit) mobilization and demobilization	▪ It is assumed that ten days of third-party mobilisation are required from GoG at 10 knots sailing speed and three days will be required to load the equipment on site and perform a custom clearance; and ▪ Similar requirements for demobilization.
Support vessels mobilization	▪ It is assumed that seven days of mobilisation of one PSV will be required from GoG at 14 knots sailing speed with three days to load the equipment with custom clearance; and ▪ 12 days of mobilisation will also be required for one HLPSV with three days to load the equipment with custom clearance.
Support vessels demobilization	▪ It is assumed that seven days of demobilisation of one PSV will be required from GoG at 14 knots sailing speed with three days to load the equipment with custom clearance; and ▪ 12 days of demobilisation will also be required for one HLPSV with three days to load the equipment with custom clearance.
Inter-well travel	▪ It is assumed that 0.5 days per well of additional travel will required
Well plugging and abandonment	▪ Cost allowance has been made for plugging and abandoning five production wells, noting that additional scenarios for the first 10 years of production (based on three wells) and inclusion of a potential additional production well (six wells) have also been costed; ▪ Well plugging will require approximately 20 days per well; ▪ Well plugging may require a combination of MODU and non-MODU vessel spread which will be confirmed during operations; and

Closure aspect	Assumption
	▪ Allowances are made for consumables such as cement, required additives and other chemical mixing agents.
Logistics during well plugging and abandonment	▪ 20 days of PSV vessels on site per well; ▪ 20 days of HL PSV on site per well; ▪ 20 days of work at base on site per well including inter-well travel; and ▪ Daily helicopters flights are assumed.
Subsea over trawl structures	It is assumed that the over-trawlable steel structure is 5 000 kg and will be purpose-built
Pipelines and umbilicals	An average well depth of 1 500 m / 4 920 ft has been assumed.
	▪ Umbilical decommissioning costs can be highly variable, and have accordingly been averaged based on a variety of factors including the following: • Water depth; • Type of diving spread (air, mixed gas or SAT) or ROV spread; • Type of vessel required (work boat, 4-point dive boat, dynamic positioning, intervention or AHV with reels for umbilical); • Umbilicals that are fluid control need to be flushed; and • Whether the umbilical to be abandoned in place or removed.
Subsea structures decommissioning	▪ It is assumed that only two days will be required for retrieval operations; and ▪ It is assumed that three days required to conduct a subsea distribution abandonment visual inspection, and another three days for a production manifolds abandonment visual inspection
Site clearance and material disposal	▪ The site clearance and verification costs are assumed as 1% of the overall costs; and ▪ The material costs are assumed as 2% of the infrastructure (wells, pipelines, and subsea infrastructure) decommissioning costs.
General	▪ These costs exclude an allowance for the decommissioning of the F-A Platform modifications as they do not form part TEEPSA's liability as part of the Project.
Additional Allowances	▪ Engineering (8%): The costs of project management, engineering and planning for plugging and abandonment, and additional engineering and fluid studies required for well re-entry; ▪ Operator upfront planning and monitoring (4%); ▪ Weather contingency allowance (30%): Provision for potential disruptions and/or delays caused by inclement weather. The increased allowance for this aspect is based on the longer duration and high likelihood of weather disruption; and ▪ Provision for other unforeseen cost requirements, noting that historically the actual total plugging and abandonment costs have consistently been found to be about 15% over the estimated cost of the major plugging and abandonment activities.

10.3.2 PRODUCTION INFRASTRUCTURE CLOSURE COST ESTIMATE

The estimated decommissioning costs for the production aspect of the Project has been based on three separate scenarios, i.e. the first ten years (three wells), full production (five wells "base case") and including a potential additional production well (six wells), as follows:

- First ten years (three wells) is estimated at approximately **USD 132.0 million;**
- Full production (five wells) is estimated at approximately **USD 175.0 million**; and
- Additional production well (six wells) is estimated at approximately **USD 196.0 million**.

Table 10-6 - Production Infrastructure Class 4 Closure Cost Estimates in USD

Closure action	Up to year 10 (3 wells) estimate	Full production (5 wells) estimate	Additional production well (6 wells) estimate
Mobilization + demobilization costs	$13 226 000	$13 676 000	$13 901 000
Well plugging and abandonment*	$51 083 000	$85 138 000	$102 165 000
Logistics during well plugging and abandonment	$8 597 000	$14 345 000	$17 219 000
Subsea over trawl structures	$167 000	$279 000	$335 000
Pipeline and umbilicals decommissioning*	$48 765 000	$48 765 000	$48 765 000
Subsea infrastructure decommissioning*	$1 861 000	$1 861 000	$1 861 000
Site clearance and materials disposal	$3 222 000	$4 236 000	$4 236 000
Operator upfront planning and monitoring (4%)	$5 077 000	$6 732 000	$7 539 000
Total:	**$131 998 000**	**$175 032 000**	**$196 021 000**

*Note – Engineering (8%), weather contingency allowance (30%), and work provision (15%) included in these costs

10.4 COMBINED EXPLORATION AND PRODUCTION CLOSURE COST ESTIMATE

As per the closure costs reflected in Table 10-4 and Table 10-6, the total combined closure costs for the exploration (4 wells) and full production infrastructure (5 wells) amounts to **USD 268.5 million.** If an additional 6th well is included, the additional costs would amount to approximately **USD 21 million,** bringing the overall exploration and full production costs to approximately **USD 289.5 million**.

TEEPSA have separately estimated the costs for the FA platform related modifications to be decommissioned, as this aspect is excluded from the Project scope, and which amounts to a further **USD 25.6 million**.

11 PROPOSED ORGANISATIONAL STRUCTURE

11.1 CLOSURE ORGANISATIONAL STRUCTURE

The project will have dedicated, competent personnel that will manage and oversee the demobilisation aspects over the project lifecycle. TEEPSA, as operator of the block, will retain the primary responsibility for meeting environmental and social commitments throughout the project life span.

The key closure management roles and responsibilities supported by a project specific organogram will be defined and validated by the operator prior to the commencement of any closure activities.

11.2 TRAINING AND CAPACITY BUILDING

The advance notice of an asset's end-of-life stage allows owners to assess the risk involved and satisfy the necessary FEED, regulatory, and logistical requirements to estimate, plan and generally prepare for a smoothly executed project. (Caletka, 2018)

Every shift unit will have a plan, training, and expertise to effectively respond to emergency situations, to minimise their potential impact on the marine environment. All key personnel are International Well Control Forum (IWCF) certified level 2 to 4. Simulator training will be undertaken focusing on well control procedure in offshore environments.

Training will take cognisance of the level of education, designation, and language preferences of the personnel.

The appointed contractor (and any sub-contractors) will also be required to institute training programmes for its personnel. The contractor will be responsible for site HSE 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 the operator, and will be audited to ensure that:

- Training programmes are adequate and all personnel requiring training have been trained; and
- Competency is verified.

12 FURTHER WORK REQUIRED FOR THE CLOSURE PLAN

The following have been identified as programs and procedures which need to be undertaken to refine the Closure Plan scenarios as the Block 11B/12B project progresses:

- Initiate the development of an Asset Restitution Plan five years before the estimated assets Cease of Production date, including a full risk assessment to implement the best practices and technologies available;
- Further developing the initial high-level comparative assessment to a greater level of detail to determine the benefits and potential environmental impacts for the scenarios of either removing or leaving certain subsea equipment on the seafloor, based on industry developments, noting that any material deviations to the current Closure Plan and closure approach would require further stakeholder engagement;
- Well abandonment program detailing design and verification tests to establish integrity;
- Revision and refinement of closure cost assessment aligned with the Financial Provisioning Regulations, 2022, as greater level of detail and design of the specific plugging and over-trawlable structure, and plugging and abandonment mobilization and decommissioning schedule becomes available; and
- This closure framework should be regarded as a live document and will be reviewed and updated annually as per the Financial Provisioning Regulations (2022) and PASA, to include new information made available through studies and improved understanding of project and the planned transition to closure.

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Appendix A

SPECIALIST CV

Johan Bothma

Earth & Environment - Rehabilitation & Closure, Visual Assessment Specialist, Registered Landscape Architect

CAREER SUMMARY

Johan is the Director for Rehabilitation and Closure based in the Midrand, South Africa office. He has 18 years consulting experience and is currently advancing closure planning and costing for mining and industrial sites, with a focus on risk mitigation, post mining land use planning and land stewardship. Johan has completed mine closure related projects for a wide variety of commodities throughout Africa and abroad. He specialises in visual assessment and graphic representation of project impact and mitigation and also has considerable experience in impact assessment, environmental management plans, and auditing for mining, industrial, commercial and property development and projects.

Johan is a professionally registered Landscape Architect and completed his master's degree in 2004, focusing on climate responsive design and energy efficiency for residential developments. He has previously worked on various landscape planning and design projects, including large scale open space management plans, as well as landscape architectural design for prestige governmental projects including the Presidential residence in Bryntirion Estate in Pretoria.

14 years with WSP

18 years of experience

Area of expertise

Advancing Closure Planning and Costing

Land Use Planning and Latent Risk Mitigation

Visual Assessment

Environmental Management Plans

Auditing for Mining, Industrial & Commercial

Property Development

Open Space Management Plans

Landscape Design Projects

Open Space Management Plans

Language

Afrikaans – Fluent

English – Fluent

EDUCATION

MLArch Landscape Architecture, University of Pretoria, Pretoria	2004
BL Landscape Architecture, University of Pretoria, Pretoria,	2001

PROFESSIONAL AFFILIATIONS

Institute of Landscape Architecture of South Africa (ILASA)	2007
South African Council for the Landscape Architectural Profession (SACLAP)	2007

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd.	July 2022 – present
Golder Associates Africa (Pty) Ltd.	2008 – June 2022
African EPA	2004 – 2007
University of Pretoria (part-time contract)	2003
Strategic Environmental Focus SA (part-time contract)	2002 – 2003
Karien Hanekom Landscape Architects (part-time contract)	2001 - 2002
Maarten Venter Landscape Architects (part-time contract)	2000

PROFESSIONAL EXPERIENCE

REHABILITATION AND CLOSURE

Anglo American Platinum – Limpopo Province, South Africa
2021 – ongoing
Project director

Ongoing closure planning and costs development aligned to the requirements of GN R. 1147, Anglo American Mine Closure Toolbox Version 3 and IRMA, including operational rehabilitation planning and residual costs quantifications.

Sasol Secunda - Mpumalanga, South Africa
2015; 2017; 2019; 2021-2022
Project manager/technical director

Project manager 2015 and 2017, and technical direction and review 2019 and 2021-22 closure costs updates, for the Sasol Secunda Synfuels and Chemicals operations complex, including waste disposal, post-closure water treatment and cash flows.

Sibanye-Stillwater Gold Mines - Gauteng, Free State, and Mpumalanga, South Africa
2013 - ongoing
Project manager/project director

Ongoing closure planning and costs updates for the Kloof, Driefontein, Cooke, Ezulwini, RUSO, Beatrix and Burnstone operations, including operational rehabilitation planning and residual costs quantifications.

Sibanye-Stillwater Platinum operations - Northwest Province and Limpopo, South Africa
2017 - ongoing
Project manager/project director

Ongoing closure planning and costs updates for RPM, Kroondal, Marikana and Blue Ridge operations, including operational rehabilitation planning and residual costs quantifications.

Arnot OpCo Coal Mine - Mpumalanga, South Africa
2016 – 2019 (Exxaro), 2020 – ongoing (OpCo)
Project manager/technical review

Comprehensive GN R. 1147 compliant closure plan and costs for final closure of Arnot Coal mine, including qualitative and quantitative risk assessments, residual and latent risk mitigation and costs.

Gold Fields South Deep Mine - Gauteng, South Africa
2013-2017; 2019
Project manager

Operational rehabilitation, closure planning and costs, detailed next land use plan, residual and latent costs determination towards GN R. 1147 compliance. Compilation of joint Sibanye/Gold Fields rehabilitation options analysis, planning and costing for the Leeuwspruit.

Mafube Coal Mine - Mpumalanga, South Africa
2017
Project manager

Closure plan and bio-physical closure costs, qualitative and quantitative risk assessments, residual and latent risk mitigation and water treatment costs, towards GN R. 1147 compliance.

Morupule thermal power station, and coal mine - Morupule area, Botswana
2016; 2018, 2021 - ongoing
Project manager/project director

Closure costs determination and closure framework for Phase 2 expansion of Morupule thermal coal power station (2016), and closure costs review and update of Morupule coal mine (2018, 2021).

Kenmare Moma Mine - Sofala, Mozambique
2015; 2018; 2020
Project manager

Scheduled and unscheduled closure cost updates for Moma sand mine in Mozambique.

Anglo New Denmark, New Vaal, Union and Goedehoop Mines interim closure planning and costing - Mpumalanga, South Africa
2013 – 2014
Project manager/closure specialist

Anglo Closure Toolbox interim closure planning for respective Anglo Coal mines, including state of the environment, rapid strategic environmental assessment, closure criteria, risk assessment, closure costing and next land use planning.

Zincor detailed land use plan - Gauteng, South Africa
2013
Project manager

Detailed evaluation of post-closure next land use options for decommissioned Zincor zinc smelter complex.
Letlhakane and Jwaneng land use plans and graphic modelling - Botswana

2012 – 2014
Closure specialist

Post-closure land use plans for the Letlhakane and Jwaneng open pit diamond mines in Botswana. Graphic modelling direction for various waste rock disposal, site-wide rehabilitation and end land use planning alternatives. Closure costs final review for Jwaneng.
Thaba Metsi Coal Mine - Limpopo, South Africa

2012
Closure specialist

Scheduled and unscheduled closure cost determinations, preliminary end land use plan for Thaba Metsi opencast and underground coal mine.

Goedehoop Colliery - Mpumalanga, South Africa
2012
Closure specialist

Scheduled and unscheduled closure cost determinations, preliminary land use plan for Goedehoop North and South underground coal mines.
International closure projects review and technical inputs (various)

Project manager/closure specialist

Specialist closure planning and costs direction and review for various African and international mines, including Kinsevere, Kipushi and Kamoa copper mines (DRC), Kansanshi copper mine (Zambia), Guelb Moghrein gold-copper mine (Mauritania), Maamba coal mine (Zambia), Torex gold mine (Mexico).

VISUAL IMPACT ASSESSMENTS

CNOOC on-shore gas project Visual Impact Assessment - Lake Albert, Uganda
2018 – 2019
Project manager/visual assessment specialist

Visual impact assessment and strategic direction for night-time light glare pollution for the new CNOOC offshore oil project on the shore of Lake Albert in Uganda.

Lonmin solar plant Visual Impact Assessment - Northwest Province, South Africa
2013
Project manager

VIA, including viewshed analysis and complex glare path analysis of a proposed photovoltaic installation at Lonmin mine.

Zonnebloem, Schoonoord, Brakfontein, Optimum, Rondebult, Doornrug, and Middelkraal mines – various locations in South Africa
2006 – 2013
Project manager/visual assessment specialist

Complex, staged VIA including viewshed analysis, for various phases of mining.

Letlhakane and Jwaneng diamond mines Visual Impact Assessment - Botswana
2012
Project manager/visual assessment specialist

Visual assessment and extensive graphic modelling for the rehabilitation, closure, and end land use of Lethlakane and Jwaneng open pit diamond mines in Botswana.

Kamoa, Dumasi mines Visual Impact Assessment - DRC, Ghana
2013
Visual assessment specialist

Visual impact assessments for open pit mines.

Schoonoord coal mine Visual Impact Assessment - Mpumalanga, South Africa
2012
Visual assessment specialist

Complex, staged VIA including viewshed analysis, for various phases of mining.

Prestea gold mine Visual Impact Assessment - Ghana, Ghana
2012
Visual assessment specialist

VIA for the redevelopment and expansion of the mothballed Prestea mine at the town of Prestea.

Letlhakane Diamond Mine Visual Impact Assessment - Orapa, Botswana
2012
Visual assessment specialist

Visual assessment and extensive graphic modelling for the rehabilitation, closure, and end land use of Letlhakane open pit diamond mine in Botswana.

Scantogo, Project title, Tabligbo, Togo
2011
Visual assessment specialist

VIA for the construction of a quarry and clinker production plant.

Crossways & Sunnyvale Estate Visual Impact Assessment - Kouga Municipality, EC, South Africa
2009
Visual assessment specialist

VIA Report for proposed new residential development just outside of Jeffrey's Bay. Report included photographic assessment of existing site conditions, GIS viewshed analysis and modelling of visual impact before and after proposed development, Graphic representation of the visibility of the development from key visual vantage points and assessment of visual mitigation measures.

Client, Boplaas Residential Estate Visual Impact Assessment - Kouga Municipality, EC, South Africa
2009
Visual assessment specialist

VIA for proposed new residential development just outside of Jeffrey's Bay. Report included photographic assessment of existing site conditions, GIS viewshed analysis and modelling of visual impact before and after proposed development, Graphic representation of the visibility of the development from key visual vantage points and assessment of visual mitigation measures.

KUKA, KUKA Aerial Ropeway Visual Impact Assessment - Mpumalanga, South Africa
2009
Visual assessment specialist

VIA specialist study for the proposed new 50 km aerial ropeway, that will transport coal ore between the Lion and CMI Smelters and Thorncliff Mine, via suspended buckets. The Ropeway itself is suspended from a series of pylons up to 22 m high, spaced several hundred meters apart. The VIA included a thorough photographic baseline assessment of the study area, modelling of the proposed infrastructure, a complex viewshed analysis that illustrated the impact of the ropeway over distance as well as the number of pylons that will be visible, a 3-dimensional photo montage of the proposed infrastructure within the landscape as well as impact assessment and mitigation report.

Tubatse Chrome WTP Visual Impact Assessment - Mpumalanga, South Africa
2009
Project manager/visual assessment specialist

VIA specialist study for the proposed new Water Treatment Plant and associated additional infrastructure for Tubatse Chrome, as part the overall Environmental Impact Assessment (EIA) process for the project. The existing Tubastse Chrome plant is situated just south of the town of Steelpoort along the R555 Road in Mpumalanga Province, South Africa.

Anglo, Coal bed methane - Anglo Coal Gas Projects, Limpopo, South Africa
2009
Visual assessment specialist

VIA specialist study for the proposed new Anglo Coal Gas Projects (Anglo Coal) 4,000 ha coal bed methane gas production site 25 km northwest of Lephalale (Ellisras), and an electricity transmission line to be routed from the proposed 4,000 ha site to a substation north of Lephalale in the Limpopo Province.
The development includes the development of 37 gas well on the farm Nooitgedacht that is approximately 1,000 ha in extent. The proposed 37 spot will be run as an extension to exploration activities, in order to provide a large-scale production test.

Western Utilities Corporation Visual Impact Assessment - Gauteng, South Africa
2009
Visual assessment specialist

VIA specialist study for the proposed new collection and distribution pipelines and associated purification and pumping infrastructure, for the ambitious WUC project, that aims to address the acid mine drainage problem in the West Rand. Although the pipeline will be mostly buried, they traverse a vast area and may potentially affect several areas of some visual significance and the project will potentially influence a very large number of people during the construction phases of the project. the VIA included a thorough photographic baseline assessment of the study area, modelling of the proposed infrastructure, GIA mapping of the visual resource quality of the landscape and anticipated of visual impact during construction, as well as impact assessment and mitigation report. the VIA report was awarded with the first Golder Africa Technical Writing Award, for excellence in technical report writing.

Cape Gate waste site Visual Impact Assessment - Gauteng, South Africa
2009
Visual assessment specialist

VIA specialist study for the proposed expansion of the Cape Gate waste and by-product storage site, which will include several large storage and discard dumps, storm water management dams, vehicular parking and loading areas and ancillary infrastructure. Analysis included extensive modelling of the dumps over the lifespan of the project, projected visibility of the dumps, the development of visual mitigation strategies and modelling of the anticipated effectiveness of the proposed mitigation of the development and management strategy.

Umcebo Rondebult, Doornrug, Steelecoal and Middelkraal mines Visual Impact Assessment - Mpumalanga, South Africa
2006
Visual assessment specialist

VIA for new opencast coal mine infrastructure and mining operations. Report included photographic assessments of existing site conditions, assessment of visual impact before and after proposed mine infrastructure, and graphic representation of proposed visual mitigation measures.

Xstrata Rhovan mine VIA - Brits, South Africa
2006
Visual assessment specialist

VIA for expansion of existing slimes dam, related infrastructure and plant area. Report included photographic assessments of existing site conditions, GIS viewshed analysis and modelling of visual impact before and after proposed mine infrastructure, and graphic representation of proposed visual mitigation measures. Preliminary cost assessment and implementation plan for proposed visual mitigation measures.

Xstrata Aloys, Lydenburg Works VIA - Mpumalanga, South Africa
2006
Visual assessment specialist

VIA for expansion of existing slimes dam, related infrastructure and plant area. Report included photographic assessments of existing site conditions, GIS viewshed analysis and modelling of visual impact before and after proposed mine infrastructure, and graphic representation of proposed visual mitigation measures. Preliminary cost assessment and implementation plan for proposed visual mitigation measures.

Paardeplaats Residential Estate VIA - Gauteng, South Africa
2006
Visual assessment specialist

VIA compiled for proposed new residential development near the National Botanical Gardens in Krugersdorp. Report included photographic assessments of existing site conditions, modelling of visual impact before and after proposed development, Graphic representation of the visibility of the development from key visual vantage points and assessment of visual mitigation measures.

Schurveberg Residential Estate, Northwest Province, South Africa
2006

Visual assessment specialist

VIA for proposed new residential development east of Pelindaba, within ecologically significant valley. Report included photographic assessments of existing site conditions, GIS viewshed analysis and modelling of visual impact before and after proposed development, Graphic representation of the visibility of the development from key visual vantage points and assessment of visual mitigation measures.

ENVIRONMENTAL ASSESMENTS

Menlyn Maine EMPs and environmental audits, Pretoria, South Africa
2011 – 2013
Project manager, EMP auditor

Compiled Environmental Management Plans for the Menlyn Maine Clinton Climate Change Initiative-endorsed Phase 1 infrastructure development as well as Falcon, Epsilon and Pegasus Buildings; and conducted construction environmental compliance audits. All projects are targeting a minimum Green Star SA four-star rating, and LEED ND certification.

Tubatse, Water treatment and pelletiser plant EMP audits, Limpopo Province, South Africa
2010 – 2013
Project manager, EMP auditor

Six-monthly environmental compliance audits in terms of approved EMP and Environmental Authorisations for construction and operation of new water treatment plant and pelletiser plant.

Rand Uranium, TSF EIA, Gauteng, South Africa
2010
EIA Lead

Long term tailings storage facility for disposal of up to 350 million tons of re-processed tailing from a number of tailing resources in the Randfontein area, including 40 km associated pipelines. Coordination of specialist assessment and public participation in terms of overall EIA process.

Transnet, New Multi-Products Pipeline (NMPP) EMP, Durban, Kwa Zulu-Natal to Jameson Park Near Heidelberg, South Africa
2008
EMP development

Compiled the Environmental Management Plan (EMP) for the design, construction, operations, and decommissioning phases of the NMPP project. This consisted of a new multi-products liquid fuel pipeline (or "Trunkline") running from Durban, Kwa Zulu-Natal to Jameson Park near Heidelberg in Gauteng, with a pump station at each terminal, and eight pump stations along the route. A coastal fuel terminal either at the Durban International Airport or and inland fuel terminal at Jameson Park near Heidelberg. The EMP ensured that recommendations of numerous specialists from a wide variety of fields were implemented. Following the compilation of a draft version of the EMP, I also facilitated a detailed workshop between the Contractor and the Client to establish that the mitigation measures proposed are feasible, following which the EMP was amended as required.

City of Tshwane, KH2 and KK1,2,3 Pipelines, Pretoria, South Africa
2008
Project manager, EMP auditor

Various environmental processes to obtain authorisation for the installation of the proposed pipeline. Amendment and update of detailed Environmental Management plan for planning, construction, and operation phases.

The Hills and Sammy Marx lifestyle estates, Water Use Licence Applications, East of Pretoria, South Africa
2008 and 2013
Project manager

Water use licence applications for two extensive mixed use lifestyle estates.

Northwest Province Department of Roads and Transport Road D419 EIA, Northwest Province, South Africa
2005
EMP development

EMP for the construction of road D419, including extensive addressing of erosion prevention and mitigation. EIA Scoping report for the proposed D419 Road between the two Lekgophung and Swartkopfontein in the Northwest Province. The distance between the two termini of the road (approximately 15 km) required extensive consideration of several alignment option and extensive public participation.

The Hills Estate EIA and WULA, Pretoria, South Africa
2004
Project manager, EIA and WULA development, EMP auditor

EIA Scoping Report, EMP and various Water Use Licence Applications for “The Hills” mixed use development in Kungwini, east of Tshwane. This project was particularly complex due to the large extent of the site, large scale of the development and many environmental factors that had to be accommodated. The project includes single stands within an ecological conservation area, medium and high density residential and commercial sectors, resort and hotel facilities, a golf course designed by Greg Norman and the Jacques Kallis cricket oval.

Landscape Design

South African Police Services, Roodeplaat dog school landscape, Gauteng, South Africa
2007 – 2014
Project manager, landscape architect

Initial planning and detail landscape design as well as construction supervision for expanded and upgraded South African Police Services dog school facilities.

DPW Mahlamba Ndlopfu, Presidential residence landscape design, Pretoria, South Africa
2006 – 2009
Project manager, landscape architect

Conceptual and detail design of landscape architectural improvements. Set up of tender documentation and full administration and management of tendering and tender adjudication process for main landscaping contractor, contractor supervision and instruction for interim improvement measures and implementation. Coordination of process with Bryntirion ISM requirements.

DPW Bryntirion Estate Detail Landscaping Design, Pretoria, South Africa
2006 – 2008
Project manager, landscape architect

Initial conceptual and detail design of the landscape associated with the proposed new inner and outer fences around the entire estate, as well as the proposed new gatehouses. Extensive coordination with the entire project team and integration of all relevant Bryntirion ISM planning principles.

Rustenburg Local Municipality, Open Space and Heritage Management Plan (ROSHMAP), Rustenburg, South Africa
2007
Spatial planning expert

Initial project execution planning and engagement of stakeholders and public as well as various departments of Rustenburg Local Municipality (RLM). Coordination of all GIS mapping and databases associated with the project. Administration and management of the Public Participation and Ward Council Engagement processes. Co-author and compilation of the Draft, Final Draft and Final versions of the comprehensive project report outlining open space and heritage management plan, including proposed genetic project proposal and management strategies.

Bloemhof, Bloemhof Dam Landscape Planning and Conceptual Design, Free State, South Africa
2007
Landscape architect

Conceptual layout and design as for the proposed Bloemhof Dam tourism and recreation resort development, as well as master plan proposal for the development. Development includes water park, sports facilities, multi-functional halls, agricultural show grounds, caravan park, fish amenities and associated facilities, as well as residential golf estate. Integration with engineering services and design of jetty structure.

Bryntirion Estate, Union Building and Ministerial Residential FM Tender, Pretoria, South Africa
2007
Project manager, landscape architect

Drafting setup and completion of tender documentation for DPW Facilities management project, including all specification, contractual matters and Provisional Bills of Quantities for landscape architectural and horticultural services for the project, and integration with architectural, engineering, safety and main Quantity Surveyor consultants on project, as well as DPW Horticultural Services. Facilities Estate and properties included in the project are the entire union Building complex, Brynition Estate and over 20 prestige portfolio residences in Gauteng. Projected landscape value of the project over 3 years amount to upwards of R 350 million.

Bryntition Estate, Heritage Conservation Management Plan, Pretoria, South Africa
2007
Project manager, landscape architect

Part of a multi-disciplinary consortium involved with the Bryntirion Heritage Integrated Services Management Plan. Duties included a landscape inventory and assessment of the individual landscape elements and gardens of Bryntition Estate. Specifically, the trees and built landscape elements were inventoried. Furthermore, the different landscape areas, that have distinct qualities and attributes that distinguish them from each other, were also identified and prescribed according to the definitions of the National Heritage Resources Act (Act No. 25 of 1999). Area of "cultural significance" in terms of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance were identified and inventoried. The significance of the individual landscape elements and areas, both natural and man-made, was determined using the criteria of the NHRA. This was done using a set of assessment sheets, developed specifically for the project.

The overall purpose of the landscape character assessment and inventory was to guide the development of the landscape character assessment and inventory was to guide the development of the landscape Heritage Conservation Plan, Landscape Development Plan and Landscape Management Programme, which I carried out for the project. Conservation, development and management guideline in terms of planting design, hard landscaping design and spatial design were set up for the entire estate and a report was written for the integration of the new outer boundary fence with the existing landscape elements of significance. Pilot projects from a landscape point of view were also identified and described.

City of Tshwane, Environmental Guidelines, Pretoria, South Africa
2005
Environmental Guidelines

Civil municipal infrastructure projects for Tshwane Municipality. This project involved determining all environmental impact caused by municipal infrastructure during the contraction, operational and maintenance phases and displaying these impacts in a matrix with all the infra-structural components. The process involved extensive participation from the various relevant departments of CTMM, including several workshops. An extended EMP was produced for all three phases of the infrastructure. A tool was developed in consultation with a programmer, which allows the electronic capture of the information, enabling the user to carry out various kinds of searches per impact or to update the database.

Bryntirion Estate, VIP Residence and Staff Quarters Landscape, Pretoria, South Africa
2005
Landscape Design

VIP residence and staff housing on Bryntirion Estate in Pretoria: Extensive co-ordination with the architectural design team, taking into account the requirement for extensive indigenous planting design, due to the proximity of the site to the Meintjieskop Hill natural area. Integration of the landscape design with the Bryntirion Estate Heritage Conservation Management Plan Final tender documentation and Bills of Quantities. Site supervision/ inspection for construction process.

Galeshewe, Open Space and Landscape Plan (GOSLP), Kimberley, South Africa
2003
Primary Project Planner
Responsibilities included liaison with all parties involved in the project, on site survey of open space network with members of the community, research and background study work, writing of articles to promote the project, participation in workshops to involve community members in the decision-making process and conceptual design solution for the identified priority projects. Extensive GIS mapping and categorisation of open space network including suggested future development and proposed projects. Creation of an interactive electronic database of all spatial and written information of the open space inventory and spatial development programme.

PUBLICATIONS

Hattingh, R and Bothma, J. 2013. Taking the risk out of a risky business: a land use approach to closure planning, in Mine Closure 2013. Edited by M. Tibbett, A.B. Fourie and C. Dogby. Australian Centre for Geomechanics: Perth.

Bothma, J. and Theron, G. 2012. Human comfort and the South African climate design regions in terms of small-scale development design, in South African Landscape Architecture - a Reader. Pretoria: Unisa Press.

Bothma, J., Crockett, D. and Southwood, J. 2012. Siting a building for human comfort, on SABMag homepage. [Online] Available: www.sabmagazine.com/blog/2011/12/21/siting-a-building-for-human-comfort/

Bothma, J. 2011. Greening the building: Plants, planting and detailing, in Green Building Handbook South Africa - the Essential Guide Volume 3. Edited by L. Van Wyk, Cape Town. Alive2green (pp209-226)

Bothma, J. 2010. Siting a building for Human Comfort, in Green Building Handbook South Africa - The Essential Guide Volume 2. Edited by L.V. Wyk, Cape Town
Alive2green (pp57-72)

Theron, G. and Bothma, J. 2009. The Ecology of Building and Landscape Design, in Green Building Handbook South Africa Volume 1: A Guide to Ecological Design. Edited by L. van Wyk, Cape Town: Alive2green cc (pp61-75).

Bothma, J. 2004. “Landscape and Architectural Devices for Energy-Efficient South African Suburban Residential Design” Submitted in partial fulfilment of the requirements for the degree Master of Landscape Architecture. Pretoria: University of Pretoria.

Tshegofatjo Mashedi
Earth & Environment - Planning and Advisory, Consultant: Mine Closure

CAREER SUMMARY

Tshegofatjo is Mine Closure Consultant in the Landuse and Closure Division at WSP Group (Pty) Ltd. Tshegofatjo has a BSc Honours in Environmental Management from the University of South Africa. As a mine closure consultant, Tshegofatjo specializes in mine closure planning, closure cost assessments and environmental risk assessments for mines locally and internationally.
Tshegofatjo has provided mine closure-related services mines in South Africa, Lesotho, Botswana, Saudi Arabia, Zambia, Mali, Ghana and Malawi.
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1 years with WSP ***3 years of experience***

Area of expertise ***Language***

Mine Closure Cost Assessments
Technical Reviews of Mine Closure Cost Assessments
Mine Closure Planning
Google Maps QGIS
Rehabilitation
Project Management
Knowledge of the Financial Provisioning Regulations and South African Environmental Legislation

English – Fluent

EDUCATION

Bachelor of Science Honours Degree, Environmental Management, University of South Africa 2020 – 2022
Bachelor of Science Degree, Geography and Environmental Management, University of Johannesburg 2016 – 2019

ADDITIONAL TRAINING

Climate change, World Merit South Africa 2019
Greenhouse effect, air pollution and the atmosphere, ACCESS HPW Online 2019
Environmental and Technical Risk mitigations and alternatives, Thero Services 2019
SA Environmental laws and practicality, EcoPartners (EIA Workshop) 2019
Air Quality laws, Department of Environmental Affairs 2019

Professional Memberships

SACNASP - Candidate Natural Scientist, South African Council for Natural Scientific Professions – Membership No. 126562 2020
GISSA - Member, The Geo-Information Society of South Africa – Member No. BSXZ-6375 2020

Tshegofatjo Mashedi
Earth & Environment - Planning and Advisory, Consultant: Mine Closure

Professional History
WSP Group Africa (Pty) Ltd, Mine Closure Consultant April 2022 – present
Digby Wells Environmental, Jnr Mine Closure Consultant 2021 – March 2022
Digby Wells Environmental, Assistant Mine Closure Consultant 2020 – 2020
Digby Wells Environmental, Mine Closure Intern 2020 – 2020

Professional Experience

Mine Closure Cost Assessment

Anglo American, Twickenham Closure Plan according to Anglo American Mine Closure Toolbox Version 3, South Africa
2022
Closure Specialist
Detailed Mine Closure plan compilation.

Sibanye Gold and Platinum, Closure Plan based on GN R. 1147 method, South Africa
2022
Closure Specialist
Detailed Mine Closure plan compilation

Glencore Plc, Closure Plan based on GN R. 1147 method, South Africa
2022
Closure Specialist
Detailed Mine Closure plan compilation.

Mbuyelo Coal (Pty) Ltd, Closure Cost Assessment for Ntshovelo (Vlakvarkfontein) and Manungu collieries based on DMRE and GN R. 1147 method, South Africa
2020 - 2022
Closure Specialist
Report compilations and closure cost calculation. Mine closure cost, final rehabilitation decommissioning closure plan, annual rehabilitation report, environmental risk report and financial provision report.

HCI Coal (Pty) Ltd, Closure Cost Assessment for Mbali and Palesa collieries based on DMRE and
GN R. 1147 method, South Africa
2020 - 2021
Closure Specialist
Report compilation and closure cost calculation. Mine closure cost, final rehabilitation decommissioning closure plan, annual rehabilitation report, environmental risk report and financial provision report.

Harmony Gold Mining Company Limited, Closure Cost Assessment based on the DMRE and GN R. 1147 method, South Africa.
2020 - 2022
Closure Specialist

Tshegofatjo Mashedi
Earth & Environment - Planning and Advisory, Consultant: Mine Closure

Report compilation and closure cost calculation. Mine closure cost, final rehabilitation decommissioning closure plan, annual rehabilitation report, environmental risk report and financial provision report.

Sasol IXIA, Rehabilitation Closure Plan for Ixia, South Africa
2020
Closure Specialist
Detailed rehabilitation plan compilation and life of mine closure cost. Mine closure cost and report forming part of an integrated ESIA project.

Storm Mountains Diamond, Closure Plan for the Kao Diamond Mine, Lesotho
2021
Closure Specialist
Detailed closure plan compilation and life of mine closure cost. Mine closure cost and closure plan report.

Barrick Gold Corporation, Closure Cost Assessment for Loulo, Gounkoto and Morilla, Mali
2020 - 2021
Closure Specialist
Report compilation and closure cost calculation. Mine closure cost and report.

PPC, Closure Cost Assessment for Cimerwa Cement Factory, Rwanda
2020 - 2021
Closure Specialist
Report compilation and closure cost calculation. Mine closure cost and report.

PPC, Closure Cost Assessment for PPC South Africa based on GN R. 1147 method, South Africa
2021
Closure Specialist
Annual rehabilitation report compilations. Mine closure cost, final rehabilitation decommissioning closure plan, annual rehabilitation report, environmental risk report and financial provision report.

LimeChem (Pty) Ltd, Closure Cost Assessment for LimeChem, South Africa
2020
Closure Specialist
Report Compilation and Closure Cost Calculation. Mine closure cost and report.

Universal Coal, Closure Cost Assessment for Kangala, NCC and NBC collieries based on the DMRE and GN R. 1147 method, South Africa
2020 - 2021
Closure Specialist
Report Compilation and Closure Cost Calculation. Mine closure cost, final rehabilitation decommissioning closure plan, annual rehabilitation report, environmental risk report and financial provision report.

Technical Review

Guardrisk Insurance Company Ltd, Technical Review for 7 Africoal Operations, South Africa
2021

Tshegofatjo Mashedi
Earth & Environment - Planning and Advisory, Consultant: Mine Closure

Closure Specialist
Closure cost review and report Compilation. Technical review.
Guardrisk Insurance Company Ltd, Technical Review for the Eyethu Kromdraai Colliery, South Africa
2021
Closure specialist
Closure cost review and report Compilation. Technical review.
Resettlement Action Plan
Mafube Colliery, Development and Implementation of a Resettlement Action Plan and Grave Relocation Process for the Mafube Colliery in the Steve Tshwete Local Municipality, Mpumalanga, South Africa
2020
Data collection
Conducting social household surveys for a stakeholder database. Household resettlement and grave relocation process.
AWARDS
2021 - Hall of Fame: Digby Wells Environmental 2016 - Top Three: Human Geography
2020 - Hall of Fame: Digby Wells Environmental 2017 - Top Ten: Climatology and Geomorphology

2019 - Top Ten: Geoinformatics 2018 - Best Achiever: Zoology (Parasitology)
2019 - Top Ten: Environmental Management
2018 - Best 1st year for four-year Life and Environmental Sciences: Chemistry
2018 - Top Ten: Environmental Management

Appendix B

RISK MATRIX

E&P universal 6x6 risk matrix

			Production Shortfall (MAP)	<2K boe	>2K, <20K boe	>20K, <200K boe	>200K, <1M boe	>1M, <10M boe	>10M boe
	Risk Classifications & Definitions from DIR-GR-SEC-002 and DIR-GR-SEC-008		**Media**	Local rumour or no media consequence	Local rumour / regional press	Regional press + regional TV, national rumour	National press + national TV	International press + international TV	International press + international TV for prolonged period
			Material	<20K €	>20K, <200 €	>200K, <2M €	>2M, <10M €	>10M, <100M €	>100M €
			Environmental [1]	Minor spill with no environmental impact	Minor pollution with a very limited environmental impact	Moderate pollution with limited environmental consequences	Pollution having significant environmental consequences	Large-scale pollution of ecosystems having a recognized ecological value	Pollution having massive and durable consequences for vast ecosystems having a high ecological value
			Human	First aid or medical treatment or restricted work days	Single lost-time injury (LTI) with no disability	Single lost-time injury (LTI) with disability or multiple lost-time injuries	Internal: 1 Fatality and/or several disabilities Public: Disabilities	Internal: 2 to 5 Fatalities Public: 1 Fatality	Internal: >5 Fatalities Public: >1 Fatality
Production Shortfall (or Gain)	**Human, Environmental, Material and Media**			**Severity of Consequence**					
				Minor	**Moderate**	**Serious**	**Very Serious**	**Catastrophic**	**Disastrous**
				1	**2**	**3**	**4**	**5**	**6**
Incident almost inevitable under current conditions (or for gain) Certain fully successful modification outcome	Expected to occur several times during plant lifetime	**Very Likely $> 10^{-1}$**	**6**	**6**	**12**	**18**	**24**	**30**	**36**
Incident probable with additional factors (or for gain) High likelihood of fully successful modification outcome	Could occur several times during over plant lifetime	**Likely 10^{-1} - 10^{-2}**	**5**	**5**	**10**	**15**	**20**	**25**	**30**
Incident possible with additional factors (or for gain) Some uncertainty of successful modification outcome	Could occur once for every 10 to 20 similar plants over 20 to 30 years of plant lifetime	**Unlikely 10^{-2} - 10^{-3}**	**4**	**4**	**8**	**12**	**16**	**20**	**24**
Combination of rare factors required to cause an incident (or for gain) High uncertainty of successful modification outcome	One time per year for at least 1000 units. One time for every 100 to 200 similar plants in the world over 20 to 30 years of plant lifetime. Has already occurred in the company but corrective action has been taken	**Very Unlikely 10^{-3} - 10^{-4}**	**3**	**3**	**6**	**9**	**12**	**15**	**18**
Freak combination of factors required to cause an incident	Has already occurred in the industry but corrective action has been taken	**Extremely Unlikely 10^{-4} - 10^{-5}**	**2**	**2**	**4**	**6**	**8**	**10**	**12**
No similar incident in industry	Event physically possible but has never or seldom occurred over a period of 20 à 30 years for a large amount of sites (> few thousands, ex: wagons, process drums,…)	**Remote $< 10^{-5}$**	**1**	**1**	**2**	**3**	**4**	**5**	**6**

Likelihood of Occurrence

Risk Level 1

Risk Level 2

Risk Level 3

Major Consequence

[1] For more details on environmental definitions, refer to the Guidance for Environmental Classification (CR EP HSE 102)