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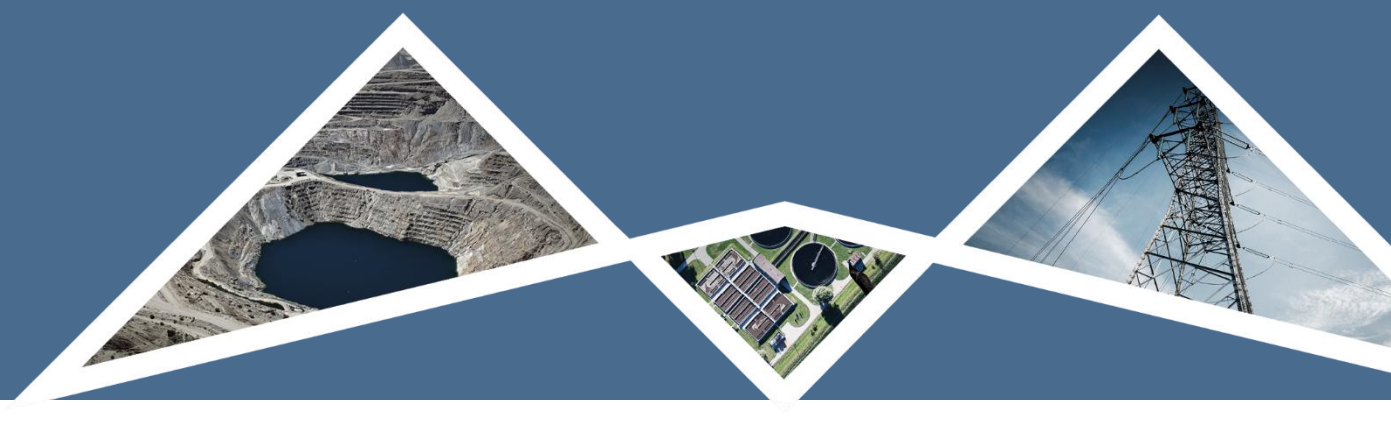
T 011 789 7170 E info@eims.co.za W www.eims.co.za

FINANCIAL PROVISION REPORT

MOTUOANE ENERGY (PTY) LTD HENNENMAN EXPLORATION RIGHT
EA REFERENCE NUMBER: 12/3/386



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COMPILED:	Jessica Jordaan		2026/05/26
CHECKED:	Liam Whitlow		2017/01/01
AUTHORIZED:	Liam Whitlow		2017/01/01

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Table of Contents

List of Figures

List of Tables

Appendices

Acronyms and Abbreviations

AQSR	Air Quality Sensitive Receptor
ARP	Annual Rehabilitation Plan
CBA	Critical Biodiversity Area
CMA	Catchment Management Agency
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services
EMPr	Environmental Management Programme
ERA	Environmental Risk Assessment
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
FRDCP	Final Rehabilitation, Decommissioning and Closure Plan
GN	Government Notice
IDP	Integrated Development Plan
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NPAES	National Protected Areas Expansion Strategy
NHRA	National Heritage Resources Act
PASA	Petroleum Agency South Africa
PWP	Project Works Programme

EXECUTIVE SUMMARY

Motuoane Energy (Pty) Ltd (the Applicant) has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) to conduct a Financial Provision Assessment for Exploration Right ER386, to be exercised within the Free State Province. This assessment forms part of the broader Environmental Impact Assessment (EIA) required to support the Environmental Authorisation (EA) application for listed activities triggered under the National Environmental Management Act (Act 107 of 1998, as amended - NEMA).

According to the National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Financial Provision Regulations (2015) (NEMA GNR 1147), every mine must make financial provision for annual rehabilitation, final rehabilitation, decommissioning and closure activities at the end of mining; and remediation and management of latent or residual environmental impacts which may become known in the future. GNR1147 also requires that every holder must annually-

a) Assess his or her environmental liability in a prescribed manner and must increase his or her financial provision to the satisfaction of the Minister responsible for mineral resources; and

b) Submit an audit report to the Minister responsible for mineral resources on the adequacy of the financial provision from an independent auditor.

This report includes the following sections which aims to comply with the requirements of the Financial Provision Regulations (2015):

- Section A: Final Rehabilitation, Decommissioning and Closure Plan (FRDCP) aligned with the requirements outlined in Appendix 4 of GNR 1147 including the closure cost estimate calculated by a third party;
- Section B: Annual Rehabilitation Plan (ARP) aligned with the requirements outlined in Appendix 3 of GNR 1147; and
- Section C: An Environmental Risk Assessment Report aligned with the requirements outlined in Appendix 5 of GNR 1147.

The closure vision for the operation is to conduct the rehabilitation, decommissioning and closure operations and manage the environmental impacts in such a manner to ensure that the landscape is safe, stable and non-polluting over the long term, and that the post-closure land use aligns with the surrounding land-use and/or agreed upon end use and does not affect the sustained utilisation thereof.

The GNR1147 financial provision is expected to represent a realistic estimation of the required cost for effective decommissioning, rehabilitation, closure, and management of ongoing residual, and reasonably foreseeable potential future latent, impacts. The financial provision estimation has been calculated using the GNR1147 method (i.e. real contractor rates). The financial provision estimate was calculated in accordance with the NEMA Financial Provision Regulations (GNR 1147, 2015) methodology and includes provision for final decommissioning and closure costs, including well closure and associated preliminaries and generals (P&Gs) and contingencies, annual rehabilitation costs; and post-closure residual and latent costs, including monitoring and latent and residual risk provision for potential redrilling and plugging of wells. The rates and assumptions applied in the estimate were informed by specialist input and contractor quotations.

The **Scheduled closure and Unscheduled closure cost** estimated for the Motuoane Hennenman Exploration Right are **R6 713 653.85 and R1 902 793.23 (excl. VAT)**, respectively. The summarised costs as determined using the NEMA GNR1147 methodology, is summarised in Table 1 below.

Table 1: Summarised Financial Provision costs.

Cost Item	Unscheduled Closure[1]	Scheduled Closure[2]
Final Decommissioning and Closure Cost	**R1 369 715.05**	**R5 216 793.55**
- Well Closure	R1 159 675.45	R4 365 574.21
- P&Gs and contingencies	R210 039.59	R851 219.34
Annual Rehabilitation Cost	**R -**	**R -**
Post closure Phase - Residual and Latent Cost	**R533 078.19**	**R1 496 860.30**
- Monitoring	R240 945.53	R1 204 727.64
- Latent and residual risk provision (redrill and plugging of wells)	R292 132.66	R292 132.66
Total quantum of Financial Provision (Excl VAT)	**R1 902 793.23**	**R6 713 653.85**

[1] Unscheduled closure refers to the process of decommissioning, rehabilitation, and closure of the production activities, assuming all production activities cease as at the date of this report. This is also referred to as unplanned closure.
[2] Scheduled closure refers to the process of decommissioning, rehabilitation, and closure of the exploration activities as at the planned cessation of these activities. This is also referred to as planned closure.

1 INTRODUCTION

Motuoane Energy (Pty) Ltd (the Applicant) has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) to conduct a Financial Provision Assessment. This assessment forms part of the broader Environmental Impact Assessment (EIA) required to support the Environmental Authorisation (EA) application for listed activities triggered under the National Environmental Management Act (Act 107 of 1998, as amended - NEMA).

A requirement of obtaining an exploration right is that Scoping and Environmental Impact Assessment (EIA) Reports must be compiled and submitted to PASA. In accordance with the EIA regulations, the details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts must be included in the EIA Reports. As stipulated by Section 24P of the NEMA, Motuoane must, before the Minister responsible for mineral resources issues the EA, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts. This Final Rehabilitation, Decommissioning and Closure Plan (FRDCP) aims to meet this requirement and has been prepared in accordance with the requirements of the NEMA Financial Provisioning Regulations (2015) (NEMA GNR 1147).

Pursuant to the regulations, financial provision must be made for annual rehabilitation, final rehabilitation, decommissioning and closure activities at the end of prospecting, exploration, mining or production operations; and remediation and management of latent or residual environmental impacts which may become known in the future. In order to address these requirements this document includes an annual rehabilitation plan, a final rehabilitation, decommissioning and mine closure plan, and an environmental risk assessment report. Section 2 of this report lists the specific requirements that must be contained in each of the three plans as per the NEMA GNR 1147 Appendices 3, 4 and 5 (Table 3, Table 2 and Table 4 respectively), as well as the associated section in the report where each requirement is addressed.

Motuoane proposes to explore all saleable gases including but not limited to Methane, Carbon Dioxide, Helium, and Nitrogen in the licensed area. Published reports, general experience, experience within Motuoane and contacts with individuals familiar with the area indicate the presence of potentially commercial quantities of these gases. Direct evidence includes gas-emitting boreholes, nearby commercial gas production, gas encountered during drilling and underground mining operations. Due to the large area and complex exploration methodology, the ER will be required for an initial period of three years with the option to renew three additional periods of two years resulting in a total of nine years.

Exploration Right 386 is a consolidation of Technical Cooperation Permit (TCP) 235 and 240 & Exploration Right Application (ERA) 341 which were tenures in 2024 before ER386 application was submitted to PASA on the 8th of October 2024. TCP235 & TCP240 were granted in October 2023 for a 12 Month Term, an ER application was applied for in October 2024. ERA341 was an application previously submitted to PASA which was held up due to changing legislation and subsequently withdrawn. The areas (ERA341, TCP235 and TCP240) were then consolidated to one ER (ER386). Motuoane's application for an exploration right (ER) for hydrocarbons was accepted on the 22nd of October 2024 in terms of Section 79 of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 – MPRDA, as amended). The accepted application for an exploration right (ER386) is located over an area of approximately 58 000 hectares (ha), covering various farm portions in Welkom near the towns of Virginia, Hennenman and Odendaalsrus, Free State Province (Figure 1).

The proposed activities to be undertaken as part of the exploration activities include the following:

- Identifying existing blowers within the ER, undertaking well workover and intervention if necessary;
- The undertaking of new core exploration well drilling and undertaking well workover and intervention where necessary (at preidentified / new areas of interest);
- Undertaking seismic survey and/or magnetotellurics survey activities (at preidentified / new areas of interest);
- Clearance of an area of 300m2 or more of indigenous vegetation within specified geographical area;

- Clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation; and
- Perform gas composition analysis on gas from existing boreholes and newly drilled wells on the ER.

The main activities are exploration drilling and seismic survey activities. The proposed approach is to first determine and map the geographic extent of all boreholes currently emitting gas on and near the ER area. Then measure rates and monitor pressures where possible and perform gas composition analysis. The geophysical wireline logging of existing boreholes (where possible) will include monitoring of water levels. If no existing gas emitting boreholes are identified near a target area, new drilling activities are proposed within that area using percussion or rotary drilling method. Although up to five (5) target areas (TA) with 500m buffer (1km corridor) within the exploration right may be undertaken over the 9-year period, the current Works Program caters for only five (5) drilling wells. It is assumed 2 wells are planned to be drilled within the first year. It should be noted that there may be a single, multiple or no drilling activities within some of the target areas. Should more than 5 drilling wells be required within the ER, the current Project Works Program (PWP) will be required to be updated accordingly.

2 REPORT STRUCTURE

According to the NEMA Financial Provision regulations (GN R 1147, 2015), financial provision must be made for annual rehabilitation, and final rehabilitation, decommissioning and closure activities at the end of prospecting, exploration, mining or production operations; and remediation and management of latent or residual environmental impacts which may become known in the future. The following sections will discuss the specific requirements that must be contained in each of the three plans as per the NEMA GN R 1147:

- Section A: Annual Rehabilitation Plan (ARP) aligned with the requirements outlined in Appendix 3 of GNR 1147;
- Section B: Final Rehabilitation, Decommissioning and Closure Plan (FRDCP) aligned with the requirements outlined in Appendix 4 of GNR 1147 including the closure cost estimate calculated by a third party;
- Section C: An Environmental Risk Assessment Report aligned with the requirements outlined in Appendix 5 of GNR 1147; and

Each of the requirements will also be accompanied by the associated section in the report where each requirement is addressed.

2.1 FINANCIAL REHABILITATION, DECOMMISSIONING AND CLOSURE PLAN

The FRDCP must be measurable and auditable, must take into consideration the proposed post-exploration end use of the affected area and must contain information that is necessary for the definition of the closure vision, objectives and design and relinquishment criteria, indicating what infrastructure and activities will ultimately be decommissioned, closed, removed and remediated and the risk drivers determining actions, indicating how the closure actions will be implemented to achieve closure relinquishment criteria and indicating monitoring, auditing and reporting requirements. Table 2 lists the requirements of the FRDCP as per the NEMA GN R 1147, Appendix 4.

The plan must detail:

- Infrastructure and activities to be decommissioned, closed, removed, or remediated;
- Risk factors driving closure actions;
- The methodology for implementing closure actions to meet relinquishment criteria; and
- Requirements for monitoring, auditing, and reporting progress

The primary objective of this FRDCP is to establish a clear, measurable, and auditable framework for the post-mining land use. This framework will:

- **Define the vision:** Provide a comprehensive vision, objectives, targets, and criteria for the final rehabilitation, decommissioning, and closure of the project.
- **Establish design principles:** Outline the fundamental design principles that will guide the closure process.
- **Conduct risk assessment:** Conduct a thorough risk assessment, identify potential risks, and link closure activities to risk mitigation strategies.
- **Detail closure actions:** Specify the precise actions required to mitigate and/or manage identified risks and outline the nature of residual risks that will necessitate post-closure monitoring and management.
- **Develop implementation plan:** Establish a detailed implementation plan, including a schedule, budget, and assignment of roles and responsibilities for each relevant activity or infrastructure item.

- **Identify knowledge gaps:** Acknowledge any knowledge gaps and outline strategies to address and fill them.
- **Estimate closure costs:** Provide a comprehensive estimate of the full closure costs for the project's lifecycle, with increasing accuracy as the project progresses and the final land use becomes more defined.
- **Establish monitoring and reporting:** Outline the specific monitoring, auditing, and reporting requirements to ensure compliance with regulatory standards and the effective implementation of the closure plan.

Table 2: NEMA GNR 1147 Final Rehabilitation, Decommissioning and Closure Plan requirements.

No.	Requirement	Section
3(a)	Details of- (i). the person or persons that prepared the plan; (ii). the professional registrations and experience of the preparers;	Section 3
3(b)	The context of the project, including- (i). material information and issues that have guided the development of the plan; (ii). an overview of- (aa) the environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity; and (bb) the social context that may influence closure activities and post-mining land use or be influenced by closure activities and post-mining land use; (iii). stakeholder issues and comments that have informed the plan; (iv). the mine plan and schedule for the full approved operations, and must include- (aa) appropriate description of the mine plan; (bb) drawings and figures to indicate how the mine develops; (cc) what areas are disturbed; and (dd) how infrastructure and structures (including ponds, residue stockpiles etc.) develop during operations;	Section 4.1
3(c)	Findings of an environmental risk assessment leading to the most appropriate closure strategy, including- (i). 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; (ii). 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; (iii). an identification of conceptual closure strategies to avoid, manage and mitigate the impacts and risks; (iv). a reassessment of the risks to determine whether, after the implementation of the closure strategy, the residual risk has been avoided and / or how it has	Section 4.4

No.	Requirement	Section
	resulted in avoidance, rehabilitation and management of impacts and whether this is acceptable to the mining operation and stakeholders; and (v). an explanation of changes to the risk assessment results, as applicable in annual updates to the plan;	
3(d)	Design principles, including- (i). the legal and governance framework and interpretation of these requirements for the closure design principles; (ii). closure vision, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations; (iii). a description and evaluation of alternative closure and post closure options where these exist that are practicable within the socioeconomic and environmental opportunities and constraints in which the operation is located; (iv). a motivation for the preferred closure action within the context of the risks and impacts that are being mitigated; (v). 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 relinquishment criteria have been achieved; (vi). details associated with any on-going research on closure options; (vii). 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;	Section 4.5
3(e)	A proposed final post-mining land use which is appropriate, feasible and possible of implementation, including- (i). descriptions of appropriate and feasible final post-mining land use for the overall project and per infrastructure or activity and a description of the methodology used to identify final post-mining land use, including the requirements of the operations stakeholders; (ii). a map of the proposed final post-mining land use;	Section 4.6
3(f)	closure actions, including- (i). the development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options, which must include all areas, infrastructure, activities and aspects both within the mine lease area and off of the mine lease area associated with mining for which the mine has the responsibility to implement closure actions; (ii). the development and maintenance of a list and assessment of threats and opportunities and any uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty;	Section 4.7
3(g)	A schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water -	Section 4.8

No.	Requirement	Section
	(i). linked to the mine works programme, if greenfields, or to the current mine plan, if brownfields; (ii). including assumptions and schedule drivers; and (iii). including a spatial map or schedule, showing planned spatial progression throughout operations;	
3(h)	An indication of the organisational capacity that will be put in place to implement the plan, including- (i). organisational structure as it pertains to the plan; (ii). responsibilities; (iii). training and capacity building that may be required to build closure competence;	Section 4.9
3(i)	An indication of gaps in the plan, including an auditable action plan and schedule to address the gaps;	Section 4.10
3(j)	Relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators;	Section 4.11
3(k)	Closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that- (i). cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; (ii). the closure cost estimation must include- (aa) an explanation of the closure cost methodology; (bb) auditable calculations of costs per activity or infrastructure; (cc) cost assumptions; (iii). the closure cost estimate 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; and	Section 4.12
3(l)	Monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps as a minimum and must include- (i). a schedule outlining internal, external and legislated audits of the plan for the year, including- (aa) the person responsible for undertaking the audit(s); (bb) the planned date of audit and frequency of audit;	Section 4.13

No.	Requirement	Section
	(cc) an explanation of the approach that will be taken to address and close out audit results and schedule; (ii). a schedule of reporting requirements providing an outline of internal and external reporting, including disclosure of updates of the plan to stakeholders; (iii). a monitoring plan which outlines- (aa) parameters to be monitored, frequency of monitoring and period of monitoring; (bb) an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities; and	
3(m)	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 per 2(i)	Section 4.14

2.2 ANNUAL REHABILITATION PLAN

The Annual Rehabilitation Plan (ARP) will be relevant for a period of 1 year, after which the plan will be updated by the holder of a right or permit to reflect progress relating to rehabilitation and remediation activities in the preceding 12 months and to establish a plan, schedule and budget for the forthcoming 12 months. The ARP must:

- contain information that defines concurrent rehabilitation and remediation activities for the forthcoming 12 months and how these relate to the operations' closure vision, as detailed in the FRDCP;
- indicate what closure objectives and criteria are being achieved through the implementation of the plan; and
- be measurable and auditable.

Table 3 lists the components to be included in the ARP. The primary objective of the annual rehabilitation plan is to:

- **Review ongoing activities:** Conduct a comprehensive review of current rehabilitation and remediation efforts to assess their progress and identify areas for improvement.
- **Establish annual goals:** Define specific rehabilitation and remediation goals and outcomes for the ensuing twelve-month period. These goals should align with the long-term post-mining land use, closure vision, and objectives outlined in the holder's final rehabilitation, decommissioning, and mine closure plan.
- **Develop implementation plan:** Create a detailed plan, schedule, and budget for the implementation of rehabilitation activities over the next twelve months.
- **Identify and address shortcomings:** Analyse the performance of rehabilitation activities during the preceding twelve-month period to identify shortcomings and develop strategies to rectify them.
- **Evaluate and update financial provisions:** Assess and update the estimated cost of rehabilitation for both the upcoming twelve-month period and the entire closure process. This information is essential for ensuring adequate financial provisions through the financial provision guarantee or other relevant financial instruments.

Table 3: NEMA GN R 1147 Annual Rehabilitation Plan requirements.

No.	Requirements	Section/s
3(a)	Details of the – (i) person or persons that prepared the plan; (ii) professional registrations and experience of the person or persons; and (iii) timeframes of implementation of the current, and review of the previous rehabilitation activities.	Section 3
3(b)	The pertinent environmental and project context relating directly to the planned annual rehabilitation and remediation activity.	Section 4.1
3(c)	Results of monitoring of risks identified in the final rehabilitation, decommissioning and mine closure plan with a view to informing rehabilitation and remediation activities.	Section 5.1
3(d)	An identification of shortcomings experienced in the preceding 12 months.	Section 5.2
3(e)	Details of the planned annual rehabilitation and remediation activities or measures for the forthcoming 12 months, including those which will address the shortcomings contemplated in 3(d) above or which were identified from monitoring in the preceding 12 months, and including - (i) if no areas are available for annual rehabilitation and remediation concurrent with mining, an indication to that effect and motivation why no annual rehabilitation or remediation can be undertaken; (ii) where areas are available for annual rehabilitation and remediation concurrent with mining, annual rehabilitation and remediation activities related to previous disturbance or expected planned impacts and disturbance, as per the mine works programme, in the period under consideration, which should be tabulated and must indicate, but not necessarily be limited to. - (aa) nature or type of activity and associated infrastructure; (bb) planned remaining life of the activity under consideration; (cc) area already disturbed or planned to be disturbed in the period of review; (dd) percentage of the already disturbed or planned to be disturbed area available for concurrent rehabilitation and remediation activities; (ee) percentage of the already disturbed or planned to be disturbed area available as per (dd) and on which concurrent rehabilitation and remediation can be undertaken; (ff) notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed; (gg) notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area; (hh) details of rehabilitation activity planned on this area for the period of review; (ii) the pertinent closure objectives and performance targets that will be addressed in the forthcoming year, which objectives and targets are aligned to the final rehabilitation, decommissioning and mine closure plan;	Section 5.3

No.	Requirements	Section/s
	(jj) description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final land use once all rehabilitation and remediation activities are complete for the activity or aspect; and (iii) a site plan indicating at least the total area disturbed, area available for rehabilitation and remediation and the area to be rehabilitated or remediated per aspect or activity.	
3(f)	A review of the previous year's annual rehabilitation and remediation activities, indicating a comparison between activities planned in the previous year's annual rehabilitation and remediation plan and actual rehabilitation and remediation implemented, which should be tabulated and as a minimum contain- (aa) area planned to be rehabilitated and remediated during the plan under review; (bb) actual area rehabilitation or remediated; and (cc) if the variance between planned and actual exceeds 15%, motivation indicating reasons for the inability to rehabilitate or remediate the full area.	N/A
	Costing, including- (i) an explanation of the closure cost methodology; (ii) auditable calculations of costs per activity or infrastructure; (iii) cost assumptions; and (iv) monitoring and maintenance costs likely to be incurred both during the period of the annual rehabilitation plan and those that will extend past the period of the final rehabilitation, decommissioning and mine closure plan, on condition that the monitoring and maintenance costs included in previous annual rehabilitation plans must be accumulated into subsequent versions of the annual rehabilitation plan until such time as the monitoring and maintenance obligation is discharged.	N/A

2.3 ENVIRONMENTAL RISK ASSESSMENT

The Environmental Risk Assessment (ERA) report must contain information that is necessary to determine the potential financial liability associated with the management of latent environmental liabilities post closure, keeping in mind the proposed post-exploration end use, once the initial relinquishment criteria has been achieved. Table 4 outlines the requirements of the ERA as per the NEMA GNR 1147, Appendix 5. The primary objective of this environmental risk assessment report is to:

- **Identify and Quantify Risks:** Accurately identify and quantify potential latent environmental risks that may arise post-closure.
- **Develop Risk Management Strategies:** Develop and detail comprehensive strategies for managing these identified risks to ensure their timely mitigation.
- **Assess Financial Implications:** Quantify the potential financial liabilities associated with the implementation of the risk management strategies.
- **Establish Monitoring and Reporting Framework:** Outline a robust monitoring, auditing, and reporting framework to track progress, verify compliance, and document the effectiveness of risk mitigation measures.

Table 4: NEMA GN R 1147 Environmental Risk Assessment.

No.	Requirements	Section
3(a)	Details of- (i). the person or persons that prepared the plan; (ii). the professional registrations and experience of the preparers;	Section 3
3(b)	details of the assessment process used to identify and quantify the latent risks, including- (i). a description of the risk assessment methodology inclusive of risk identification and quantification; (ii). substantiation why each risk is latent, including why the risk was not or could not be mitigated during concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan; (iii). a detailed description of the drivers that could result in the manifestation of the risks, to be presented within the context of closure actions already having been implemented during the execution of concurrent rehabilitation or during the implementation of the final rehabilitation, decommission and closure plan; (iv). a description of the expected timeframe in which the risk is likely to manifest, typically as expected years after closure, and the duration of the impact, including motivation to support these timeframes; (v). a detailed description of the triggers which can be used to identify that the risk is imminent or has manifested, how this will be measured and any cost implications thereof; (vi). results and findings of the risk assessment; (vii). an explanation of changes to the risk assessment results as applicable in annual updates to the plan;	Section 6.1
3(c)	management activities, including- (i). monitoring of results and findings, which informs adaptive or corrective management and/or risk reduction activities; (ii). an assessment of alternatives to mitigate or manage the impacts once the risk has become manifested, which must be focussed on practicality as well as cost of the implementation; (iii). motivation why the selected alternative is the appropriate approach to mitigate the impact; (iv). a detailed description of how the alternative will be implemented;	Section 6.2.2
3(d)	costing, calculated using the current value of money and no discounting or net present value calculations included in the determination of the quantum of the liability, including- (i). a cost estimation, which must include- (aa) an explanation of the closure cost methodology; (bb) an auditable calculations of costs per activity or infrastructure; (cc) cost assumptions; (dd) monitoring costs post closure to determine whether the risk is imminent or has manifest are to be included in the assessment as are monitoring costs	Section 6.2.3

No.	Requirements	Section
	likely to be incurred during the implementation of the strategy to manage or mitigate the impacts once the risk has become manifest; (ii). where appropriate, a differentiation between capital, operating, replacement and maintenance costs; (iii). cost estimates for operations, or components of operations that are more than 30 years from closure prepared as conceptual estimates within an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; and	
3(e)	Monitoring, auditing and reporting requirements, which must include requirements prior to the manifestation of the risk and impacts as well as those once the impacts resulting from the manifestation of the risk are realised, inclusive of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities.	Section 6.2.1

3 DETAILS OF SPECIALIST

Environmental Impact Management Services (Pty) Ltd (EIMS) was appointed by Motuoane Energy (Pty) Ltd to develop the Financial Provision (FP) report inclusive of the Annual Rehabilitation Plan (ARP), Final Rehabilitation, Decommissioning and Closure Plan (FRDCP) and the Environmental Risk Assessment (ERA), in support of the Environmental Authorisation application processes. The details of the professionals who contributed to the preparation of this report is provided in Table 2 below. Detailed CVs can be found in Appendix 3.

Table 5: Details of Specialists.

Name	Role	Qualifications / Experience	Professional Registrations
Liam Whitlow	Environmental Consultant	BSc Hons Environmental Management. ~25 years environmental consulting experience.	South African Council for Natural Scientific Professions - Registered Professional Natural Scientist (Environmental Science, 400148/08). Registered Environmental Assessment Practitioner (2019/222). Member of Land Rehabilitation Society of Southern Africa.
Jessica Jordaan	Environmental Consultant	BSc in Geology and BSc Hons in Soil Science. ~5 years in soil science and environmental consulting experience	South African Council for Natural Scientific Professions - Registered Candidate Natural Scientist (Soil Science, 124758). Registered Candidate Environmental Assessment Practitioner (2023/7087). Member of Land Rehabilitation Society of Southern Africa.

4 SECTION A: FINAL REHABILITATION, DECOMMISSIONING AND CLOSURE PLAN

The objective of the FRDCP is to identify a post- exploration land use that is feasible through the identification and provision of various components as outlined in Appendix 4 2(a) – (h) of GNR 1147. The FRDCP provides the vision, objectives and targets through detailing closure actions and measures. The required resources such as costs; time and personnel, including roles and responsibilities, is detailed in the FRDCP to be able to monitor, measure and audit the committed closure actions. It is critical that the objectives included in the FRDCP must be measurable and auditable. Knowledge gaps and how these will be addressed need to be identified to improve the level of cost accuracy.

This section of the report aims to achieve the GNR 1147 Appendix 4 Section 2(a) – (h) objectives and to discuss and align to the Appendix 4 Section 3 (a) – (m) requirements.

4.1 PROJECT CONTEXT

This section aims to provide context and focus attention on the material information and issues that have guided the development of this FRDCP. Additional project and environmental context are provided in the 2026 EIA Report and EMPr, developed as part of the requirements for the Environmental Authorisation application.

The description and definition of the environmental context is critical to ensure that the ultimate closure objectives and associated end land use are achieved. The content of this section is sourced and summarised primarily from the available Scoping Report and draft EIAr.

The key environmental aspects related to the project area and specifically the closure and rehabilitation strategies are summarised in the remainder of this Section. The exploration activities, which would require inclusion in the FRDCP are presented herein and are derived from the available information on the historic operations and the current conditions on-site.

4.1.1 LOCATION

The proposed project area is approximately 57 000 hectares (ha) and falls within the Matjhabeng and Moqhaka Local Municipalities, Lejweleputswa and Fezile Dabi District Municipalities. The project area encompasses various farms and farm portions around the towns of Virginia, Hennenman, Riebeeckstad and Welkom in the Free State Province. The boundaries of ER386 are 28°13'28.95"S; 26°55'2.76"E in the South, 27°57'37.57"S; 26°48'49.15"E in the West, 27°59'13.57"S; 27°11'13.06"E in the East and 27°46'34.45"S; 26°57'44.05"E in the North, the central coordinates are approximately 27°58'23.27"S; 26°59'38.94"E (Figure 1).

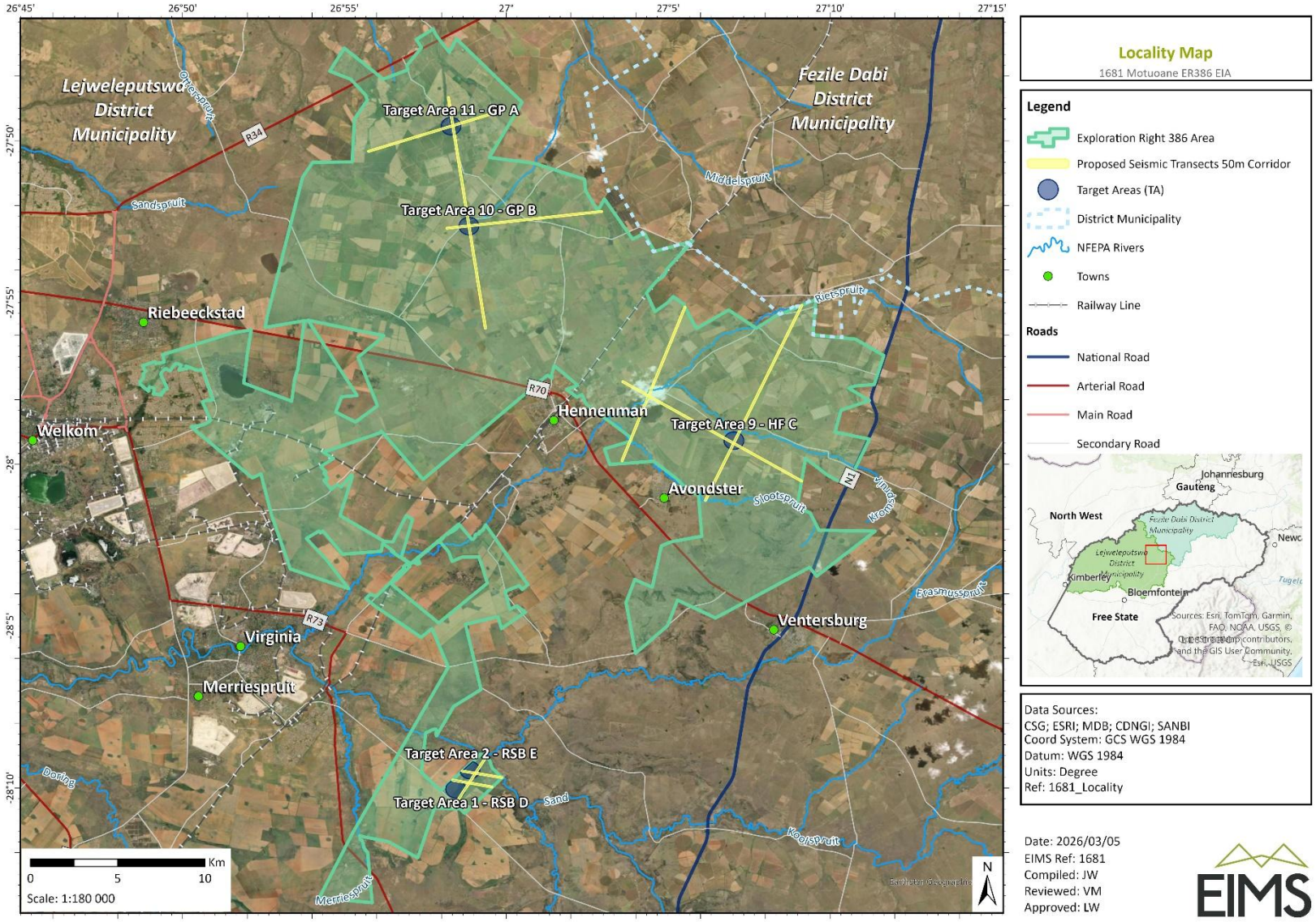


Figure 1: Exploration Right project area locality map.

4.1.2 PROJECT DESCRIPTION

For the purposes of this FRDCP the following infrastructure and operations were considered as part of the calculations and is considered as the battery limits for the cost estimates:

- The proposed exploration wells and associated infrastructure as per the 2026 EIAr and PWP;
- Seismic activities to be undertaken.

Table 6: Summary of proposed exploration activities and features.

Authorisations/Applications	Wells associated with Exploration Activities and Features	
	Exploration wells	**Seismic Transect Corridors[3]**
2026 EIAr (ER386)	5	340 Ha

4.1.2.1 GEOTECHNICAL AND SOIL SAMPLING

Once the background data and geological and geophysical data has been analysed this information will delineate the areas susceptible for geotechnical and soil sampling. This process involves the removal of small sections of the soil profile using a soil auger drilling to a depth between 15 and 30 centimetres. The number of samples to be collected will be determined by the results of the desktop study. These samples will then be submitted to a laboratory for analysis to determine the presence of hydrocarbon tracing and microbes.

4.1.2.2 WELL DRILLING

Using the data gathered during the preceding background review and surveying, the exploration boreholes will be sited. The proposed drilling process entails the construction of exploration well using a two-string telescopic casing design is outlined below:

- The Spud casing will be set and cemented in to case off the unconsolidated material to approximately 6m True Vertical Depth (TVD).
- Drilling will be continued past the unconsolidated material to approximately 80mTVD, conductor casing will be cemented from shoe to surface;
- The hole is then percussion drilled ahead and into the Ventersdorp Lavas below the base of the Karoo at approximately 450m TVD; Intermediate casing will be run and cemented to surface;
- Integrity of this section will be tested by running a Cement Bond Log (CBL) and the pressure tested prior to drilling out the casing shoe. A further Formation Integrity Test (FIT) is then performed on drilling out the casing shoe.
- The next section (open hole section) will be percussion drilled through the primary target, the Ventersdorp Supergroup, to a depth ± 650 m TVD. This section TVD maybe called earlier if significant gas flows are encountered.

The project will involve the drilling of up to 11 wells within the assessed 500m buffer drilling sites. Each exploration well will have an overall depth of up to 650m and a maximum width of 350mm, commencing with a 323mm width spud hole section drilled to 6m total vertical depth (TVD), followed by 254mm width conductor hole section drilled to 80m TVD, then an intermediate hole section of 203mm width drilled to 450m TVD and finally an open hole section of 144mm width drilled up to 650m TVD. The actual casing sizes and configurations will vary depending on the specific geological characteristics and functional requirements. Each borehole will be steel cased and have cement barriers to prevent leaks as well as plugged at the end of exploration to prevent

[3] 9 transects are planned, with a width of 50m each transect, and a grand total of 68 000m in length for all the transects.

groundwater seepage (Figure 2). Drilling activities are estimated to be one to two weeks per hole during which time there will be a drill rig, a service truck and an LDV on site. Intermittent use of a TLB will be used during site establishment and demobilisation. In order to establish the gas contents a mobile desorption laboratory will be established.

The construction of each drill pad will disturb an area of up to 50 x 50 m (Figure 2). Within the disturbed area, the drill rig and drilling rods will be located. Impermeable, lined sumps will be used to circulate and store the drill fluid and mud consisting of drilling foams and Bentonite. Exploration trays, hazardous and general storage, waste storage, chemical toilets, and any site offices required will also be placed inside the drill pad (Figure 2). Each drill site will be suitably rehabilitated before drilling continues at the next drill site. Depending on the results of the sampling, each borehole will either be plugged entirely or left as is for future analysis. Regardless of which of these options is chosen, the borehole will be capped with a steel cap that is engraved with the borehole number according to industry specifications.

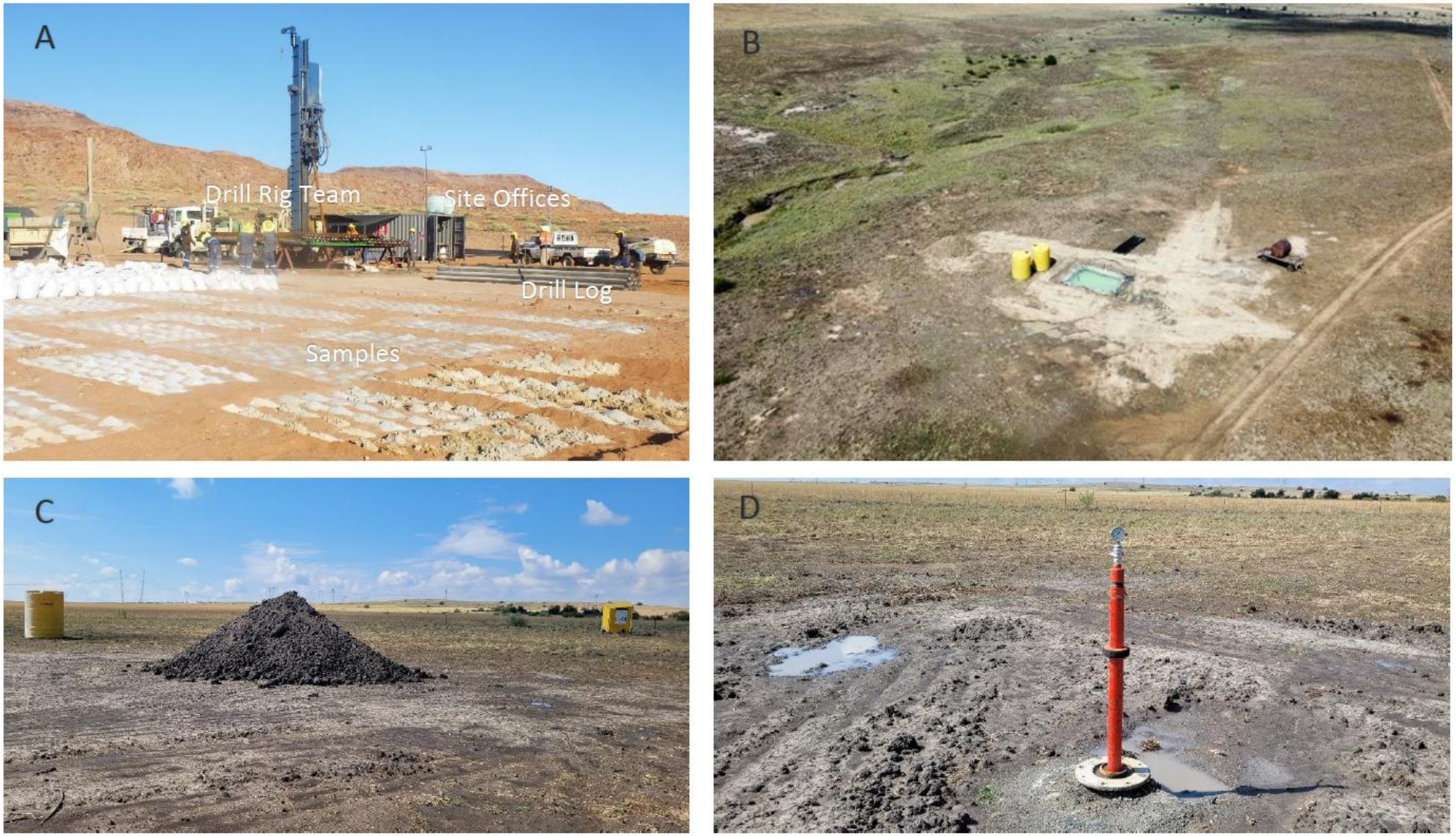


Figure 2: Exploration drilling and potential impacts. (A) Showing the drilling process and associated infrastructure, (B) Showing the drill pad footprint at one of the active Motuoane drilling sites, (C) Showing some of impacts associated with drilling activities.

4.1.2.3 SUPPORTING INFRASTRUCTURE

None of the proposed exploration activities require the establishment of any permanent infrastructure. Sites will be accessed on existing roads or farm tracks, if available. Water required for the operation of the drilling rig, as well as potable water will be obtained locally, by agreement with landowners or purchased from a supplier. Chemical toilets will be provided for the personnel.

Once a well is completed, the drill site will be decommissioned, and the following progressive decommissioning and closure actions undertaken:

- Drill equipment will be removed,
- Sumps will be emptied and content thereof disposed at a suitably licenced facility,
- Stored sub-soils from the stripping of any specific areas (including the well collar) will be replaced;
- Topsoil reinstated;
- Compacted areas will be ripped;
- Cleared vegetation will be placed over barren areas to reduce erosion;
- Revegetated with natural vegetation if natural succession fails; and
- Any surface infrastructure not required for the logging and well monitoring removed.

Exploration drilling entails the use of a truck, trailer or skid mounted drill rig to drill to varying depths in order to strike the gas reserve. Percussion drills typically require clearance of an area of 50 m x 50 m in order to set up the rig and begin drilling activities. All exploration boreholes to be drilled in accordance with best industry best practice and internal procedures. The wells will be sealed with a combination of casing and cementing to ensure vertical isolation of the gas from both the surrounding geology and hydrological regime. In addition to the drill rig, lined sumps will be required to store and recirculate water for the drilling process. The drilling of exploration boreholes is a temporary and short-duration activity and the equipment to be used during drilling activities includes a truck/trailer or skid mounted percussion drill rig, excavator, dozer, grader water cart, light motor vehicle for transport of personnel and chemical toilets. Figure 3 outlines the possible outcomes for exploration wells based on whether results are successful, unsuccessful, or inconclusive. In the event that an exploration well is deemed successful, Motuoane may seek to convert it to an operational/production well. However, this conversion can only proceed once a Production Right has been obtained, as the current authorisation permits exploration activities only.

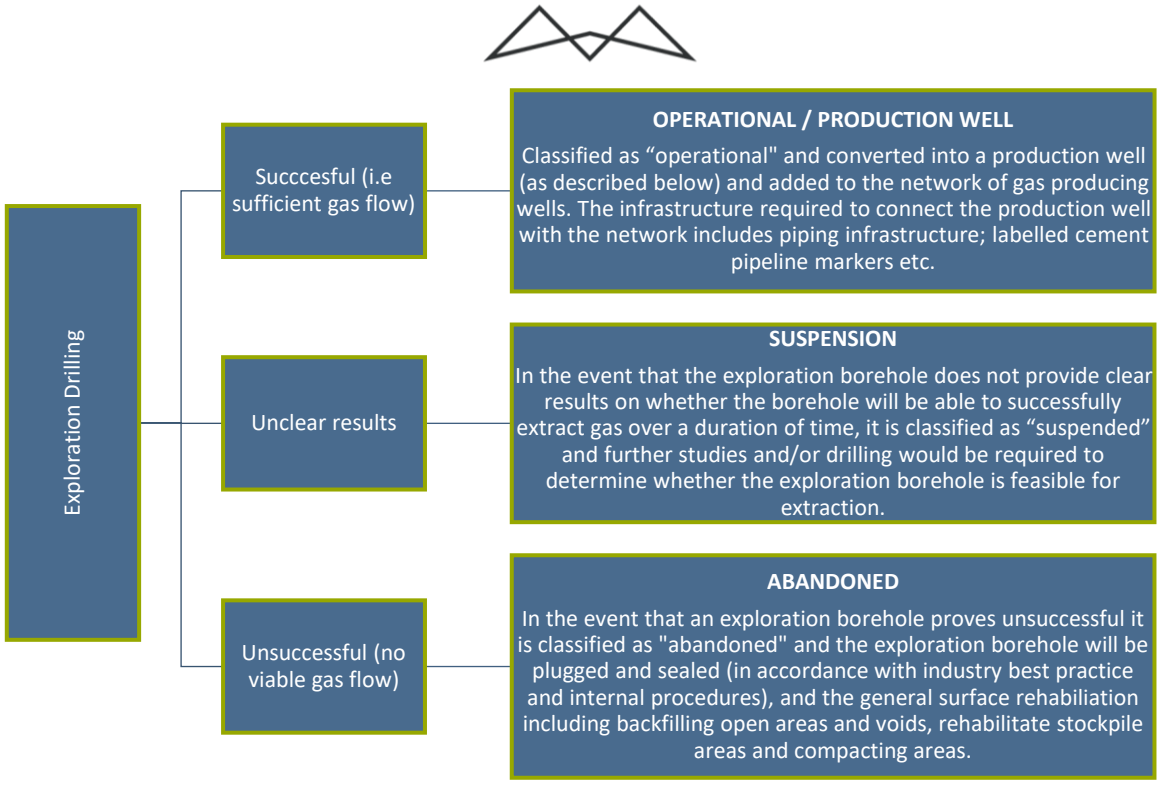


Figure 3: Outcomes of exploration drilling, showing pathways for wells deemed successful, unsuccessful, or with unclear results.[4]

4.1.2.4 SURFACE INFRASTRUCTURE

The project requires other surface infrastructure not specifically described in the preceding sections. Such additional infrastructure includes:

- Access roads;
- Fencing;
- Chemical storage;
- Sumps;
- Temporary hazardous waste storage;
- Temporary general waste storage; and
- Mobile offices and ablution facilities.

[4] Should any exploration well be identified for future production, a separate EIA process and the relevant Production Right and Environmental Authorisation would first be required. For the purposes of this report, the wells costed are assumed to remain as suspended exploration wells pending approval of a Production Right.

Figure 4: Waste bins and spill kits.

Figure 5: Waste skips.

Figure 6: Temporary crew quarters.

Figure 7: On-site storage container.

Figure 8: Temporary office.

Figure 9: Water containers.

Figure 10: Lay down area.

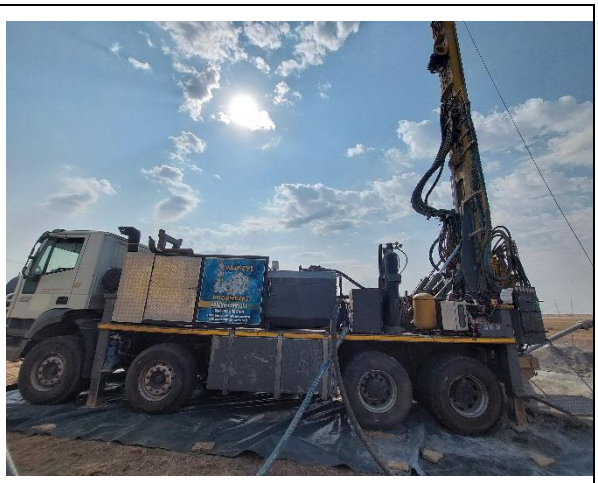


Figure 11: Drill rig.

Figure 12: Power generator.

Figure 13: Lined area surrounding sump.

Figure 14: fenced off well with diverter.

Figure 15: Fenced off well.

Figure 16: Access road.

4.1.2.5 SEISMIC SURVEYS

Seismic surveying along the transects through a Vibroseis technique will be undertaken by a small team (approximately 15 personnel) by deploying an array of energy sources from a small-sized Seismic Vibrator and an array of sensors or receivers (geophones) on the identified area of interest (Figure 3). A single Seismic Vibrator consisting of a vibrating baseplate that is connected to the ground will be used. The vibrating plate emits a low frequency signal (4-80 Hz) into the ground, called a sweep. The vibrator vehicle moves slowly along the pre-determined lines (transects) using GPS for navigation. It stops, emits a signal 8-20 seconds long, moves approximately 10 meters ahead, stops, emits a signal and so on until all the transects have been traversed (Figure 3). Several small geophones will be used to convert the ground movements or seismic waves from the Seismic Vibrator into voltage, which will be recorded at a nearby recording station (Figure 3). The team will then generate and analyse the 2-D sub-surface geological network and identify areas of interest for further exploration. The outcome of the seismic survey will be used to inform preferable drilling locations.

Although the Vibroseis technique is the likely method to be undertaken for the seismic activities. There are also potential alternatives to the Vibroseis known as the Propelled Energy Generators (PEGs), more commonly referred to as the Accelerated Weight Drop Seismic (AWD) as well as Magnetotellurics Survey (MT) which Motuoane may consider over the Vibroseis. AWD are light weight, highly portable seismic energy sources designed for a multitude of applications within the fields of geology, geophysics, civil engineering, and more. AWD systems utilize simple and effective elastomer band technology to propel the hammer to a high velocity. The AWD is comprised of two easily manageable components for fast and efficient installation and de-installation in the field. The AWD's lightweight, streamlined design also affords its users economy in shipping. The AWD-40Kg is designed to easily mount on trucks, bakkie, trailers, and all-terrain vehicles (Figure 3). AWD is a variant of seismic source of the “weight drop” type. The hammer is equipped with an inclined platform, allowing it to be installed at an angle of 45 degrees, and a special stop, adding stability in an upright position, what allows to perform survey on shear waves (Figure 3). The source AWD-40PS is mounted on a compact lightweight frame equipped with reliable wheel blocks. The source can be used on a rugged terrain. The total weight of the source without battery pack is less than 120 kg. The energy of a single impact reaches 1000J.

Magnetotellurics (MT) is a passive geophysical technique that uses naturally occurring electromagnetic fields to image the subsurface electrical resistivity structure by measuring the Earth's natural time-varying electric and magnetic fields. The MT method utilizes naturally occurring, broadband electromagnetic waves over the Earth's surface to image subsurface resistivity structure. The electromagnetic waves originate from regional and worldwide thunderstorm activity and from the interaction of solar wind with the Earth's magnetosphere. Due to the remote nature of the sources and the high refractive index of the Earth relative to air, the electromagnetic waves are assumed to be planar and to propagate vertically into the Earth. However, the scattering of electromagnetic waves by subsurface structure can be arbitrary in polarization, necessitating a tensor description (Wannamaker et al., 2005). Accordingly, two components of electric field (Ex and Ey) and three

components of magnetic field (Hx, Hy and Hz) are measured. The frequencies of the waves (signals) range from about 1 Hz to a fraction of milli Hertz, which allows to image a wide depth range. A detailed account of the MT method is given in Vozoff (1991).

4.2 ENVIRONMENTAL AND SOCIAL CONTEXT

The description and definition of the pre-exploration environmental context is critical to ensure that the ultimate closure objectives and associated end land-use are achieved. In this regard, the description of the baseline environment (on-site and surrounding) was obtained from various studies undertaken by the specialist team and in conjunction with EIMS. The following assessments applicable to this project were considered for the environmental and social context:

- The Scoping Report and accompanying specialist studies undertaken in 2025;
- The EIR and accompanying specialist studies undertaken in 2026.

All specialist studies undertaken for the proposed Hennenman exploration right project are included as supporting technical appendices to the EIR report. The key environmental aspects related to the exploration right area are summarised in the remainder of this Section.

4.2.1 ARCHAEOLOGICAL AND CULTURAL HERITAGE

The objective of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) is to introduce an integrated system for the management of national heritage resources. The Act defines a 'heritage resource' as any place or object of cultural significance (aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance). The identification, evaluation and assessment of any cultural heritage site, artefact or find in South Africa is required by this Act. This section of the report presents the heritage status of the proposed Motuoane Exploration area project.

Based on the Baseline Heritage Impact Assessment Report undertaken by Dr Lucien James in support of the 2026 EIAr (EIMS, 2026), with the exception of the Grade II provincial heritage features identified, 32 structures, buildings, or complexes, two large in-situ colonial period artefacts as well as six (6) grave sites were identified as having or potentially having heritage significance. The graves and graveyards in question are protected by the NHRA and have been provisionally graded as Grade III A or of High significance. All structures, buildings, complexes, or ruins thereof have been provisionally graded as Grade IV A or of High to Medium significance. This suggests that mitigation must take place should proposed activities have the potential to disturb these features. The two large artefacts identified have been graded as Grade IV B or Medium sensitivity. Figure 17 presents a visual summary of the main desktop findings and their locations. Buffers of the Grade II features are illustrated on the maps. Buffers associated with other sites are too small to be illustrated on the maps. Table 7 provides a summary of the different features identified, a description of the feature, as well as the coordinates of a relative central point associated with the find.

The exploration area is extensive, the site intersects, and is in proximity of several Grade III heritage sites, as well as several Grade II or nominated Provincial heritage sites. This highlighted sensitivity corresponds with Grade II sites, the farmhouse, Ferreirasrust (9/2/318/0001), and several graves of political figures located along the outskirts of Welkom. It was further ascertained that the Very High sensitivity attributed to the site is in relation to Ferreirasrust, and the graves nominated as Grade II provincial sites. Since the ER area is so extensive, sections of the area intersect with the applied buffers of 2km which surrounds these Grade II provincial heritage sites. It is understood that the proposed seismic transects may intersect with the 2km buffers associated with Ferreirasrust and a Grade II grave in Welkom, however, the proposed activities will have no impact on the Provincial heritage features highlighted given their distance from the TAs, and the nature of the proposed seismic survey activities (the impact of this survey is not expected to affect the sense of place which the buffer in place is meant to preserve). Further, the defined 500 m TAs do not fall within any of the buffers associated with these features.

Table 7: Summary of different finds identified, excluding grade II sites. Grade III A features are highlighted by red text (EIMS, 2026).

Feature No.	Description	Ratings and Significance	Coordinate
MO002	Farm dam – Structure dating 60 years or older. Additional features were noted in proximity including an associated windmill, and telephone junction box located between MO002, and MO037.	Grade IV A Medium	28°9'34.51"S, 26°58'42.32"E
MO003	Historical ruin – structure dating 60 years or older.	Grade IV A Medium	28°2'9.46"S, 26°57'23.46"E
MO004	Farm dam – Structure dating 60 years or older.	Grade IV A Medium	28°2'24.61"S, 26°57'12.05"E
MO005	Farm Complex – Structures dating 60 years or older.	Grade IV A Medium	28°2'41.14"S, 26°58'23.09"E
MO006	Ruins of a farm dam – foundation remains dating 60 years or older.	Grade IV A Medium	28°2'42.82"S, 26°58'13.19"E
MO007	Farm Complex – Welgegund. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	28°1'30.53"S, 26°54'31.33"E
MO008	Farm Complex – Roemryk. Farm complex may include structures dating 60 years or older. Also includes a nearby hut.	Grade IV A Medium	27°58'14.81"S, 26°57'0.58"E
MO009	Historical ruins of a settlement area – structure dating 60 years or older.	Grade IV A Medium	27°56'21.84"S, 27°8'29.78"E
MO010	Cemetery – Graves may be 60 years or older.	Grade III A High	27°56'32.13"S, 27°8'32.11"E
MO011	Historical ruin – structure dating 60 years or older.	Grade IV A Medium	27°55'10.98"S, 27°5'29.68"E
MO012	Historical ruins of a settlement area – structure dating 60 years or older.	Grade IV A Medium	27°52'21.61"S, 26°59'12.08"E
MO013	Farm dam – Structure dating 60 years or older.	Grade IV A Medium	27°51'20.91"S, 26°58'37.08"E
MO014	Farm Complex – Bluegum Grove. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	27°51'18.03"S, 26°58'39.63"E

Feature No.	Description	Ratings and Significance	Coordinate
MO015	Historical ruins of a settlement area – structures dating 60 years or older.	Grade IV A Medium	27°51'7.97"S, 26°58'35.34"E
MO016	Farm Complex – Graspan. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	27°49'15.07"S, 26°58'20.42"E
MO017	Ruins of Farm Complex – Donkerhoek. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	27°49'44.18"S, 26°58'9.80"E
MO018	Farm dam and Kraal area - structures dating 60 years or older.	Grade IV A Medium	27°54'8.61"S, 26°59'15.77"E
MO019	Huts or structures – Although no longer present, site may still hold remains dating 60 years or older.	Grade IV A Medium	27°52'26.02"S, 27°0'27.92"E
MO020	Historical ruin – foundation of structure dating 60 years or older.	Grade IV A Medium	28°0'54.37"S, 27°6'20.88"E
MO021	Historical ruins of a settlement area – structures dating 60 years or older.	Grade IV A Medium	28°0'57.06"S, 27°6'24.33"E
MO022	Location of demolished Farm Complex – Wolzak. Site may include heritage finds.	Grade IV A Medium	27°57'46.77"S, 27°4'49.38"E
MO023	Grave site - Graves may be 60 years or older.	Grade III A High	27°57'49.01"S, 27°4'58.16"E
MO024	Historical ruins of a settlement area – structures dating 60 years or older.	Grade IV A Medium	27°57'24.80"S, 26°54'47.82"E
MO025	Farm dam – Structure dating 60 years or older.	Grade IV A Medium	27°56'17.31"S, 26°54'5.26"E
MO026	Farm Complex – Dew Drop. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	27°52'28.35"S, 27°1'40.77"E
MO027	Location of demolished Farm Complex – Uitzicht or Uitkyk. Site may include heritage finds.	Grade IV A Medium	27°50'12.63"S, 26°56'22.40"E
MO028	Location marked as ruins - Site may include heritage finds.	Grade IV A Medium	27°50'43.90"S, 26°55'35.43"E
MO029	Prospecting borehole – feature older than 60 years	Grade IV A Medium	28°0'34.41"S, 26°54'0.32"E

Feature No.	Description	Ratings and Significance	Coordinate
MO031	Historical ruin – structure dating 60 years or older.	Grade IV A Medium	27°56'23.30"S, 26°54'11.65"E
MO032	Huts or structures – Although no longer present, site may still hold remains dating 60 years or older.	Grade IV A Medium	27°55'15.93"S, 27°8'58.63"E
MO033	Hut or structure – Site is densely vegetated but may still hold remains dating 60 years or older.	Grade IV A Medium	27°58'31.72"S, 26°53'3.69"E
MO034	Hut or structure – Site is densely vegetated but may still hold remains dating 60 years or older.	Grade IV A Medium	27°58'17.72"S, 26°53'8.61"E
MO035	Cemetery – Graves may be 60 years or older.	Grade III A High	28°0'48.61"S, 27° 5'54.48"E
MO036	Farm Complex – Bothasrus. Farm complex may include structures dating 60 years or older.	Grade IV A Medium	27°49'48.46"S, 26°58'27.12"E
MO037	Farm dam – The feature is related to the infrastructure identified as MO002. Feature is older than 60 years.	Grade IV A Medium	28°9'33.92"S, 26°58'44.90"E
MO038	Graveyard – The feature was noted along a dirt path close to ruined buildings of Donkerhoek (MO017)	Grade III A High	27°49'22.35"S, 26°58'5.32"E
MO039	Grave yard including at least 4 individual graves. Graves are marked with headstones. Only noted headstone with a date dated back to 2002.	Grade III A High	27°52'23.66"S, 26°58'58.84"E
MO040	Rotary hoe of the mid-20th Century – The feature is potentially older than 60 years.	Grade IV B Medium	27°59'1.68"S, 27°6'43.99"E
MO041	Graveyard including at least 30 individual graves. Graves are marked with headstones dating as early as 1949.	Grade III A High	27°58'54.02"S, 27° 6'40.10"E
MO042	Feeding trough made of a mid-20th Century tank – The feature is potentially older than 60 years.	Grade IV B Medium	28°9'40.03"S, 26°58'44.50"E

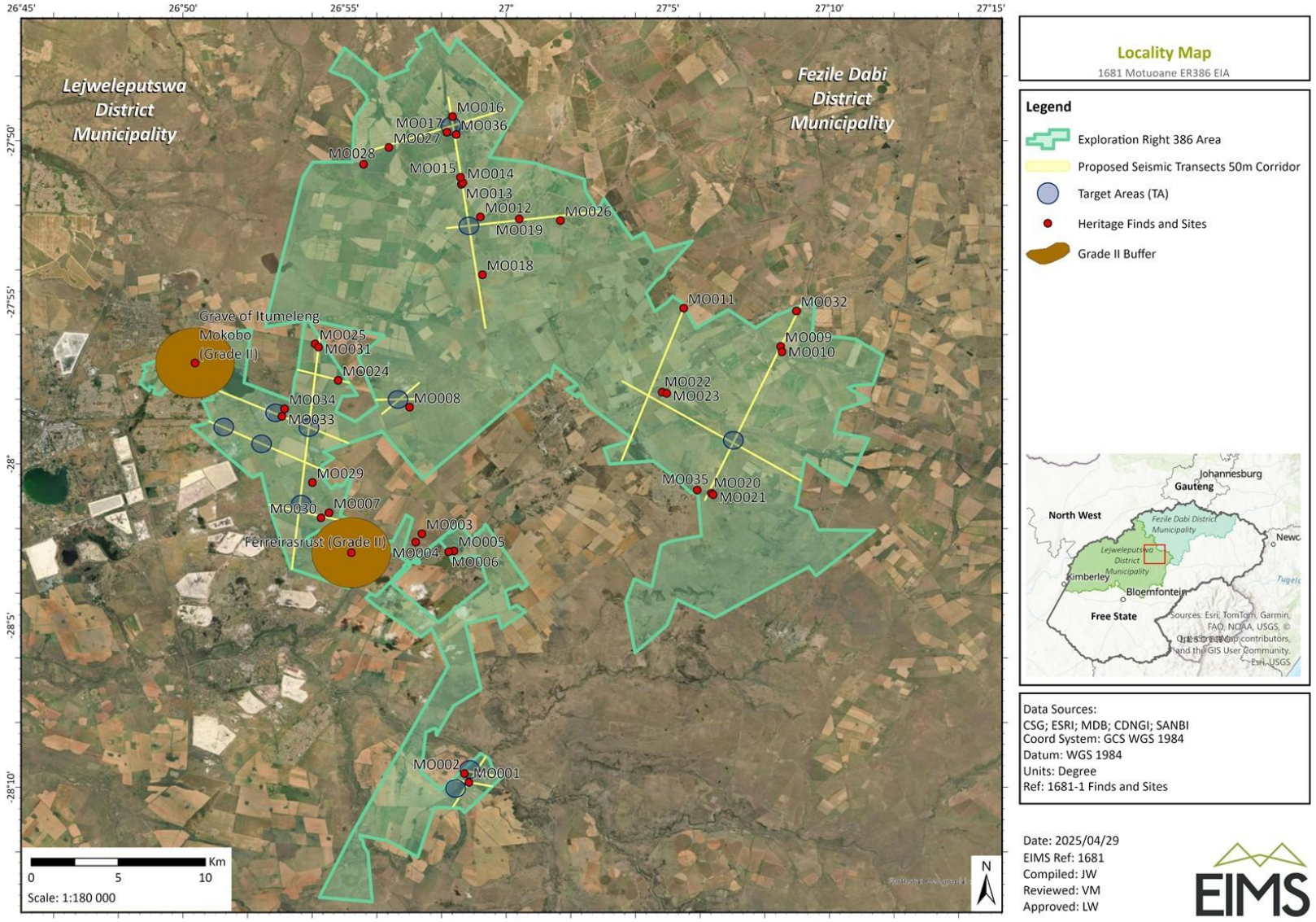


Figure 17: Map of potential heritage features across the ER Area including Grade II site 2km buffers (EIMS, 2025).

4.2.2 SOCIO-ECONOMIC

The following section provides a summary of the social and economic environment that may be influenced by the proposed project. Information in this section was obtained from the Integrated Development Plans (IDPs) for the Matjhabeng-, Masilonyana-, and Moqhaka Local Municipalities as well as from the Stats SA website. The information provided in the IDPs are based on a 2011 National census.

According to the National Environmental Management Act (NEMA, 1998) environment refers to the surroundings in which humans exist. When viewing the environment from a socio-economic perspective the question can be asked what exactly the social environment is. Different definitions for social environment exist, but a clear and comprehensive definition that is widely accepted remains elusive. Barnett & Casper (Barnett, 2001) offers the following definition of human social environment:

"Human social environments encompass the immediate physical surroundings, social relationships, and cultural milieus within which defined groups of people function and interact. Components of the social environment include built infrastructure; industrial and occupational structure; labour markets; social and economic processes; wealth; social, human, and health services; power relations; government; race relations; social inequality; cultural practices; the arts; religious institutions and practices; and beliefs about place and community. The social environment subsumes many aspects of the physical environment, given that contemporary landscapes, water resources, and other natural resources have been at least partially configured by human social processes. Embedded within contemporary social environments are historical social and power relations that have become institutionalized over time. Social environments can be experienced at multiple scales, often simultaneously, including households, kin networks, neighbourhoods, towns and cities, and regions. Social environments are dynamic and change over time as the result of both internal and external forces. There are relationships of dependency among the social environments of different local areas, because these areas are connected through larger regional, national, and international social and economic processes and power relations."

Environment-behaviour relationships are interrelationships (Bell, 1996). The environment influences and constrains behaviour, but behaviour also leads to changes in the environment. The impacts of a project on people can only be truly understood if their environmental context is understood. The baseline description of the social environment will include a description of the area within a provincial, district and local context that will focus on the identity and history of the area as well as a description of the population of the area based on a number of demographic, social and economic variables. Table 8 presents a summary of the socio-economic aspects that may be influenced by the proposed project

Table 8: Summary of the socio-economic aspects of the exploration project (IDPs for the Matjhabeng, Masilonyana, and Moqhaka Local Municipalities & Stats SA)

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
District Municipality	Lejweleputswa	Lejweleputswa	Fezile Dabi
Province	Free State	Free State	Free State
Municipal Area Size	5155.46 km^2	6796.08 km^2	7925 km^2
Number of Wards	36 wards	10 wards	25 wards
Social			
Population Size	406 461 individuals	63 334individuals	160 532 individuals
Number of households	123 195	17 575	45 661
Estimated growth/change in population size from 2001	2.4% increase	Decline of 0.17%	Decline of 0.45%
Population composition	89.48% individuals of the population are Black African, followed by 8.75% White, 1.42% Coloured, and 0.35% Indian or Asian.	91.6% individuals of the population are Black African, followed by 6.66% White, 1.5% Coloured, 0.33% Indian or Asian, and 0.27% classified as Other.	87.4% individuals of the population are Black African, followed by 9.4% White, 2.9% Coloured, and 0.3% Indian or Asian.
Languages	Sesotho – 64.0%. IsiXhosa – 12.3%.	Sesotho – 66.9%. IsiXhosa – 10.8%.	Sesotho – 74.6%. Afrikaans – 13.6%

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
	Afrikaans – 12.3%. English – 3.6%. Other – 7.8%.	Afrikaans – 9.6%. Setswana – 6.9%. Other – 5.8%.	IsiXhosa – 3.9%. English – 2.5% Other – 5.4%
Gender	They are slightly more females than males as 50.42% of the population are females, and the remaining 49.58% are males.	There are slightly more males (50.46%) than females (49.54%).	The sex ratio in the Census 2001 results was 99.2, and as of the Census 2011 the ratio is 98.1. In general, there are slightly more females than males especially for age groups above 40 years old.
Land use	The following land uses occur currently in this municipality: Business, cemetery, education, government, industrial, parks and residential.	The region accommodates predominantly agricultural related activities, land use in the area comprises of commercial agriculture (59%), Residential (10%), Unspecified (38%) and Conservation area (3%). A significant portion of the area is under dry land cultivation. The following irrigation schemes do however exist that enables intensive farming: The sand-vet scheme below the Erfenis and Allemanskraal Dams; ad Irrigation along the Modder River.	
Housing	Formal dwellings numbers were 56.8% in Census 2001, and the number increased to 78.5% in Census 2011. Housing owned/paying off was 51.4% in Census 2001and this has increased to 58.5% in Census 2011.	Although the Municipality has continued to provide housing opportunities to the people, it must be mentioned that the number of people who qualify for housing subsidy, is growing on daily basis, especially because the masses of the people continue to migrate to the area in search of employment opportunities. In the spirit of intergovernmental relations and line with Intergovernmental Relations Act, the Municipality is working closely with the Department of Human Settlements as well as the Department of Agriculture	Formal dwellings numbers have increased from 82.5% in Census 2001 to 88.7% in Census 2011. Housing owned/paying off – Census 2001 indicated 61.4% and this has decreased to 56.1% according to the Census 2011 results.

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
		and Rural Department; to solicit land for housing development. Middle income housing is one area that has been neglected for so long. The Municipality will continue to play an enabling environment with aim of addressing the middle income housing backlog.	
Access to water	Water infrastructure consists mostly of reservoirs (18) and 99 Km of bulk pipelines of Sedibeng Water, 29 pump stations, 1 water treatment plant and 12 waste water treatment plant. Sedibeng Water is the water service provider in terms of Water Service Act, and supply mainly the Goldfields region and the mines with water from the Vaal River, Bulkfontein near Bothaville and to a lesser extent from the Sand River. Main reservoirs are east of Allanridge, in Welkom, north and south of Virginia. Pump stations are east of Allanridge and at Virginia where purification plant exist. Other water infrastructure resources were constructed by the DWS including dams in Allemanskraal and canals serving the Sand – Vet irrigation scheme.	Census 2011 results show a significant decline of piped water to dwelling as compared to 78.7 % in Census 2001.	There are 45 661 households in the municipality, with an average household size of 3.2 persons per household. 57.7% of households have access to piped water either in their dwelling or in the yard. Only 1% of households do not have access to piped water. Access to piped water inside dwelling was 28.4% in Census 2001 results, and 57.7% in Census 2011.
Sanitation facilities	The second generation of democratic local government was mandated to among others to improve levels of sanitation and eradicate bucket system as form of sanitation. In this regard this mandates were fulfilled. However, challenges were identified, among others were poor project planning, execution and reporting. This has led to a particular number of households still not able to use proper sanitation thus reverting back to old system.	The Census results also indicate an increase of access to sanitation by 70.5% as compared to 23.4% in Census 2001.	Flush toilet connected to sewerage – was 65.6% in Census 2001, and 85.6% in Census 2011.

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
	The other challenge that came with expansion of service has been the capacity of waste water treatment plants and pump stations. As indicated above there are 12 treatment plants and all of them require major upgrade and refurbishment.		
Energy	The bulk electrical network is well established around the Matjhabeng area. Eskom serves all mines and all townships in the municipal area and thus there is sufficient bulk infrastructure available to serve the whole area. Main challenge however remains an aging electrical infrastructure in particular in towns where the municipality is provider. A change in cost recovery and their subsidisation policy has made it very expensive to electrify the rural areas, and these include farms and farming communities who need such basic power support. The municipality is overly dependent on electricity as a source of energy for lighting, cooking and heating. In fact, the statistics reflect an increase of electricity as energy source in that the use electricity for lighting has increased from 84.98 to 8702; for cooking from 60% to 80%; and heating from 54% to 57%.	According to Census 2011, electricity provision has increased significantly by 93.2% compared to Census 2001 figures.	Electricity for lighting – was 83.8% in Census 2001 and has increased to 93.3% in Census 2011.
Economic			
Percentage unemployment	The number of unemployed residents in Matjhabeng has marginally decreased since 2001.	General and youth unemployment trends in the municipality show a 3.3 % decline of overall unemployment rate between Census 2001 and 2011 respectively. Similarly, results show a minimal decline of 4.6 % of youth unemployment during the same	Overall unemployment rate is 35.2%; and youth the unemployment rate is 47.2%. Employment opportunities mainly created in Kroonstad as a

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
	However, Matjhabeng still has the worst unemployment rate within the District at 42.0%, which is also above the provincial rate.	period. However, unemployment remains a serious challenge in the municipality.	continuous growth point, whilst opportunities in the other smaller towns, remain limited and agricultural orientated.
Largest Employing sector	The district of Mangaung is the biggest employer in the province, employing 30% of the people employed in the province; this is in line with its 31% contribution to provincial GDP. The biggest regional economy is within the Fezile Dabi District, with a GDP share of around 35%, only employs 19% of the employed in the province, although its share has increased from only 15% in 2002. As is the case with the ranking in terms of GDP, Lejweleputswa (24%), and Thabo Mofutsanyane (22%) hold the third and fourth positions respectively in terms of employment share.		
Largest economic contribution	The current statistics shows that the economies of Welkom 53%, Odendaalsrus 38%, and Virginia 78% are dominated by mining, whilst Hennenman is dominated by manufacturing 41%, agriculture 17%, trade 10%, and finance 10%. The total area percentages show a combined figure of 58% dominance by the mining sector. The biggest sectors in the district in 2012 were: Mining (42.9%); Community services (20.4%); and Trade (11.7%). Matjhabeng has a relatively large economy with a production value of almost R27 billion (current prices 2011). The mining sector is by far the largest sectoral contributor.	The agricultural sector of certain areas in the district is extremely prominent and contributes largely to the GDP of the Lejweleputswa District, which emphasize the agricultural significance of this district. The latter results to industrial development that is agricultural orientated. The Municipal area has a significant weekend related tourism potential that could, in future, contribute to the GDP of the district and should be further exploited. Brick Making projects in Masilo, Tshepong (Verkeerdevlei) and resuscitating the same project in Makeleketla (Winburg). Transportation modes the residents use mostly consist of private vehicles buses, minibuses/ taxis, bicycles, motorcycles and non-motorized transport; walking is also common.	The Greater Kroonstad is the centre of a large agriculture community that plays an important role in the economy of the district. Industrial activities subsequently contribute significantly to the district's economy.
Tourist attractions/ heritage resources	There is one formal land-based protected area in the municipality, being the Willem Pretorius Nature Reserve.	Brandfort is also known for its rich political history, which includes the National Military Museum on a farm that used to be a concentration camp during the Anglo-Boer War and the Winnie Mandela House, where	Kroonstad has of late become a distinguished holiday destination due to the ultra-modern and popular holiday resort of

Aspect	Matjhabeng Local Municipality	Masilonyana Local Municipality	Moqhaka Local Municipality
		Mandela was sentenced to House Arrest during the State of Emergency in the 1980s. Winburg prides itself with the Voortrekker Monument as its Heritage Site, and Masilonyana boasts several game reserves across all its towns (e.g. Erfenis Dam Nature Reserve and Soetdoring Nature Reserve).	Kroonpark, adjacent to the Vals River. The hunting and guesthouse industries displayed an exceedingly rapid growth the past few years.

4.2.3 GEOLOGY AND PALAEONTOLOGY

4.2.3.1 **GEOLOGY**

According to information obtained from the Baseline Geohydrological Assessment Report undertaken by Gradient Groundwater Consulting in support of the Scoping Report, based on the Council for Geoscience (CGS) 1:250 000 geological maps (Geological Map Sheet 2726 Kroonstad and Geological Map Sheet 2826 Winburg) the surface geology of the study area is characterized by a variety of lithologies, formations, and intrusions. These include geologically recent Quaternary deposits; sediments of the Beaufort and Ecca Groups within the Karoo Supergroup; dolerite dykes, sheets, and sills associated with the Karoo Dolerite Suite; and post-Karoo kimberlite pipes and dykes. **Figure 18** depicts the regional geology and stratigraphy.

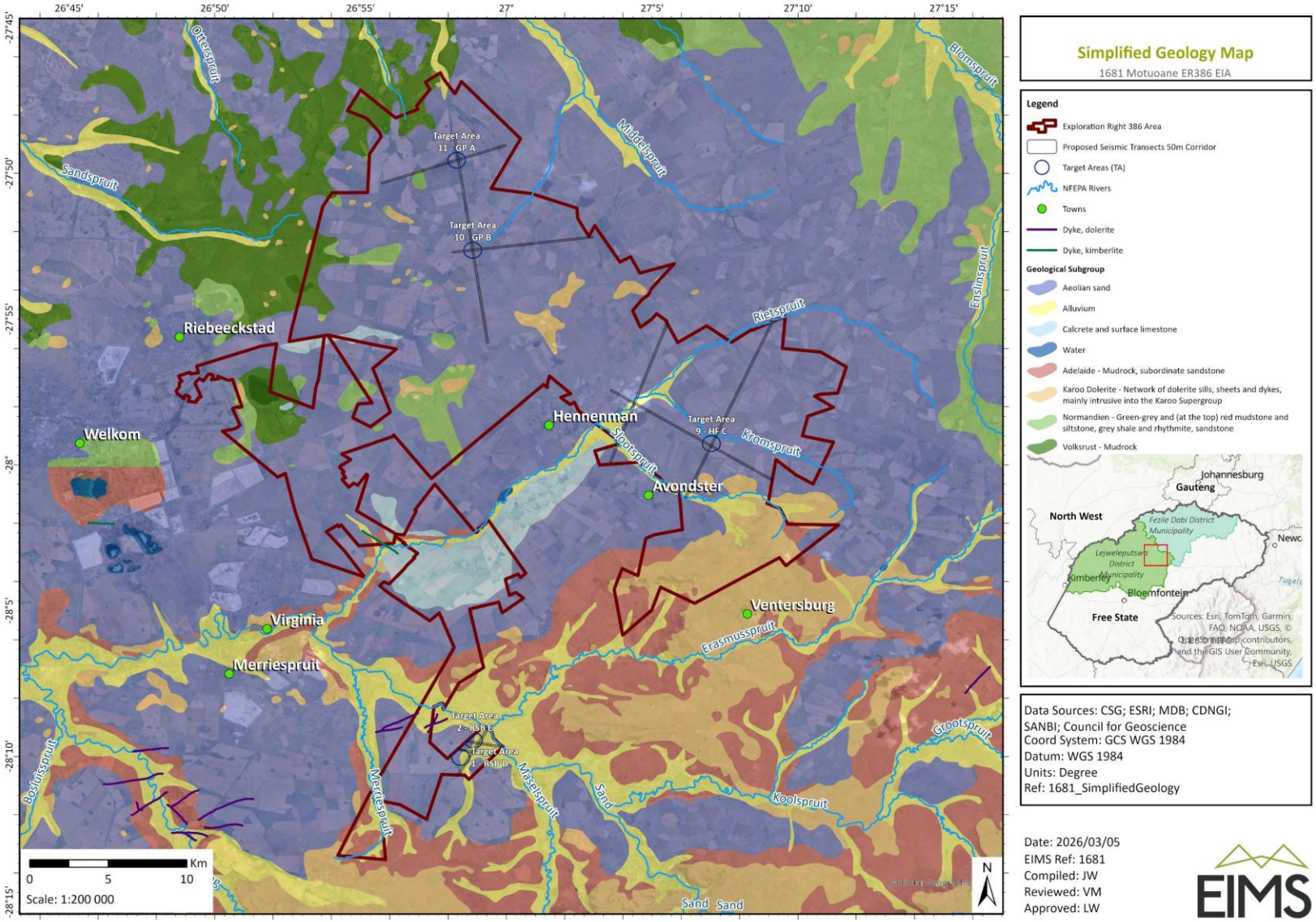


Figure 18: Regional geology and stratigraphy.

The Quaternary deposits, which were deposited less than 0.01 million years ago (Department of Water Affairs (DWA), 2012), cover most of the northern and central parts of the study area, while also being present in the southern parts of the study area. These deposits include aeolian (wind-blown) dune sand in the northern and central parts of the study area; alluvium, including calcified alluvium and river gravel, in the northern, northeastern, central, and southern parts of the study area along the banks and floodplains of surface water drainage features; and patches of calcrete and surface limestone in the western and northwestern parts of the study area.

The sediments of the Beaufort Group, which are primarily of fluvial and deltaic origin (Baran, 2003), were deposited during the late Permian Period between approximately 248 and 239 million years ago and are associated with the orogeny and tectonic paroxysm of the Cape Fold Belt (Woodford, 2002). The Adelaide Subgroup within the Beaufort Group occurs toward the northeastern parts of the study area, while also being present in the central and southern parts of the study area. Specifically, the Normandien Formation within the Adelaide Subgroup occurs towards the northeast of the study area and comprises of greenish grey (bottom of formation) to red (top of formation) mudstone and siltstone, grey shale and rhythmite, and sandstone. The Adelaide Subgroup covering the central and southern parts of the study area is not differentiated into specific formations and comprises of mudstone with subordinate sandstone.

The sediments of the Ecca Group were deposited during the Permian Period between approximately 290 and 248 million years ago (Woodford, 2002). The Volksrust Formation within the Ecca Group occurs toward the northwestern parts of the study area. Fluvial and deltaic sediments were supplied to the Volksrust Formation as a result of continental provenance towards the north and northeast of the Karoo Basin (Woodford, 2002). The Volksrust Formation, which interfingers with the overlying Beaufort Group (Woodford, 2002) is a primarily argillaceous formation comprising of mudstone, siltstone, and shale.

A vast network of dolerite dykes, sheets, and sills associated with the Karoo Dolerite Suite occurs throughout the study area and is especially prominent in the southern and central parts of the study area. The Karoo Dolerite Suite intruded into the Karoo Supergroup approximately 180 million years ago during the early stages of the break-up of Gondwanaland (Woodford, 2002). Furthermore, kimberlite and associated alkaline-rich intrusive rocks, including carbonatite and olivine melelitite, intruded into the Karoo Basin between approximately 130 and 70 million years ago (Woodford, 2002).

4.2.3.2 **PALAEONTOLOGY**

Cultural Heritage in South Africa, including all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include “all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”. Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

According to the Baseline Palaeontological Impact Assessment Report for the ER (Fourie, 2025), the study area is underlain by Quaternary deposits, while the largest portion of the development is underlain by the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). The bulk of the site is underlain by the Karoo Supergroup Formations covered by vegetation, grass, trees, roads, and buildings. According to the Council for Geoscience (CGS) 1:250 000 geological maps (Geological Map Sheet 2726 Kroonstad and Geological Map Sheet 2826 Winburg), the surface geology of the study area is characterized by a variety of lithologies, formations, and intrusions. These include geologically recent Quaternary deposits; sediments of the Beaufort and Ecca Groups within the Karoo Supergroup; dolerite dykes, sheets, and sills associated with the Karoo Dolerite Suite; and post-Karoo kimberlite pipes and dykes. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of all Karoo Supergroup geological formations are ranked as Very Low to Very High, and here the impact is potentially Very High for the Beaufort Group, High for Quaternary (Qs), Moderate for Ecca rocks and the Qauternary (Qc). A wide range of possible fossil remains occur in the Cenozoic, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g.

calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. The Jurassic Dolerite does not contain fossils.

However, it is anticipated that no visible evidence of fossiliferous outcrops will be found in within the target areas and seismic transects during the EIA Phase based on previous studies in the area and thus an overall medium palaeontological significance is likely to be allocated for the project area. It is therefore, currently considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised in its whole extent. The ECO for this project must be informed that the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) has a Very High Palaeontological Sensitivity. If Palaeontological Heritage is uncovered during surface clearing and excavations the Chance find Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.

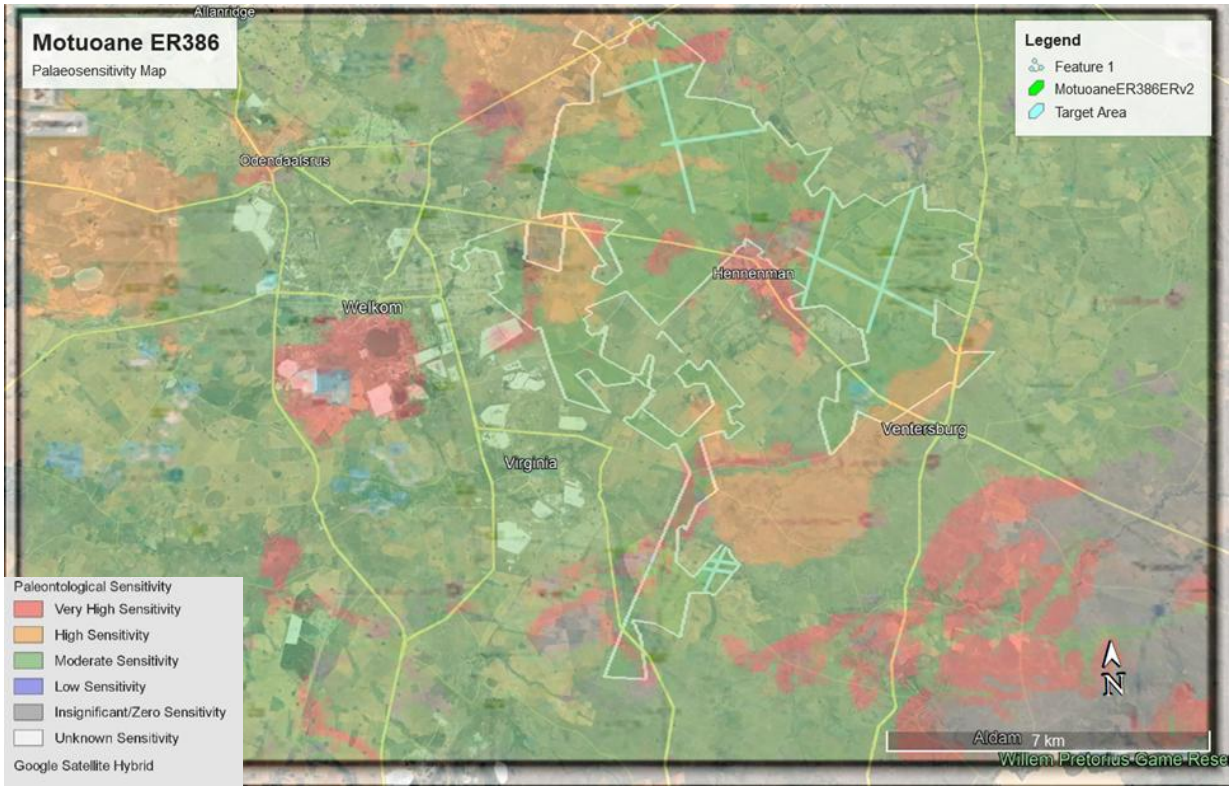


Figure 19: Extract of the SAHRIS PalaeoMap map (Dr Fourie, 2025)

4.2.4 CLIMATE

Climate can be defined as weather conditions that have occurred over a long period of time in an area. Dominant climatic features that climate is centred around are temperature, rainfall, wind and evaporation. These climatic features can affect the exploration environment in several ways:

- Influence erosion;
- Influence vegetation growth, which affects rehabilitation planning;
- System monitoring of ground water availability;
- Air temperature can influence air dispersion through atmospheric stability and mixing layers; and
- Wind speed & direction can influence erosion and the dispersion of potential atmospheric pollutants.

The study area has warm summers and cold winters. Frost is a common phenomenon and the coldest periods (usually from June to August) are exacerbated by seasonal aridity. The daily minima for the coldest months are below freezing. The monthly distribution of average daily maximum temperatures shows midday temperatures ranging from 17°C in June to 29°C in January. The region is the coldest during July when the temperatures drop to 0°C on average during the night. Winter frost and cold is therefore a potentially limiting factor for plant growth. The study area is situated in a summer rainfall area, with rainfall peaking in January and at a lowest during July. Rainfall data was obtained from rainfall station 0365058 (Hennenman) and the Mean Annual Precipitation (MAP) was calculated at 612 millimetres per annum (mm/a) over a 36-year period. The 95th percentile is 884 mm/a and the 5th percentile 408 mm/a. Annual rainfall is approximately 450 mm/a, which is considered to be relatively dry for an area of grassland.

4.2.5 SOILS AND AGRICULTURE LAND POTENTIAL

The baseline soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006).The land type data is presented at a scale of 1:250 000 and comprises of the division of land into land types. In addition, a Digital Elevation Model (DEM) as well as the slope percentage of the area was calculated by means of the NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data by means of QGIS and SAGA software.

The land capability was determined by using the guidelines described in “The farming handbook” (Smith, 2006) which the DAFF land capabilities were further developed from. Accordingly, the identified soil forms associated with the ER are restricted to land capability 2 and 3, categorised between land capability 6-8 (Pinedene, Westleigh, Augrabies, Swartland and Glen soils) and land capability 8 (Witbank soil), categorised between land capability 1-5. The baseline soil land capability was compared to the National Land Capability data (DAFF, 2017). The land potential classes are further determined by combining the land capability results and the climate capability of a region

According to the land type database (Land Type Survey Staff, 1972 - 2006), the ER is characterized by the Bb1, Dc12, Dc8, Bd19, Bd21, Bd20, Ea40, Dc9 land types. The associated land capability ranges from Very Low-Low (02) to Moderate-High (10). Refer to Figure 20 and Figure 21 for the land types and land capabilities within the ER.

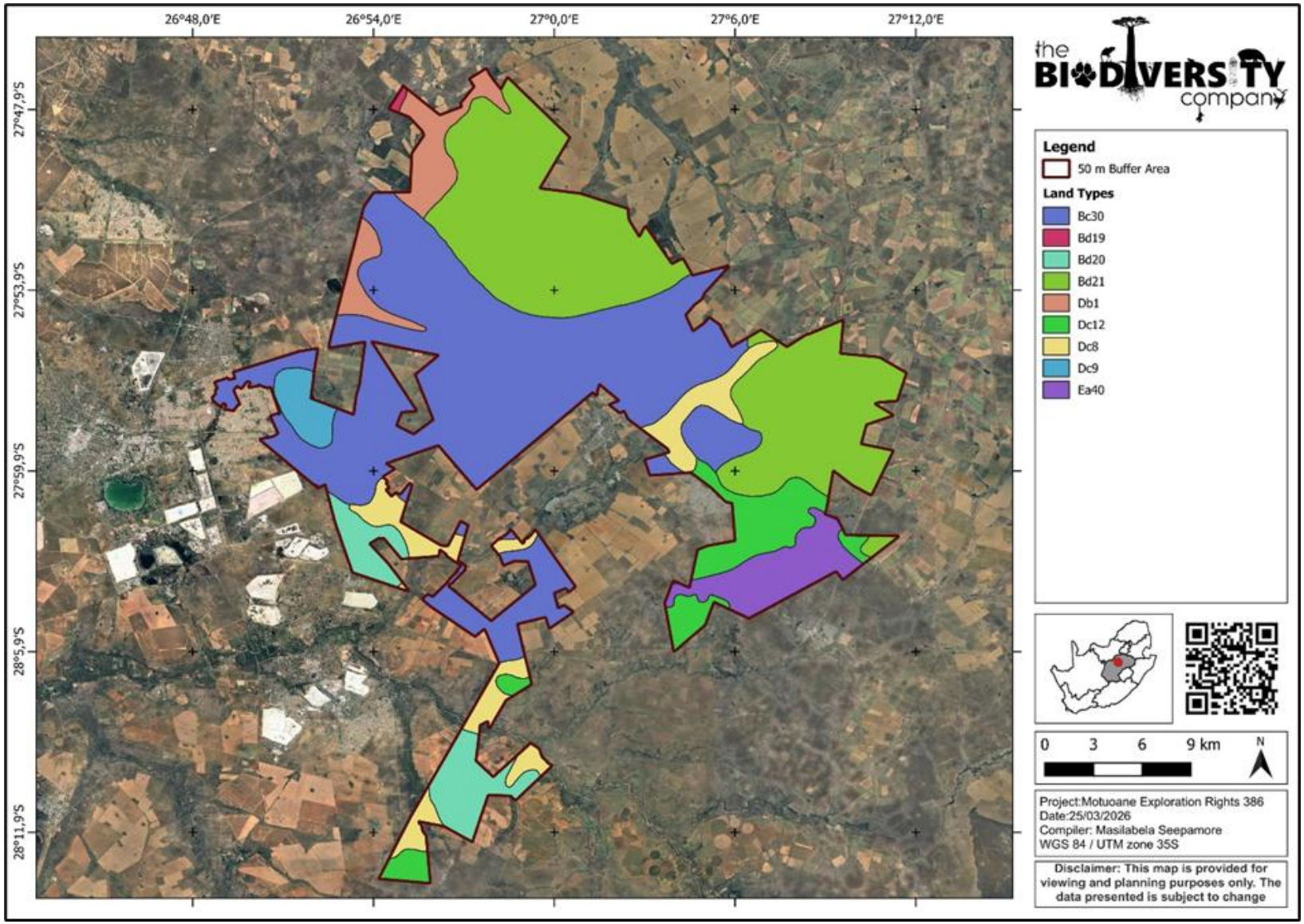


Figure 20: The land type associated with the exploration right (The Biodiversity Company, 2026).

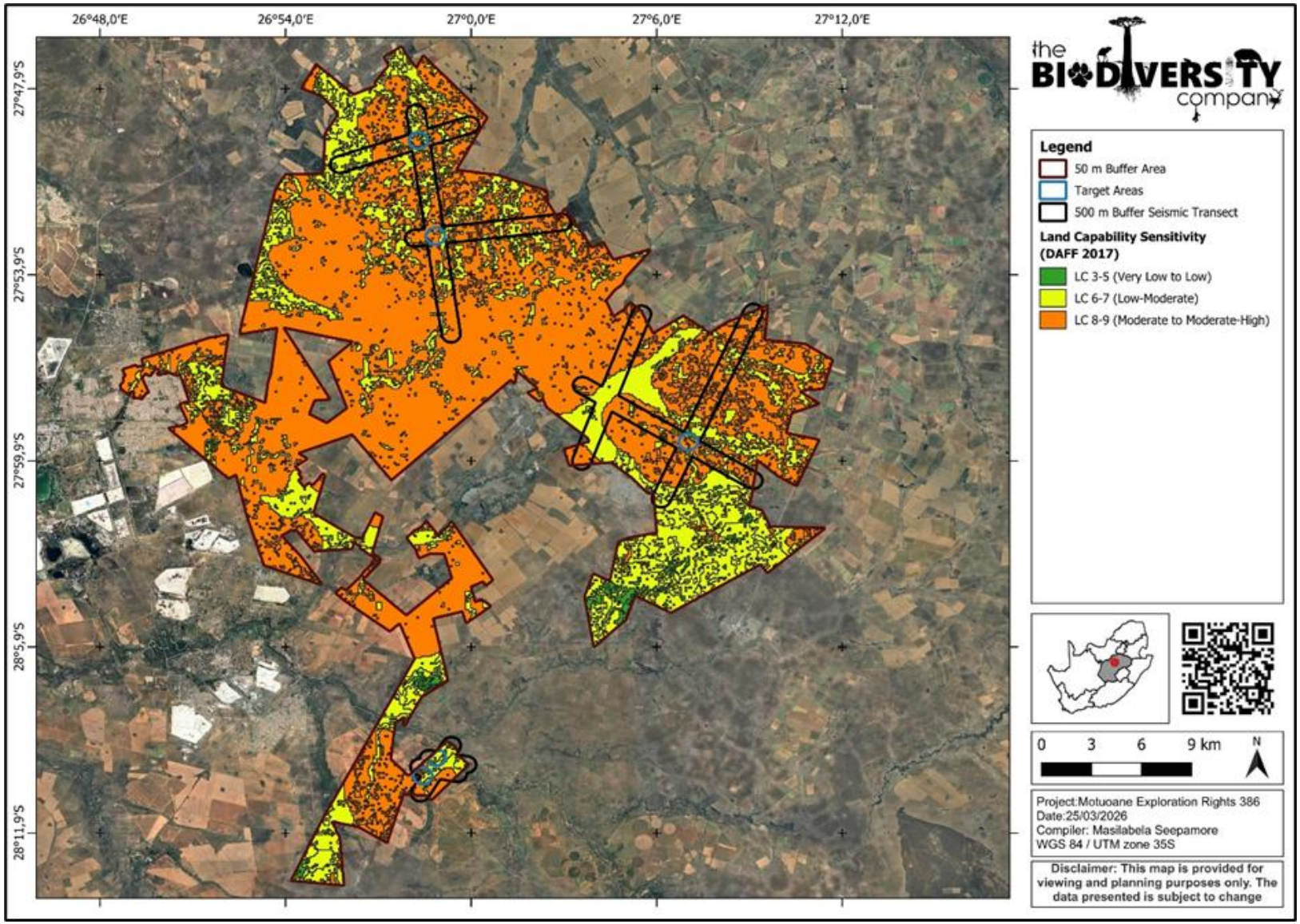


Figure 21: The land capability sensitivity for the 50 m buffer area of the entire seismic right assessment area (The Biodiversity Company, 2026)

4.2.6 TERRESTRIAL BIODIVERSITY

Terrestrial biodiversity is the variety of life forms on the land surface of the Earth. High biodiversity is an indicator of a healthy ecosystem, which is directly linked to human health. Animals and plants are responsible for many vital services our lives depend on, oxygen production, water regulation, soil retaining; and providing flood protection.

Biodiversity is both a part of nature and affected by it. Some biodiversity loss is because of events such as seasonal changes or ecological disturbances (wildfires, floods, etc.), but these effects are usually temporary, and ecosystems have managed to adapt to these threats. Human-driven biodiversity loss, in contrast, tends to be more severe and long-lasting. The human-made climate crisis is leading to environmental destruction, habitat loss, and species extinction. Terrestrial biodiversity is decreasing rapidly through habitat loss: a process where a natural habitat becomes incapable of supporting its native species, which are consequently displaced or killed. In the recent past, there have been increased efforts implemented to prevent further loss of terrestrial biodiversity and the ecosystem services they provide. The characteristics and implications of the terrestrial biodiversity within the development site are discussed below.

4.2.6.1 ECOLOGICALLY IMPORTANT LANDSCAPE FEATURES

The following features describe the general area and habitat, this assessment is based on the Terrestrial Biodiversity Impact Statement and Wetland and Baseline Risk Assessment Report undertaken by specialists (The Biodiversity Company, 2026)

Table 9: Spatial relevance of the Project Area to local ecologically important landscape features (The Biodiversity Company, 2026).

Desktop Information Considered	Relevant/Irrelevant
Ecosystem Threat Status (RLE 2021)	Relevant. Overlaps with 'Endangered (EN) and 'Least Concern (LC)' ecosystems.
Ecosystem Protection Level	Relevant. Overlaps with 'Not Protected (NP)' and 'Poorly Protected (PP)' ecosystems.
Provincial Conservation Plan	Relevant. Overlaps with Other Natural Areas (ONAs), Ecological Support Areas 1 & 2 (ESAs 1 & 2), Degraded Areas (DAs) as well as Critical Biodiversity Areas 1 & 2 (CBAs 1 & 2).
South Africa Protected Areas Database - SAPAD and South Africa Conservation Areas Database - SACAD	Relevant. Overlaps with the Thabong Game Range and falls within >5 km of Tara Wildlife Safaris, Newlands Game Ranch, De Rust Private Nature Reserve and Goliatskraal Private Nature Reserve.
National Protected Areas Expansion Strategy (NPAES)	Relevant. The ER overlaps with NPAES Priority Focus Areas.
Key Biodiversity Areas (KBA)	Irrelevant. The nearest KBA is situated over 30 km from the ER.
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Relevant. The ER overlaps with 'Least Concern' (LC) and 'Critically Endangered' (CR) wetlands.
National Freshwater Priority Area	Relevant. The ER overlaps with non-priority and priority FEPA wetlands.

Mining and Biodiversity Guidelines	Relevant. The ER overlaps with an area of Highest Biodiversity Importance.
Strategic Water Source Areas (SWSA)	Irrelevant. The ER does not overlap with any SWSA.
Coordinated Avifaunal Roadcount (CAR)	Irrelevant. Three CAR routes are located within the Project Area. FW19, FW20, FW49.
Coordinated Waterbird Counts (CWAC)	Relevant. A CWAC location, Toronto Pan, is located approximately 11 km from the Project Area.

The ER overlaps several areas identified in the South Africa Protected Areas Database (SAPAD), including the Thabong Game Reserve and the 5 km buffer zones of the Tara Wildlife Safaris, Newlands Game Ranch, De Rust, and Goliatskraal Private Nature Reserves. However, site-specific verification indicates that the Thabong Game Reserve designation is based on outdated GIS data; the area (now the Harmony Cluster) is currently characterized by mining, residential, and grazing activities. Additionally, southern portions of the ER intersect with National Protected Area Expansion Strategy (NPAES) Priority Focus Areas, which are critical for ecosystem-specific conservation targets and climate change resilience.

4.2.6.2 PROVINCIAL BIODIVERSITY PLANNING

According to the Free State Biodiversity Sector Plan, the study area contains a mosaic of Critical Biodiversity Areas (CBA 1 & 2), Ecological Support Areas (ESA 1 & 2), and Other Natural Areas (ONA). While these classifications indicate high conservation priority, the majority of the proposed target areas and seismic transects are situated within transformed landscapes dominated by commercial crop cultivation, mining, and livestock grazing.

4.2.6.3 VEGETATION AND ECOSYSTEM STATUS

The ER is located within the Grassland Biome, specifically intersecting four vegetation types:

- Vaal-Vet Sandy Grassland (Endangered): Approximately 63% transformed, with only 0.3% statutorily conserved.
- Central Free State Grassland (Vulnerable): Nearly 25% transformed due to cultivation and dam construction.
- Highveld Alluvial Vegetation (Least Threatened): Associated with riparian thickets and seasonal floodplains.
- Winburg Grassy Shrubland (Least Threatened): A mosaic of solitary hills and open grasslands.

4.2.6.4 FAUNA AND SPECIES OF CONSERVATION CONCERN (SCC)

A baseline assessment by The Biodiversity Company (2025) identified several potential SCC within the ER:

- **Flora:** 243 species are expected, though no specific SCC were flagged by the DFFE Screening Tool.
- **Mammals:** Two SCC are noted, including the Cape clawless otter (Near Threatened) and Spotted-necked Otter (Vulnerable), both dependent on the health of local aquatic systems.
- **Avifauna:** Of the 298 species expected, 21 are considered SCC. High-likelihood species include the Secretarybird (Vulnerable), Lanner Falcon (Vulnerable), and Blue Korhaan (Near Threatened).
- **Amphibians:** The Giant Bullfrog (Near Threatened) has a moderate likelihood of occurrence.

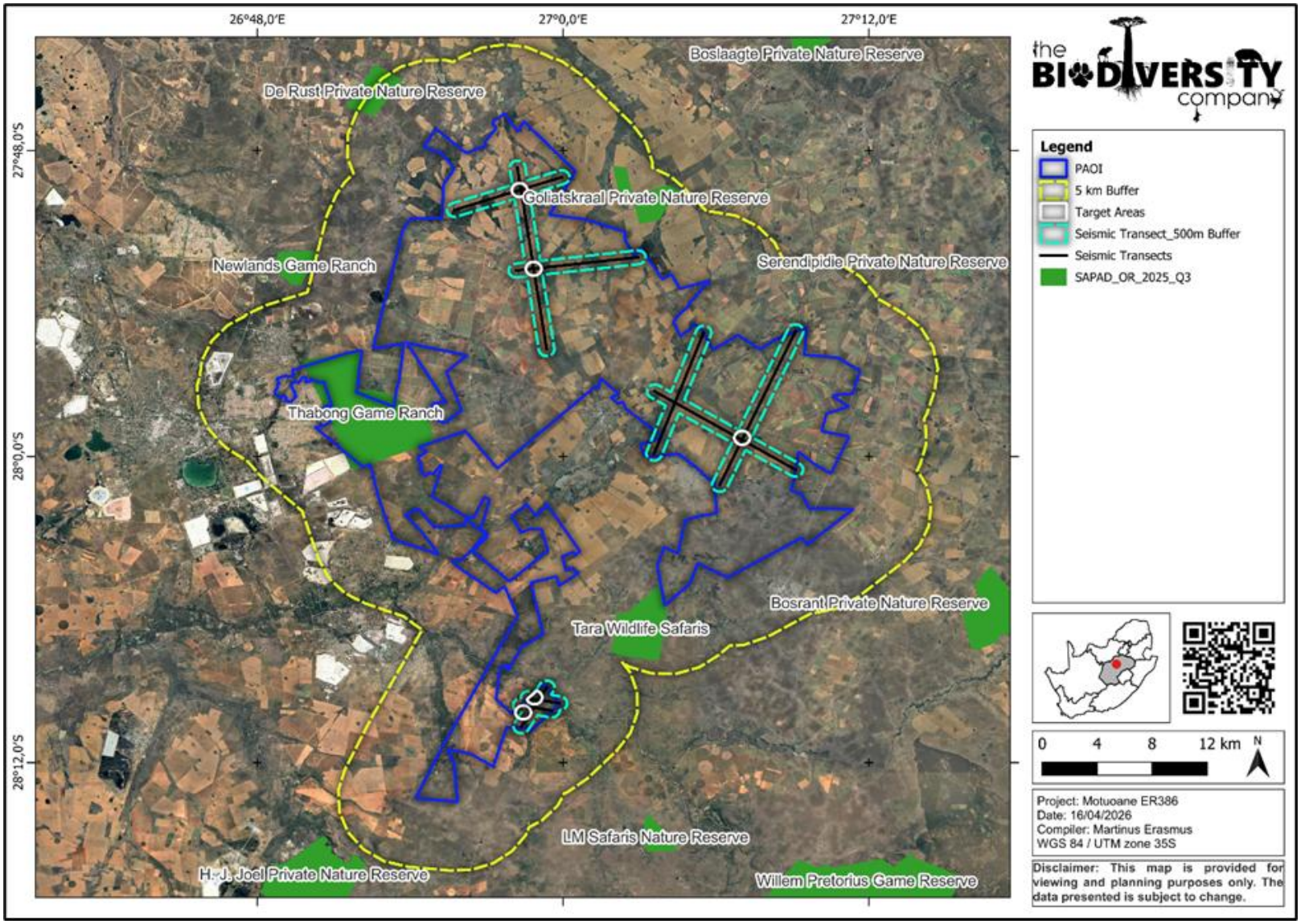


Figure 22: Map illustrating the ER in relation to the Protected Areas (The Biodiversity Company, 2026)

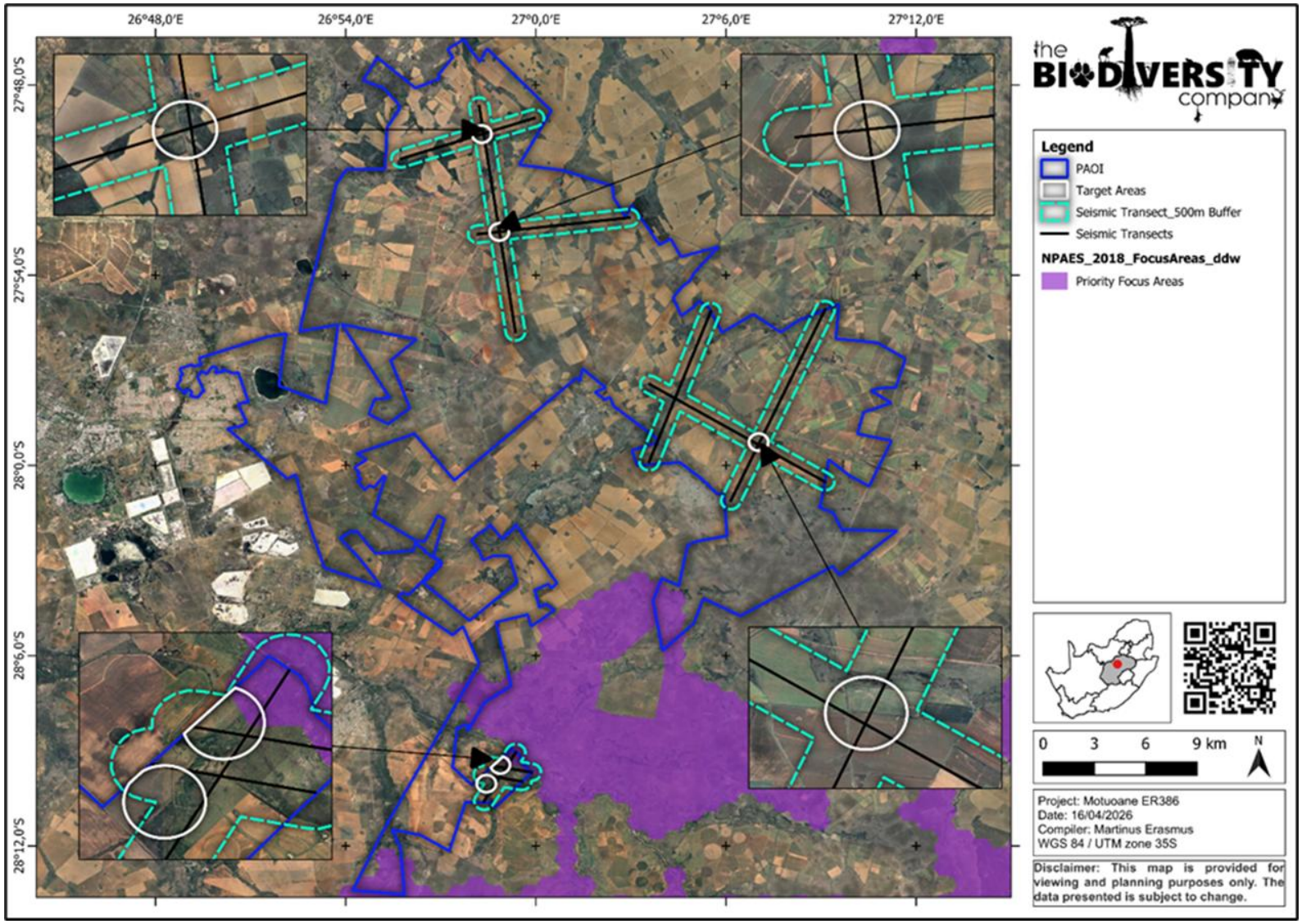


Figure 23: Map illustrating the ER in relation to the NPAES areas (The Biodiversity Company, 2026).

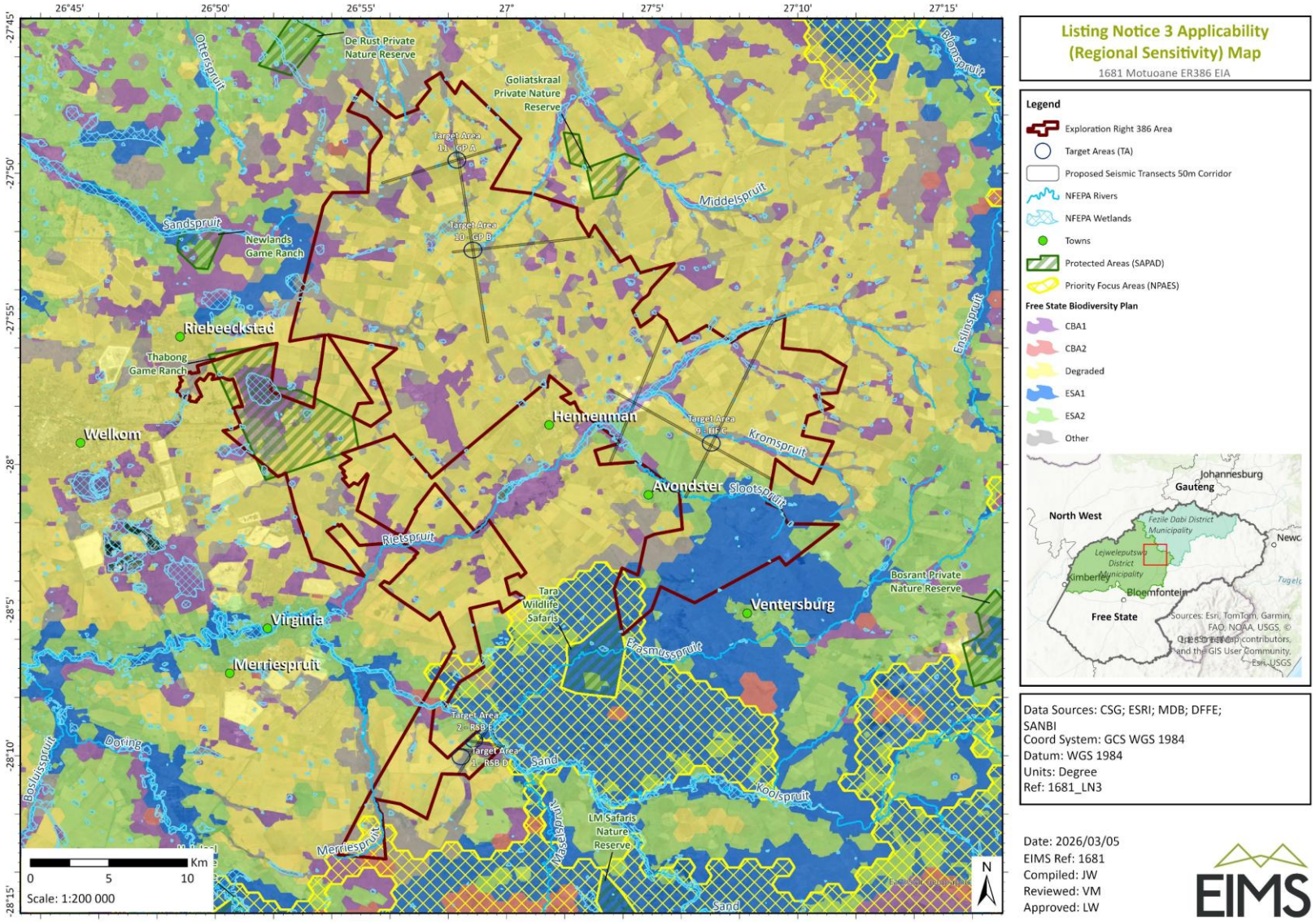


Figure 24: Map illustrating the ER in relation to the Free State Biodiversity plan.

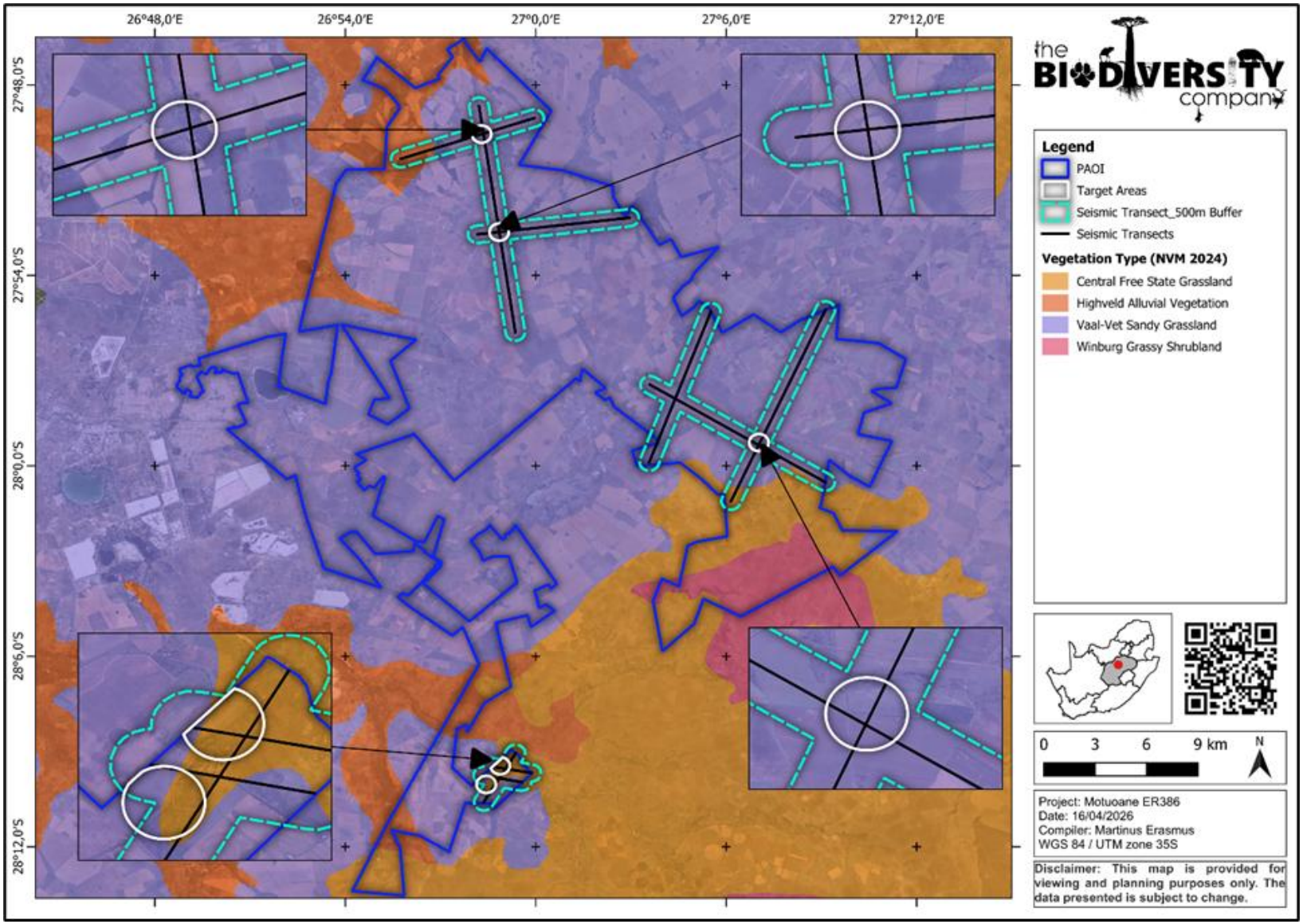


Figure 25: Vegetation types associated with the ER (The Biodiversity Company, 2026).

4.2.7 FRESHWATER ECOLOGY - SURFACE WATER AND WETLAND

4.2.7.1 **DRAINAGE AND CATCHMENT**

This section provides an overview of the regional hydrological (surface water) environment across the extent of the project area. Information in this section has been sourced from the Baseline Geohydrological Assessment undertaken by Gradient Groundwater Consulting and the Baseline Soils, Agriculture, Freshwater and Terrestrial Biodiversity Assessment undertaken by the Biodiversity Company.

South Africa is divided into nineteen (19) Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level is achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA progressively develops a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA. This is to ensure that on a regional scale, water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons. The main instrument that guides and governs the activities of a WMA is the CMS which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. The greater study is situated in primary catchment (C) of the Vaal River drainage system which covers a total area of approximately 580.0km^2. The resource management falls under the Vaal Water Management Area (WMA5) (previously Middle Vaal WMA[5]) which spans portions of the North West Province, northern Free State as well northern sections of the Northern Cape. The study area encompasses several quaternary catchments of the Vaal WMA. These include Quaternary Catchments C25B, C42H, C42J and C60H. The main watercourses within the Middle Vaal WMA are the Mooi, Vet, and Vaal Rivers (WRC, 2016). The Vaal River is a major tributary of the Orange River, which generally drains in an eastern direction towards the Atlantic Ocean. The primary rivers in and around the study area include the Vals River towards the northeast of the study area, the Sand River in the central parts of the study area, and the Vet River towards the southwest of the study area (WRC, 2016).

The perennial Vals River, a major tributary of the Vaal River, flows across the northeastern extremity of the study area, where it is dammed by the Serfontein Dam, and drains in a northwestern direction. The Serfontein Dam has a surface area of approximately 1.09 km^2. Minor tributaries of the Vals River located within the study area include Blomspruit and Enslinspruit toward the northeast of the study area, Middelspruit and Otterspruit toward the north of the study area, and Sandspruit towards the northwest of the study area. Blomspruit, Middelspruit and Sand Spruit drain in a northwestern direction toward the Vals River, while Enslinspruit and Otterspruit drain toward the north.

The perennial Sand River, a tributary of the Vet River, flows across the central parts of the study area and drains in a western direction. The Sand River is dammed by the Allemanskraal Dam southeast of the study area. The Allemanskraal Dam has a surface area of approximately 28.64 km^2. Minor tributaries of the Sand River located within the study area include Koolspruit, Erasmusspruit, and Rietspruit north of the Sand River and Maselspruit, Merriespruit, and the Doring River south of the Sand River. Koolspruit, Erasmusspruit, and Rietspruit drain in a southwestern direction toward the Sand River, Maselspruit and Merriespruit drain in a northern direction toward the Sand River, and the Doring River drains in a northwest direction toward the Sand River.

The perennial Vet River, a major tributary of the Vaal River, is located towards the southwest of the study area and drains in a northwestern direction. The Vet River is dammed by the Erfenis Dam towards the south of the study area. The Erfenis Dam has a surface area of approximately 32.40 km^2. Minor tributaries of the Vet River located within the study area include Soutspruit and Kromspruit north of the Vet River. Soutspruit drains is a southern direction towards the Vet River, while Kromspruit drains towards the southwest. Surface water drainage overall occurs in a western to northwestern direction within the study area. The mean annual runoff (MAR) for the study area is estimated at approximately 13.16 Mm^3/a, based on MAR data obtained from

[5] It should be noted that the Department of Water Affairs (DWA), now the Department of Water and Sanitation (DWS), replaced the original 19 WMAs established in 2004 by 9 new WMAs as defined in Government Gazette No. 35517, July 2012. This resulted in the grouping of the Upper, Middle, and Lower Vaal WMAs into the single Vaal WMA.

WR2012 (WRC, 2016). Table 10 provides a summary of relevant climatological and hydrogeological information for the relevant quaternary catchments. Refer to Figure 26 and Figure 27 for the hydrological conditions.

Table 10: Study Area Catchment and Hydrological Properties (Gradient Groundwater Counseling, 2026)

Quaternary Catchment	Area (km^2)	% Covered by Study Area	MAP (mm/a)	MAE (mm/a)	MAR (Mm^3/a)	Rainfall Zone	Evaporation Zone
C25B	1 887.67	1.91	509.21	1 750	7.23	C2H	9A
C42H	445.00	9.83	540.00	1 590	10.16	C4C	19C
C42J	1 013.93	26.69	529.79	1 600	21.26	C4C	19C
C60H	1 232.02	19.39	512.75	1 650	2.64	C6B	11A

4.2.7.2 SOUTH AFRICAN INVENTORY OF INLAND AQUATIC ECOSYSTEMS

The South African Inventory of Inland Aquatic Ecosystems spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA 2018). National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE, 2018). Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT, with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer, et al., 2018). The ER overlaps with a CR and LC wetlands (Figure 28).

4.2.7.3 NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREA STATUS

To better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's (NEM:BA) biodiversity goals (Nel, 2011). Figure 29 shows that the ER overlaps with non-priority and priority FEPA wetlands.

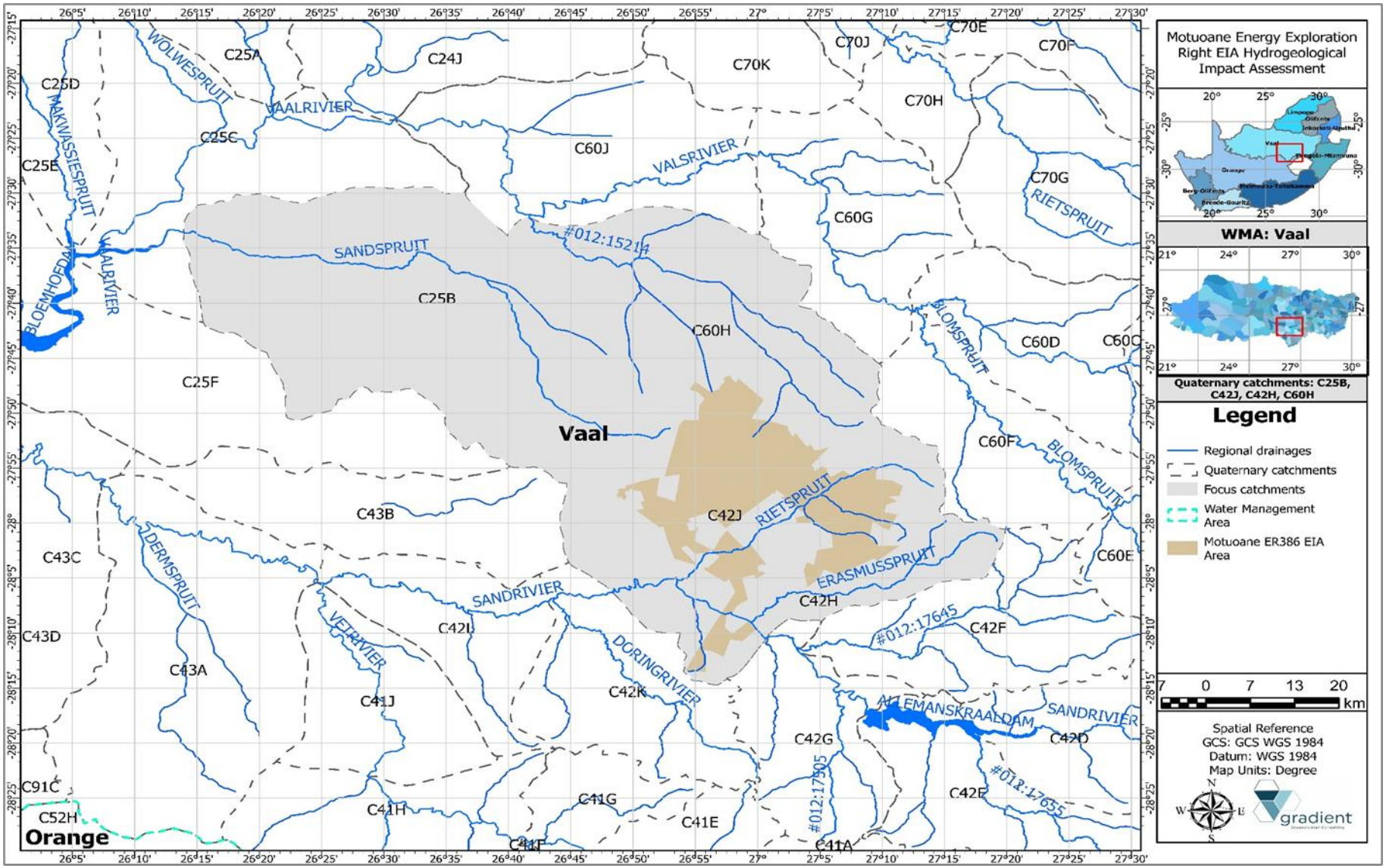


Figure 26: Quaternary catchments and water management area (Gradient Groundwater Consulting, 2025).

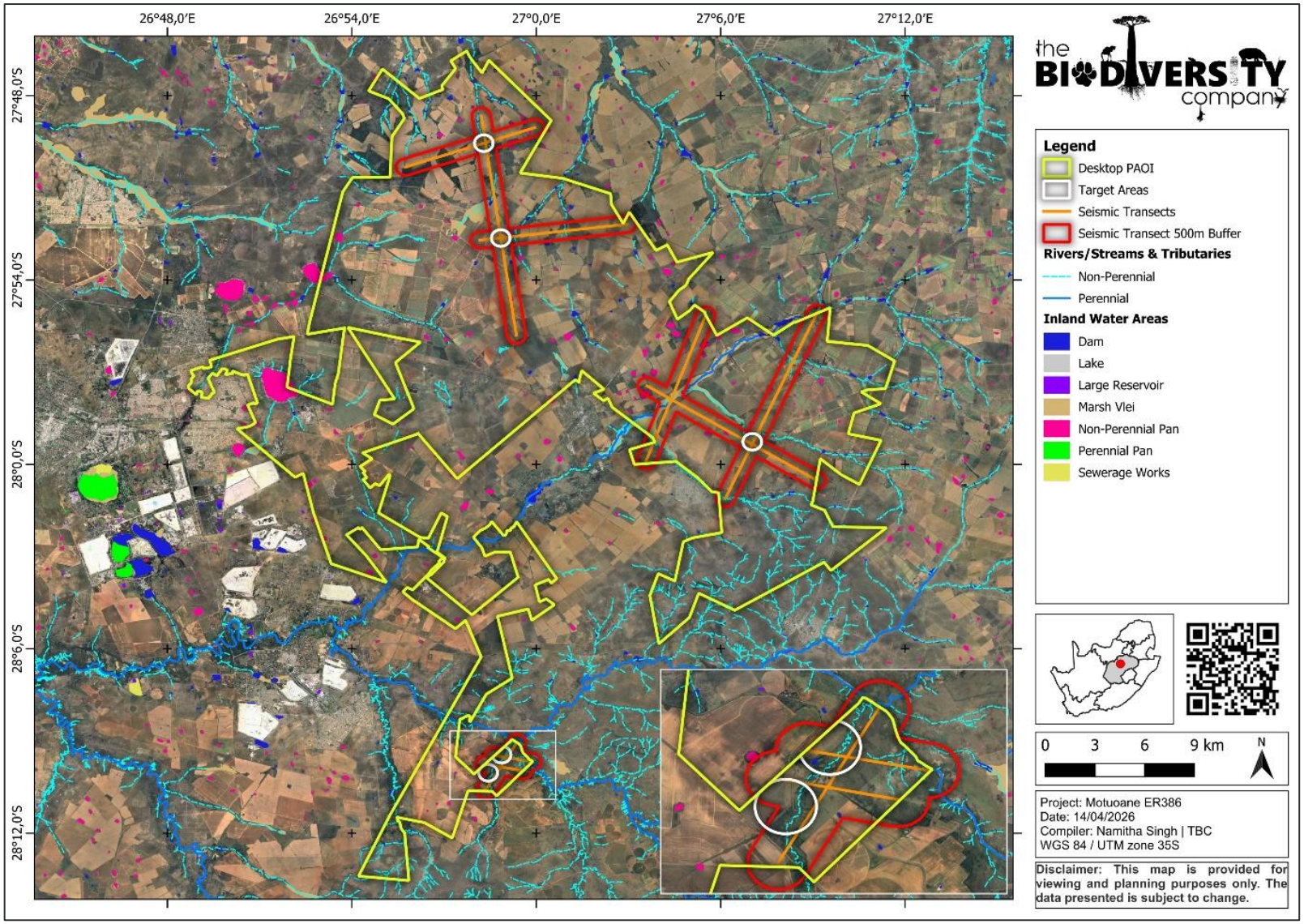


Figure 27: Site Hydrological Map (The Biodiversity Company, 2026).

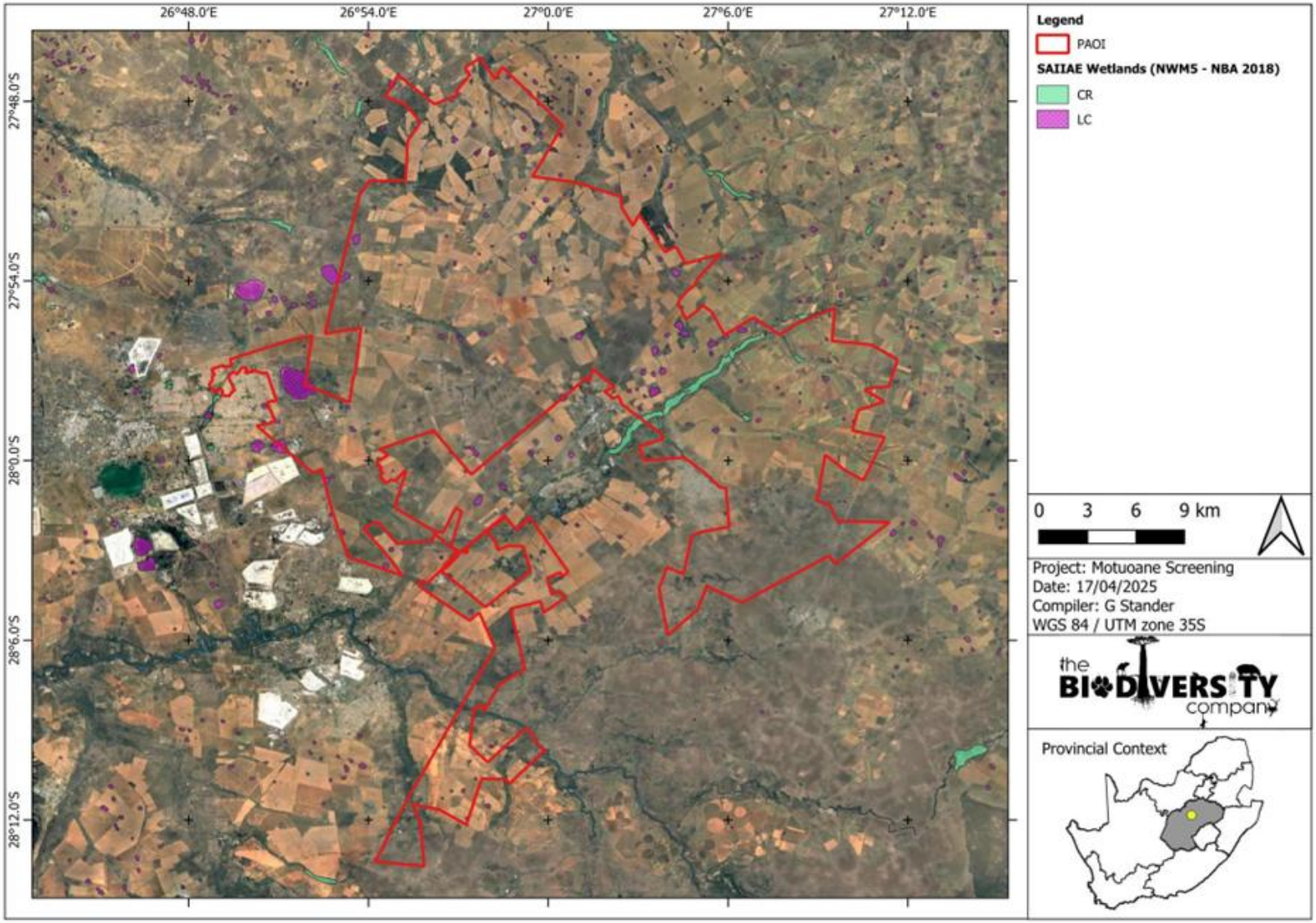


Figure 28: Map illustrating ecosystem threat status of rivers and wetlands in the ER (The Biodiversity Company, 2026).

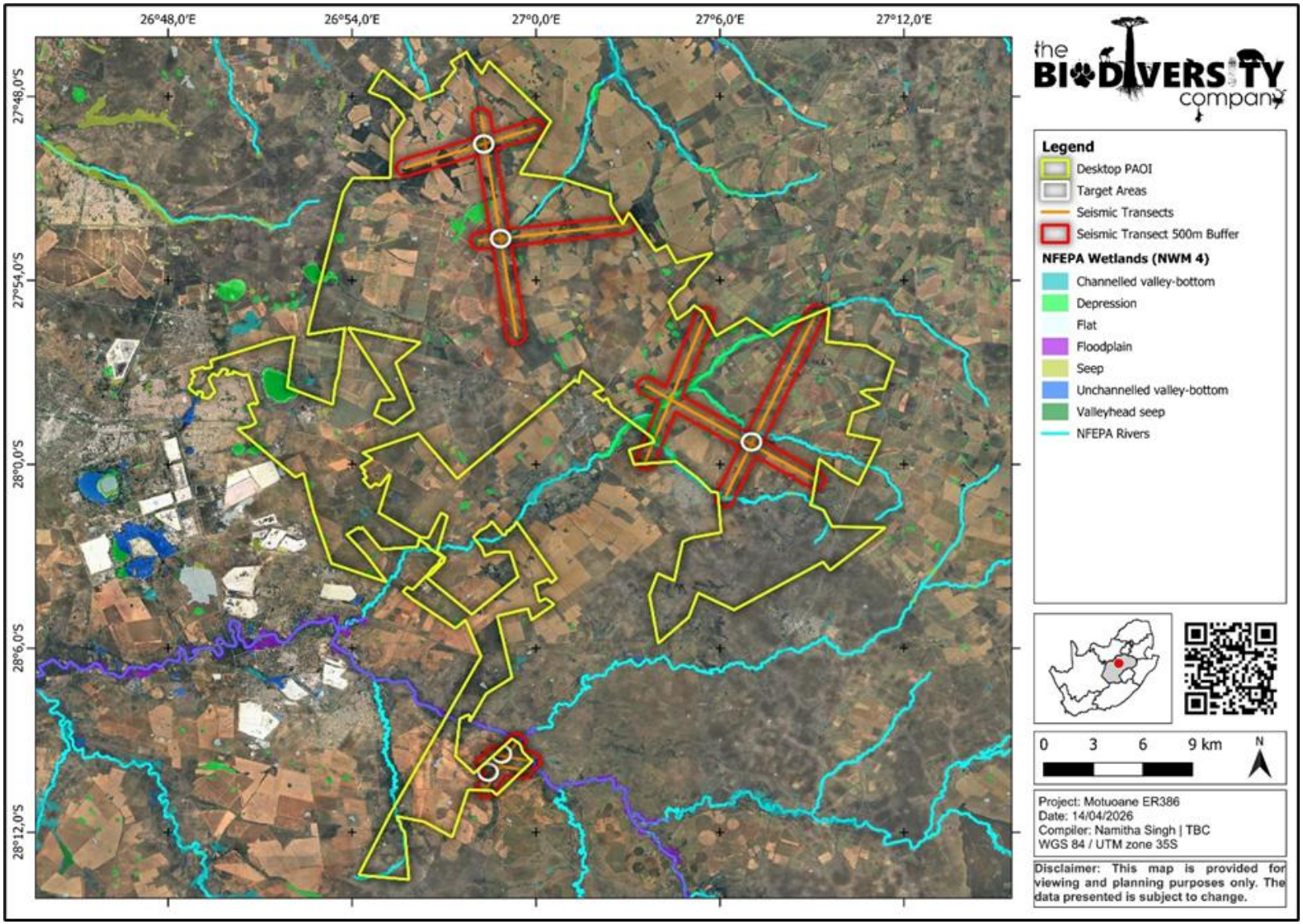


Figure 29: The ER in relation to the National Freshwater Ecosystem Priority Areas (The Biodiversity Company, 2026).

4.2.8 HYDROGEOLOGY - GROUNDWATER

This section summarises the regional and site-specific hydrogeology as obtained from the Baseline Geohydrological Assessment by Gradient Groundwater Consulting (2026). The geohydrological setting and conceptual model of the study area is described according to the following criteria:

- Regional hydrogeology information;
- Local hydrostratigraphic units;
- Unsaturated zone;
- Groundwater-surface water interaction;
- Hydraulic parameters;
- Aquifer classification; and
- Hydrogeological conceptual model.

4.2.8.1 REGIONAL HYDROGEOLOGY INFORMATION

The Department have characterised South African aquifers based on host-rock formations in which it occurs together with its capacity to transmit water to boreholes drilled into relative formations. The water bearing properties of respective formations can be classified into four aquifer classes defined below. Each of these classes is further subdivided into groups relating to the capacity of an aquifer to transmit water to boreholes, typically measured in Litres per second (L/s). The groups therefore represent various ranges of borehole yields:

a. **Class A:** Intergranular Aquifers associated either with loose and unconsolidated formations such as sands and gravels or with rock that has weathered to only partially consolidated material.

b. **Class B:** Fractured Aquifers associated with hard and compact rock formations in which fractures, fissures and/or joints occur that are capable of both storing and transmitting water in useful quantities.

c. **Class C:** Karst Aquifers associated with carbonate rocks such as limestone and dolomite in which groundwater is predominantly stored in and transmitted through cavities that can develop in these rocks.

d. **Class D:** Intergranular and fractured Aquifers that represent a combination of Class A and B aquifer types. This is a common characteristic of South African aquifers. Substantial quantities of water are stored in the intergranular voids of weathered rock but can only be tapped via fractures penetrated by boreholes drilled into it.

According to the DWS Hydrogeological map (DWS Hydrogeological map series 2726 Kroonstad) the study area is predominantly underlain by a Class d2 intergranular and fractured aquifer (typically associated with median borehole yields ranging between 0.1 and 0.5 L/s), while small portions towards the northwest of the study area are underlain by a Class d3 intergranular and fractured aquifer (typically associated with median borehole yields ranging between 0.5 and 2.0 L/s). Both the Class d2 and Class d3 aquifers consist of primarily argillaceous (clay-containing) rocks, including shale, mudstone, and subordinate siltstone. Most hard-rock aquifers are secondary in nature with groundwater associated with fracturing, fault zones as well as contact zones of the dolerite intrusions. Aquifer hosts in the Beaufort Group comprise of mudstone and sandstone intruded by dolerite dykes and sheets, however, will not only be multi-layered, but also multi-porous with variable thicknesses. The contact plane between two different sedimentary layers will cause a discontinuity in the hydraulic properties of the composite aquifer. The Ecca Group aquifers consist mainly of shales and sandstones that are very dense with permeability usually very low due to poorly sorted matrices. Accordingly, it can be assumed that the aquifer has a low development potential, it should however be noted that higher yielding boreholes (>5.0l/s) may occur along intruding dyke contact zones and other structural features i.e., fault zones etc. (Barnard, 2000).

According to Vegter's groundwater regions delineated (2000) the study area can be classified as falling under the Northeastern Upper Karoo Region (Region 30) towards the central, eastern and southern areas whereas the northern and northwestern section forming part of the Northeastern Pan Belt Region (Region 33). Groundwater

Region 33 comprises of mudstone and sandstone (with dolerite dyke and sill intrusions) of the Adelaide and Tarkastad Subgroups within the Beaufort Group of the Karoo Supergroup (WRC, 2016). The maximum aquifer thickness i.e., shallow, intergranular aquifer system within the Northeastern Pan Belt Region is <20m while the maximum aquifer thickness within the Northeastern Upper Karoo Region is slightly thicker at 20 – 30m with water stored mainly in decomposed/partly decomposed rock and water bearing fractures principally restricted to a shallow zone below the static groundwater level.

The average groundwater level within Groundwater Region 33 is 14.90 mbgl, while the average saturated thickness of the weathered (shallow) and fractured (deeper) zones are 22.60 m and 75.00 m, respectively (WRC, 2016). Groundwater Region 30 comprises of compact, dominantly argillaceous strata of the Ecca Group within the Karoo Supergroup (WRC, 2016). The average groundwater level within Groundwater Region 30 is 18.20 mbgl, while the average saturated thickness of the weathered (shallow) and fractured (deeper) zones are 9.30 m and 185.00 m, respectively (WRC, 2016). Refer to **Figure 31** for a map illustrating the typical groundwater occurrence for the greater study area while **Figure 32** depicts the hydrogeological map of the greater study area.

4.2.8.2 LOCAL HYDROSTRATIGRAPHIC UNITS

For the purposes of this investigation, three main hydrostratigraphic units/aquifer systems can be inferred in the saturated zone[6]:

i. A **shallow Quaternary (perched and unconfined) aquifer**: These aquifers consist of recent types of sediments and are characteristically primary porosity aquifers, such that groundwater flow occurs in the pore spaces between soil and sediment particles. These aquifers are formed by alluvial material along the riparian zone of local drainages and are limited to a zone of variable width and depth. Clay lenses in the soil and unsaturated zones may cause local, perched water tables which occur above the regional water table.

ii. A **shallow, intergranular and fractured aquifer within the Beaufort Group**: These aquifers occur in the transitional soil and weathered bedrock formations underlain by more consolidated bedrock. Groundwater flow patterns usually follow the topography, discharging as natural springs at topographic low-lying areas. Usually, these aquifers can be classified as a secondary porosity aquifer and is generally unconfined with phreatic water levels. In secondary porosity aquifers, groundwater flow occurs along fractures, while water is stored within the rock matrix. Due to higher effective porosity (n) this aquifer is more susceptible to impacts from contaminant sources compared to confined aquifers.

iii. A **deeper, fractured aquifer within the Ecca Group and pre-Karoo rocks**: In fractured aquifers, pores are well-cemented and do not allow any significant flow of water. Groundwater flow is dictated by transmissive secondary porosity structures such as bedding planes fractures, faults and contact zones fracture zones that occur in the relatively competent host rock. Fractured mudstone, sandstone, shales sequences as well as dolerite dykes and sills are considered as fractured rock aquifers holding water in storage in both pore spaces and fractures. Groundwater yields, although more heterogeneous, can be expected to be higher than the weathered zone (shallow) aquifer. This aquifer system usually displays semi-confined or confined characteristics with potentiometric heads often significantly higher than the water-bearing fracture position.

4.2.8.3 UNSATURATED ZONE

The unsaturated (vadose) zone is defined as the subsurface zone between the ground surface and the main water table where pores are filled with both air and water as depicted in **Figure 30** (Fetter and Kreamer, 2023). According to WR2012 (WRC, 2016), the average thickness of the unsaturated zones of Groundwater Region 30 and 33 are 18.20 m and 14.90 m, respectively. According to the 1.0×1.0 km groundwater level grid obtained from WR2012 (WRC, 2016), the thickness of the unsaturated zone ranges between 15.98 to 56.82 m, with an average thickness of 29.48 m.

[6] Refer to project assumptions and limitations, it should be noted that no site characterisation boreholes have been drilled to confirm this statement.

4.2.8.4 GROUNDWATER-SURFACE WATER INTERACTION

Groundwater and surface water interaction is an essential component of the hydrological cycle. The hyporheic zone (stream bed) is the zone of most interaction (Adams *et. al*.,2012). According to records documented by Van Tonder and Dennis (2003), under natural conditions this area exhibits certain regions where there is pronounced interaction between surface and groundwater. The two regimes are therefore well-linked and should be integrated to manage any water-related issues in these catchments. Regional drainages can be generally classified as influent or gaining stream systems as the groundwater head elevation of the water table in the vicinity of the stream is higher than the altitude of the stream bed and, accordingly, there definitely exists groundwater discharge as baseflow to local drainages. The alluvial associated with the floodplains within the greater study area forms a primary aquifer and may potentially be directly connected with surface water resources, especially during high flow conditions.

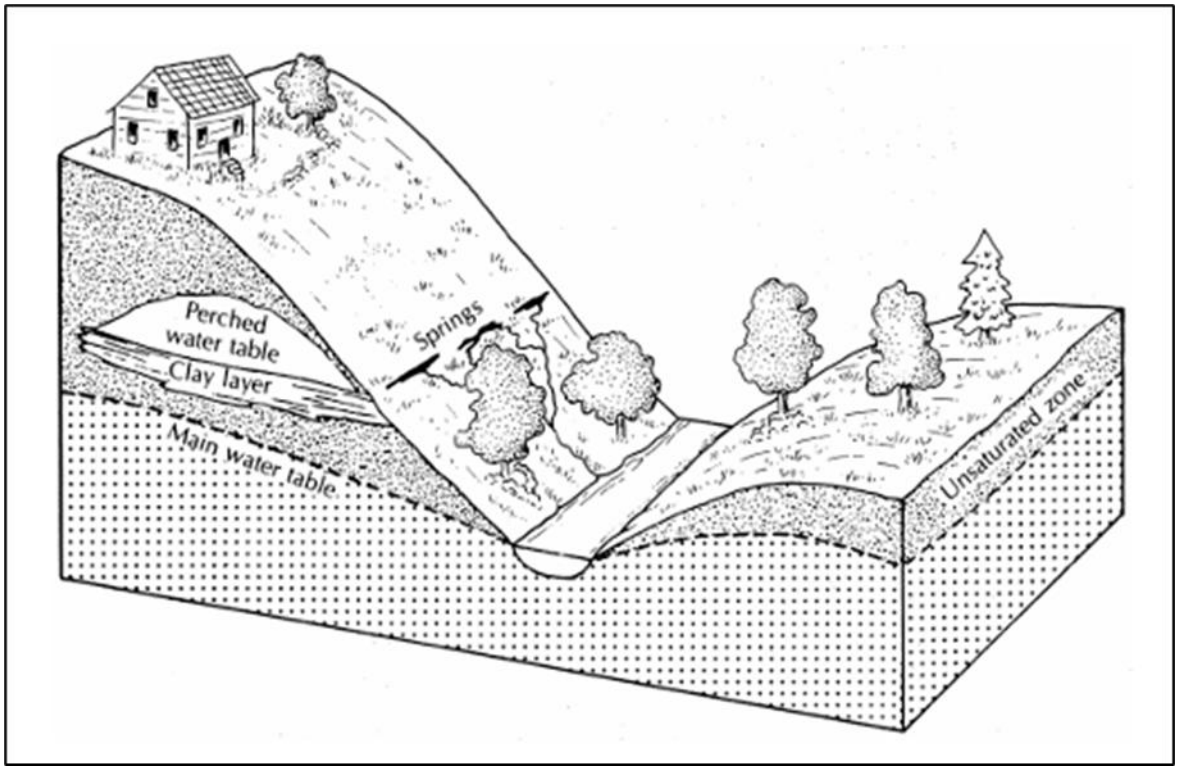


Figure 30: Illustration of the Unsaturated Zone (Fetter and Kreamer, 2023).

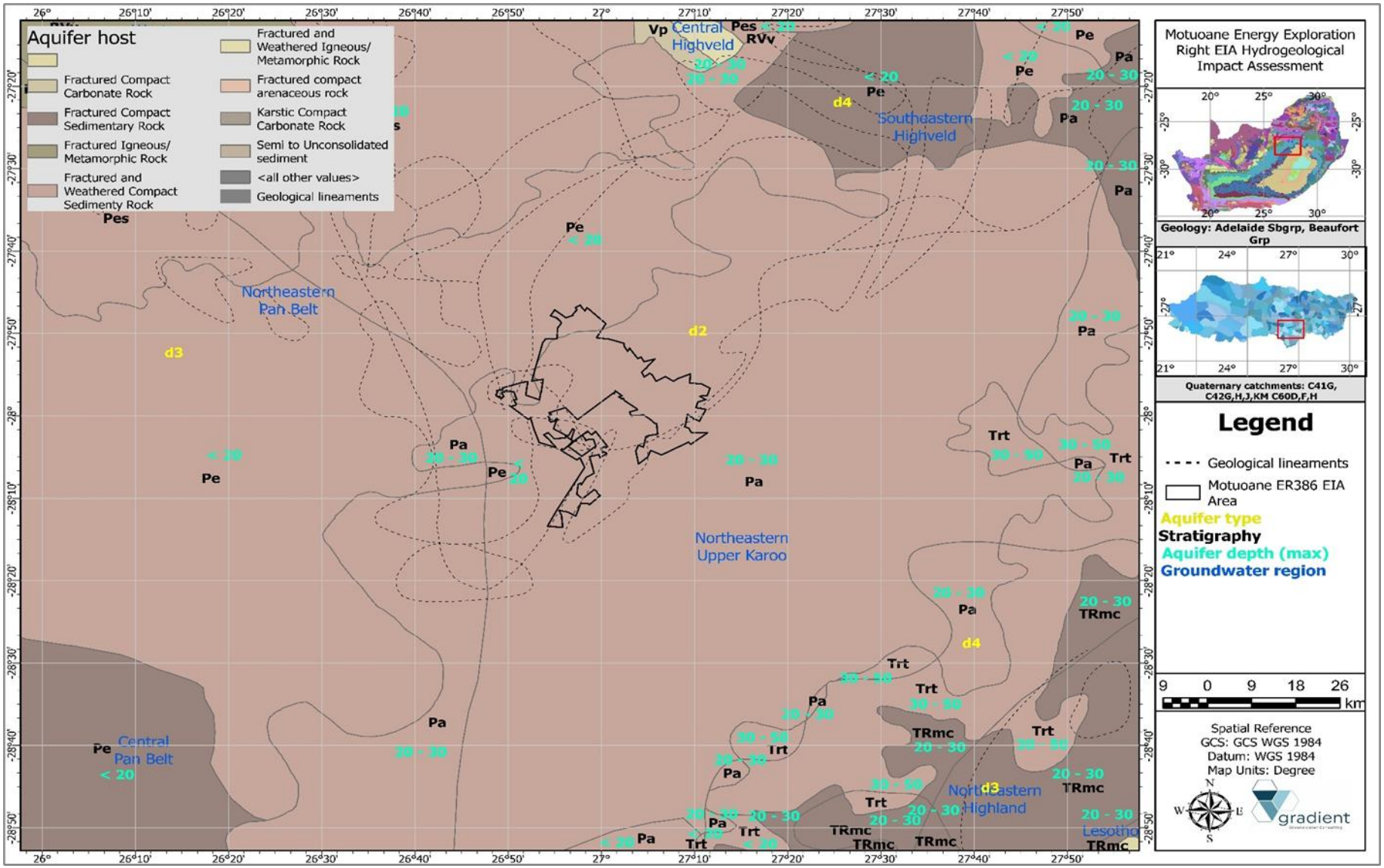


Figure 31: Typical aquifer hosts and groundwater occurrence for the study region (Gradient Groundwater Counseling, 2026).

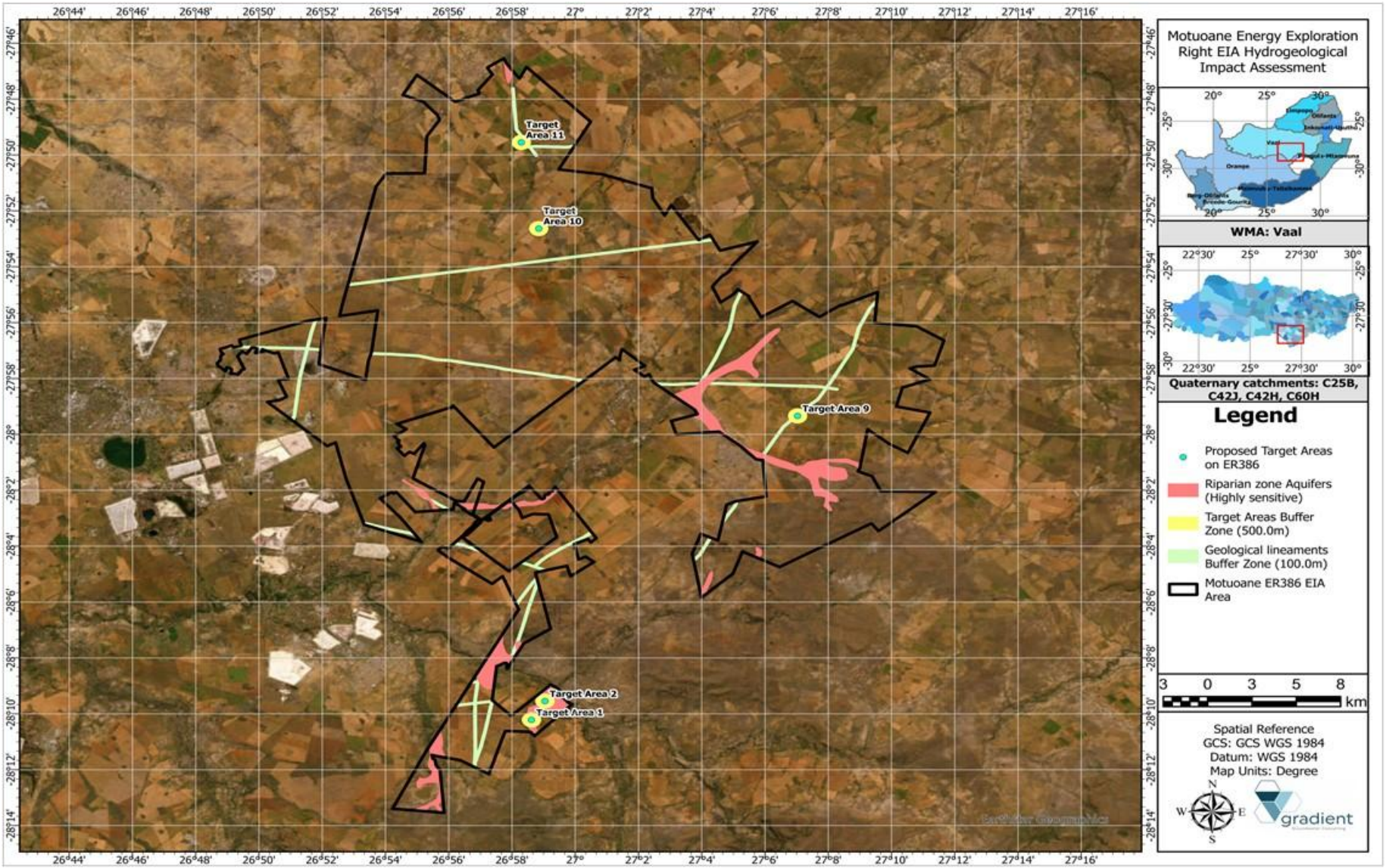


Figure 32: Hydrogeological Sensitivity Map (Gradient Groundwater Counseling, 2026).

4.2.8.5 AQUIFER CLASSIFICATION

The most widely accepted definition of groundwater contamination is defined as the introduction into water of any substance in undesirable concentration not normally present in water e.g. microorganisms, chemicals, waste or sewerage, which renders the water unfit for its intended use (UNESCO, 1992).

An aquifer classification system provides a framework and objective basis for identifying and setting appropriate levels of groundwater resource protection. This would facilitate the adoption of a policy of differentiated groundwater protection. The aquifer classification system used to classify the aquifers is the proposed National Aquifer Classification System of Parsons (1995). This system has a certain amount of flexibility and can be linked to second classifications such as a vulnerability or usage classification. Parsons suggests that aquifer classification forms a very useful planning tool that can be used to guide the management of groundwater issues. Parsons also suggests that some level of flexibility should be incorporated when using such a classification system.

According to the aquifer classification map of South Africa the project area is underlain by a “Minor aquifer”, which are fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although this aquifer seldom produces large quantities of water, they are both important for local supplies and in supplying base flow for rivers

The following potential sources have been identified:

i. Migration of saline groundwater from the deep, fractured aquifer to the overlying, potable aquifer(s) during the gas exploration phase.

ii. Migration of stray gas from the deep, fractured aquifer to the overlying, potable aquifer(s) during the gas exploration phase.

iii. Migration of contaminants from the plant footprint as well as associated waste facilities and infrastructure into local water resources and host aquifers.

iv. Mobilisation and maintenance of heavy vehicles and machinery on-site may cause hydrocarbon contamination of groundwater resources.

The following aquifer pathways have been identified:

i. Vertical flow through the unsaturated/vadose zone as well as saturated zone to the underlying intergranular and fractured rock aquifers. The rate at which seepage will take place is governed by the permeability of sub-surface soil layers and host-rock formations.

ii. Preferential flow-paths include the contact between the depth of weathering and fresh un-weathered rock, fractures, faults, joints and bedding planes. Secondary fractures may also potentially act as transport mechanisms.

iii. If not adequately sealed and suitably mitigated, gas exploration and exploration wells will form preferential flow paths and serve as a direct connection between the deeper, fractured aquifer and shallow, potable aquifer unit(s)

The following receptors were identified:

i. Shallow, inter-granular as well as the intermediate, fractured aquifer units situated within the plume migration footprint(s). The riparian zone aquifer associated with drainage patterns throughout the greater study area can also be viewed as a sensitive groundwater receptor.

ii. Down-gradient drainages and streams including associated riparian zone aquifer system(s) and baseflow contribution.

iii. Private or neighbouring boreholes associated with relevant fracture zones and/or structures(s)if intercepted by the pollution plume migration footprint.

4.2.9 AIR QUALITY

The information presented in this section was obtained from the Baseline Air Quality Assessment Report undertaken by Airshed Planning Professionals. Air quality sensitive receptors (AQSRs) refer to places where humans reside. Ambient air quality, in contrast to occupation exposure, pertains to areas outside of an industrial site or boundary where the public has access to and according to the Air Quality Act, excludes air regulated by the Occupational Health and Safety Act (Act No 85 of 1993). Potential sensitive receptors within the project area, include individual households and residential areas (i.e., Welkom, Hennenman, Virginia and Ventersburg).

4.2.9.1 **CLIMATE AND ATMOSPHERIC DISPERSION POTENTIAL**

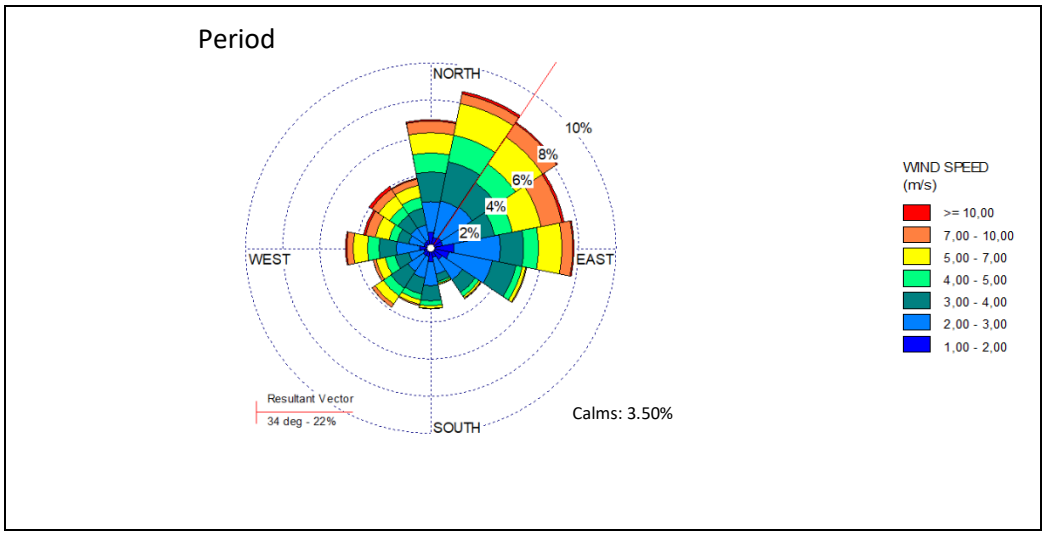
Meteorological mechanisms direct the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. This dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. The pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Tiwary and Colls, 2010).

The spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). The atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area. A qualitative description of the synoptic systems determining the macro-ventilation potential of the region may be provided based on the review of pertinent literature. These meso-scale systems may be investigated through the analysis of meteorological data observed for the region.

4.2.9.1.1 LOCAL WIND FIELD

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness (Tiwary and Colls, 2010).

Period and diurnal wind roses drawn from the Welkom SAWS station shown in **Figure 33**. During the period 2019 to 2021, the wind field was dominated by winds from the northeastern sector. Calms conditions occurred for 3.5% of the time. Wind speeds decreased during night-time conditions with an increase in calms to 4.65%.



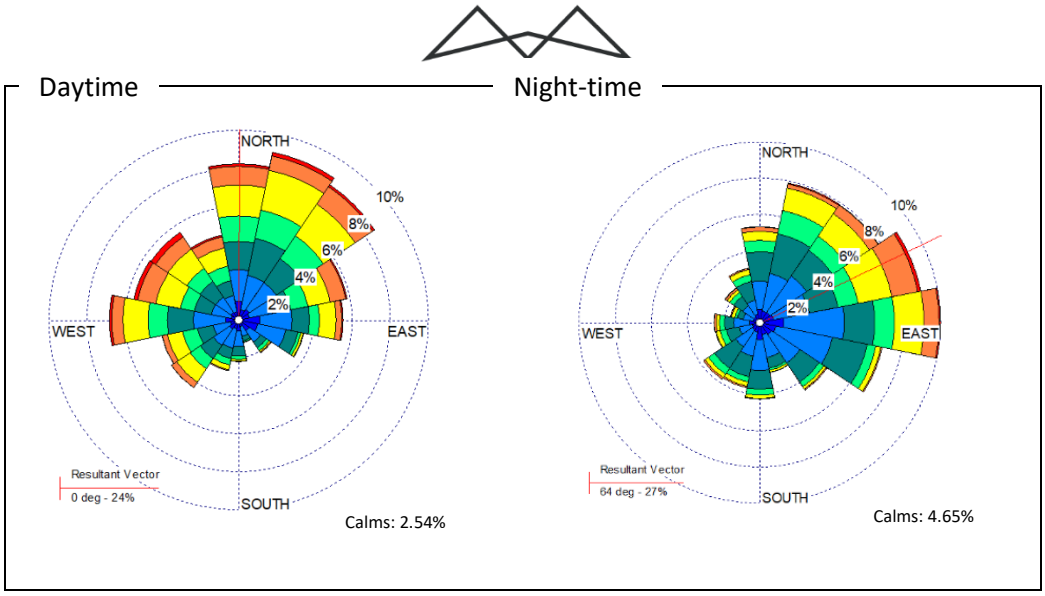


Figure 33: Period average, daytime and night-time wind roses measured data; January 2019 to December 2021 from SAWS Welkom monitoring station (Airshed Planning Professionals, 2025)

4.2.9.2 ATMOSPHERIC STABILITY AND MIXING DEPTH

The new generation air dispersion models differ from the models traditionally used in a number of aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters: the boundary layer depth and the Monin-Obukhov length, rather than in terms of the single parameter Pasquill Class. The Monin-Obukhov length (LMo) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and less dilution potential. During windy and/or cloudy conditions, the atmosphere is normally neutral. For low level releases, the highest ground level concentrations would occur during weak wind speeds and stable (night-time) atmospheric conditions.

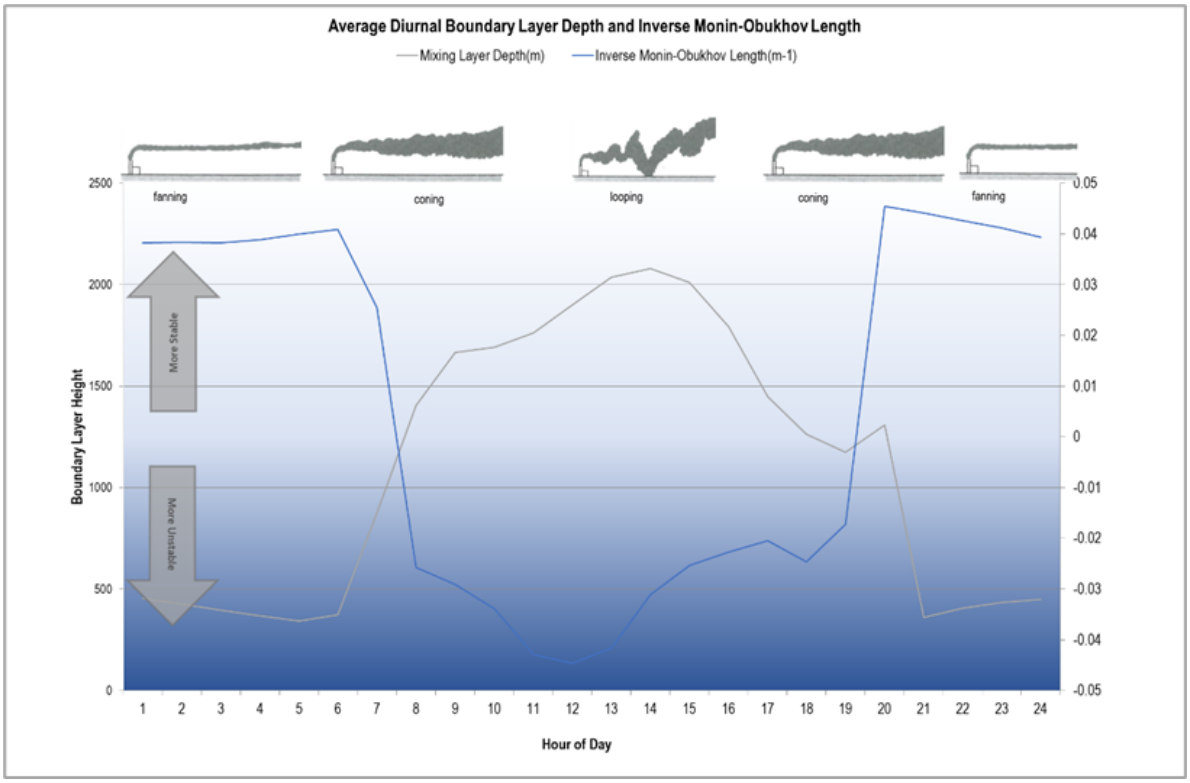


Figure 34: Diurnal atmospheric stability as described by the inverse of the measured Monin-Obukhov length (SAWS Welkom Data: 2019 to 2021)

4.2.9.3 AMBIENT AIR QUALITY WITHIN THE REGION

4.2.9.3.1 SOURCES OF POLLUTION IN THE REGION

Neighbouring land-use in the surrounding of the proposed project comprises predominantly of agriculture activities. These land-uses contribute to baseline pollutant concentrations via fugitive and process emissions, vehicle tailpipe emissions, household fuel combustion, biomass burning and windblown dust from exposed areas.

Agriculture is a major land-use activity within and beyond the Project boundary. These activities include crop farming such as maize, and livestock farming. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are derived from windblown dust, burning crop residue, and dust entrainment as a result of vehicles travelling along dirt roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odiferous emissions. Crop residue burning is also an additional source of particulate emissions and other toxins.

Livestock farms, especially cattle, are also significant sources of fugitive dust especially when feedlots are used and the cattle trample in confined areas. Pollutants associated with dairy production for instance include ammonia (NH_3), hydrogen sulfide (H_2S), methane (CH_4), carbon dioxide (CO_2), oxides of nitrogen (NOx) and odour related trace gasses. According to the US-EPA, cattle emit methane through a digestive process that is unique to ruminant animals called enteric fermentation. The calf-cow sector of the beef industry was found to be the largest emitter of methane emissions. Where animals are densely confined the main pollutants of concern include dust from the animal movements, their feed and their manure, NH_3 from the animal urine and manure, and H_2S from manure pits.

Organic dust includes dandruff, dried manure, urine, feed, mould, fungi, bacteria and endotoxins (produced by bacteria, and viruses). Inorganic dust is composed of numerous aerosols from building, materials and the environment. Since the dust is biological it may react with the defence system of the respiratory tract. Odours and VOCs associated with animal manure is also a concern when cattle are kept in feedlots. The main impact

from methane is on the dietary energy due to the reduction of carbon from the rumen. Dust and gasses levels are higher in winter or whenever animals are fed, handled or moved.

Particulates represent the main pollutant of concern at mining operations, whether it is underground or opencast. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions (e.g. high wind speeds, rainfall, etc.). Mining of gold, including ore extraction, processing plants, waste rock dumps and tailings storage facilities are all commercial activities situated in the region of the project.

Domestic households are known to have the potential to be one the most significant sources that contribute to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities or settlements utilize coal, paraffin and/or wood for cooking and/or space heating (mainly during winter) purposes. Pollutants arising from the combustion of wood include respirable particulates, CO and SO_2 with trace amounts of polycyclic aromatic hydrocarbons (PAHs), in particular benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons.

Coal is relatively inexpensive in the region and is easily accessible due to the proximity of the region to coal mines and the well-developed coal merchant industry. Coal burning emits a large amount of gaseous and particulate pollutants including SO_2, heavy metals, PM including heavy metals and inorganic ash, CO, PAHs (recognized carcinogens), NO2 and various toxins. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

Biomass burning includes the burning of evergreen and deciduous forests, woodlands, grasslands, and agricultural lands. Within the project vicinity, crop-residue burning and wildfires (locally known as veld fires) may represent significant sources of combustion-related emissions. The frequency of wildfires in the grasslands varies between annual and triennial. Biomass burning is an incomplete combustion process (Cachier, 1992), with carbon monoxide, methane and nitrogen dioxide gases being emitted. Approximately 40% of the nitrogen in biomass is emitted as nitrogen, 10% is left in the ashes, and it may be assumed that 20% of the nitrogen is emitted as higher molecular weight nitrogen compounds (Held, *et al.,* 1996). The visibility of the smoke plumes is attributed to the aerosol (particulate matter) content. In addition to the impact of biomass burning within the vicinity of the project activity, long-range transported emissions from this source can be expected to impact on the air quality between the months of August to October. It is impossible to control this source of atmospheric pollution loading; however, it should be noted as part of the background or baseline condition before considering the impacts of other local sources.

Fugitive dust sources are termed fugitive because they are not discharged to the atmosphere in a confined flow stream. Sources of fugitive dust identified in the study area include paved and unpaved roads and wind erosion of sparsely vegetated surfaces.

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Unpaved roads in the region are mainly haul and access roads.

Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface. Paved roads in the region include the N1, R70, R73 and the R34.

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, its

erosion potential has to be restored; that is, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity. Every time a surface is disturbed, its erosion potential is restored (US EPA, 2006). Erodible surfaces may occur as a result of agriculture and/or grazing activities.

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include CO_2, carbon (C), SO_2, oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include NO_2, photochemical oxidants such as ozone, sulfur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Vehicle type (i.e. model-year, fuel delivery system), fuel (i.e. oxygen content), operating (i.e. vehicle speed, load) and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates.

4.2.10 CURRENT LAND USE

The study area can be subdivided into four sections namely, the northern section, southern section, western section, and the eastern section (refer to Figure 1 for the site locality). The northern section is closer to the R34 and located between Odendaalsrus and Kroonstad. There are currently two target areas proposed within this section namely, Target Area 10 (GP B) and Target Area 11 (GP A) and three seismic transect (Transect G1, G2 and G3). This section consists almost entirely of cultivated land with several natural and artificial watercourses. The eastern section is located immediately north of Ventersburg and bounded by the N1 and Phomolong. This section is primarily dominated by cultivated land, open areas and minor game farms. There are distinctive watercourses within this area including the Kromspruit which is immediately to the north of the sole proposed drilling site, Target Area 9 (HF C) 500m assessment area within this section. There are three proposed transects within this section, namely, Transect HF1, HF2 and HF7. Which intersect the Kromspruit, Rietspruit and Slootspruit.

The tip of the southern section is approximately 8.5km south of southern Virginia (Meloding) while the two target areas, Target Area 1 (RSB D) and Target Area 2 (RSB E) are approximately 7km east of southern Virginia. The R73 cuts across this section. Similarly to the northern and eastern sections, the southern section is primarily dominated by cultivated land, open areas and minor game farms, several natural and artificial watercourses. Although there are two target areas within this section, two of the three seismic transects intersect the Sandrivier. There is also a canal that separated the two target areas.

The western section is the section where majority of the exploration activities are being proposed. This section is within a mining area and adjacent to mining towns. The edges of the residential areas of Saaiplaas, Bronville and Thabong form part of the western boundary of this section and ER386. There are six target areas Target Area 3 (ED G), Target Area 4 (ED H), Target Area 5 (ED J), Target Area 6 (ED I), Target Area 7 (ED F) and Target Area 8 (VEG A) as well as seven (7) seismic transects (Transects ED 1-5, VEG 1-2). Although this section also consists largely of cultivated land, open areas and minor game farms, several natural and artificial watercourses, it is the most transformed section within the ER comprising of mining activities, residential areas, road and electrical infrastructure. This section also comprises of several farms earmarked for renewable energy developments.

4.2.11 TOPOGRAPHY

Information on the area's topography was obtained from the Baseline Geohydrological Assessment Report undertaken by Gradient Groundwater Consulting in March 2025. The topography of the greater study area generally has a jagged topography and can be classified as a central interior plain or plateau. Large dolerite intrusions are observed throughout the study area and because of its relative resistance to erosion, the Karoo dolerite sheets generally give rise to very prominent high-standing topographic features (DWAF, 2004). The relief of the area varies between 0 – 130.0m towards the western perimeter and 30 – 210.0m to the south and northern boundaries. Elevations within the study area range between 1 300 and 1 533 meters above mean sea level (mamsl) based on elevations extracted from the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) raster interpolation. Elevations generally increase towards the south and east of the study area, with the lowest elevation of 1 300 mamsl in the central-western parts of the study area and the greatest

elevation of 1 533 mamsl in the eastern parts of the study area. Based on calculations performed using GIS, the slope of the study area ranges between 0% (indicating water bodies such as wetlands, pans, and dams) and 45.17% (indicating steep hillslopes), while the average slope is calculated as 3.58% with a standard deviation of 2.35%. The greater study flattens out towards the northwest and west which also correlates to the general drainage direction. **Figure 35** shows the regional topographical contours and setting.

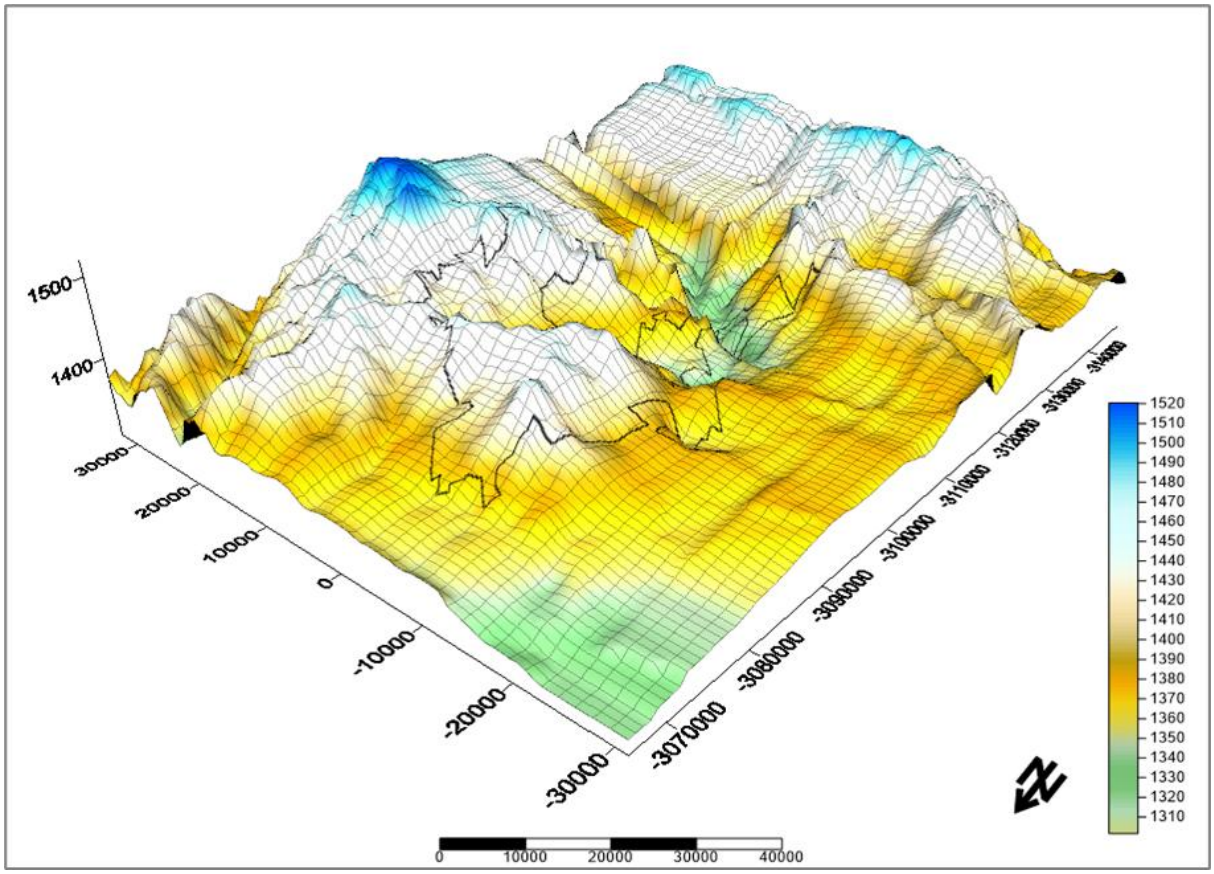


Figure 35: General topography of the study area (Gradient Groundwater Consulting, 2025).

4.2.12 NOISE

Areas away from busy roads and mining activities are very quiet, with measurement locations closer to houses, busy roads and mining activities indicating higher sound levels. Vegetation growth closer to dwellings creates habitat, attracting birds and insects, which in turn make sounds that increases the ambient sound levels. The vegetation also increased wind-induced noises. The larger area, away from roads, dwellings and mining activities can be rated as Rural as per the South African National Standards: The measurement and rating of environmental noise concerning annoyance and to speech communication criteria (SANS 10103:2008).

4.3 STAKEHOLDER ISSUES AND COMMENTS

A public participation process as required by the NEMA EIA regulation (GNR 982) has been undertaken for the proposed exploration (Scoping Phase). In this regard, please refer to the Scoping Report (2025) for a comprehensive record of the process followed and comments received. The comments and issues raised through the public participation have been considered and have, where applicable, informed the compilation of this FRDCP. Following the EIA phase, additional comments will be considered to finalise the FRDCP, where relevant.

No comments directly addressed the Decommissioning, Closure and Rehabilitation Phase of the project were received, however full details of the stakeholder's submissions are available in the Public Participation Report (PPR).

4.4 ENVIRONMENTAL RISK ASSESSMENT FINDINGS

A detailed description of the environmental impact/risk identification and assessment (including the methodology and findings) undertaken for the exploration activities is provided in the EIAr (2026). This risk assessment assesses each identified environmental impact by considering the consequence of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood of the impact occurring. The EIA further considers other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, to determine a prioritisation factor (PF) which is applied to the Environmental Risk to determine the overall significance.

Table 11 lists the environmental impacts and risks identified and assessed in the EIAr (2026), which relate to final rehabilitation, decommissioning and closure of the exploration. The EMPr addresses the management and mitigation of environmental impacts associated with the construction and operational phases whilst the three reports and plans as prescribed in the Financial Provisioning Regulations, 2015 (to be reviewed annually) will provide for the planning and financial provisioning for the concurrent rehabilitation and final closure of the exploration activities.

The applicable conceptual closure strategy to avoid, manage and mitigate the impacts and risks are also included in Table 11, together with the reassessment of the environmental risk. The environmental risk assessment of the impacts associated with final rehabilitation, decommissioning and closure will inform the most appropriate closure strategy for the exploration. It is expected that, in most cases, if all the management and mitigation measures identified in the EIA and EMPr are adhered to and successfully implemented, then no latent or residual environmental impacts will remain. Impacts that are classified as high-risk post-mitigation will be considered as latent environmental impacts and financial provision will be provided to remediate these specific impacts. Please see Table 11 for further details.

Table 11: Impact assessment for rehabilitation, decommissioning and closure.

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Interference with Existing Land Uses (Damage / Disruption of activities / services / infrastructure)	Medium to low -	• Prior to accessing any portion of land, the Applicant must enter into formal written agreements with the affected landowner. This formal agreement should additionally stipulate landowners special conditions which would form a binding agreement. • Landowners must be notified beforehand of the activities to be undertaken on their properties and requested to indicate the type and location of services within their properties. • There must be a formal procedure in place on how to report incidents to ensure records of all grievances are kept, and responses are given within a certain time. • Before the project commences, an asset and services baseline of services that may be affected within 50 m of the activities must be compiled. A copy of the baseline records should be given to each landowner/ service provider, and a master document kept by the applicant. • Underground mining companies (if any) within the identified drilling locations must be engaged during the planning phase to ensure the drilling activities do not interfere with underground mining activities. • If any damage occurs to services / infrastructure, the applicant will be liable to fix it to its original state. • The Developer shall inform all landowners of the commencement of construction activities at least 30 days before commencement. Landowners must be requested to indicate the type and location of services within their properties. • Before the project commences, an asset and services baseline of services that may be affected within 10m of the centreline of the seismic transect and 10m from the edge of drilling point must be compiled. A copy of the baseline records should be given to each landowner/ service provider, and a master document kept by the applicant. • A services impact and interruption plan must be developed for sites which intersect existing services in order to minimise and manage potential interruptions should they occur due to an incident. Notice of planned service interruptions (if any) must be given at least 2 days before the interruption	Low -	Low -
Impacts on Traffic and road infrastructure	Medium to low -		Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		takes place and must be as short as reasonably possible – an SMS or e-mail system can be used for this purpose		
Soils and Agricultural Potential: Soil erosion and sedimentation Loss of land capability Loss of cultivated lands Soil compaction	Low -	• As far as possible interference with existing land uses/livelihoods should be avoided. If any interference takes place, the landowner should be compensated for their losses. • Make use of existing roads or upgrade tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum. • The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on soils and agricultural activities. • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities. • Use native adapted plant species for revegetation to prevent the spread of invasive species. • All construction / exploration and access must make use of the existing roads to avoid unnecessary disturbance to soils and agricultural land.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• Soils and agricultural fields outside the direct project footprint, should under no circumstances be disturbed. • Landowner engagement must be undertaken during the project phases to investigate possible scenarios for appropriate compensation of landowners for loss / disturbance of high land capability and/or grazing areas where necessary. • There must be stormwater management and erosion prevention implemented for the development. • Conduct post-plugging inspections and long-tern monitoring to confirm the integrity of the seals and detect any potential leaks. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • Apply mulch, geotextiles, or cover crops to protect bare soil while vegetation establishes. • Use physical structures such as retaining walls or silt fences on steep or unstable slopes to prevent soil erosion. • The Emergency Response Plan must be updated to contain measures to prevent and react to abnormal events including but not limited to: o Blowout Preventers / Diverters o Shut-In Procedures to trigger the Blowout Preventers / Diverters system to physically seal the well and stop the flow of fluids o Emergency Shutdown Systems (ESD) to isolate valves and shuts rig power to prevent escalation into a major incident o High-Efficiency Flare Systems for flaring of excess gas to destroy toxic Volatile Organic Compounds (VOCs) and prevent dangerous emissions o Specific, site-tailored intervention strategies to be deployed to circulate out reservoir influxes and re-establish hydrostatic pressure o A 500-meter danger zone is immediately enforced around the wellhead o Active Spill Prevention, Control, and Countermeasure		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		○ Emergency contact numbers of nearby response team with sufficient containment materials and berms to be used to prevent leaked fluids from entering local waterways or soil		
Landownership and displacement of landowners and livestock	Medium to low -	• Ensure that all affected landowners are identified, and relevant information is provided to the landowners during the application phase. • Prior to accessing any portion of land, the Applicant must enter into formal written agreements with the affected landowner. This formal agreement should additionally stipulate landowner's special conditions which would form a legally binding agreement. • Negotiations with affected landowners must be undertaken and any loss of revenue caused by the exploration works must be reasonably compensated.	Low -	Low -
Increase in noise levels (daytime)	Medium to low -	• The working hours stipulated in the Construction permit, where applicable, must be adhered to. Where this is not applicable, the following working hours must be adhered to: Monday to Friday from sunrise to sunset and where applicable on a Saturday which must be agreed upon between the affected parties and the Contractor. • The contractor must attempt to restrict noisy activities as far as possible to times and locations whereby the potential for noise nuisance is reduced.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• All construction plant and other equipment must be in a good working order to reduce possible noise pollution. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • All residents within 2 km of drilling activities and 1 km of seismic surveys should be informed regarding the exploration activities. Scheduling of activities should be communicated and coordinated with adjacent residents (where applicable). • Signage indicating the channels for logging grievances should be posted at the closest public road boundary and at the site entrance. • A noise complaints register must be kept. If complaints are received, noise sampling should be undertaken at the NSRs and source of noise should be investigated. Channels for logging of complaints should be communicated to all residents within 2 km of the drilling site and 1km of the seismic transects. • Should noise become a nuisance (complaints), adequate / viable noise suppression measures must be implemented. • All equipment should be kept in line with manufacturers specifications. This should particularly include the regular inspection and, if necessary, replacement of rotary equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.		
Ambient Air quality / Greenhouse Gas Emissions	Medium to low -	• Limit air emissions as far as practically possible. • Reduce to nuisance factor of dust to neighbouring residents. • All drilling sites must be properly sealed to trap all gases from escaping. • Implement dust suppression measures in all areas that will be affected by construction activities and where dust will be generated. Dust suppression must also be undertaken during windy and dry weather conditions.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance

		• Speed restriction of no more than 20 km/h must be implemented for all construction vehicles within the construction site
		
		New relevant management and mitigation measures identified as part of this assessment added to the EMPr:
		
		• An air quality monitoring programme must be implemented to include monthly dustfall sampling during construction and passive VOC sampling campaigns at receptors within 600 m of the active testing wells.
		
		• The Emergency Response Plan must be updated to contain measures to prevent and react to abnormal events including but not limited to:
		  ○ Blowout Preventers / Diverters
		  ○ Shut-In Procedures to trigger the Blowout Preventers / Diverters system to physically seal the well and stop the flow of fluids
		  ○ Emergency Shutdown Systems (ESD) to isolate valves and shuts rig power to prevent escalation into a major incident
		  ○ High-Efficiency Flare Systems for flaring of excess gas to destroy toxic Volatile Organic Compounds (VOCs) and prevent dangerous emissions
		  ○ Specific, site-tailored intervention strategies to be deployed to circulate out reservoir influxes and re-establish hydrostatic pressure
		  ○ A 500-meter danger zone is immediately enforced around the wellhead
		  ○ Active Spill Prevention, Control, and Countermeasure
		  ○ Emergency contact numbers of nearby response team with sufficient containment materials and berms to be used to prevent leaked fluids from entering local waterways or soil
		• Reducing methane releases during well testing. Methane emissions must be monitored during well testing to assist with the greenhouse gas quantification. Options for gas capture and reuse/flaring should be investigated and implemented if reasonably practical.
		
		• In order to ensure lower exhaust emissions from vehicles and machinery, equipment suppliers or contractors should be required to ensure compliance with appropriate emission standards. Also, maintenance and repair of diesel		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance

		engines should be carried out as prescribed by manufacturer in order to maximise combustion and reduce gaseous emissions.
		• All residents within 600 m of the target areas and 300 m of the seismic transects should be notified before commencement of activities.
		• The Grievance Mechanism must be established and maintained throughout the project activities to indicate air quality complaints and responses. Channels for logging of complaints should be communicated to all residents within 600 m of the target areas and 300 m of the seismic transects. If complaints are received, they must be promptly investigated, recorded and addressed.
		• Robust Leak Detection and Repair (LDAR) Programs:
		  ○ Advanced LDAR programs can include visual checks, utilising infrared cameras (optical gas imaging), drones, satellites, and sensors to detect, locate, and quantify methane leaks from wells.
		  ○ Leading practices recommend frequent (quarterly or even continuous) inspection, particularly for high-emitting components.
		  ○ Upon detection, leaks must be repaired promptly to minimise fugitive emissions
		• Proper plugging and abandonment
		  ○ To prevent leaks from abandoned or inactive wells, wells must be plugged in accordance with international best practice and aligned with the approved FRDCP.
		  ○ Regular monitoring of plugged wells is necessary to identify and remediate leakage from degraded cement or casing, which is a major source of methane seepage.		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance

Climate Change Impacts Emanating from the Project:
 	
The project would release GHG emissions into the atmosphere during the exploration activities.
 	
Increased heat extremes may result in occupational health and operational risks on the project. These risks are driven by higher ambient temperatures which can lead to heat-related illnesses
 	
The impact of the project on the resources is limited to some clearing of land for the exploration areas.
	Medium to low -	• The duration of the construction should be minimized to as short term as possible.
		• Limit air emissions as far as practically possible.
		• All drilling sites must be properly sealed to trap all gases from escaping.
		
		New relevant management and mitigation measures identified as part of this assessment added to the EMPr:
		
		• Ensure all onsite employees receive annual extreme heat training, maintain updated risk assessments, and monitor heat-related incidents with defined performance targets and corrective action timelines.
		• Reducing methane releases during well testing. Methane emissions must be monitored during well testing to assist with the greenhouse gas quantification. Options for gas capture and reuse/flaring should be investigated and implemented if reasonably practical.
		• In order to ensure lower exhaust emissions from vehicles and machinery, equipment suppliers or contractors should be required to ensure compliance with appropriate emission standards. Also, maintenance and repair of diesel engines should be carried out as prescribed by manufacturer in order to maximise combustion and reduce gaseous emissions.
		• All residents within 600 m of the target areas and 300 m of the seismic transects should be notified before commencement of activities.
		• The Emergency Response Plan must be updated to contain measures to prevent and react to abnormal events including but not limited to:
		  ○ Blowout Preventers / Diverters
		  ○ Shut-In Procedures to trigger the Blowout Preventers / Diverters system to physically seal the well and stop the flow of fluids
		  ○ Emergency Shutdown Systems (ESD) to isolate valves and shuts rig power to prevent escalation into a major incident
		  ○ High-Efficiency Flare Systems for flaring of excess gas to destroy toxic Volatile Organic Compounds (VOCs) and prevent dangerous emissions
			Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		○ Specific, site-tailored intervention strategies to be deployed to circulate out reservoir influxes and re-establish hydrostatic pressure ○ A 500-meter danger zone is immediately enforced around the wellhead ○ Active Spill Prevention, Control, and Countermeasure ○ Emergency contact numbers of nearby response team with sufficient containment materials and berms to be used to prevent leaked fluids from entering local waterways or soil • Robust Leak Detection and Repair (LDAR) Programs: ○ Advanced LDAR programs can include visual checks, utilising infrared cameras (optical gas imaging), drones, satellites, and sensors to detect, locate, and quantify methane leaks from wells. ○ Leading practices recommend frequent (quarterly or even continuous) inspection, particularly for high-emitting components. ○ Upon detection, leaks must be repaired promptly to minimise fugitive emissions • Proper plugging and abandonment ○ To prevent leaks from abandoned or inactive wells, wells must be plugged in accordance with international best practice and aligned with the approved FRDCP. ○ Regular monitoring of plugged wells is necessary to identify and remediate leakage from degraded cement or casing, which is a major source of methane seepage.		
Nuisance and Impact on Sense of Place	Medium to low -	• Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• All construction/operational and access must make use of the existing roads. • Noise producing activities should be limited to daytime after 07h00 and 17h00 on weekdays. • Adequate dust suppression measures should be utilized to minimize dust production. • The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on the area. • Areas outside the direct project footprint, should under no circumstances be disturbed. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • All residents within 2 km of drilling activities and 1 km of seismic surveys should be informed regarding the exploration activities. Scheduling of activities should be communicated and coordinated with adjacent residents (where applicable). • Signage indicating the channels for logging grievances should be posted at the closest public road boundary and at the site entrance. • A noise complaints register must be kept. If complaints are received, noise sampling should be undertaken at the NSRs and source of noise should be investigated. Channels for logging of complaints should be communicated to all residents within 2 km of the drilling site and 1km of the seismic transects. • Should noise become a nuisance (complaints), adequate / viable noise suppression measures must be implemented. • All equipment should be kept in line with manufacturers specifications. This should particularly include the regular inspection and, if necessary, replacement of rotary equipment. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance.		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Migration of saline groundwater from the deep, fractured aquifer to the overlying, potable aquifer(s) during the borehole closure and decommissioning phase.	High -	• Ensure that detailed baseline water quality and quantity samples are obtained and analysed for reference purposes. • Ensure that all mitigation measures as stipulated in the EMPr relating to the drilling (specifically technical specifications) as well as the MPRDA regulations are adhered to. • The best drilling fluid option should be selected during construction towards minimising the potential for groundwater contamination and the exploration wells should be constructed such no gas or oil leakage occurs during the operational phase. • The correct type of fluids should be used during the construction phase and the boreholes should be correctly constructed so that no gas leakage occurs during the construction or operational phases. Biodegradable drilling fluids should be used wherever possible. • Excavations should be open for as short period as practically possible and drilling circulation fluid sumps be cleaned out and rehabilitated. • Construction vehicles and machines must be maintained properly to ensure that oil spillages are kept at a minimum. • Spill trays must be provided if refuelling of drilling rig and vehicles are done on site. • Chemical sanitary facilities should be provided for drilling crew. Construction workers should only be allowed to use temporary chemical	Medium to high -	Medium to high -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Migration of stray gas from the deep, fractured aquifer to the overlying, potable aquifer(s) borehole closure and decommissioning phase.	High -	toilets on the site. Chemical toilets shall not be within close proximity of the drainage system. Frequent maintenance should include the removal without spillages. • Adequate fuel containment facilities to be used during exploration phase. • The use of all materials, fuels and chemicals which could potentially leach into the environment must be controlled. • All materials, fuels and chemicals must be stored in a specific and secured area to prevent pollution from spillages and leakages. • No uncontrolled discharges from the drilling pad or site shall be permitted. and • Any spills that occur during the exploration phase must immediately be cleaned up and the contaminated soils, etc. suitably disposed of at a registered waste disposal facility. and • Sound groundwater management measures need to be developed based on the results of the impact assessment. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • Mitigation and management measures as set out in the groundwater management plan of the EMPr should be implemented as far as practically possible.	Medium to high -	Medium to high -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Poor quality leachate may emanate from the workshop and/or drilling pad footprint areas which may have a negative impact on groundwater quality.	Medium to high -	• Due to the sensitivity of the riparian zone, any development and/or drilling which takes place within the primary porosity aquifer associated with alluvium material deposited in flood plains must be restricted if it cannot be avoided. Pitless drilling must be implemented for drilling within the riparian zone (i.e., Target Areas 1 & 2) to further reduce the risk of contamination from the drill sump. • Additional monitoring boreholes should be established within the proposed target areas buffer zone as identified to evaluate the mass load contribution to sensitive environmental and groundwater receptors. • Newly established monitoring boreholes should be subjected to aquifer hydraulic parameters testing to supplement and verify existing hydraulic parameters interpreted as part of the first phase drilling and testing run. • Due to limited aquifer characterisation data pertaining to the deep hydrostratigraphical unit, it is recommended that potential water strikes encountered during proposed exploration drilling be recorded along with associated water levels in order to get a better understanding of the deeper aquifer piezometric head and expected behaviour. • It is recommended that the monitoring program and network as set out in this report should be implemented and adhered to. It is imperative that monitoring be conducted to serve as an early warning and detection system. Monitoring results should be evaluated on a bi-annual basis by a suitably qualified person for interpretation and trend analysis and submitted to the Regional Head: Department of Water and Sanitation.	Medium to low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
De-mobilisation of heavy vehicles, drilling rig as well as associated machinery on-site may cause hydrocarbon contamination of groundwater resources.	Medium to high -	• It is recommended that a weather station be established on-site in order to keep record of all rainfall events and assess potential climatic changes. The latter should be incorporated into the numerical groundwater flow model update accordingly. • All preferred groundwater flow pathways which are in direct connection with surface topography such as decommissioned gas production boreholes as well as historical mining exploration boreholes used as part of the exploration activities should be sealed off and rehabilitated according to best practise guidelines.	Medium to low -	Medium to low -
Impaired water quality from contaminated runoff (accidental chemical and oil spills from machinery and equipment) **Continued degradation of wetlands from improper post-exploration rehabilitation**	Medium to low -	• Ensure that detailed baseline water quality and quantity samples are obtained and analysed for reference purposes. • Construction/drilling should preferably not be conducted during rainy days. If drilling is to be undertaken during rainy days, additional precautionary measures in consultation with the ECO must be implemented to prevent contamination on surface water.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• Excavations should be open for as short period as practically possible and drilling circulation fluid sumps be cleaned out and rehabilitated. • Construction vehicles and machines must be maintained properly to ensure that oil spillages are kept at a minimum. • Spill trays must be provided if refuelling of drilling rig and vehicles are done on site. • Chemical sanitary facilities should be provided for drilling crew. Construction workers should only be allowed to use temporary chemical toilets on the site. Chemical toilets shall not be within close proximity of the drainage system. Frequent maintenance should include the removal without spillages. • Adequate fuel containment facilities to be used during exploration phase. • The use of all materials, fuels and chemicals which could potentially leach into the environment must be controlled. • All materials, fuels and chemicals must be stored in a specific and secured area to prevent pollution from spillages and leakages. • No uncontrolled discharges from the drilling pad or site shall be permitted. • Any spills that occur during the exploration phase must immediately be cleaned up and the contaminated soils, etc. suitably disposed of at a registered waste disposal facility. • No seismic activities nor drilling activities are to be permitted within on wetlands or watercourses (32m prelitigation and a 15m post-mitigation buffer. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • Engage wetland specialists or ECO to review rehabilitation success and recommend improvements. • The Emergency Response Plan must be updated to contain measures to prevent and react to abnormal events including but not limited to:		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		○ Blowout Preventers / Diverters ○ Shut-In Procedures to trigger the Blowout Preventers / Diverters system to physically seal the well and stop the flow of fluids ○ Emergency Shutdown Systems (ESD) to isolate valves and shuts rig power to prevent escalation into a major incident ○ High-Efficiency Flare Systems for flaring of excess gas to destroy toxic Volatile Organic Compounds (VOCs) and prevent dangerous emissions ○ Specific, site-tailored intervention strategies to be deployed to circulate out reservoir influxes and re-establish hydrostatic pressure ○ A 500-meter danger zone is immediately enforced around the wellhead ○ Active Spill Prevention, Control, and Countermeasure ○ Emergency contact numbers of nearby response team with sufficient containment materials and berms to be used to prevent leaked fluids from entering local waterways or soil.		
Improvement in wetland functionality from successful rehabilitation	Low +	• Engage wetland specialists or ECO to review rehabilitation success and recommend improvements.	Medium to Low +	Medium to Low +
Impacts on natural habitat Destruction, further loss and fragmentation of the vegetation community	Medium to low -	• Minimise vegetation clearance. Existing gravel roads must be used as far as possible, and the closest disturbed areas must be considered for drill pads. Clearance of vegetation must be kept to the required footprint (i.e. 50 x 50 m drill pad). Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed. A vegetation clearance management plan should be compiled prior commencement of activities which at minimum should state how the minimisation with be managed based on the affected environmental aspect or phase of the exploration. • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		land use, and this must be undertaken within six (6) months post drilling activities. • An Invasive Species Management Plan must be compiled and implemented during the lifecycle of the project. • All construction/exploration and access must make use of the existing roads as far as possible. • A suitable qualified Environmental Officer (EO) or Environmental Compliance Officer (ECO) must be appointed prior to the construction / exploration phase. If the final seismic transect route and/or the drilling location changes from the currently proposed areas, but within the assessed footprint and is situated within the high sensitive area, the EO / ECO must undertake final walkdown along the specific final planned transect route/s and drilling location/s in order to ensure that no sensitive vegetation or floral SCC are to be impacted. • Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. • Areas rated as High sensitivity outside of the direct development areas should be declared as 'no-go' areas during the life of the project, and all efforts must be made to prevent development access to these areas from construction workers and machinery. • All laydown, chemical toilets etc. should be restricted to low / medium sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction/exploration phase has been concluded. • The exploration activities may only be undertaken within the assessed corridors i.e. 50 corridors for seismic transects and 1km corridors for drilling wells. • Should additional seismic surveys and/or drilling wells fall outside of the EA Amendment assessed footprint areas, but within the Exploration Right, then depending on the final location of the seismic survey / drill site with respect to the locations sensitivity as defined by the Sensitivity maps, and		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		in consultation with the ECO and relevant specialists, the following must be undertaken prior to surveying / drilling: ○ In low sensitive areas, the conditions of the EMPr must be complied with; ○ In medium sensitive areas, the respective specialists must be brought to site to assess the final seismic survey / drill site and surroundings (1km radius around the site) and develop site . Furthermore, the conditions of the EMPr must be complied with; and ○ In high sensitive areas, the respective specialists must be brought to site to assess the seismic survey / drill sites and surroundings (with relevant buffer zones, e.g. 1km radius for wetlands, etc.) and develop site specific mitigation measures. These measures (site specific EMPr conditions) must be submitted to the PASA for approval prior to commencement with the seismic survey / drilling operations. New relevant management and mitigation measures: • A walkdown by a qualified independent ECO must be undertaken at final drilling sites and along final seismic transects as part of the preconstruction survey. The ECO must advise on additional mitigation measures where applicable.		
Destruction, further loss and fragmentation of the vegetation community	Medium to low -	• Minimise vegetation clearance. Existing gravel roads must be used as far as possible, and the closest disturbed areas must be considered for drill pads. Clearance of vegetation must be kept to the required footprint (i.e. 50 x 50 m drill pad). Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed. A vegetation clearance management plan should be compiled prior commencement of activities which at minimum should	Medium to low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Introduction of alien species, especially plants	Medium to low -	state how the minimisation with be managed based on the affected environmental aspect or phase of the exploration. • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities. • All construction / exploration and access must make use of the existing roads as far as possible. • A suitable qualified Environmental Officer (EO) or Environmental Compliance Officer (ECO) must be appointed prior to the construction / exploration phase. If the final seismic transect route and/or the drilling location changes from the currently proposed areas, but within the assessed footprint and is situated within the high sensitive area, the EO / ECO must undertake final walkdown along the specific final planned transect route/s and drilling location/s in order to ensure that no sensitive vegetation or floral SCC are to be impacted. • Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed. • Areas rated as High sensitivity outside of the direct construction / exploration areas should be declared as 'no-go' areas during the life of the	Medium to low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Displacement of faunal community (including SSCs) due to habitat loss, direct mortalities and disturbance	Medium to low -	project, and all efforts must be made to prevent impacts and access to these areas from construction workers and machinery. • All laydown, chemical toilets etc. should be restricted to low / medium sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction/exploration phase has been concluded. • An Alien Invasive Plant Management Plan must be compiled and implemented during the construction / exploration phase. • All activities must be restricted too within the very low sensitivity areas as far as possible. No further loss of high sensitivity areas should be permitted. • All construction/operational and access must make use of the existing roads as far as possible. • Identified protected or SCC flora species that will be impacted upon must be relocated by a suitably qualified environmentalist / ecologist. • The exploration activities may only be undertaken within the assessed corridors i.e. 50 corridors for seismic transects and 1km corridors for drilling wells. • Should additional seismic surveys and/or drilling wells fall outside of the EA Amendment assessed footprint areas, but within the Exploration Right, then depending on the final location of the seismic survey / drill site with respect to the locations sensitivity as defined by the Sensitivity maps, and	Medium to low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Potential leaks, discharges, pollutant from machinery and storage leaching into the surrounding environment	Medium to low -	in consultation with the ECO and relevant specialists, the following must be undertaken prior to surveying / drilling: ○ In low sensitive areas, the conditions of the EMPr must be complied with; ○ In medium sensitive areas, the respective specialists must be brought to site to assess the final seismic survey / drill site and surroundings (1km radius around the site) and develop site. Furthermore, the conditions of the EMPr must be complied with; and ○ In high sensitive areas, the respective specialists must be brought to site to assess the seismic survey / drill sites and surroundings (with relevant buffer zones, e.g. 1km radius for wetlands, etc.) and develop site specific mitigation measures. These measures (site specific EMPr conditions) must be submitted to the PASA for approval prior to commencement with the seismic survey / drilling operations. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • A walkdown by a qualified independent ECO must be undertaken at final drilling sites and along final seismic transects as part of the preconstruction survey. The ECO must advise on additional mitigation measures where applicable. • A walkdown by a suitable specialist (ecologist) must be undertaken along final seismic transects as part of the preconstruction survey. The specialist must investigate and/or confirm presence of SCCs. Should any SCCs be identified, the specialist must provide additional mitigation measures to avoid impacts on the identified SCCs. Permits / Licenses must be obtained prior any disturbance and/or relocation of SCCs.	Medium to low -	Medium to low -
Impacts on Fauna Species	Medium to low -	• The duration of the construction / exploration should be minimized to as short term as possible, to reduce the period of disturbance on fauna.	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals. • No trapping, killing, or poisoning of any wildlife is to be permitted on site. • Outside lighting should be designed and limited to minimize impacts on fauna. • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities. • All construction/operational and access must make use of the existing roads as far as possible. • Construction impacts associated with the proposed project must be contained within the footprint of the demarcated areas as indicated on the final approved project layout plan. • A suitable qualified Environmental Officer must be appointed prior to the construction / exploration phase. The EO must undertake walkdowns / surveys along the final planned transect routes and drilling locations in order to ensure that no sensitive, protected or SCC fauna species are to be directly impacted • Identified protected or SCC fauna species that will be impacted upon must be relocated by a suitably qualified environmentalist / ecologist. • Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further. • Areas rated as High sensitivity outside of the direct development areas should be declared as 'no-go' areas during the life of the project, and all efforts must be made to prevent impacts / access to these areas from construction workers and machinery.		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		• The exploration activities may only be undertaken within the assessed corridors i.e. 50 corridors for seismic transects and 1km corridors for drilling wells. • Should additional seismic surveys and/or drilling wells fall outside of the EA Amendment assessed footprint areas, but within the Exploration Right, then depending on the final location of the seismic survey / drill site with respect to the locations sensitivity as defined by the Sensitivity maps, and in consultation with the ECO and relevant specialists, the following must be undertaken prior to surveying / drilling: ○ In low sensitive areas, the conditions of the EMPr must be complied with; ○ In medium sensitive areas, the respective specialists must be brought to site to assess the final seismic survey / drill site and surroundings (1km radius around the site) and develop site . Furthermore, the conditions of the EMPr must be complied with; and ○ In high sensitive areas, the respective specialists must be brought to site to assess the seismic survey / drill sites and surroundings (with relevant buffer zones, e.g. 1km radius for wetlands, etc.) and develop site specific mitigation measures. These measures (site specific EMPr conditions) must be submitted to the PASA for approval prior to commencement with the seismic survey / drilling operations. New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • A walkdown by a qualified independent ECO must be undertaken at final drilling sites and along final seismic transects as part of the preconstruction survey. The ECO must advise on additional mitigation measures where applicable. • A walkdown by a suitable specialist (ecologist) must be undertaken along final seismic transects as part of the preconstruction survey. The specialist must investigate and/or confirm presence of SCCS. Should any SCCs be identified, the specialist must provide additional mitigation measures to		

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		avoid impacts on the identified SCCs. Permits / Licenses must be obtained prior any disturbance and/or relocation of SCCs.		
Destruction of disturbance of structures and artefacts older than 60 years **Destruction or disturbance of identified graves**	Medium to low -	• Should additional seismic surveys and/or drilling wells fall outside of the assessed footprint areas, but within the Exploration Right, then depending on the final location of the seismic survey / drill site in relation to known heritage features (less than 500m from a known heritage feature), a public participation process must be implemented during which the Interested & Affected Parties are invited to come forward and state whether they are aware of any sacred water sites (secret or not) located within a 500m radius area from each proposed exploration positions. • The planning of all additional exploration footprints must take cognizance of the heritage sensitivities depicted on the heritage sensitivity maps. To the extent possible, identified heritage sensitivities must be avoided in the establishment of additional exploration footprints. • An independent and suitably qualified ECO must be appointed and must train the Contractor to recognise potential heritage features. • All archaeological structures be retained and avoided with a buffer zone of 30m as per SAHRA guidelines. If this is not possible, the graves could be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of s36 of the NHRA and its regulations as well as the National Health Act and its regulations. • Should any heritage features be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the ECO shall be notified within 24hours, and a Chance Find Protocol must be implemented. The responsible heritage resources authority (FSPHRA), as well as the South African Police Service (SAPS) must be notified within 72hours. New relevant management and mitigation measures identified as part of this assessment added to the EMPr:	Low -	Low -
Destruction or disturbance of undiscovered below-ground heritage features	Medium to low -		Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Disturbance / Destruction of Palaeontological Features	Medium to low -	• A walkdown by a qualified archaeologist must be undertaken at final drilling sites and along final seismic transects as part of the preconstruction survey. The archaeologist must advise on additional mitigation measures should any heritage features be identified along the seismic transects and/or drilling site. • A 50m buffer around all identified graves must be implemented within which no proposed activities are to take place.	Low -	Low -

Safety and security (Health and Safety of the Community)	Medium to low -	• All farm gates must be closed immediately upon entry/exit.
		• Fencing of all drill sites with security access control and warning signs.
		• All drilling sites must be properly sealed to trap gases from escaping. Wells should be plugged to prevent crossflow of gas into aquifers and isolate all potential hydrocarbon / water bearing formations by utilizing placed cement plugs extending at least 30m above and below the reservoir.
		• There must be access control to the entry / exit points of the exploration sites.
		• Vehicles should be clearly marked as construction vehicles.
		• The Applicant must ensure that the Emergency Preparedness and Response Plan make provision for environmental emergencies, including, but not limited to:
		  ○ Fire Prevention;
		  ○ Fire Emergency Response;
			Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
		○ Spill prevention; ○ Spill Response; ○ Contamination of a water resource; ○ Accidents to employees; and ○ Use of hazardous substances and materials, etc. • The Applicant and Contractor must ensure that lists of all emergency telephone numbers/contact persons (including fire control) are kept up to date and that all numbers and names are posted at relevant locations throughout the lifespan of the project. • In the event of an emergency incident (unexpected sudden occurrence), including a major emission, fire or explosion leading to serious danger to the public or potentially serious pollution of or detriment to the environment, whether immediate or delayed, the Applicant shall notify the relevant authorities in accordance with legal requirements (e.g. Section 30 of NEMA and Section 20 of the NWA). New relevant management and mitigation measures identified as part of this assessment added to the EMPr: • The Holder should work with the existing and preferred farmers' security group and implement the AgriSA farm access protocol (or equivalent protocol) for everybody that need to access the properties.		
Gender and social inclusion impacts	Medium to low -	• All farm gates must be closed immediately upon entry/exit. • Developer must allow for a transparent employment opportunity for locals. • Local suppliers and workers must be prioritised as far as possible for economic and professional growth. • Prior to accessing any portion of land, the Applicant must enter into formal written agreements with the affected landowner. This formal agreement	Low -	Low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Upliftment of Communities / Employment Opportunities	Medium to low -	should additionally stipulate landowners special conditions which would form a legally binding agreement. • Landowners must be notified beforehand of the activities to be undertaken in their properties and requested to indicate the type and location of services within their properties. • There must be a formal procedure in place on how to report incidents to ensure records of all grievances are kept, and responses are given within a certain time. • Before the project commences, an asset and services baseline of services that may be affected within 50 m of the exploration area must be compiled. A copy of the baseline records should be given to each landowner/ service provider, and a master document kept by the applicant. • Motuoane must appoint a public / landowner liaison officer that must continue to deal with the affected landowners throughout the life of the project. • The specification of the cement and steel casing that will be used to secure the drilled well and prevent fluid migration and protect freshwater aquifers must be according to the key international standards and best practices. • Conduct a water quality assessment of all identified boreholes and surface water sources near the exploration sites before any field activity begins. Share results with landowners. • exploration and drilling be planned for the dry / sunny days to avoid causing additional damage and/or erosion of the gravel access roads due to movement of heavy machinery. • Develop and implement a Spill Prevention and Response Plan, with adequate resources and capacity in place to ensure its effective	Medium to low -	Medium to low -
Overlapping land use with renewable energy projects	Medium -		Low -	Medium to low -
Impacts on safety and security of local residents.	Medium to high -		Low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Water contamination and groundwater safety	Medium to high -	implementation. The plan should address potential spill scenarios involving gas, chemicals, and fuel, originating from fixed facilities, transportation vehicles, loading and unloading operation. Ensure onsite staff are trained on emergency spill procedure. New relevant management and mitigation measures: • To prevent conflicts between gas exploration activities and pre-existing or planned renewable energy developments, site-specific agreements must be negotiated with affected landowners and renewable energy developers prior to any on-site activities.	Low -	Medium to low -
Damage to farm roads, existing services and infrastructure	Medium to high -	• Motuoane should work with the existing and preferred farmers' security group and implement the AgriSA farm access protocol (or equivalent protocol) for everybody that need to access the properties. • Co-develop Access and Rehabilitation Agreements outlining duration, extent of disturbance, rehabilitation obligations, biosecurity protocols, and opt-out clauses for landowners. • Prior to commencement on a property, conduct one-on-one meetings with affected landowners to explain the exact scope and timing of exploration activities on the specific property.	Low -	Medium to low -
Distrust from previous development projects	Medium to high -	• Maintain regular and proactive communication with landowners to inform them of activities, schedules, and any changes to personnel or site access. • Motuoane should adopt a formal recruitment policy that ensures equal access to employment and training opportunities for women and other marginalised groups. • If the drill pads and/or site camps are fenced, the fences must be checked for snares on a daily basis for the duration of the exploration activities. All incidences must be recorded and the ECO must be informed to advise on	Low -	Medium to low -

Impact	Pre-Mitigation Significance	Mitigation Measures	Post-Mitigation Significance	Final Significance
Increase in poaching incidents and stock theft	Medium to high -	additional mitigation measures. Anti-poaching toolbox talks should form part of the induction process of all the fencing teams. Any contractor or employee caught poaching should be removed from site.	Medium to low -	Medium to low -
Impact on farming community livelihoods and interference with existing land uses	Medium to low -		Low -	Medium to low -

It is important to note that the environmental risk assessment will be revised and updated after the finalisation of the EIAr and on an annual basis to ensure that this FRDCP remains applicable to the actual and predicted environmental impacts and risks.

4.5 DESIGN PRINCIPLES

4.5.1 LEGISLATIVE AND GOVERNANCE FRAMEWORK

The requirement for final rehabilitation, decommissioning and closure stems primarily from the legislative requirements of the MPRDA and the NEMA. The relevant extracts from each of these are presented in this section. Please also refer to the EIA Report (2026) for an overview of other enviro-legal requirements which may influence closure planning.

4.5.1.1 MINERALS AND PETROLEUM RESOURCES DEVELOPMENT ACT, ACT 28 OF 2002

The following extracts relate to the principle of closure for any right issued under the MPRDA:

- Section 43(1): *The holder of a prospecting right, mining right, retention permit, mining permit, or previous holder of an old order right or previous owner of works that has ceased to exist, remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure thereof, until the Minister has issued a closure certificate in terms of this Act to the holder or owner concerned.*

- Section 43(4): *An application for a closure certificate must be made to the Regional Manager in whose region the land in question is situated within 180 days of the occurrence of the lapsing, abandonment, cancellation, cessation, relinquishment or completion contemplated in subsection (3) and must be accompanied by the required information, programmes, plans and reports prescribed in terms of this Act and the National Environmental Management Act, 1998.*

- Section 43 (5): *No closure certificate may be issued unless the Chief Inspector and each government department charged with the administration of any law which relates to any matter affecting the environment have confirmed in writing that the provisions pertaining to health and safety and management pollution to water resources, the pumping and treatment of extraneous water and compliance to the conditions of the environmental authorisation have been addressed.*

- Section 43 (7): *The holder of a prospecting right, mining right, retention permit, mining permit, or previous holder of an old order right or previous owner of works that has ceased to exist, or the person contemplated in subsection (2), as the case may be, must plan for, manage and implement such procedures and such requirements on mine closure as may be prescribed.*

- Section 43 (8): *Procedures and requirements on mine closure as it relates to the compliance of the conditions of an environmental authorisation, are prescribed in terms of the National Environmental Management Act, 1998.*

4.5.1.2 FINANCIAL PROVISIONING REGULATIONS

On 20th November 2015 the Minister promulgated the Financial Provisioning Regulations under the NEMA (GN R 1147, 2015). The regulations aim to regulate the determine and making of financial provision as contemplated in the NEMA 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. These regulations provide for, inter alia:

- Determination of financial provision: 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, as contemplated in the Act and to the satisfaction of the Minister responsible for mineral resources.

- Scope of the financial provision: Rehabilitation and remediation; decommissioning and closure activities at the end of operations; and remediation and management of latent or residual impacts.
- Regulation 6: Method for determining financial provision – An applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for:
    - Annual rehabilitation – annual rehabilitation plan
    - Final rehabilitation, decommission and closure at end of life of operations – rehabilitation, decommissioning and closure plan; and
    - Remediation of latent defects and residual impacts – environmental risk assessment report.
- Regulation 10: An applicant must-
    - ensure that a determination is made of the financial provision and the plans contemplated in regulation 6 are submitted as part of the information submitted for consideration by the Minister responsible for mineral resources of an application for environmental authorisation, the associated environmental management programme and the associated right or permit in terms of the Mineral and Petroleum Resources Development Act, 2002; and
    - Provide proof of payment or arrangements to provide the financial provision prior to commencing with any prospecting, exploration, mining or production operations.
- Regulation 11: Requires annual review, assessment and adjustment of the financial provision. The review of the adequacy of the financial provision including the proof of payment must be independently audited (annually) and included in the audit of the EMPR as required by the EIA regulations.

Appendix 4 of the Financial Provisioning Regulations provides the minimum content of a final rehabilitation, decommissioning and closure plan. This FRDCP has been prepared to align with these requirements. Appendices 3 and 5 of the Financial Provisioning Regulations provide content requirements for the Annual Rehabilitation Plan and Environmental Risk Assessment Report respectively.

4.5.1.3 OTHER GUIDELINES

The following additional guidelines which relate to financial provisioning and closure have been published in the South African context:

- Best Practice Guideline G5: Water Management Aspects for Mine Closure: This guideline was prepared by the DWS and aims to provide a logical and clear process that can be applied by mines and the competent authorities to enable proper mine closure planning that meets the requirements of the relevant authorities. This guideline is aimed primarily at larger scale mines and does not specifically address closure issues related to closure of exploration activities, however certain principles related to closure and water management are relevant. The following technical factors which should be considered during closure, and those which are likely to relate to exploration activities, have been considered:
    - Land use plan: directly interlinked with water management issues insofar as water is required to support the intended land use- in this regard the surrounding communities and the land uses implemented rely on available ground and surface water to be sustained. Management of water quality and quantity has been identified as an aspect to be covered in this FRDCP.
    - Public participation and consultation: consultation is fundamental to closure and there is a need for full involvement of stakeholders in the development of the final closure plans, and in

the agreement of closure objectives- in this regard this FRDCP has been made available through the EIA public participation process for comment by relevant stakeholders.

- Guideline for the Evaluation of the Quantum of Closure Related Financial Provision Provided by a Mine: The objectives of the guideline include the need to improve the understanding of the financial and legal aspects pertaining to the costing of remediation measures as a result of mining activities. Whilst this guideline predates the recent NEMA Financial Provisioning Regulations, it does contain certain principles and concepts that remain valid and have been considered in this FRDCP.

4.5.2 BOREHOLE PLUGGING AND ABANDONMENT

In respect of the rehabilitation plugging and abandonment reference has been made to the American Petroleum Institute (API) recommended Practice 65-3 (American Petroleum Institute, 2021). This document provides practical guidance for permanently and temporarily abandoning gas wells.

The primary goals of the practice document are protection of useable water sources, isolation of hydrocarbon bearing or water injection intervals, prevent any leakage to the surface, and prevention of unintended cross flows. Where applicable and relevant recommendations and actions defined in this practice document has been included in this FRDCP.

4.5.3 GENERAL SURFACE REHABILITATION

The Land Rehabilitation Society of South Africa (LARRSA) has recently published a guideline for the surface rehabilitation of coal mines (LaRSSA, 2019). There are aspects of these guidelines which can be applied to the surface rehabilitation actions for most projects and are presented below in Table 12.

Table 12: Key principles for surface land rehabilitation.

Component	Rehabilitation principle
Regulatory compliance	- Achieving legal compliance is a minimum for appropriate rehabilitation planning. - Rehabilitation objectives and associated actions will not conflict with local legislation and will aim to complement and possibly go beyond legal compliance, where possible.
Concurrent implementation	- Concurrent, progressive rehabilitation will be undertaken throughout the operational stage of mining[7]. - A risk-based approach will be applied to ensure concurrently implemented rehabilitation actions will achieve the desired post-mining landscape and land capability aligned with end land use targets.
Stakeholder engagement and custodianship	- Relevant mining-affected stakeholders will be identified and involved in rehabilitation planning throughout the mining lifecycle, as required. - Rehabilitation planning will leverage from local stakeholder views, experiences, cultures and/or customs, on possible uses and needs of the rehabilitated landscape, to foster a land stewardship culture from potential next land users.
Landform Management	- Rehabilitation will be undertaken and aligned to a site-specific surface landform design that will be compiled during the planning stage of an operation. - The site-specific landform design will incorporate the surface profiling needs of the target post-mining land capability and land use/s, to optimize material

[7] Where reference is made to mining in these guidelines it can be extended to relevant and similar activities associated with exploration activities.

Component	Rehabilitation principle
	movement throughout the operational and decommissioning periods, and to ensure the long-term sustainability of the rehabilitated landscape. - A 'management-of-change review process' will be incorporated into the mine planning process, to ensure that changes to the mine plan do not compromise either the proposed final landform or its potential use.
Land capability	- Post-mining land capability will, as far as is practically possible, be constructed to resemble the pre-mining land capability of the disturbed area. - Attention will be given to rehabilitating the site to specified land capabilities that can support a suite of mixed land uses. - Soil physical and chemical properties will be aligned to the productivity needs of the post-mining land use/s, and to support these in the long-term.
Land use	- Post-mining land use planning will consider the needs of changing regional development and planning, over time. - The site will be left in an environmentally physically safe, stable, and non-polluting condition for the defined post-mining land uses. - The defined post-mining land use/s will provide socio-economic value to next land users, as agreed with these land users (once exact post-mining land uses can be defined).
Climate uncertainty	- Predictive modelling will form the basis for longer-term environmental impact identification and risk management.
Monitoring	- Monitoring will be initiated as soon as the first ground has been moved (at construction). - Monitoring will be continued progressively throughout the project lifecycle, in parallel with concurrent rehabilitation activities. - Data obtained through ongoing monitoring will be frequently assessed for trends that could demonstrate rehabilitation success, and where corrective action may be required. - The monitoring process must be linked to a corrective action process.
Adaptive land management	- An adaptive land management approach will be adopted on-site, allowing for implementation of alternative and improved rehabilitation strategies and corrective action, where required.

4.5.4 CLOSURE VISION, OBJECTIVE AND TARGETS

The vision, and consequent objective and targets for rehabilitation, decommissioning and closure, aim to reflect the local environmental and socio-economic context of the project, and to represent both the corporate requirements and the stakeholder expectations.

The receiving environment within which the exploration activities will be undertaken include the following key land-uses:

- Agriculture- cultivated fields;
- Natural and Degraded Veld primarily utilised or livestock grazing;
- Mining areas; and

- Low density rural residential.

With reference to both the environmental context of the project and the feedback from the consultation process the vision for closure is to:

- *Ensure that the post closure land use aligns with the surrounding land-use and does not affect the sustained utilisation of the land.*

In practice the post closure land-use will depend on the pre-exploration land-use applicable to the specific location of the invasive exploration activities. Considering that the exact locations of a large portion of the planned exploration is unknown at this stage, there is a need to revisit and refine this closure plan on a site-specific basis, as and when site specific location are known. This FRDCP does however aim to address the key closure objectives which are likely to remain consistent for the majority of the exploration activities.

Driven by the closure vision and with due consideration of the project context the following closure objectives are presented:

- Set the course for eventual ecosystem restoration, including the restoration of the natural vegetation community, hydrology, and wildlife habitats.
- Prevent future environmental issues related to fluid or gas leakage or lateral movement through the well.
- Protection of water resources.
- Ensure that land is usable, in alignment with surrounding land uses.

Please refer to Table 18 for the stipulated targets related to these closure objectives.

4.5.5 ALTERNATIVE CLOSURE AND POST CLOSURE OPTIONS

There are various alternative closure and post closure options available. The identification and consideration of the most suitable alternatives are driven by, inter alia the following considerations:

- The ability of the selected alternative to adequately meet the specified closure vision and objectives.
- The efficiency, viability, and practicality of the selected alternative.
- The alignment with the local environmental and socio-economic context and associated opportunities and constrains.

Table 13 presents some available options and alternatives related to the process of abandoning and closure of a well site. The options in the table below that are marked with an "X" are considered the preferred options.

Table 13: Closure alternatives.

Exploration Activity	Aspect	Options	Comment
Exploration wells	Casing	**Retain** X	The retention of the casing is strongly dependant on the nature of the geological strata and location of groundwater aquifer and other permeable zone. The presence of thief zones may also be a hindrance to the removal of a casing string.
		Remove	Casing is often removed in an attempt to recover and salvage the steel. Depending on the nature of the well corrosion of the casing over time may affect the integrity of the plug.

Exploration Activity	Aspect	Options	Comment
	Plugging extent	~~**Complete**~~	The well bore is to be cemented for the full length and diameter of the wellbore to surface.
		Partial/ intermittent	Due to the cost of complete cementing, there may be instances where intermittent casing could be used. This is dependent on the nature of the well and the geological strata.
	Plugging Material	~~**API Standard**~~	The cement to be used should comply with the relevant API standards. API standards provide recognised requirements for well design, cementing, plugging and abandonment to ensure boreholes are safely sealed and isolated. Their relevance to plugging concrete is that the concrete/cement slurry used must be durable, low-permeability, and suitable for downhole conditions so it can form an effective long-term seal and prevent fluid or gas migration.
	Plugging techniques	Dump Bailer	Outdated. This technique has the potential to allow for contamination of the well plug and therefore may affect the plug integrity.
		~~**Squeeze**~~	The displacement method minimises the contamination of the cement by being able to displace fluid within the well. Allows for a more stable well plug.
	Surface Infrastructure	~~**Complete removal**~~	The surface area of a decommissioning well must be clear of obstructions and equipment. In order to allow unhindered land use of the well area, it is suggested that all surface infrastructure be removed.
		Retain	Surface infrastructure would typically include the well, cap, flange, and /or collar.
Drill site	Surface Infrastructure	~~**Complete removal**~~	The surface area of a decommissioning well site must be clear of obstructions and equipment. In order to allow unhindered land use of the well area, it is suggested that all surface infrastructure be removed.
		Retain	Surface infrastructure of the drill site would typically include containers, temporary offices, ablutions, vehicles, waste bins/skips and the drill rig.
	Sump	~~**Emptied and backfilled**~~	Sumps will be emptied and content thereof disposed at a suitably licenced facility. It has been suggested to replace sumps with mobile containers above ground to minimise the impacts.
		Retain	The sumps were emptied by evaporating the liquids and removing the drill muds but are not backfilled.
	Access roads	~~**Rehabilitate**~~	The intention is to rehabilitate the area, including the access route, to the pre-exploration condition.

Exploration Activity	Aspect	Options	Comment
		Retain	In certain instances, the landowner may request the retention of the access route.
	Revegetation	Proactive revegetation	Actively reestablish natural indigenous vegetation via hydroseeding.
		Passive revegetation	Allow for natural reestablishment of indigenous vegetation and implement an Alien Invasive Management programme and monitoring of vegetation growth.

As mentioned previously the final closure and decommissioning of an exploration well must be pre-empted by a site-specific assessment and where applicable the implementation of the most appropriate rehabilitation and closure strategy. Furthermore, the annual review of this FRDCP must, where applicable, include an assessment and adjustment of the closure strategy to reflect the most recent technical development and industry best practice, as well as any lessons learnt from the implementation of closure on this project.

4.5.6 MOTIVATION FOR PREFERRED CLOSURE OPTION

With reference to Sections 4.5.4 and 4.5.5, the preferred closure option is as follows:

- Retain casing (informed by a pre-closure inspection of casing integrity) and plug using a pump/squeeze technique, the full length of the well with a suitable plugging cement, as prescribed by, and in accordance with, the applicable API Guidelines and standards.
- Cut surface casing at a depth to be informed by end land-use (presumed below plough depth), remove and bury.
- Rehabilitate access routes or retain when requested by a landowner.
- It is anticipated that the closure option presented above, together with monitoring of the post closure period, will achieve the stipulated closure objective. This closure option is in line with industry best practice and the requirements of the MPRDA Regulations.
- Effective abandonment depends on knowledge of the well construction, geology, and the hydrogeology. In this regard it is recommended that prior to commencement of closure and decommissioning of any specific well the following must be undertaken:
- A detailed site-specific decommissioning plan must be prepared by an appropriately qualified specialist or specialists. This plan must take into consideration the following site-specific factors:
    - Current condition and design of the well (informed by suitable well integrity testing);
    - Records of the drilling results (geological logs), cement used and testing results for the life of each well, including the cement bond log tests immediately after grouting and prior to decommissioning as well as any periodic maintenance checks during the operational life;
    - Height of cement in annulus outside casing;
    - Considerations for the composition and placement of the plug or barriers should include:
        - Location of potential flow zones and pore pressures.
        - Location of useable water sources.
        - Formation fracture pressure of natural seals.

        - Crossflow potentials; direction and resultant equalised pressures.
        - Future field plans.
        - Compaction, subsidence, and recharged formations.
        - Corrosion risks.
        - Locations of natural faults and their ability to transmit fluids and/or pressure.
        - Ability to be able to verify the barrier.
        - Operating environment (temperature, pressures, chemical characteristics).
    - Cement casing overlaps;
    - The need for abandonment plugs to cover the full diameter of the hole;
    - The type of fluid in annuli above cement;
    - The chemical composition of the prevailing groundwater;
    - The following considerations apply to determining the composition of the barrier material/s:
        - Inability for wellbore fluids to bypass in either direction.
        - No degradation of sealing capacity over time.
        - The specific host rock thermal and effective stress characteristic which may affect permanent plug integrity.
        - Avoidance of movement.
        - Appropriate for the environment (e.g. Temperature, pressure, chemical exposure) and application.[8]
    - Potential difficulties of injecting cement into the annulus;
    - Future monitoring of the integrity of the well plug; and
    - The depth below surface at which casing must be cut.
- The applicable landowner must be consulted and input obtained regarding the current and planned land-uses applicable to the area and the need to retain surface infrastructure, well accessibility and/or access tracks.

The revised decommissioning plan and the feedback from the landowner consultation must be submitted to the PASA for review and approval prior to implementation.

Table 14 provides a list of threats, opportunities and uncertainties related to the preferred closure options. Where applicable actions to address these uncertainties are presented in Section 4.4.

Table 14: Threats, opportunities and uncertainties associated with preferred closure option.

Item:	Description:
Threats:	- Insufficient financial provision to adequately implement closure plan. - Insufficient management commitment to effective rehabilitation.

[8] The development of an applicable well bore stress model would assist in planning the final specific barrier characteristics.

Item:	Description:
	- Inadequate topsoil management during construction phases to allow for adequate topsoil cover to enable rehabilitation. - Inability to identify and implement a suitable alternative land use on the defined alternative land use areas. - Groundwater modelling inaccurately predicts the potential medium to long term impacts on the groundwater resources. - Incorrect plug/ barrier materials used for well bore plugging could result in long term degradation of plug effectiveness. - Third party activities may affect the success of the rehabilitation and closure strategies (e.g. ongoing mining activities such as blasting and excavations may impact on the long-term integrity of well barriers and casing). - Movement of faults which may intersect the zone of influence of a well may compromise the long-term stability of the barrier or casing.
Opportunities:	- NEMA requires annual review of the rehabilitation and closure plans and associated financial provisions- this provides an ideal opportunity to ensure that the rehabilitation process is assessed for relevance on a continual basis.
Uncertainties:	- There are certain closure actions and parameters which are uncertain prior to actual closure. These include the status of the well bores at the time of closure. The specific circumstances will need to be assessed at the time of closure by a qualified well engineer and a decommissioning plan prepared. - The extent to which the infrastructure established for the production may be of value for reuse or repurposing by the landowners is uncertain at this stage and must be ascertained prior to final closure. - The groundwater model should continue to be updated based on monitoring data and the predictions of impacts to water resources should be reviewed and revised. - An adaptive land management approach will be adopted on-site, allowing for implementation of alternative and improved rehabilitation strategies and corrective action, where required.

4.5.7 CLOSURE PERIOD AND POST CLOSURE REQUIREMENTS

The closure period is defined as the period between the cessation of exploration, and the completion of active rehabilitation actions on the applicable site. For the purposes of the FRDCP we assumed active decommissioning will be undertaken for one year after a well is abandoned (year 1), This will be followed by a four-year period (Years 2–5) to meet the necessary relinquishment, closure, and rehabilitation criteria. The post-closure phase will commence thereafter.[9] It may become necessary to decommission and plug unsuccessful or dry wells during the operational phase (should a Production Right be obtained). In these instances, it is suggested that closure on these specific wells is initiated as soon as possible. Monitoring will be conducted on an annual basis until a closure certificate is issued, confirming that rehabilitation is complete. For the purpose of this assessment, a five-year monitoring period has been assumed before closure is complete. The following actions, to be adjusted based on the completion of the pre-closure site assessment, are proposed:

- Groundwater and surface water monitoring via the proposed monitoring boreholes and surface water monitoring points will be utilised to analyse groundwater and surface water quality. Sampling will test for dissolved methane, as well as changes to physical parameters such as electrical conductivity and

[9] Should the relinquishment criteria not be met within the assumed four-year timeframe, the holder remains obligated to continue all prescribed monitoring until the relinquishment criteria are achieved.

pH. This will serve as an early indicator for migrating saline groundwater or gas resulting from potential subsurface casing or cement annulus failures. Following decommissioning, monitoring will be conducted bi-annually for the first year. Thereafter, monitoring will proceed on an annual basis for a period of four years, or until a formal closure certificate is issued.

- Fugitive gas emissions using either soil vapour probes, efluxes, Flir Methane Cameras, or surface methanometers will be monitored annually for 5 years after decommissioning;
- Well plugging and abandonment verification to confirm that there is proper and effective vertical isolation (this could include: bond log tests, cementing tests, communication tests, hydraulic pressure tests, applied weight test); and
- Biodiversity assessments mid-wet season (i.e. annual) should be undertaken by a qualified ecologist/botanist to monitor the rehabilitation progress with regards to flora for a period of 3 years after rehabilitation.

There are however certain residual and latent impacts which may manifest in the post-closure phase. These relate primarily to the risk of well plug integrity and associated long-term management of vertical migration of gas and/or fluids to the shallow water resources or the surface. The management and monitoring associated with these residual and latent risks are addressed in Section 6.

4.5.8 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply to this FRDCP:

- Location and consequent end land use is largely unknown for significant parts of future planned invasive exploration works. The closure liability estimate will need to be updated (and where necessary the closure plan amended) on an annual basis to include the locations of the new exploration sites.
- Due to the uncertainty of the exact site-specific conditions applicable to aspects of the planned exploration, the following assumptions have been made and used as the basis for the financial provision calculations:
    - Post closure land use: natural grassland associated with livestock grazing.
    - Distance of access track (requiring rehabilitation): 100m.
    - 2 Boreholes, and 1 surface water monitoring point (if present) within the zone of influence to be utilised for water monitoring.
    - The access roads prepared for the exploration activities will be rehabilitated during closure. Existing roads will be used as far as possible.
    - No construction camps or explorations camps will be constructed during the exploration programme.
    - Mobile and temporary site offices will be established.
    - Chemical toilet facilities will be supplied at all drill sites and established work areas. The closure actions and associated period will commence as soon as a well is abandoned.
    - It is assumed that the entire length and diameter of the well bore will be plugged/cemented.
- It is assumed that the management and mitigation measures suggested in the EIA Report relating to ongoing environmental management are complied with. This includes post drilling clean-up and rehabilitation.
- It is assumed that the drilling, including casing and grouting, is carried out in accordance with industry best practice and that permeable zones are adequately isolated (including the usable ground water aquifers).

- It is assumed that once a decision is made to initiate closure on a well that a suitably qualified specialist is appointed to undertake and assessment and consult with the landowner and prepare a site-specific decommissioning plan for submission to PASA for review and approval.

Closure cost estimations were determined using the general and site-specific assumptions and qualifications listed below.

4.5.8.1 GENERAL:

The financial provision estimate includes the following cost components:

- Allowance has been made for third-party contractors and consultants to conduct post-closure care and maintenance work, as well as compliance monitoring.
- Costs pertaining to workforce management, and re-training/re-skilling are outside the scope of this costing.
- Concrete footings and bases would be demolished to a maximum of 1 000 mm below the final surface topography.
- All infrastructure will be completely dismantled, regardless of whether it is foreseen that certain components would be sold off/transferred to third parties post closure. Hence, no allowance was made for the beneficial re use of any of the infrastructure. Until such agreements have been put in place, the assumption remains that total demolition would be required.
- Movable assets will be removed from site for sale and/or re-used by Motuoane, and the cost associated with dismantling and transport of these items are not included in the cost determination.
- Fixed ratios for P&Gs, contingencies and socio-economic mitigation measures have been applied.
- Income from the sale of salvage steel does not offset closure cost allowances.
- Closure costs have been determined for the scheduled closure scenario only. Scheduled closure takes place at a planned date and/or time horizon in accordance with overall exploration planning and unscheduled takes place should the exploration end with the infrastructure as is at present, which is currently assumed that one (1) exploration wells are planned to be drilled within the following 12 months of receiving an Environmental Authorisation and is therefore costed for at this stage.
- The costs have been reported in present day costs. Closure cost estimations were determined using the following general and site-specific assumptions and qualifications:
- It is assumed that the management and mitigation measures suggested in the EMPr relating to ongoing environmental management are complied with. This includes post-exploration clean-up and rehabilitation.
- It is assumed that that the plugging of the wells will be able to apply an economies of scale factor which will enable a 25% reduction in the plugging of wells rate due to the number of wells (bulk rate vs rate per one well).

4.5.8.2 SITE-SPECIFIC

- It is assumed that five (5) exploration wells will be sealed off by pumping cement into the well as part of the closure and rehabilitation phase. The pressure cementing of the wells will be undertaken from near the base of the well to the surface. In addition, it is assumed that all drilling, including casing and grouting, is carried out following industry best practice and the applicable guidelines and that permeable zones are adequately isolated (including the usable groundwater aquifers) as part of the well closure;

- It is assumed that the well engineer or other suitably qualified specialist will provide a statement, based on the well bond log and other integrity tests carried out during the operational phase, to inform the closure methodology of each well during the construction phase. In the event of unplanned closure, the latest statement will be used to inform the decommissioning plan;
- General waste generated during the demolition and remediation phase will be disposed of at a licenced facility.
- Hazardous waste generated during demolition will be disposed of at a registered hazardous landfill site;
- No allowance was made for post closure water treatment after rehabilitation has been completed;
- It was assumed that water required for demolition and remediation purposes will be available from licenced farm owners within a 50km radius. No allowance was made for bulk water supply during closure phase;
- Socio-economic mitigation: Allowance of 3% of sub-total A (rehabilitation and closure actions);
- Additional studies: nominal allowances for technical and specialist studies required to adequately plan for and implement closure activities
- Preliminaries and general: allowance of 13% of sub-total A (rehabilitation and closure actions); and
- Contingencies: Allowance for 11% of sub-total A (rehabilitation and closure actions).
- It is assumed that natural reestablishment of indigenous vegetation will be sufficient for rehabilitation purposes, with an alien invasive management plan in effect.
- The following assumptions were implemented for the Down Hole surveys and unblocking of collapsed wells:
    - Wells < 5 years old = 1 : 50 wells
    - Wells > 5 years old = 3 : 50 wells
- The following assumptions were implemented for the Bond log testing:
    - Wells < 5 years old = No bond log testing will be required as these would have been tested at the completion stage.
    - Wells > 5 years old = Bond log test will be required for all operational wells.
- Given that the wells will have been drilled in less than five years, the model assumes that a downhole survey and remediation of collapsed wells will be required on an average of one in every 50 wells.

4.6 FINAL POST-EXPLORATION LAND-USE

The ultimate aim of most closure and land rehabilitation is to return the land to the same or similar state to what it was pre-exploration. In order to inform this target, it is important to have a clear understanding of what the pre-exploration land use and land capability were. Land use is the way land is used by people for a defined purpose and may comprise one or more land uses. In most instances, one landscape can support numerous land uses within the constraints of land capability, creating a multifunctional landscape.

The main economic activities within and/or surrounding the exploration right area relate to farming (livestock/ game grazing and cultivated lands), renewable energy sites, and mining (primarily gold mining). The final post closure land use will depend on the specific site circumstances, in so far as it relates to the pre-exploration uses and also the prevailing uses, at the time of closure. It is proposed that, prior to initiating closure, a suitably qualified environmental scientist undertake an assessment and consult with the landowner and prepare a site-specific decommissioning plan for submission to PASA for review and approval. For the purposes of this FRDCP

it is assumed that the post closure land use will be congruent with the agricultural and natural veld mix of land use and capability in the region.

4.7 CLOSURE ACTIONS

In order to align with the defined closure plan and final land use objectives, the Holder will need to implement a series of actions which address the infrastructure, facilities, and rights area, as well as ongoing maintenance and management thereof. These actions and obligations apply to all infrastructure, activities, and aspects both within the exploration right area and off the exploration right area which were associated with the exploration activities and over which the Holder has responsibility.

The anticipated closure actions can be summarised as follows:

- Phase 1: Preparation for closure.
- Phase 2: Making safe.
- Phase 3: Rehabilitation.
- Phase 4: Monitoring and maintenance.

The detailed closure actions are presented in the sections below.

4.7.1 PHASE 1: PREPARATION FOR CLOSURE

4.7.1.1 PREPARATION FOR WELL DECOMMISSIONING AND CLOSURE

A well that is no longer active or producing, or for which an approved suspension period has passed, must be plugged, and decommissioned in accordance with an approved decommissioning plan. The following tasks will be undertaken prior to decommissioning:

- Site inspection and assessment by a suitably qualified environmental professional with the aim to:
    - Confirm pre-closure site conditions.
    - Undertake a site-specific closure risk assessment.
    - Consult with the affected landowner to confirm closure land use.
- Site inspection by a suitably qualified specialist/s to:
    - Assess the conditions of the specific well in respect of inter alia:
        - Current condition and design of the well; and
        - The integrity of the casing and grouting;
    - Determine the most suitable and appropriate decommissioning strategy with specific focus on the plugging method (including plug dimensions and plugging materials to be used) to ensure no vertical gas and/or fluid movements within the well.[10]
    - Prepare a technical decommissioning plan addressing the factors listed in Section 4.5.6.
- Preparation of a consolidated site-specific closure and decommissioning plan.

The site-specific closure and decommissioning plan will be submitted to the PASA for review and approval prior to initiating closure.

[10] Internationally accepted best practice should be applied and reference should be made to the relevant British Oil and Gas (OPp71), and/or the API guidelines and standards.

4.7.2 PHASE 2: CLOSURE AND REHABILITATION

Phase 2 closure actions will be informed, and guided, by the approved closure and decommissioning plan prepared in Phase 1. Table 15 provides an indication of typical closure and rehabilitation actions that would be followed.

Table 15: Summary of typical closure actions.

Component	Closure Action
Dismantling and removal of any on-site infrastructure	- Pre-emptive planning for post closure land use including development of surface infrastructure inventory and the identification of infrastructure which is available for reuse and repurposing post closure. - Removal of all services, structures, machinery, and infrastructure unless these are specifically required for post-exploration land use, post-exploration projects or have been requested by the landowner. - Establish formal agreements for any infrastructure handed over for third party use, and management. - All identified infrastructure should be broken down to natural ground level. All waste materials to be disposed of at suitably licenced disposal facilities. - Remove all power lines unless agreed in writing to retain for beneficial end use. - Dismantle and dispose of all fences that do not form part of post-closure property boundaries. - Areas where infrastructure was demolished should be assessed through a risk-based system to determine if there are any residual contamination or risk and appropriate remediation measures implemented. Where contaminated material is detected, this should be removed and disposed of. - Profile the area to be free draining. - Remove and rehabilitate all Stormwater management infrastructure not required in the final closure plan. - Assess available topsoil stockpiles in respect of quantity and quality- the topsoil's to be placed for rehabilitation must be suitable for revegetation. - Revegetate disturbed areas with suitable local grass mix in areas where natural regrowth is not successful or anticipated. - A waste and infrastructure hierarchical principal should be applied to all decommissioned infrastructure or wastes, as follows: Reduce, re-use, recycle, dispose. - Monitor and manage dust generated from decommissioning activities to relevant standards. - Removal and safe disposal of any remnant processing waste deposits, including PCD's and evaporation ponds/ dams. - Pump and treat or dispose (at licenced facility) remnant polluted water from PCD's. - Remove liners and residue and dispose at suitably licenced facility. - Ongoing monitoring to ensure no erosion, ponding, and adequate revegetation.
Rehabilitation of access roads	- Develop transport layout plan to utilise existing access routes where possible and minimise unnecessary access roads.

Component	Closure Action
	- Restrict vehicular movements to designated access and routes to avoid unnecessary soil compaction. - Conclude final closure layout plan defining access roads required for ongoing monitoring, management, and maintenance. - Retained access roads to be designed in accordance with relevant engineering standards and specifications- including specific management of stormwater. - Closure, decommissioning, and rehabilitation of all access roads (incl. associated structures, signage, culverts, etc) unless these are specifically required for post-closure land use, post-closure projects, or have been requested by the landowner. - Remove any contaminated soil from roads, dispose at suitably licenced facilities. - Deep rip all compacted areas prior to rehabilitation. - Topsoil rehabilitation and amelioration as is necessary. - Revegetation. - Apply dust suppression (e.g. water sprays) where necessary.
Well site	- The borehole must be cleared of obstructions prior to abandonment. This includes associated surface infrastructure. - Remove any waste materials from the well sites and dispose at a suitably licenced waste disposal facility. - Prior to placing plugs- the state and effectiveness of the applicable annular barrier must be evaluated and verified (method may include cement bond logs, calliper logging, or communication tests). Where necessary this may require remediation of this annular barrier prior to plugging. - Suitably qualified specialist or specialists to design the most suitable and appropriate closure strategy to ensure no vertical gas or fluid movements and that all potential hydrocarbon / water bearing formations by utilizing placed cement plugs. This must include determination of plug length/ location and plug material specifications. - The cement plugs are stacked along the entire length of the wellbore (both in the open hole as well as the upper casing) to ensure efficient redundancy. The extent of plugging to be confirmed during the Preparation phase. - All plugs are tagged to ensure successful placement. - Cementation technique to follow the squeeze displacement technique (or alternative as directed by the well engineer). Wiper plugs must be utilised where applicable. - Conduct cement top-ups along the annulus, and existing cemented sections showing “no bond” or “poor bond” from logging results. - The integrity and effectiveness of the plug must be evaluated and verified once completed. There are many evaluation and verification methods which can be used subject to a specific well circumstance (e.g. physical or mechanical tests, or hydraulic/ pressure tests). The most suitable verification method to be determined by a suitably qualified well engineer. - A surface / shallow cement plug (+/-50 m below ground Level) is set, and the well is cut and capped +/-1 m below ground level to remove the wellhead and all casing above this point.

Component	Closure Action
	- The collar is then collapsed and the surface reinstated and the site rehabilitated. - Rehabilitation must reflect the local environment -ecosystem rehabilitation of impacted areas, including natural fauna and flora, hydrology and hydrogeology. - Ensure that than the final landscape is safe, stable and non-polluting over the long term, and that post closure land use does not affect the sustained utilization. - Placement of a "surface tag" in order to ensure monitoring can continue once the casing is cut and the area revegetated. The well location can be recorded on the Title/SG Diagram if a physical surface is not possible. - Groundwater and surface water monitoring.
General Surface Rehabilitation	- Develop and implement an alien vegetation eradication control and management plan (AVECMP). - The removal and/or disturbance of previously unaffected topsoil's must be avoided as far as possible and limited to the existing areas of disturbance. - Develop and implement a revegetation plan. If required, seeding and planting to be done at, or immediately after, the first rains in spring, and into freshly prepared, fine-tilled seedbeds (where soils are not prone to crusting). - Annual monitoring of the status of rehabilitation and revegetation. - No driving will be permissible on any rehabilitated areas- only on pre-defined designated routes for monitoring. - Implement soil amelioration as is necessary. - Any contamination of the topsoil on surrounding areas must be avoided by ensuring machinery is well maintained and leak free. If contamination has occurred, the area must be remediated and ameliorated immediately. - Monitoring, including review and assessment of soil balances, soil surveys (stripped, stockpiles, and placed). - Implement defoliation on established grasses and vegetation under direction of rehabilitation specialist- to allow for reintroduction of organic matter. - Ongoing rehabilitation monitoring (including soil surveys) and maintenance until relinquishment. - Ongoing rehabilitation of eroded areas through a root cause investigation and rectification approach. - Shape all channels and drains (where applicable) to smooth slopes and integrate into the natural drainage pattern. - Construct contour banks and energy dissipating structures as necessary to protect disturbed areas from erosion prior to stabilisation. - Implement controlled livestock grazing once vegetation is established. Restrict access of livestock newly rehabilitated unless specifically required for defoliation as instructed by a suitably qualified rehabilitation specialist. - Ongoing rehabilitation monitoring and maintenance until relinquishment. Including but not limited to: Alien invasive monitoring and management, erosion control and remediation, vegetation growth and supplementation).

Component	Closure Action
Social and economic change management.	- Public review and comment on rehabilitation, decommissioning, and closure planning. - Regular consultation with I&APs on closure planning and rehabilitation progress, and any intrusive activities. - Develop final land management and maintenance plan with relevant landowners. - Implement land management and maintenance plan.

Landform, erosion control and re-vegetation is an important part of the rehabilitation process. Landform and land use are closely interrelated, and the landform should be returned as closely as possible to the original landform. Community expectations, compatibility with local land use practices and regional infrastructure, or the need to replace natural ecosystems and faunal habitats all support returning the land as closely as possible to its original appearance and productive capacity.

4.7.3 PHASE 3: MONITORING, MAINTENANCE AND RELINQUISHMENT

The purpose of monitoring is to ensure that the objectives of the rehabilitation and closure plan are met. In this regard the following actions, to be adjusted based on the completion of the pre-closure site assessment, are proposed:

- Groundwater and surface water monitoring via the proposed monitoring boreholes and surface water monitoring points will be utilised to analyse groundwater and surface water quality. Sampling will test for dissolved methane, as well as changes to physical parameters such as electrical conductivity and pH. This will serve as an early indicator for migrating saline groundwater or gas resulting from potential subsurface casing or cement annulus failures. Following decommissioning, monitoring will be conducted bi-annually for the first year. Thereafter, monitoring will proceed on an annual basis for a period of four years, or until a formal closure certificate is issued.

- Fugitive gas emissions using either soil vapour probes, efluxes, Flir Methane Cameras, or surface methanometers will be monitored annually for 5 years after decommissioning;

- Well plugging and abandonment verification to confirm that there is proper and effective vertical isolation (this could include: bond log tests, cementing tests, communication tests, hydraulic pressure tests, applied weight test); and

- Biodiversity assessments mid-wet season (i.e. annual) should be undertaken by a qualified ecologist/botanist to monitor the rehabilitation progress with regards to flora for a period of 3 years after rehabilitation.

There are however certain residual and latent impacts which may manifest in the post-closure phase. These relate primarily to the risk of well plug integrity and associated long-term management of vertical migration of gas and/or fluids to the shallow water resources or the surface. The management and monitoring associated with these residual and latent risks are addressed in Section 6.

Annual (or as agreed with PASA) environmental reports will be submitted to the PASA and other relevant stakeholders for at least 5-years post-decommissioning. The monitoring reports shall include a list of any remedial action necessary to ensure that infrastructure that has not been removed remains safe and pollution-free and that rehabilitation of project sites is in a stable, weed-free condition. Electronic/digital photographs will be taken before and after rehabilitation. Please refer to Section 4.13 for further detail on the required auditing and monitoring requirements.

4.8 FINAL REHABALITATION, DECOMMISSIOING AND CLOSURE SCHEDULE

This section presents a high-level list of rehabilitation and closure components, and the key actions related to the final rehabilitation, decommissioning, and closure. The key schedule drivers for each activity are presented in Table 16. It is important to note that there are potential permits and licences which may be required before initiating closure activities these may include water use licences and/or environmental authorisations. These should be initiated as soon as practically possible as the timeframes for these processes can be extensive.

Table 16: Closure schedule drivers.

Activity	Closure schedule driver
Ongoing activities.	Ongoing decommissioning and closure of abandoned exploration wells. The timing of this will depend on when a decision is made to abandon a specific well.
Planning and preparation for Closure.	Updated FRDCP and compliance with the Financial Provision Regulations. Obtain relevant closure related environmental authorisations, licences, and permissions (if applicable).
Dismantling and removal of any on-site infrastructure.	Progressively as infrastructure is no longer required. Final dismantling of all infrastructure not to be retained at cessation of exploration activities.
Rehabilitation of access roads.	Cessation of exploration activities and where relevant rehabilitation activities- if possible, rehabilitation of access roads should be done progressively as these roads are no longer required.
Decommissioning and closure of well sites.	Well decommissioning and plugging will be initiated once a well site is no longer yielding viable gas volumes or lapsing of the approved suspension period. The closure will commence on completion and approval of the site-specific decommissioning plan.
Removal and safe disposal of processing waste deposits, including PCD's and evaporation ponds/ dams.	PCDs/Sumps to be decommissioned once dirty water areas and need for PCDs ends (i.e. once pollution source terms are removed)- most likely at the end of decommissioning and rehabilitation.
General surface rehabilitation (incl. backfilled open cast areas and voids, stockpile areas, compacted areas, etc).	Completion of decommissioning. Seeding and planting is most successful when done at or immediately after the first rains in spring, and into freshly prepared, fine-tilled seedbeds (where soils are not prone to crusting). It has been determined that natural reestablishment of indigenous vegetation is sufficient, should an alien invasive management plan be in effect.
Rehabilitation Monitoring.	Ongoing throughout rehabilitation activities and into the closure and post closure periods.
Social and economic change management.	Ongoing throughout rehabilitation activities and into the closure period.

4.9 ORGANISATIONAL CAPACITY

It is critical that roles and responsibilities for the effective planning, implementation, monitoring, and revision of the closure process are clearly defined and provided for. The Holder of the Exploration Right is ultimately responsible for ensuring compliance with all the provisions of the Right and associated plans, as well as other relevant legal requirements. The Holder must ensure knowledge and understanding of the applicable legislation, guidelines, and industry best practices.

Capacity in the following key roles and responsibilities must be provided for:

- Internal Closure champion: a suitably qualified person(s) who will be accountable for the following:
    - Driving the ongoing development, refinement and implementation of the closure plan;
    - Resourcing and implementing the plan;
    - Ongoing management and monitoring requirements to support the closure plan;
    - To ensure the integration of the rehabilitation and closure activities with general operational activities; and
    - Ensure legal compliance and deliver on commitments.
- Internal Social champion: a suitably qualified person(s) who will be accountable for the following:
    - Develop and implement training strategies for internal training;
    - Develop and implement effective communication with all stakeholders;
    - Develop and implement a stakeholder forum to promote information and idea sharing regarding closure related aspects and/or ensuring meaningful contributions to existing forums; and
    - Continually develop the relationship with I&APs, to promote the social licence to operate and close and decommission.
- Independent Environmental Assessment Practitioner: This individual will be appointed to ensure compliance with the requirements of the FRDCP and specifically to undertake the following tasks:
    - Undertake the required pre-closure environmental site assessment, risk assessment, and if required landowner consultations.
    - Prepare a site-specific final closure and decommissioning plan.
    - Undertake the required periodic compliance monitoring and reporting during the closure period.
- Well Engineer and or suitably qualified specialist/s: This individual must be a suitably qualified professional who must have relevant experience in petroleum exploration and production. Key attributes must include experience and qualifications related to the technologies applicable to exploration well closure and abandonment, as well as a thorough understanding of internationally accepted well closure and abandonment standard and guidelines. This specialist will be responsible for ensuring that the closure plan is implemented to ensure that the risks to the environment and surrounding communities are prevented or limited.

Further education, training and capacity building is critical to ensure that the exploration activities align with evolving internally accepted best practice and research. In this regard the Holder must ensure that regular review of international best practice is undertaken and where applicable implemented throughout the project programme. It needs to be recognised that closure planning needs to start early within the project lifecycle and continued as an integral component of the operations.

4.10 IDENTIFICATION OF CLOSURE GAPS

The scope and content of the closure plan is largely dependent on the specific environmental context associated with the activities. The closure liability estimate will need to be updated (and where necessary the closure plan amended) once the exact locations of future drilling campaigns have been formally scoped.

The following actions have been proposed to address these gaps:

- A site-specific environmental assessment will be undertaken once the specific locations for all exploration activities have been defined. This will be done prior to the commencement of any invasive exploration activities and will include relevant specialist input as and where necessary.
- A detailed drilling log will be prepared and maintained for each of the wells to ensure that the specific geological stratigraphy and sub-surface conditions are considering and inform the final site-specific closure and decommissioning plan.
- A site-specific closure and decommissioning plan will be prepared for each invasive activities and will where applicable be informed by a specialist environmental site assessment, and risk assessment, as well as a specialist assessment and plan for well plugging and abandonment.

Further the financial provisioning regulations requires that the FRDCP be revisited, assessed, and revised on an annual basis. This annual review must aim to ensure that the gaps identified above are addressed, as applicable, and the relevant financial provisioning updated.

4.11 RELINQUISHMENTS CRITERIA

Relinquishment can be defined as the formal approval by the relevant regulating authority indicating that the completion criteria for the exploration activities have been met to the satisfaction of the authority. In this regard the relinquishment criteria are driven by the objectives of closure and consequently the indicators applicable to each impact associated with the closure and decommissioning. Reference is made to Table 11 which presents each identified environmental impact, the associated indicators and proposed closure targets. In summary the proposed relinquishment criteria include:

- **Groundwater:** the quality and quantity of the groundwater levels must be consistent with the pre-exploration condition - or adjusted depending on external inputs and drivers.
- **Air quality:** Evidence must be provided there are no gas emissions from the well sites.
- **Biodiversity:** The vegetation cover of the affected areas must be consistent with surrounding vegetative cover. There must be ecosystem functionality which is consistent with the surroundings.
- **Social:** There must be no unattended complaints.
- **Waste:** There must be no waste materials remaining on-site.
- **Land use:** The area must be available for ongoing land uses. The location of all historic production/exploration wells must be demarcated and where appropriate reflected on the relevant property title information.

Following the initial 5-year post-abandonment/decommissioning monitoring period, and on condition that defined relinquishment criteria have been met, a closure certificate will be applied for in terms of Regulation 43 (1) of the MPRDA:

> *"43. Issuing of a closure certificate:*
>
> *(1) The holder of a prospecting right, mining right, retention permit, mining permit, or previous holder of an old order right or previous owner of works that has ceased to exist, remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and*

sustainable closure thereof, until the Minister has issued a closure certificate in terms of this Act to the holder or owner concerned."

Section 9(6) of the Financial Provision Regulations Requires that, on issuance of a closure certificate under the MPRDA, any financial provision held for future latent or residual environmental impacts must be transferred to the Minister responsible for mineral resources:

"9. General requirements for financial provision:

(6) Where financial provision is made for remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as contemplated in regulation 5(c) and 6(c), the financial vehicle used for that purpose must, on issuance of a closure certificate in terms of the Mineral and Petroleum Resources Development Act, 2002, be ceded to the Minister responsible for mineral resources, or, if the financial vehicle contemplated in regulation 8(1)(c) is used, the trustees must authorise payment to the Minister responsible for mineral resources."

Therefore, long-term monitoring of the decommissioned well locations for latent risks will thereafter be undertaken by the relevant authority. The proposed monitoring program involves periodic (e.g., five-year) surface gas screening to confirm plug integrity and the absence of gas migration. Financial provision for such long-term monitoring has been made and will be transferred to the competent authority upon issuance of the closure certificate, in accordance with the applicable legislative framework.

4.12 CLOSURE COST AND FINANCIAL PROVISION

The closure cost estimation is based on the requirements of GNR 1147. The quantum is expected to represent a realistic estimation of the required cost for effective decommissioning, rehabilitation, closure, and management of ongoing residual, and potential future latent, impacts.

4.12.1 APPROACH TO FINAL CLOSURE COST DETERMINATION

Funds must be available at any time, equal to the sum of the actual costs of implementing the plans and reports for a period of 10 years (as per Section 7, Chapter 2 of the Financial Provisions Regulations). Although the NEMA Financial Provisioning Regulations (2015) specify an accuracy level of 90%, the aim will be to ensure 100% accurate costings for closure at all times. The remainder of this section provides details on the proposed closure cost. The assumptions and limitations stated in Section 4.5.8, also underpin the basis of this closure cost determination.

The closure cost has been calculated through the following steps:

- Review of available information to inform the closure battery limits for the Motuoane operation;
- Verify unit rates for infrastructure dismantling and demolition as well as associated rehabilitation of disturbed areas, considering the latest demolition equipment available;
- Develop layout plans indicating existing and proposed infrastructure to be included in the rehabilitation and closure cost estimation;
- Unit rates were sourced from available precedents, inputs from specialists in the field, and experience;
- Rates are based on third-party contractor rates and not mining rates; and
- Apply the verified unit rates and associated quantities measured from the layout plans in spreadsheets to determine the closure costs.
- Methane/natural gas monitoring to be conducted every six months during the post closure period.
- Vegetation monitoring to be undertaken once per year during post-closure phase.

The battery limits for this closure provision assessment are limited to:

- Access roads;
- Well heads;
- Operational, abandoned and suspension wells;
- Fencing and firebreak;
- Temporary Hazardous waste storage;
- Temporary General waste storage;
- Mobile offices and ablution facilities;

4.12.2 DESCRIPTION OF UNIT RATES

Unit rates that were applied during the closure determination were obtained from third-party quotes. The rates are recorded in a database, which is updated in consultation with the civil contractors. The post-closure unit rates that are included in the applied rates are summarised in the subsections below.

Site-specific unit rates were calculated based on experience and rates obtained from contractors. The site-specific unit rates and assumptions are discussed in Table 17.

Table 17: Site-specific unit rates and assumptions.

Aspect	Comment and Assumptions	Rates
General Surface Rehabilitation		
Surface Water Monitoring	Allowance has been made to conduct the surface water monitoring at five monitoring points near the wells. If assumed that it would take at least one man-day of an independent specialist (including the preparation of the sampling equipment) to conduct the sampling at these points. It has been assumed that surface water monitoring should continue bi-annually for the first year after decommissioning. Thereafter, monitoring will proceed on an annual basis for a period of four years, or until a formal closure certificate is issued.	**R 29 167.84** per sampling event (2 boreholes and one surface water monitoring points at each well, with five wells equating to a total of 15 monitoring sites per sampling event) for professional fees and associated disbursements.
Groundwater Monitoring	It has been assumed that 2 groundwater monitoring boreholes would be required to reflect post-closure groundwater quality at each of the wells, therefore a total of 10 borehole monitoring boreholes for all 5 wells are planned. The water quality monitoring program will include the sampling of two boreholes at each of the five proposed well locations. It has been assumed that groundwater monitoring should continue bi-annually for the first year after decommissioning. Thereafter, monitoring will proceed on an annual basis for a period of four years, or until a formal closure certificate is issued.	
Rehabilitation / ECO Monitoring	Rehabilitation monitoring to be undertaken by a qualified specialist or EAP annually as required in the EMPr. The purpose of a Rehabilitation Monitoring Program is to ensure that the management measures, rehabilitation and decommissioning objectives for the management of various environmental aspects, are met and that the rehabilitation process is followed. The frequency of monitoring must be adequate to identify potential gaps in the effectiveness of the management plans. A rehabilitation programme must be implemented during the exploration and decommissioning phases of the exploration activities. The following identified aspects require monitoring during the exploration and decommissioning phase: • Erosion and sedimentation status of disturbed areas; • Surface drainage and surface water quality; • Groundwater quality; • Successful re-vegetation and basal cover proportions; • Rehabilitation effectiveness; • Fauna and flora re-colonization; and • Control of invasive vegetation species.	These costs amount to about **R29 950.00** per event and can run concurrently with the groundwater monitoring

Aspect	Comment and Assumptions	Rates
	To achieve the primary objective, management infrastructure must be designed and operated with the following objectives in mind (DWAF, 2008): • Visual impacts of disturbed areas should be minimized by restoring the landform to a condition suited to the surrounding landscape; • Management of invasive/alien vegetation; • Restoration of native vegetation covers and ecology; • Minimize the area of vegetation clearing for exploration activities; • Ensure that water management measures take into account and fit into the broader regional water • management context; • Ensure that water of different quality (clean and dirty water) is kept separate and managed separately if possible. This implies minimizing the contact between water of different qualities to minimise potential deterioration of water quality; • Address water pollution issued at sources; and • The need for long-term monitoring must be reduced.	
Site Specific		
Downhole Surveys	Allowance was made to survey the existing and proposed wells for blockages to ensure the wells are plugged/rehabilitated to the ultimate depth. Unit rate composition: - Set up of Rig, TLB, and equipment, at R36 000, (R18 000 per way). - Setup of drill machine and site @ R 600.00/hr (assume 12 hours per site), - Inter-hole moving of rig and equipment @ R3 300/hr (assume 4 hours per move). - Clean out string to identify and investigate potential blockages/cavities within the well @ R 2 800.00/hour, this also includes unblocking, cleaning and/or flushing of the well.	Total cost for conducting pre-closure down hole survey for all five wells is **R424 166.67.**

Aspect	Comment and Assumptions	Rates
Bond Log Testing	Allowance was made to test the integrity of the grouting in the wells to ensure there are no poor grouting bonds or inconsistent densities. All gas well locations will require CBL test work to be done prior to final closure. The cost provided by Quicklog Geophysics comes down to R 28 833.33 per well.	Total cost for all five wells amounts to **R 144 166.67**
Borehole plugging	Allowance was made for the cementing of the wells to a depth of 600 m. An additional 25% cementing volume was allowed, resulting in a total volume of 9.4m^3 per well. Unit rate composition: - Supply and install cement plug within well. Grouting of the well (filling the annulus) is undertaken during drilling, therefore only cementing of the open well will be required. The cost is assumed to be similar to that of grouting, for the well plugging. Cement formulations and volumetric calculations to be approved by well engineer/cement specialist). Total cost of cement @ R 5 625.00/cube, totalling to R 52 603.51.00 per well; - Operational Time - Preparing cementing equipment @ R 3 330.00/h, assuming it will take 3 hours, totalling to R 9 990 per well; - Operational Time - Cementing of well @ R 3 477.63/h, assuming it will take 4 hours, totalling to R 16 650.00 per well; - Operational Time - Cleaning of cementing equipment @ R 3 330.00/h, assuming it will take 3 hours, totalling to R 9 900.00 per well; - Cementation integrity testing (Integrity of the plugs must be confirmed by setting weight down on the upper most plug (using the drill string) as well as a differential pressure test for 4 hours at determined pressure with less than 10% bleed over the period. Pressure test data to be captured in 15-minute intervals for the entire 4-hour testing period.), @ R 3 330.00/hr, assuming 1 hour per well, giving a total of R 3 300.00 per well.	Total cost for well cement plug is **R 396 217.57** for all five wells.

Aspect	Comment and Assumptions	Rates
General Surface Rehabilitation	Ripping of compacted drill site area and redistributing subsoil and topsoil. Assumed R6 927.58 per hectare. Indigenous vegetation must be fully rehabilitated to its pre-disturbance condition, or in accordance with the landowner agreement. Assume surrounding area (approximately 50m x 50m) to be ripped as well due to compaction of vehicles and machinery movement. Assumed R71 099.09 per hectare. Sumps to be cleared and backfilled with excavated material, assuming three sumps per site, each sump 6x4x2, giving a total volume of 144m3 per drill site. Assume R76.82 per m^3.	Total cost for all five well sites is **R109 824.54.**
Waste	Transport of demolition hazardous waste, R3 239.38 per m^3 and assumed 32 m^3 per sump (3 sumps per site). Disposal of demolition hazardous waste R1 756.90 per m^3 and assumed 32 m^3 per sump (3 sumps per site).	Total cost for all five well sites is **R1 598 809.60.**

4.13 MONITORING, AUDITING AND REPORTING REQUIREMENTS

Table 18 below provides a list of the environmental impacts identified for the rehabilitation, decommissioning and closure of the exploration. In addition, environmental indicators are identified for each impact, together with proposed monitoring requirements. The indicators and monitoring will aim to inform ongoing rehabilitation and remediation activities. These indicators will also inform the assessment of whether the closure objectives have been adequately met.

Table 18: Environmental indicators and monitoring requirements.

Aspect	Impact	Monitoring Requirements	Indicators	Closure Targets
DECOMMISSIONING				
Soils	Soil stability and pollution	Regular monitoring of rehabilitation progress (monthly ECO reports) during decommissioning. This must additionally form part of the annual performance assessment.	Vegetation cover	Consistent with surrounding vegetative cover.
	Soil pollution	Regular monitoring of rehabilitation progress (monthly ECO reports) during decommissioning. This must additionally form part of the annual performance assessment.	Vegetation cover	Consistent with surrounding vegetative cover.
Surface water	Surface water contamination	Monitoring will be conducted bi-annually throughout the well decommissioning phase, which is assumed to last one year.	Surface water quality	Consistent with pre-exploration condition.

Aspect	Impact	Monitoring Requirements	Indicators	Closure Targets
Groundwater	Groundwater contamination	Monitoring will be conducted bi-annually throughout the well decommissioning phase, which is assumed to last one year.	Groundwater quality	Consistent with pre-exploration condition.
Social	Safety and security	As part of the annual environmental audits, the impact of safety and security must be assessed and reported on.	Complaints register	No unaddressed issues.
	Damage to road infrastructure	Regular monitoring and reporting (monthly ECO reports) during decommissioning. As part of the annual performance assessments, the impact of safety and security must be assessed and reported on.	Complaints register	No unaddressed issues.
Environmental Pollution	Pollution of the environment through waste	Regular monitoring of waste management as well as waste disposal records (monthly ECO reports) during decommissioning. This must additionally form part of the annual performance assessment.	Physical evidence of waste.	No waste on site.
Noise	Noise	Regular monitoring and reporting (monthly ECO reports) during decommissioning. If repeat complaints are received then trigger onsite sound level monitoring.	Noise nuisance complaints	No noise nuisance complaints.
CLOSURE AND REHABILITATION				
Soils	Soil compaction	Annual monitoring of rehabilitation progress must be conducted by an Environmental Control Officer (ECO) throughout the closure and rehabilitation phases. These findings must be integrated into the facility's annual environmental audits. Furthermore, to ensure long-term drainage efficacy, annual monitoring must be	Vegetation cover	Consistent with surrounding vegetative cover.
	Soil contamination		Vegetation cover	Consistent with surrounding vegetative cover.

Aspect	Impact	Monitoring Requirements	Indicators	Closure Targets
		maintained across all rehabilitated areas for a minimum of five (5) years during the closure period.		
Surface water	Surface water contamination	Within the first year of the closure and rehabilitation phase bi-annual monitoring of surface water should be undertaken (i.e. two monitoring events), thereafter annual monitoring of surface water quality should be undertaken for four (4) years during closure and rehabilitation. This must additionally form part of the annual environmental audit.	Surface water quality	Consistent with pre-exploration condition.
	Altered hydrological regime	Annual monitoring of rehabilitation progress must be conducted by an ECO throughout the closure and rehabilitation phases. These findings must be integrated into the annual internal environmental audit. Furthermore, to ensure long-term drainage efficacy, annual monitoring must be maintained across all rehabilitated areas for a minimum of five (5) years during the closure period.	Change to natural drainage patterns.	Consistent with pre-exploration condition.
Groundwater	Groundwater contamination	A well engineer must oversee the decommissioning and closure of the wells to confirm compliance with the MPRDA technical specifications; and Within the first year of the closure and rehabilitation phase bi-annual monitoring of groundwater should be undertaken (i.e. two monitoring events), thereafter annual monitoring of groundwater quality should be undertaken for four (4) years during closure and rehabilitation. This must additionally form part of the annual environmental audit.	Groundwater quality	Consistent with pre-exploration condition.

Aspect	Impact	Monitoring Requirements	Indicators	Closure Targets
Ecology	Introduction/invasion of alien species	Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist to monitor the rehabilitation progress with regards to flora.	Vegetation cover.	Consistent with surrounding vegetative cover.
	Loss of biodiversity	Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist to monitor the rehabilitation progress with regards to flora.	Vegetation cover.	Consistent with surrounding vegetative cover.
	Disturbance to wildlife	Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist to monitor any negative impacts on fauna must be undertaken.	Physical evidence of mortality	No mortalities.
Topography and Landform	Erosion	Annual monitoring of rehabilitation progress must be conducted by an Environmental Control Officer (ECO) throughout the closure and rehabilitation phases. These findings must be integrated into the facility's annual performance assessment. Furthermore, to ensure long-term drainage efficacy, annual monitoring must be maintained across all rehabilitated areas for a minimum of five (5) years during the closure period.	Vegetation cover.	Consistent with surrounding vegetative cover.
Social	Safety and security	As part of the annual environmental audits, the impact of safety and security must be assessed and reported on.	Complaints register	No unaddressed issues.
	Disturbance to communities in vicinity	As part of the annual environmental audits, the impact of safety and security must be assessed and reported on.	Complaints register	No unaddressed issues.
POST-CLOSURE				

Aspect	Impact	Monitoring Requirements	Indicators	Closure Targets
Surface water	Surface water contamination	Monitoring of the groundwater quality, post-closure of wells, must be undertaken in 5-year intervals for 45 years after closure.	Surface water quality	Consistent with pre-exploration condition.
Groundwater	Groundwater contamination	Monitoring of the surface water quality, post-closure of wells, must be undertaken in 5-year intervals for 45 years after closure.	Groundwater quality	Consistent with pre-exploration condition.
Air Quality	Fugitive emissions	Monitoring of the fugitive gas emissions, post-closure of wells, must be undertaken in 5-year intervals for 45 years after closure.	Fugitive gas emissions	Consistent with pre-exploration condition.

4.14 MOTIVATIONS FOR AMENDMENTS BASED ON MONITORING OUTCOMES AND IDENTIFIED GAPS

As this assessment is compiled in support of the EIAr, no amendments to the proposed monitoring framework are recommended at this stage. The monitoring outcomes and any identified gaps will be reviewed annually, with updates implemented as required.

5 SECTION B: ANNUAL REHABILITATION PLAN

The Annual Rehabilitation Plan (ARP) aims to:

- Review concurrent rehabilitation and remediation activities already implemented;
- Establish rehabilitation and remediation goals and outcomes for the forthcoming 12 months, which contribute to the gradual achievement of the post- exploration land use, closure vision and objectives identified in the holder's final rehabilitation, decommissioning, and mine closure plan;
- Establish a plan, schedule, and budget for rehabilitation for the forthcoming 12 months;
- Identify and address shortcomings experienced in the preceding 12 months of rehabilitation; and
- Evaluate and update the cost of rehabilitation for the 12-month period and for closure, for purposes of supplementing the financial provision guarantee or other financial provision instrument.

The purpose of an ARP report is to provide a record containing the relevant information regarding concurrent rehabilitation and remediation activities for the site for the forthcoming 12 months and how these relate to the operation's closure vision, as detailed in the final exploration rehabilitation, decommissioning and closure plan. The ARP also indicates what closure objectives and criteria are being achieved through the implementation of the plan.

5.1 STATUS OF ENVIRONMENTAL MONITORING

This section presents the key findings of the environmental and groundwater monitoring carried out on the site. The monitoring is done in accordance with the current obligations and requirements as specified in the EMPR.

As this assessment is compiled in support of the EIAr, no monitoring has been undertaken at this stage and will commence once the activities have commenced, should the EA be granted. The FRDCP report will be updated annually with the status of the environmental monitoring.

5.2 SHORTCOMINGS IDENTIFIED DURING THE PRECEDING PERIOD

It is important to identify shortcomings in the rehabilitation activities from the preceding period, to ensure that a rehabilitation backlog does not develop. Since this assessment is compiled in support of the EIAr, no shortcomings are identified at this stage. Shortcomings are to be recorded and included/updated annually in the FRDCP report.

5.3 PLANNED REHABILITATION AND REMEDIATION

Planned rehabilitation is divided into two main categories, namely:

- Addressing accumulated rehabilitation backlog or identified shortcomings from previous periods; and
- Progressive rehabilitation associated with ongoing operations.

Following the receipt of the Environmental Authorisation, one well is scheduled to be drilled within the first year. Consequently, this well has been accounted for in the ARP section under Unscheduled Closure Costing. However, in total 5 wells are planned to be drilled during the exploration phase (refer to Figure 1):

- Target Area 1 (RSB D)
- Target Area 2 (RSB E)
- Target Area 9 (HF C)
- Target Area 10 (GP B)
- Target Area 11 (GP A)

The ARP therefore focuses on aspects or components which pose an environmental liability, and which are no longer required for the future exploration phase and are consequently eligible for final rehabilitation.

6 SECTION C: ENVIRONMENTAL RISK ASSESSMENT

According to the Financial Provisioning Regulations (2015) the objective of the environmental risk assessment report that relates to latent and residual impacts 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.

This section of the report aims to address these objectives separately. In certain cases, these objectives have been discussed and presented in the preceding sections of this report.

6.1 THE ASSESSMENT PROCESS: LATENT ENVIRONMENTAL RISK

Appendix 1 provides a detailed description of the environmental impact/risk identification and assessment (including the methodology and findings) undertaken. Table 11 also includes identified mitigation measures which, once implemented successfully, will result in the avoidance or acceptable reduction of the associated impact. The primary latent and residual risks identified to potentially occur are listed below:

- Well casing and/or cementation failure affecting groundwater quality as a result of vertical migration of fluid and/or gas.

During the decommissioning phase the environmental significance rating of groundwater quality impacts on down-gradient receptors are rated as medium to high without implementation of remedial measures and medium to low with implementation of proposed mitigation measures. The main impacts associated with the decommissioning phase activities include the following:

- Migration of saline groundwater from the deep, fractured aquifer to the overlying, potable aquifer(s) during the borehole closure and decommissioning phase.
- Migration of stray gas from the deep, fractured aquifer to the overlying, potable aquifer(s) borehole closure and decommissioning phase.
- Poor quality leachate may emanate from the workshop and/or drilling pad footprint areas which may have a negative impact on groundwater quality.
- De-mobilisation of heavy vehicles, drilling rig as well as associated machinery on-site may cause hydrocarbon contamination of groundwater resources.

Mitigation and management measures associated with the post-operational and decommissioning phase activities include the following:

- In the event that the casing and/or cementation in a well failure, the well can become a high-permeability conduit for saline water and stray gas from deep-seated formations to the overlying shallow Karoo aquifers. All exploration wells should be sealed-off with a combination of casing and grouting to ensure isolation of the gas from the host-aquifer(s).
- Sealed off boreholes should also be equipped with gas-detection equipment and monitored throughout the decommissioning phase in order to serve as an early warning for potential stray gas migration into the shallow, potable aquifer.

- The contractor should prepare a consolidated site-specific closure/sealing plan to be submitted for approval. The plan should include a detailed description of the following aspects:
    - Calliper Logging should be conducted to identify and investigate potential blockages/cavities within well.
    - Cement Bond Logging should be performed to investigate the current integrity of the casing and cementation.
    - Contractor to determine the most suitable and appropriate closure, sealing and rehabilitation strategy with specific focus on the plugging method to ensure no vertical gas and/or fluid movements within the well.
    - Contractor to prepare a consolidated site-specific closure/sealing plan to be submitted for approval.
    - Develop cement formulation for cementing the entire well annulus.
    - Develop cement formulation to top-up “no bond” or “poor bond” cemented sections between casing and formation walls – ensure cement seals and does not disperse into porous formations.
    - Cement formulations and volumetric calculations to be approved by well engineer/cement specialist.
    - Contractor must ensure cement mixture seals the entire well length along the well annulus. Cement plugs must be stacked along the full length and diameter of the well to surface (open hole section above the packer as well as the upper casing) to ensure efficient redundancy.
    - All plugs must be tagged to ensure successful placement.
    - Cementation extent: Should be from end of hole (bottom of well) to surface.
    - Cementation technique: Squeeze technique - this displacement method minimizes the contamination of the cement by being able to displace fluid within the well, thus allowing for a more stable well plug. Contractor must also make use of wiper plugs for cement displacement.
    - Contractor to conduct cement top-ups along the annulus and existing cemented sections showing “no bond” or “poor bond” from logging results.
    - A surface / shallow cement plug (+/ 50m below ground Level) must be set, and the well casing must be cut and capped 1 m below ground level to remove the wellhead and all casing above this point.
    - Integrity of the plugs must be confirmed by setting weight down on the upper most plug (using the drill string) as well as a differential pressure test for 4 hours at determined pressure with less than 10% bleed over the period. Pressure test data to be captured in 15-minute intervals for the entire 4-hour testing period.
    - Contractor to prepare a comprehensive project report containing the following:
        - Calliper and CBL logging results;
        - Cement formulations and Material Safety Datasheets of all additives; Cementation methodology and photographs;
        - Recorded pressure test data;
        - Well tagging photographs and coordinates;

- Surface rehabilitation photographs.

- Well-specific plugging requirements should be implemented to protect the shallow potable Karoo aquifers at closure. The integrity of the seals will be pressure tested before the well decommissioning can be signed off.
- A surface casing vent flow test should be conducted to determine whether gas or liquid or a combination thereof is escaping from the casing. If gas is detected during this test, additional seals should be designed and implemented.
- Development and implementation of a post-closure groundwater monitoring program evaluating hydrochemistry will serve as early warning and detection mechanism to implement mitigation measures.
- A rehabilitation plan must be developed based on site-specific issues and performed in accordance to best practise guidelines and guided by the closure and rehabilitation plans.
- All preferred groundwater flow pathways which are in direct connection with surface topography i.e., unrehabilitated exploration boreholes should be sealed off and rehabilitated according to best practise guideline.
- It is expected that post-closure the generated pollution plume and local groundwater contamination footprint will decay and be diluted by rainfall recharge, however the lasting effect and subsequent impact on neighbouring borehole qualities should be monitored with alternative water supply sources or compensation measures available for nearby users if impacted on.

To ensure that the closure vision, objectives and targets are met, the possibility that the integrity of the well plug may deteriorate over very long periods has been considered in the ERA. The following assumption has been made (refer to Section 4.5.8) for the Down Hole surveys and unblocking of collapsed wells, relevant to the current phase/s of this project:

- Wells < 5 years old = 1:50 wells (2% of the total wells) will be required to undergo down hole surveys and unblocking of collapsed wells. No bond log testing will be required as these would have been tested at the completion stage.

Table 19: Latent and residual risks[11].

Aspect	Impact	Pre-mitigation risk	Post-mitigation risk	Final Significance	Impact Drivers	Impact Timeframes	Impact Triggers
Groundwater	Migration of saline groundwater from the deep, fractured aquifer to the overlying, potable aquifer(s) during the borehole closure and decommissioning phase.	High -	Medium to High -	Medium to High -	Geological profile of closed well bore. Well casing integrity. Suitability and quality of the annulus barrier. Suitability and quality of final well bore plug (mechanical factors as well as plug material factors). Nature of the intersected flow (gas/ water) zones.	Unknown. Depending in the nature of the well and formations the impact may occur at any time in the future.	Elevations in dissolved gas and deep aquifer indicators in shallow groundwater. Gas emissions on surface.
	Migration of stray gas from the deep, fractured aquifer to the overlying, potable aquifer(s) borehole closure and decommissioning phase.	High -	Medium to High -	Medium to High -			
	Poor quality leachate may emanate from the workshop and/or drilling pad footprint areas which may have a negative impact on groundwater quality.	Medium to High -	Medium to Low -	Medium to Low -			
	De-mobilisation of heavy vehicles, drilling rig as well as associated machinery on-site may cause hydrocarbon contamination of groundwater resources.	Medium to High -	Medium to Low -	Medium to Low -			

[11] Mitigation Measures can be found in Section 6.1 of this report.

6.2 MANAGEMENT ACTIVITIES, COSTING, AND MONITORING REQUIREMENTS

Prevention through accuracy of implementation is the key to addressing and reducing possible latent and residual impacts. This section aims to define the actions required during the post-closure phase to manage, address, and monitor residual and latent risks.

6.2.1 MONITORING REQUIREMENTS AND CORRECTIVE MANAGEMENT

Section 4.13 provides a breakdown of the monitoring and auditing requirements for the operation, rehabilitation and decommissioning, closure, as well as post-closure phases. The post-closure phase monitoring will aim primarily to monitor key drivers and parameters which causally relate to the predicted latent and residual impacts, and where applicable to trigger management and mitigation activities associated with these. The specific post-closure monitoring aspects identified include the following (refer to Table 18 for more detail):

- Groundwater and surface water monitoring: The post-closure monitoring should take place once every five (5) years for 45 years or until a long-term acceptable trend can be determined; and
- Surface gas: The post-closure monitoring should take place once every five (5) years for 45 years or until a long-term acceptable trend can be determined; and

Testing of grouting and barriers will be essential for this project and should be implemented for each well, immediately after grouting. Effective records of the drilling results, cement used, and testing results must be kept for the life of each well. A final test should be carried out during the closure phase and is to be informed by a qualified well engineer. The results and the life of well records must be made available to the well engineer, to inform the plug design.

6.2.2 MANAGEMENT AND MITIGATION ACTIVITIES

The monitoring plan described above will provide invaluable insight into the likelihood that the risk will materialise and the expected timeframes and durations of the impacts. Based on the current risk assessment and predictive methods, it is expected that certain post-closure management activities and mitigation measures will be required. Table 20 presents the impacts and associated mitigation measures identified once the impact is manifest. The alternatives considered and the motivation for the proposed alternatives are also presented. Please refer to for a more detailed explanation of each alternative and the associated advantages and disadvantages.

Table 20: Post-closure management activities and mitigation measures.

Impact	Alternative	Selected Alternative
Well casing and/or cementation failure affecting groundwater quality as a result of vertical migration of fluid and/or gas.	Identify the specific sources of the fluid /or gas and remove the pathway. This could include redrilling and plugging affected well sites.	Motuoane should make provision for re-plugging/topping up a reasonable percentage of wells.
	Identify affected receptors and provide alternative resources (e.g. alternative water supply options).	
	Interception of contaminated water, treatment and discharge.	
	Restrict future development on affected high risk areas.	

6.2.3 COSTING ESTIMATION FOR RESIDUAL AND LATENT IMPACTS

The monitoring plan described above will provide invaluable insight into the likelihood that the risk will materialise and the expected timeframes and durations of the impacts. However, it is considered prudent that some form of financial provision is made for well integrity failure post-closure at this early stage. Patroni (2007) completed a study on the lifespan of wells based corrosion and casing thickness and found that the lifespan of the casing tested is 75 – 110 years. In addition, the hydrogeological specialist study compiled as part of the EIA considers the post-mitigation risk as relatively low (-7.5). Furthermore, various studies carried out in Pennsylvania, USA between 2008 and 2013 have found gas well failures resulting in gas leaks to be as low as 2,5% to 3,4% (Vidic et al, 2013). Based on this variable information the following conservative approach is proposed:

- Surface Methane Monitoring: The surface methane gas monitoring period is to be undertaken for 45 years (post-closure) at a frequency of every 5 years for each well. This can be undertaken through appropriate sampling techniques, either soil vapour probes or surface methanometers. If it is assumed that one man-day would be required to conduct a monitoring event (including preparation, site establishment, equipment hire ex.) this would equate to R 26 771.73 per monitoring event.

- Contingency provision for re-drilling and re-plugging of Wells: Given that the total number of wells currently considered in this phase is five, the 3.4% failure rate calculates to less than one well (5×0.034 ≈ 0.17 wells). However, for a risk-averse approach the current provision will account for a single failed well.

Please refer to Appendix 2 for a detailed breakdown of the items, quantities and costs.

Table 21: Latent and residual cost estimate.

Item	Unscheduled Closure[12]	Scheduled Closure[13]
Post closure Phase - Residual and Latent Cost	**R533 078.19**	**R1 496 860.30**
- Monitoring	R240 945.53	R1 204 727.64
- Latent and residual risk provision (redrill and plugging of wells)	R292 132.66	R292 132.66

The site-specific environmental assessments performed once the exact drill sites are known, as well as geological data gathered during the drilling process, will allow for a more detailed understanding of the risks related to this specific impact. This information, along with new international best practice guidelines that may be developed in the future will be considered in all annual updates of the financial provisions and changes to the risk assessment will be reported on.

[12] Unscheduled closure refers to the process of decommissioning, rehabilitation, and closure of the production activities, assuming all production activities cease as at the date of this report. This is also referred to as unplanned closure.

[13] Scheduled closure refers to the process of decommissioning, rehabilitation, and closure of the exploration activities as at the planned cessation of these activities. This is also referred to as planned closure.

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Appendix 1: Impact Assessment Methodology

Appendix 2: FRDCP Closure Costing.

Appendix 3: Specialists CVs